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Flora of Espírito Santo, Brazil

Flora of Espírito Santo: Eriocaulaceae

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Abstract

We present a floristic treatment of the Eriocaulaceae from Espírito Santo state. A total of 22 species distributed in seven genera were recorded. *Paepalanthus* is the richest genus with ten species, followed by *Leiothrix* and *Syngonanthus* with three species each, *Comanthera* with two species, and *Actinocephalus*, *Eriocaulon*, and *Tonina* with one species each. Most of the species occur in the restingas (14 spp.), but the diversity in elevated areas is also relevant. The Paulo Cesar Vinha State Park is highlighted as a conservation unit encompassing ten species. Photos, descriptions, an identification key, as well as comments on geographic distribution and morphological variation are provided.

Key words: morphology, Paepalanthoideae, *Paepalanthus*, taxonomy.

Resumo

Apresentamos o tratamento florístico das Eriocaulaceae do Espírito Santo. Foram registradas 22 espécies distribuídas em sete gêneros. *Paepalanthus* é o gênero mais rico com 10 espécies, seguido por *Leiothrix* e *Syngonanthus* com três espécies cada, *Comanthera* com duas espécies, e *Actinocephalus*, *Eriocaulon*, e *Tonina* com uma espécie cada. A maior parte das espécies ocorre em restingas (14 spp.), mas a diversidade em áreas elevadas também é relevante. O Parque Estadual Paulo César Vinha é destacado como a unidade de conservação com maior riqueza, compreendendo dez espécies. São fornecidas fotos, descrições, chave de identificação, além de comentários sobre a distribuição geográfica e morfológica.

Palavras-chave: morfologia, Paepalanthoideae, *Paepalanthus*, taxonomia.

Introduction

Eriocaulaceae comprises approximately 1,200 species distributed in 10 genera (Giulietti & Hensold 1990; Giulietti *et al*. 2012). The species are usually small, annual or perennial, aquatic or terrestrial herbs with capitulate inflorescences usually protected by involucral bracts. Such inflorescences are supported by scapes and are often used in handicrafts for decoration (Koernicke 1863; Ruhland 1903; Giulietti & Hensold 1990; Stützel 1998; Giulietti *et al*. 2012). Brazil hosts approximately 633 species distributed in eight genera, of which 565 species are endemic to the country (BFG 2015). The species are found mainly in the Espinhaço Range in Minas Gerais and Bahia, the two main diversity centers (Giulietti & Hensold 1990; Giulietti *et al*. 2005).

The literature reports the occurrence of at least 15 species of Eriocaulaceae in Espírito Santo state (BFG 2015), whose vegetation consists predominantly of severely fragmented and insufficiently documented Atlantic Forest (Simonelli & Fraga 2007; SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais 2015; Zorzanelli *et al.* 2015; Luber *et al.* 2016). Recent data show that the family's diversity in the state is greater than expected (Silva & Trovó 2016; Trovó *et al.* 2016). In Caparaó National Park, four species of Eriocaulaceae were recorded (Trovó *et al*. 2007). A study in the Vale Natural Reserve (Silva & Trovó 2016) pointed out the occurrence of nine species in six genera, revealing that this single reserve has a species richness equivalent to all the restingas in Rio de Janeiro (Silva & Trovó 2014).

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The newly described species *Paepalanthus capixaba* Trovó, Fraga & Sano (Trovó *et al*. 2016), *Paepalanthus calvescens* L.E.F. Silva & Trovó (Silva & Trovó 2019) and the advances in the knowledge of *Paepalanthus macaheensis* Körn (Trovó & Sano 2015) and the Espírito Santo checklist (Silva & Trovó 2020) reinforce that the richness and diversity of Eriocaulaceae species in the state was underestimated. Therefore, in this manuscript we provide a floristic treatment of Eriocaulaceae species occurring in Espírito Santo state based on field collections and visits to the relevant herbaria.

Material and Methods

The floristic treatment is based on field expeditions to several remnants of native vegetation covering most of the state, outside and inside conservation units. The locations were selected prioritizing areas with few collection records and/or areas where rare or threatened species occur. The floristic treatment was also based on an analysis of the following herbarium collections (acronyms according to Thiers, continuously updated): CVRD, GUA, MBML, R, RB, RBR, RFA, SAMES, SPF and VIES. Virtual herbaria Reflora and INCT were also checked.

The usual procedures for collecting, pressing, drying, and storing botanical material were applied (Mori *et al*. 2011). Specimens collected during the period of this work were georeferenced and deposited in the herbaria: R, RB, and RFA. For the morphological description of vegetative structures, we followed the terminology proposed by Radford (1974) and for the reproductive structures, the terminology proposed by Weberling (1989).

Results and Discussion

A total of 22 species of Eriocaulaceae were recorded belonging to seven genera. *Paepalanthus* has 11 species, *Leiothrix* and *Syngonanthus* have three species each, *Comanthera* has two species and *Actinocephalus*, *Eriocaulon*, and *Tonina* have only one species each. Twelve conservation units have Eriocaulaceae records, the Paulo César Vinha State Park with ten species, is the area with the greatest species richness. The Pedra Azul State Park, Goiapaba-Açu Municipal Park, Guanandy Environmental Protection Area, and Augusto Ruschi Biological Reserve are the areas with the lowest richness, registering only one species each. Of the 22 species founded in Espírito Santo, 17 have been recorded in conservation units. Five species have not been found in protected areas, however, except for *Paepalanthus capixaba* and *Paepalanthus calvescens* L.E.F. Silva & Trovó, which are endemic to the state, the rest are found in conservation units in other states. Silva & Trovó (2020) evaluate the distribution of the family in the Espírito Santo detailing the occurrence records for each species.

Identification key of Eriocaulaceae

1. Petals of the staminate and pistillate flowers with glands. Staminate flowers with six stamens. Gynoecium only with stigmas ..... 4. *Eriocaulon ligulatum*
1'. Petals of the staminate and pistillate flowers without glands. Staminate flowers with three stamens. Gynoecium with stigmatic and nectariferous branches 2
    2. Scapes arranged in umbels at the apex of lateral branches forming numerous inflorescences..... ..... 1. *Actinocephalus ramosus*
    2'. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort or in an terminal umbel. 3
        3. Spathes open. Pistillate flowers with petals reduced to lobes ..... 22. *Tonina fluviatilis*
        3'. Spathes closed. Pistillate flowers with petals developed 4
            4. Pistillate flowers with petals fused at the median portion..... 5
            4'. Pistillate flowers with petals totally free or fused only at the base 9
                5. Involucral bracts longer than the floral disc. Floral bracts absent. Staminate flowers with petals fused up to the median portion or totally free..... 6
                5'. Involucral bracts shorter than the floral disc. Floral bracts present. Staminate flowers with petals fused up to the apical portion..... 7
                    6. Leaves lanceolate. Leaves and spathes floccose to glabrescent, pubescent, or glabrous. Involucral bracts light castaneous to hyaline distally, apex retuse .. .. 2. *Comanthera caespitosa*

6’. Leaves acicular or linear. Leaves pilose to glabrescent and spathes pubescent to glabrescent. Involucral bracts white, apex obtuse ..... 3. *Comanthera nivea*
7. Leaves linear. Spathes with acute apex. Involucral bracts hyaline, apex obtuse. Staminate flowers ca. 1.5 mm long..... 20. *Syngonanthus gracilis*
7’. Leaves lanceolate. Spathes with obtuse apex. Involucral bracts cream-colored, apex acute. Staminate flowers ca. 2 mm long 8
8. Leaves arranged along the stem. Capitula ca. 4 mm diam. Involucral bracts up to 2.5 mm long, elliptical..... 19. *Syngonanthus caulescens*
8’. Leaves arranged in a rosette. Capitula ca. 6–7.5 mm diam. Involucral bracts ca. 3 mm long, ovate .....21. *Syngonanthus restingensis*
9. Gynoecium with stigmatic and nectariferous branches arising from the column at different heights. Anthers basifixed 10
9’. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height. Anthers dorsifixed 12
10. Plants reaching up to 65 cm tall. Involucral and floral bracts ca. 3.5 mm long. Staminate flower ca. 3 mm long and pistillate flower ca. 3.5 mm long ....5. *Leiothrix hirsuta*
10’. Plants reaching up to 24 cm tall. Involucral and floral bracts up to 2.5 mm long. Staminate and pistillate flowers up to 2 mm long 11
11. Leaves 5.9–11.7 cm long. Spathes 3.7–4.2 cm long. Capitula grayish. Involucral bracts hyaline.....6. *Leiothrix pilulifera*
11’. Leaves 3.3–4.3 cm long. Spathes 1.2–1.6 cm long. Capitula cream-colored to dark castaneous or reddish. Involucral bracts dark castaneous ....7. *Leiothrix rufula*
12. Scapes fused 13
12’. Scapes free..... 14
13. Stem elongated, not restricted to rosette, more than 10 cm long .... 16. *Paepalanthus macropodus*
13’. Stem short, restricted to rosette, up to 2 cm long ....17. *Paepalanthus planifolius*
14. Stem elongated, not restricted to rosette..... 15
14’. Stem short, restricted to rosette 17
15. Capitula castaneous .....15. *Paepalanthus macaheensis*
15’. Capitula cream-colored or blackish..... 16
16. Capitula cream-colored, hemispherical. Involucral bracts greenish, lanceolate-linear .... 9. *Paepalanthus bifidus*
16’. Capitula blackish, spherical to conical. Involucral bracts black, ovate ..... 18. *Paepalanthus tortilis*
17. Leaves up to 0.3 cm wide. Involucral bracts dark castaneous 18
17’. Leaves up to 2.4 cm wide. Involucral bracts light castaneous, cream-colored, or golden..... 20
18. Leaves 0.3–0.4 cm long. Floral bracts with apex obtuse .... 8. *Paepalanthus acantholimon*
18’. Leaves more than 1 cm long. Floral bracts with acuminate apex 19
19. Leaves glabrous. Spathes glabrous. Anthers black. Stigmatic branches and nectariferous branches of the same length .... 11. *Paepalanthus caparoensis*

19'. Leaves pilose to densely pilose. Spathes pilose. Anthers cream-colored. Stigmatic branches longer than the nectariferous branches.....13. *Paepalanthus globosus*
20. Leaves rigid. Floral bracts narrow elliptical to linear. Staminate flowers with sepals free .....
.....14. *Paepalanthus klotzschianus*
20'. Leaves chartaceous. Floral bracts oblong, obovate, or obtrullate. Staminate flowers with sepals fused up to the median portion.....21
21. Leaves, spathes and scapes sericeous. Floral bracts oblong. Staminate flowers ca. 3 mm long. Pistillate flowers ca. 3.5 mm long ..... 12. *Paepalanthus capixaba*
21'. Leaves, spathes and scapes sparsely pilose to glabrescent. Floral bracts obovate or rarely obtrullate. Staminate flowers ca. 4.5 mm long. Pistillate flowers with ca. 4.5 mm long.....
.....10. *Paepalanthus calvescens*

Taxonomic treatment

1. *Actinocephalus ramosus* (Wikstr.) Sano, Taxon 53: 104. 2004. Fig. 1a

Herbs 19.3–83.2 cm tall, stem short, restricted to a rosette. Leaves arranged in a rosette, 2.3–89.2 × 0.3–1.4 cm, lanceolate, pilose to pubescent to glabrescent on both surfaces, margins ciliate to glabrescent, apex acute. Spathes 0.4–1.5 cm long, closed, surfaces pilose, apex acute. Scapes arranged in umbels at the apex of lateral branches forming numerous inflorescences, 1.9–7.8 cm long, surfaces pilose. Capitula white, ca. 5 mm diam., obconic. Involucral bracts castaneous, ca. 2 mm long, shorter than the floral disc, obovate, surfaces sparsely pilose to glabrescent, margins ciliate, apex acute to rarely obtuse. Floral bracts castaneous, ca. 2 mm long, linear to obovate, surfaces sparsely pilose to glabrescent, margins ciliate, apex acuminate to acute. Staminate flowers ca. 2 mm long, pedicel 0.5–1 mm long, with long trichomes; sepals free, castaneous, obovate, surfaces glabrous, margins ciliate, apex acuminate to acute; petals fused into a tube, without glands, castaneous, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 2 mm long, sessile; sepals castaneous, obovate, surfaces glabrous, margins ciliate, apex acuminate to acute; petals developed, free, without glands, castaneous to hyaline, elliptical to lanceolate, surfaces sparsely pilose to glabrescent, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, two times longer than the nectariferous branches.

Selected material: 1952, fl., *M. Inácio* (MBML1511). Aracruz, 26.VIII.1992, fl., *O.J. Pereira et al. 3807* (VIES). Conceição da Barra, 8.IV.2017, fl., *L.E.F. Silva & I.M. Rollim 79* (RFA). Guarapari, 25.IX.2016, fl., *L.E.F. Silva et al. 51* (R, RB). Jaguaré, 28.I.2014, fl., *J.O. Machado et al. 179* (VIES). Linhares, 7.XI.2014, fl., *L.E.F. Silva 37* (CVRD, RFA). Presidente Kennedy, 18.V.1983, fl., *D. Araujo & N.C. Maciel 5601* (SPF). São Mateus, 1.VIII.2007, fl., *R.F.A. Martins et al. 246* (SAMES, VIES). Vila Velha, 15.VII.2004, fl., *G.G.K. Lube & O.J. Pereira 104* (VIES).

The only species of *Actinocephalus* in the state, it is easily distinguished by its robust habit and the umbelliform inflorescence at the apex of lateral branches arising from a central inflorescence axis. Endemic to Brazil, the species has a distribution extending through Bahia, Espírito Santo, Minas Gerais, and Rio de Janeiro (Ruhland 1903; Sano 2004; BFG 2015). In Espírito Santo, the species occurs at Conceição da Barra Environmental Protection Area, Itaúnas State Park, Paulo César Vinha State Park, Jacarenema Reserve State, and Vale Natural Reserve; it is very common in sand dunes, forming dense populations.

2. *Comanthera caespitosa* (Wikstr.) L.R.Parra & Giul., Taxon 59 (4): 1143. 2010. Fig. 1b

Herbs 12–39.3 cm tall, stem short, rarely reaching 1.5 cm long. Leaves arranged in a rosette, 1–5.6 × 0.1–0.2 cm, lanceolate, floccose to glabrescent on abaxial surface, margins floccose, apex rounded to obtuse. Spathes 2.2–4.1 cm long, closed, surfaces floccose, pubescent, or glabrous, apex acuminate to acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 7.3–27.6 cm long, surfaces pubescent. Capitula cream-colored, ca. 5 mm diam., hemispherical to urceolate. Involucral bracts light castaneous to hyaline distally, ca. 4 mm long, longer than the floral disc, obovate, surfaces glabrous, margins glabrous, apex retuse. Floral bracts absent. Staminate flowers ca. 1.5 mm long, pedicel ca. 1 mm long, with long trichomes; sepals free, hyaline, elliptical, surfaces glabrous, margins

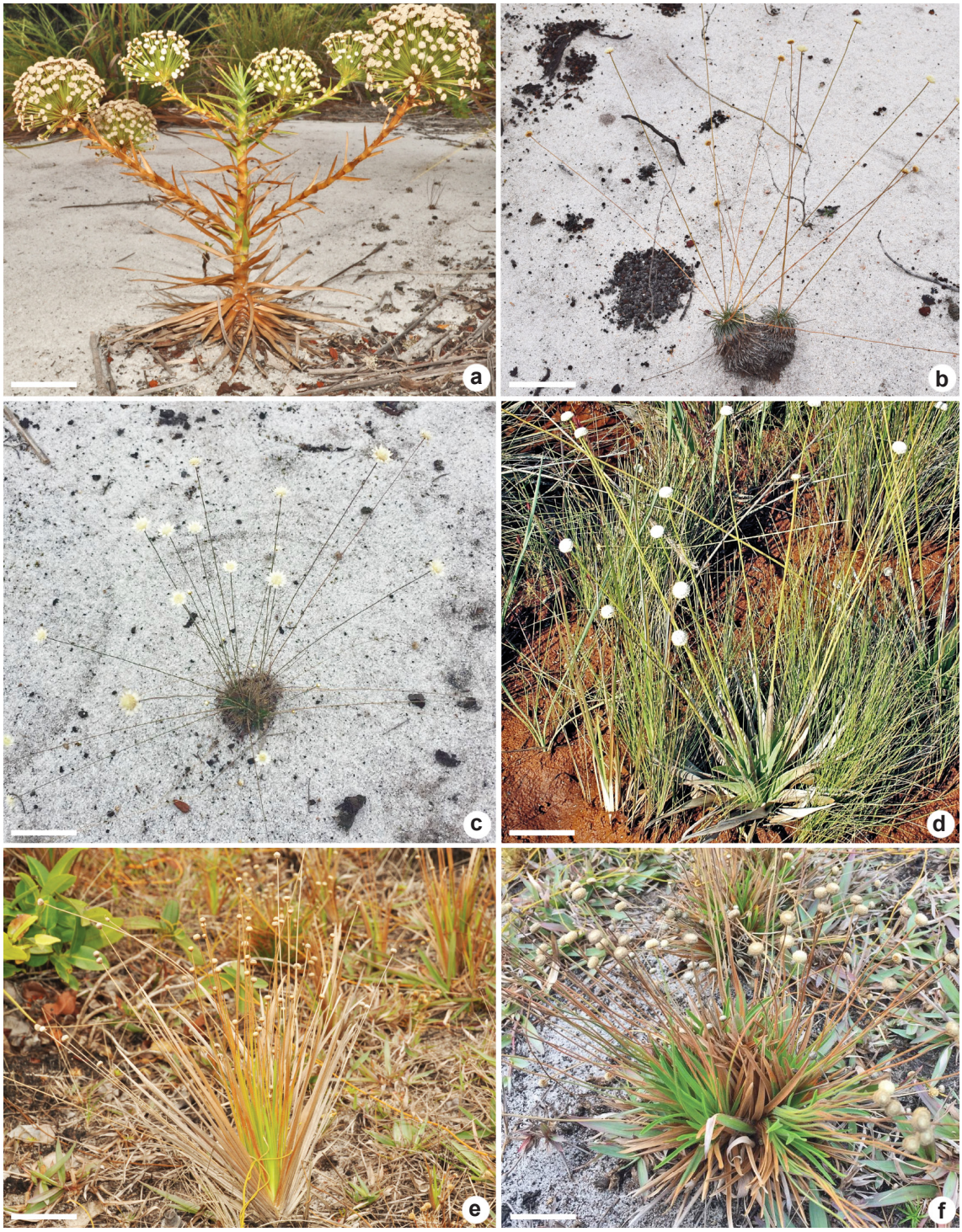

Figure 1 – a-f. Habit and habitat of Eriocaulaceae species in Espírito Santo – a. *Actinocephalus ramosus*; b. *Comanthera caespitosa*; c. *Comanthera nivea*; d. *Eriocaulon ligulatum*; e. *Leiothrix hirsuta*; f. *Leiothrix pilulifera*. Photos: a,c,d,e,f. Marcelo Trovó; b. Isis Rollim. Scale bars: a = 7 cm; b = 9 cm; c = 12 cm; d = 11 cm; e = 10 cm; f = 5 cm.

glabrous, apex obtuse; petals fused up to the median portion or totally free, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 2 mm long, sessile or pedicellate ca. 1.5 mm long; sepals hyaline, elliptical, surfaces glabrous, margins glabrous, apex obtuse; petals developed, fused at the median portion, free at the apex and at the base, without glands, hyaline, linear, surfaces glabrous, margins ciliate at the median portion, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches whole from the base, ca. 0.8 mm long, longer than the nectariferous branches.

Selected material: Guarapari, fl., *Curso de Taxonomia Vegetal* (VIES381). Vila Velha, 24.IV.1983, fl., *C. Farney & H.C. Lima 316* (RB).

Similar to *Comanthera nivea* (Bong.) L.R. Parra & Giul. due to its involucral bracts longer than the floral disc. However, it is differentiated by its thicker leaves with a recurved apex, usually white trichomes and cilia, which are small and easily fall (floccose), and light castaneous involucral bracts, which are rigid and adpressed to the capitula. Endemic to Brazil, the species has a distribution extending through Bahia, Espírito Santo, Minas Gerais, and Rio de Janeiro (Parra 2000; Parra *et al.* 2010; BFG 2015). In Espírito Santo, the species only occurs at Paulo César Vinha State Park; it is very common in sand dunes, forming dense populations.

3. *Comanthera nivea* (Bong.) L.R. Parra & Giul., Taxon 59: 1141. 2010. Fig. 1c

Herbs 11–30.9 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 0.6–4.2 × 0.1 cm, acicular or linear, pilose to glabrescent on both surfaces, margins ciliate, apex rounded to obtuse. Spathes 1.5–4 cm long, closed, surfaces pubescent to glabrescent, apex obtuse. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 8–28.5 cm long, surfaces pubescent to glabrescent between the scape ribs. Capitula cream-colored, ca. 3–4 mm diam., hemispherical. Involucral bracts white, showy, ca. 3 mm long, longer than the floral disc, obovate, surfaces glabrous, margins glabrous, apex obtuse. Floral bracts absent. Staminate flowers ca. 1 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused at the base, hyaline, elliptical, surfaces glabrous, margins glabrous, apex rounded; petals fused up to the median portion or totally free, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers 2–2.5 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals hyaline, elliptical, surfaces glabrous, margins glabrous, apex rounded; petals developed, fused at the median portion, free at the apex and at the base, without glands, hyaline, linear, surfaces sparsely pilose to glabrescent at the median portion, margins sparsely ciliate to glabrescent only at the median portion, apex rounded. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches whole from the base, ca. 0.5 mm long, longer than the nectariferous branches.

Selected material: Guarapari, 25.IX.2016, fl., *L.E.F. Silva et al. 49* (RB). Linhares, 7.XI.2014, fl., *L.E.F. Silva 35* (CVRD, RFA). Vila Velha, 12.II.2013, fl., *L.A. Silva 342* (VIES). Vitória, 23.XII.1998, fl., *A.M. Assis 683* (VIES).

Easily distinguished from the other species by the showy white involucral bracts that exceed the diameter of the capitula (Parra *et al.* 2010). The species is endemic to Brazil, with a distribution extending through Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo (Ruhland 1903; Sano & Giulietti 2012; BFG 2015). In Espírito Santo, it occurs at Paulo César Vinha State Park, Jacarenema Reserve State, Camburi Sand Dunes Municipal Ecological Reserve, and Vale Natural Reserve; it is frequent in sand dunes, forming aggregate populations.

4. *Eriocaulon ligulatum* (Vell.) L.B.Sm., Contr. Gray Herb. 124: 5. 1939. Fig. 1d

Herbs 56.5–79.8 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 37.8–74.3 × 2.5–3 cm, lanceolate, pilose to glabrescent on both surfaces, margins ciliate to glabrescent, apex rounded. Spathes 12.6–72.5 cm long, closed, pilose at the base to glabrescent distally, apex acute to truncate. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 31–68 cm long, surfaces pubescent to glabrous. Capitula white to cream-colored, ca. 15 mm diam., hemispherical. Involucral bracts castaneous-reddish or cream-colored to hyaline distally, ca. 6 mm long, longer than the floral disc, oblong to ovate, surfaces glabrous, margins sparsely ciliate to glabrescent, apex obtuse. Floral bracts cream-colored, ca. 6 mm long, linear, surfaces floccose at the apex, margins floccose, apex obtuse. Staminate flowers ca. 5 mm long, sessile, glabrous; sepals fused up to the apical

portion, hyaline, obovate, surfaces floccose at the apex, margins floccose, apex obtuse; petals totally free, glandular, hyaline, stamens 6, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 5 mm long, sessile; sepals hyaline, linear, surfaces floccose at the apex, margins floccose, apex obtuse; petals developed, totally free, glandular, hyaline, obovate, floccose on adaxial surface, margins floccose, apex obtuse to rounded. Gynoecium only with stigmas.
Selected material: Linhares, 24.I.2000, fl., *C.N. de Fraga 582* (MBML).

The only species of *Eriocaulon* recorded to Espírito Santo, it is distinguished by its diplostemonous flowers with glandular petals. Endemic to Brazil (Chagas 2017), the species has a distribution extending through Bahia, Espírito Santo, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina, and São Paulo (BFG 2015). In Espírito Santo, it is not present in any conservation unit; it is recorded from a flooded area over sand dunes.

5. *Leiothrix hirsuta* (Wikstr.) Ruhland, Pflanzenr. (Engler) IV. 30 (Heft 13): 229. 1903. Fig. 1e

Herbs 11.5–65 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 1.8–39.7 × 0.3–1.1 cm, lanceolate-linear, densely hirsute to pilose on both surfaces, margins ciliate to glabrescent, apex rounded to obtuse. Spathes 2.1–10 cm long, closed, surfaces densely hirsute to pilose, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 6.5–61.9 cm long, surfaces hirsute to pilose. Capitula cream-colored, ca. 5 mm diam., hemispherical. Involucral bracts castaneous to hyaline, ca. 3.5 mm long, shorter than the floral disc, elliptical to linear, surfaces glabrous, margins glabrous, apex acuminate. Floral bracts hyaline, ca. 3.5 mm long, linear to obovate, surfaces glabrous, margins glabrous, apex acuminate. Staminate flowers ca. 3 mm long, pedicel ca. 1 mm long, with long trichomes; sepals free, hyaline, elliptical, surfaces glabrous, margins ciliate, apex obtuse; petals fused up to the basal portion, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers basifixed, carpellodes papillose. Pistillate flowers ca. 3.5 mm long, pedicel ca. 1 mm long, pilose to glabrescent; sepals hyaline, elliptical, surfaces glabrous, margins ciliate to glabrescent, apex acute; petals developed, totally free, without glands, hyaline, elliptical, surfaces glabrous, margins ciliate to glabrescent, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at different heights, stigmatic branches bifid at the apex, ca. 1 mm longer than the nectariferous branches.
Selected material: Aracruz, 28.VII.1992, fl., *O.J. Pereira et al. 3654* (VIES). Conceição da Barra, 28.VIII.2012, fl., *T.B. Flores & G.O. Romão 1240* (MBML, RB, VIES). Guarapari, 10.VIII.1996, fl., *C.N. de Fraga et al. 341* (SPF). Linhares, 7.XI.2014, fl., *L.E.F. Silva 38* (CVRD, RFA). São Mateus, 1.VIII.2007, fl., *R.F.A. Martins et al. 19* (SAMES, VIES). Vila Velha, 11.VIII.1987, fl., *B. Weinberg et al.* (MBML4267).

Distinguished from *Leiothrix pilulifera* and *Leiothrix rufula* by its robust habit usually with distichous, hirsute leaves. The species is endemic to Brazil, with records in Bahia, Espírito Santo, Minas Gerais, and Rio de Janeiro (Ruhland 1903; BFG 2015). In Espírito Santo, it occurs in Conceição da Barra Environmental Protection Area, Itaúnas State Park, Paulo César Vinha State Park, and Vale Natural Reserve; it is very common in sand dunes, forming dense populations.

6. *Leiothrix pilulifera* (Körn.) Ruhland, Pflanzenr. (Engler) IV, Fam. 30: 231. 1903. Figs. 1f; 2a

Herbs 19–24 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 5.9–11.7 × 0.2–0.4 cm, lanceolate, pilose to glabrescent on both surfaces, margins ciliate to glabrescent, apex acute. Spathes 3.7–4.2 cm long, closed, surfaces pilose to glabrescent, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 13–22.1 cm long, ribs 6, surfaces pilose to glabrescent. Capitula grayish, ca. 5 mm diam., hemispherical. Involucral bracts hyaline, 2–2.5 mm long, shorter than the floral disc, elliptical, surfaces glabrous, margins glabrous, apex cuspidate. Floral bracts hyaline, 2–2.5 mm long, obovate, surfaces pilose-glabrescent, margins ciliate to glabrescent, apex obtuse. Staminate flowers ca. 2 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused up to the median portion, hyaline, obovate, surfaces glabrous, margins ciliate, apex obtuse; petals fused up to the apical portion, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers basifixed, carpellodes papillose. Pistillate flowers 1.5–2 mm long, pedicel 0.5–1 mm long, pilose to glabrescent; sepals hyaline, elliptical, surfaces glabrous, margins glabrous, apex obtuse; petals developed, totally free, without glands, hyaline, elliptical, surfaces glabrous, margins ciliate, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising

from the column at different heights, stigmatic branches bifid at the apex, ca. 0.5 mm longer than the nectariferous branches.
Selected material: Guarapari, fl., *L. Krieger & M. Sabino 18641* (SPF).

Leiothrix pilulifera is a smaller than the other two species of the genus, usually forming aggregates and being differentiated by its flat leaves. This species is very similar to *Leiothrix rufula* but can be distinguished by its grayish capitula and the presence of six ribs on the scape (Giulietti 1984). Endemic to Brazil, the species has records in Alagoas, Bahia, Espírito Santo, Pernambuco, and Rio de Janeiro (BFG 2015). In Espírito Santo, it is not present in any conservation unit; it is recorded only from sand dunes.

7. *Leiothrix rufula* (A. St.-Hil.) Ruhland, Pflanzenr. (Engler) IV. 30 (Heft 13): 230. 1903. Fig. 2a,b

Herbs 8.4–11.4 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 3.3–4.3 × 0.1–0.2 cm, lanceolate, pilose on both surfaces, margins ciliate, apex obtuse. Spathes 1.2–1.6 cm long, closed, surfaces hirsute, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 5.1–11.2 cm long, ribs 4, surfaces hirsute. Capitula cream-colored to dark castaneous or reddish, ca. 4 mm diam., hemispherical. Involucral bracts dark castaneous, ca. 2 mm long, shorter than the floral disc, elliptical to obovate, surfaces pubescent to glabrescent, margins ciliate to glabrescent, apex acuminate. Floral bracts light castaneous to hyaline, ca. 2 mm long, obovate, surfaces glabrous, margins ciliate to glabrescent, apex acute. Staminate flowers ca. 1 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused up to the median portion, hyaline, obovate, surfaces glabrous, margins ciliate to glabrescent, apex rounded to truncate; petals fused up to the apical portion, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers basifixed, carpellodes papillose. Pistillate flowers ca. 2 mm long, pedicel ca. 1 mm long, pilose to glabrescent; sepals castaneous to hyaline, elliptical, surfaces pilose at the apex to glabrescent, margins ciliate, apex rounded; petals developed, totally free, without glands, hyaline, narrowly elliptical, surfaces glabrous, margins ciliate to glabrescent, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at different heights, stigmatic branches whole from the base, ca. 0.3 mm longer than the nectariferous branches.
Selected material: Guarapari, 4.X.1981, fl., *L. Krieger 18642* (SPF40815). Vila Velha, 15.XI.2007, fl., *F.B.C. Souza et al. 69* (VIES).

Although quite similar to *Leiothrix hirsuta* in terms of size and habit, *Leiothrix rufula* has flat leaves and smaller floral organs (Giulietti 1984). Endemic to Brazil, the species is recorded from Bahia, Espírito Santo, Minas Gerais, and Rio de Janeiro (Ruhland 1903; BFG 2015). In Espírito Santo, it is found in sand dunes.

8. *Paepalanthus acantholimon* Ruhland, Pflanzenr. (Engler) IV, Fam. 30: 163. 1903. Fig. 2c

Herbs 8.1–11.4 cm tall, stem short, restricted to rosette, 0.5–1.5 cm long. Leaves arranged along a stem, 0.3–0.4 × 0.1 cm, linear, glabrous on both surfaces, margins glabrous, apex acute. Spathes 1.5–1.7 cm long, closed, surfaces sparsely pilose to glabrescent, margins glabrous, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 8.2–9.7 cm long, surfaces sparsely pilose. Capitula castaneous, ca. 5 mm diam., hemispherical. Involucral bracts dark castaneous, ca. 2 mm long, shorter than the floral disc, elliptical to obovate, surfaces glabrous, margins ciliate, apex obtuse. Floral bracts castaneous to hyaline, ca. 2 mm long, linear to obovate, wrapped around the pedicel at the basal portion, surfaces with long trichomes, margins with long and numerous cilia, apex obtuse. Staminate flowers ca. 1.5 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused up to the median portion, castaneous to hyaline, obovate, surfaces glabrous, margins densely ciliate, apex acuminate; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 2 mm long, pedicel ca. 1 mm long, pilose to glabrescent; sepals castaneous to hyaline, obovate, surfaces sparsely pilose, margins ciliate, apex acuminate; petals developed, totally free, without glands, hyaline, linear, surfaces sparsely pilose to glabrescent, margins ciliate, apex acuminate. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches whole from the base, ca. 0.5 mm longer than the nectariferous branches.
Selected material: Alegre, 2.III.1959, fl., *H.S. Irwin 2758* (R). Ibitirama, 10.IX.2000, fl., *A.M. Assis 847* (VIES).

The species can be distinguished by the smaller size of its leaves, ca. 0.6–5.6 cm long, and

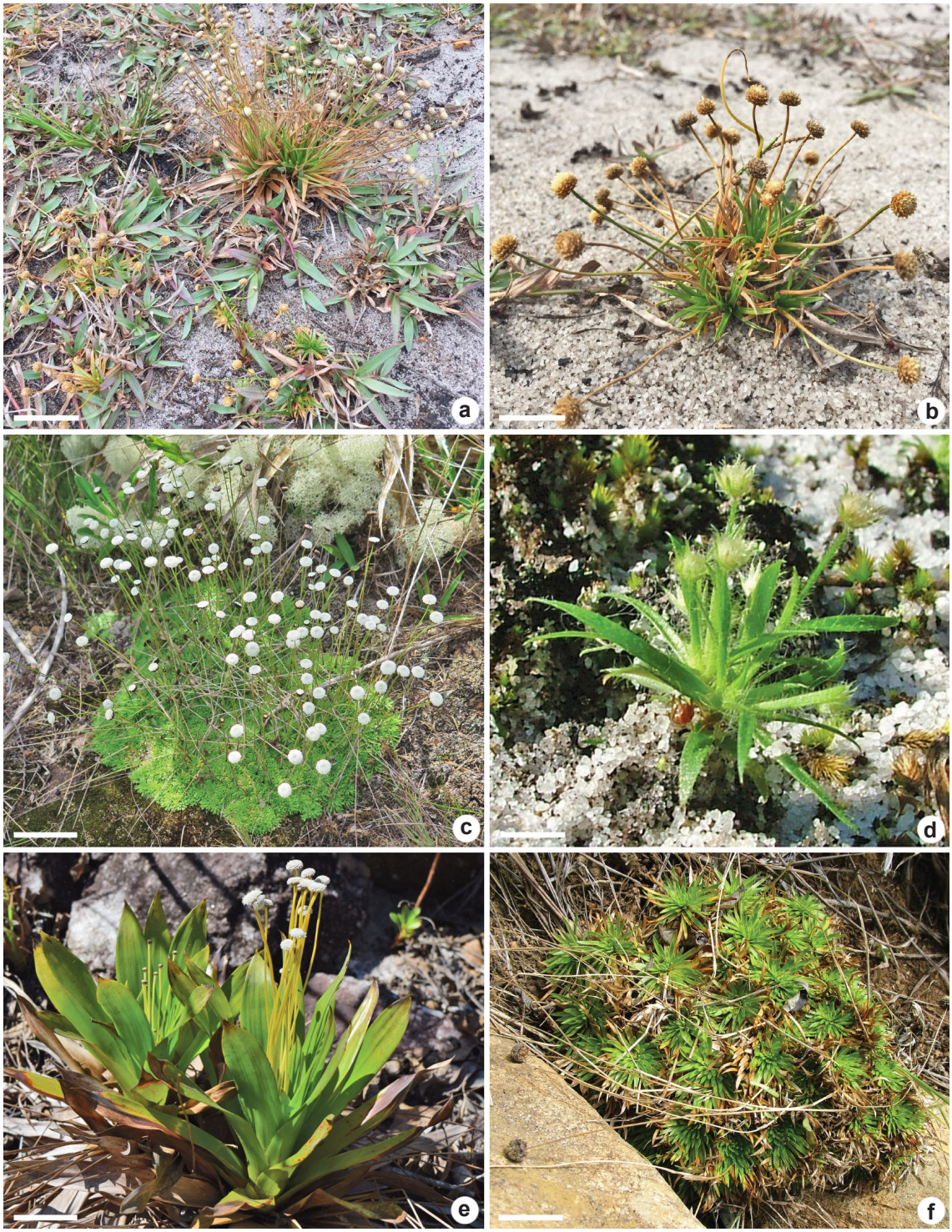

Figure 2 – a-f. Habit and habitat of Eriocaulaceae species in Espírito Santo – a. *Leiothrix pilulifera* (top) and *Leiothrix rufula* (bottom); b. *Leiothrix rufula*; c. *Paepalanthus acantholimon*; d. *Paepalanthus bifidus*; e. *Paepalanthus calvescens*; f. *Paepalanthus caparoensis*. Photos: a,b,e,f. Marcelo Trovó; c. Marina Moreira; d. Isis Rollim. Scale bars: a= 4 cm; b = 9 cm; c = 4 cm; d = 2.5 cm; e = 13 cm; f = 10 cm.

consequently reduced rosette diameter, usually with small capitula and small floral organs than *P. caparoensis* and *P. globosus*. Endemic to Brazil, the species is recorded from Espírito Santo, and Minas Gerais (Ruhland 1903; Trovó *et al.* 2007; Trovó & Sano 2010; BFG 2015). In Espírito Santo, it occurs only in Caparaó National Park, with records from high elevations, forming dense aggregate populations.

9. *Paepalanthus bifidus* (Schrad.) Kunth, Enum. Pl. 3: 512. 1841. Fig. 2d

Herbs 0.7–15.2 cm tall, stem elongated, not restricted to rosette, 0.3–1.5 cm long. Leaves arranged along a stem, 0.3–3.6 × 0.1–0.2 cm, lanceolate, hirsute to lanuginous on abaxial surface, margins ciliate, apex acute. Spathes 0.5–4.5 cm long, closed, surfaces lanuginous, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 0.2–5.9 cm long, surfaces pilose. Capitula cream-colored, ca. 4 mm diam., hemispherical. Involucral bracts greenish, ca. 3 mm long, longer than the floral disc, lanceolate-linear, surfaces pilose to glabrescent, margins hirsute, apex obtuse. Floral bracts castaneous, ca. 2 mm long, oblong or ovate, surfaces pilose to glabrescent, margins ciliate, apex acute. Staminate flowers ca. 2 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals fused up to the median portion, hyaline, elliptical or obovate, surfaces pilose to glabrescent, margins ciliate, apex acuminate to acute; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 2 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals castaneous to hyaline, linear to obovate, surfaces glabrous, margins glabrous, apex acuminate; petals developed, totally free, without glands, hyaline, elliptical to obovate, surfaces pilose to glabrescent, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches whole from the base, ca. 0.2 mm longer than the nectariferous branches.

Selected material: Aracruz, 20.II.1992, fl., *O.J. Pereira 2756* (VIES). Conceição da Barra, 8.VIII.2013, fl., *W.O. Souza et al. 143* (VIES). Guarapari, 6.X.1997, fl., *A.M. Assis 252* (VIES). Linhares, 7.XI.2014, fl., *L.E.F. Silva 39* (CVRD, RFA). São Mateus, 25.VIII.2008, fl., *M.M. Monteiro et al. 60* (SAMES).

Plant of very delicate habit, under 20 centimeters in height. Easily distinguished from other species of the genus by its leaves arranged along an evident stem and by its lanceolate-linear, greenish involucral bracts. The species occurs in Brazil, Colombia, Guiana, and Suriname. In Brazil, there are records in Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Maranhão, Minas Gerais, Pará, Paraíba, Pernambuco, Piauí, Rio de Janeiro, Rio Grande do Norte, and Sergipe (Ruhland 1903; BFG 2015). In Espírito Santo, it occurs in Conceição da Barra Environmental Protection Area, Itaúnas State Park, Paulo César Vinha State Park, Camburi Sand Dunes Municipal Ecological Reserve, and Vale Natural Reserve; it is very common in sand dunes, forming small populations.

10. *Paepalanthus calvescens* L.E.F. Silva & Trovó, Phytotaxa 397(2): 193-198. 2019. Fig. 2e

Herbs 23.7–38.3 cm tall, stem short, restricted to rosette, ca. 2 cm long. Leaves arranged in a rosette, 13.7–30.3 × 1–2.4 cm, lanceolate, chartaceous, sparsely pilose to glabrescent on both surfaces, margins ciliate or hirsute to glabrescent, apex acute. Spathes 5.1–10.9 cm long, closed, surfaces sparsely pilose to rarely glabrescent, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 12.8–29.2 cm long, surfaces sparsely pilose to glabrescent. Capitula white, 6–12 mm diam., hemispherical to globose or hemispherical to discoid when young. Involucral bracts golden to light castaneous, ca. 3 mm long, shorter than the floral disc, deltoid to ovate, surfaces glabrous, margins ciliate, apex mucronate to obtuse. Floral bracts golden up to the median portion and castaneous at the apex, ca. 3 mm long, obovate or rarely obtrullate, surfaces pilose at the apical portion, margins densely ciliate at the apex and with long cilia laterally, apex acuminate. Staminate flowers ca. 4.5 mm long, pedicel ca. 1 mm long, pilose to glabrescent; sepals fused up to the median portion, cream-colored to golden up to the median portion and dark castaneous at the apex, obovate, surfaces pilose at the apex, margins densely ciliate at the apex and with long cilia laterally, apex obtuse; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 4.5 mm long, pedicel 0.5–0.8 mm long, with long trichomes; sepals cream-colored up to the median portion and castaneous at the apex, obovate, surfaces pilose at the apex, margins densely ciliate at the apex and with long cilia laterally, apex acuminate to

mucronate; petals developed, totally free, without glands, hyaline, obovate, surfaces pilose at the apex, margins densely ciliate at the apex and with long cilia laterally, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, three times longer than the nectariferous branches.

Selected material: Vargem Alta, 11.IV.2017, fl., *L.E.F. Silva & I.M. Rollim 83* (RB).

Differing from *Paepalanthus capixaba*, *Paepalanthus calvescens* has light green leaves, discoid capitula, and floral bracts, sepals and petals of staminate and pistillate flowers pilose only at the apex, densely ciliate at the apex with long cilia. Recently described, the species has a distribution restricted to Vargem Alta (Espírito Santo); there are records in high fields over rocky soils, forming dense populations under the canopy of trees.

11. *Paepalanthus caparoensis* Ruhland, in Pflanzenr. (Engler) IV. 30 (Heft 13): 145. 1903. Fig. 2f

Herbs 14.2–20.9 cm tall, stem short, restricted to rosette, ca. 2 cm long. Leaves arranged in a rosette, 1–4.5 × 0.1–0.2 cm, linear, glabrous on both surfaces, margins ciliate, apex acute. Spathes 3.5–4.7 cm long, closed, surfaces glabrous, margins ciliate, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 21.1–20.2 cm long, surfaces sparsely pilose to glabrescent. Capitula dark castaneous, ca. 9 mm diam., hemispherical. Involucral bracts dark castaneous, ca. 4 mm long, longer than the floral disc, ovate, surfaces glabrous, margins ciliate, mainly at the apex, apex obtuse. Floral bracts castaneous, ca. 3 mm long, elliptical to oblong, surfaces pilose to glabrescent, margins ciliate, apex acuminate. Staminate flowers ca. 3 mm long, sessile or pedicel ca. 0.5 mm long, with long trichomes; sepals fused up to the median portion, dark castaneous, obovate, surfaces pilose to glabrescent, margins densely ciliate, apex acuminate; petals fused into a tube, without glands, castaneous to hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, black, carpellodes papillose. Pistillate flowers ca. 3 mm long, sessile; sepals castaneous to hyaline, obovate, surfaces pilose to glabrescent, margins ciliate, apex cuspidate; petals developed, totally free or fused only at the base, without glands, castaneous to hyaline, obovate, surfaces pilose, margins ciliate, apex cuspidate or obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, the same length as the nectariferous branches.

Selected material: Caparaó, 9-12.III.1917, fl., *A. Lutz 1208* (R).

This species is easily distinguished from other species of the genus by its dark castaneous capitula due to the contrast of colors with trichomes of the involucral bracts at the capitula apex and the dark coloration of the anthers. Endemic to Brazil, the species is recorded from Espírito Santo, Minas Gerais, and Rio de Janeiro (Ruhland 1903; Trovó & Sano 2010; BFG 2015). In Espírito Santo, it occurs only at Caparaó National Park; it is recorded from high open fields, forming dense populations.

12. *Paepalanthus capixaba* Trovó, Fraga & Sano, Phytotaxa 258(1): 84. 2016. Fig. 3a

Herbs 33.4–47 cm tall, stem short, restricted to rosette, ca. 2 cm long. Leaves arranged in a rosette, 3.9–26.4 × 0.5–1.5 cm, lanceolate, chartaceous, sericeous on both surfaces, margins ciliate, apex acute. Spathes 6.5–17 cm long, closed, surfaces sericeous, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 23–45.5 cm long, surfaces sericeous. Capitula white, ca. 9 mm diam., hemispherical to spherical. Involucral bracts cream-colored to golden, ca. 3 mm long, shorter than the floral disc, ovate, surfaces pubescent to glabrescent, margins ciliate, apex mucronate to obtuse. Floral bracts golden up to the median portion and castaneous at the apex, ca. 3 mm long, oblong, surfaces pubescent at the apex, margins ciliate, apex mucronate to obtuse. Staminate flowers ca. 3 mm long, pedicel ca. 1 mm long, surfaces pilose to glabrescent; sepals fused up to the median portion, cream-colored to golden or light castaneous up to the median portion and dark castaneous at the apex, obovate, surfaces pubescent at the median portion and apex, margins ciliate, apex mucronate; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 3.5 mm long, pedicel 0.5–1 mm long, with long trichomes; sepals castaneous, obovate, surfaces pubescent at the median portion and apex, margins ciliate at the apex or glabrescent, apex obtuse; petals developed, totally free, without glands, hyaline, obovate, surfaces glabrous, margins ciliate, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same

height, stigmatic branches bifid at the apex, ca. 2 mm longer than the nectariferous branches.
Selected material: Cachoeiro de Itapemerim, 16.VIII.1981, fl., *V.F. Ferreira 1851* (RB, SPF). Vargem Alta, 23.IX.2016, fl., *L.E.F. Silva et al. 43* (R, RB, RFA).

The species differs from other species of the genus by its densely sericeous leaves, spathes and scapes. It can be distinguished from *Paepalanthus klotzschianus* Körn by its chartaceous leaves, inconspicuous aerial stem, and sepals and petals with apex never acute. Recently described, the species occurs only in Cachoeiro de Itapemerim and Vargem Alta (Espírito Santo) (Trovó *et al.* 2016), where it is recorded from high open fields over sandy soils, forming dense populations.

13. *Paepalanthus globosus* Ruhland, Pflanzenr. (Engler) 4, Fam. 30: 143. 1903. Fig. 3b,c

Herbs 21.9–29 cm tall, stem short, restricted to rosette, ca. 2 cm long. Leaves arranged in a rosette, 1–6.1 × 0.2–0.3 cm, lanceolate-linear, pilose to densely pilose on both surfaces, margins ciliate, apex acute. Spathes 4.2–8.1 cm long, closed, surfaces pilose, apex obtuse. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 6.6–28 cm long, surfaces pilose. Capitula white or castaneous, ca. 10 mm diam., hemispherical. Involucral bracts dark castaneous, ca. 4 mm long, longer than the floral disc, oblong, surfaces glabrous, margins ciliate, apex acute. Floral bracts castaneous, ca. 3 mm long, linear, surfaces pilose at the apex, margins densely ciliate at the apex and with long cilia laterally, apex acuminate. Staminate flowers ca. 3 mm long, sessile or pedicel ca. 0.5 mm long, with long trichomes; sepals fused at the basal portion, castaneous, obovate, surfaces pilose at the apex, margins ciliate, apex acute; petals fused into a tube, without glands, castaneous, stamens 3, filaments not fused to the corolla, anthers dorsifixed, cream-colored, carpellodes papillose. Pistillate flowers ca. 2.5 mm long, sessile; sepals castaneous, obovate, surfaces pilose at the apex, margins ciliate, apex acute; petals developed, totally free, without glands, hyaline, obovate, surfaces glabrous, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 0.5 mm longer than the nectariferous branches.
Selected material: Iúna, 18.II.2000, fl., *V.C. Souza et al. 23406* (RB, SPF).

The species differs from *Paepalanthus caparoensis* by its leaves and spathes with dense indument formed of short trichomes. Endemic to Brazil, the species is recorded from Espírito Santo and Minas Gerais (BFG 2015). In Espírito Santo, it occurs only in the Caparaó National Park, where it has been recorded from high open fields.

14. *Paepalanthus klotzschianus* Körn, in *Fl. bras.* (Mart.) 3(1): 389. 1863. Fig. 3d

Herbs 10.9–49 cm tall, stem short, restricted to rosette, ca. 2.5 cm long. Leaves arranged in a rosette, 2.1–12.2 × 0.3–0.8 cm, lanceolate, rigid, densely pilose to sericeous on both surfaces, margins ciliate to sericeous, apex acute. Spathes 3–9.1 cm long, closed, surfaces densely pilose to sericeous, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 6.4–37.6 cm long, surfaces pilose to glabrescent. Capitula castaneous, 6–12 mm diam., hemispherical. Involucral bracts castaneous, ca. 3 mm long, shorter than the floral disc, elliptical to ovate, surfaces pubescent, margins pubescent to glabrescent, apex acuminate. Floral bracts castaneous, ca. 2.3 mm long, narrowly elliptical to linear, surfaces pilose to glabrescent, margins ciliate, apex acute. Staminate flowers ca. 3 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals free, castaneous to hyaline, obovate, surfaces glabrous, margins ciliate to glabrescent, apex acuminate to acute; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 3 mm long, pedicel ca. 1 mm long, pilose to glabrescent; sepals light castaneous, linear to obovate, surfaces glabrous, margins ciliate to glabrescent, apex acuminate to acute; petals developed, totally free, without glands, castaneous to hyaline, obovate, surfaces with long trichomes, margins with long cilia, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 1 mm longer than the nectariferous branches.
Selected material: Aracruz, 20.II.1992, fl., *O.J. Pereira 2755* (VIES). Conceição de Barra, 8.IV.2017, fl., *L.E.F. Silva & I.M. Rollim 80* (R). Guarapari, 25.IX.2016, fl., *L.E.F. Silva et al. 50* (R, RB). Itapemirim, 22.VII.1986, fl., *O.J. Pereira et al. 1428* (VIES). Linhares, 7.XI.2014, fl., *L.E.F.Silva 36* (CVRD, RFA). São Mateus, 28.VIII.2009, fl., *R.C. Andrade et al. 43* (SAMES, VIES). Vila Velha, 26.VII.2012, fl., *L.A. Silva & R.T. Valadares 257* (VIES). Vitória, 2.IX.1998, fl., *A.M. Assis 600* (VIES).

The species differs from other species of *Paepalanthus* by its densely pilose leaves and long

Figure 3 – a-f. Habit and habitat of Eriocaulaceae species in Espírito Santo – a. *Paepalanthus capixaba*; b-c. *Paepalanthus globosus*; d. *Paepalanthus klotzschianus*; e. *Paepalanthus macaheensis*; f. *Paepalanthus macropodus*. Photos: a. Isis Rollim; b-d, f. Marcelo Trovó; e. Claudio Nicoletti de Fraga. Scale bars: a = 7 cm; b = 12 cm; c = 2.5 cm; d = 13 cm; e = 10 cm; f = 7 cm.

and sericeous scapes. Endemic to Brazil, the species is recorded from Bahia, Espírito Santo, and Rio de Janeiro (BFG 2015). In Espírito Santo, it occurs at Conceição da Barra Environmental Protection Area, APA de Guanandy, Itaúnas State Park, Paulo César Vinha State Park, Jacarenema Reserve State, Camburi Sand Dunes Municipal Ecological Reserve, and Vale Natural Reserve; it is very frequent in sand dunes, forming dense populations.

15. ***Paepalanthus macaheensis*** Körn, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1871: 311. 1871. Fig. 3e

Herbs 17.8–61.2 cm tall, stem elongated, not restricted to rosette, 4–23 cm long. Leaves arranged along a stem, 1.6–23.7 × 0.4–1 cm, lanceolate, pilose to pubescent on both surfaces, rarely glabrous, margins ciliate to glabrescent, apex acuminate to acute. Spathes 3.5–9.1 cm long, closed, surfaces pubescent, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 11.1–37.8 cm long, surfaces pubescent. Capitula castaneous, 6–12 mm diam., hemispherical. Involucral bracts light castaneous, ca. 5–7 mm long, longer than the floral disc, ovate to deltoid, surfaces glabrous, margins ciliate, apex obtuse. Floral bracts castaneous, ca. 2.5 mm long, obovate, surfaces pubescent at the apex, margins ciliate to pubescent, apex cuspidate to obtuse. Staminate flowers ca. 2.5 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused at the base, castaneous, oblong to obovate, surfaces pilose to pubescent at the apex, margins pubescent, apex cuspidate to obtuse; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 3 mm long, sessile or pedicel ca. 0.5 mm long, pilose to glabrescent; sepals castaneous, obovate, surfaces pilose to pubescent at the apex, margins pubescent, apex obtuse; petals developed, totally free or fused only at the base, without glands, hyaline, linear to oblong, surfaces pilose at the apex to glabrescent, margins ciliate, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 0.5 mm longer than the nectariferous branches.
Selected material: Alfredo Chaves, 8.V.1985, fl., *G. Martinelli et al. 10892* (RB). Castelo, 13.II.2008, fl., *R.C. Forzza et al. 4991* (MBML, RB). Domingos Martins, 12.IX.1975, fl., *G. Martinelli 779* (RB).

It differs from other species of the genus by its very elongated stem, reaching 23 cm long, and castaneous capitula (Trovó & Sano 2015). Endemic to Brazil, the species is recorded from Espírito Santo, Minas Gerais, and Rio de Janeiro (BFG 2015; Trovó & Sano 2015). In Espírito Santo, it occurs only at Forno Grande State Park, where it has been recorded from cloud forests growing under a canopy of trees.

16. ***Paepalanthus macropodus*** Ruhland, in Pflanzenr. (Engler) IV. 30 (Heft 13): 212. 1903. Fig. 3f

Herbs 29.5–64.3 cm tall, stem elongated, not restricted to rosette, more than 10 cm long. Leaves arranged along a stem, 12.6–16 × 1–2.5 cm, lanceolate, hirsute-pilose to glabrescent on both surfaces, margins hirsute-lanuginous to glabrescent when old, apex acute. Spathes 4.2–7.1 cm long, closed, surfaces pilose-hirsute to glabrescent, apex obtuse. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, fused, 9.3–24.7 cm long, surfaces pubescent. Capitula castaneous or white, 4–8 mm diam., hemispherical, divided into four portions. Involucral bracts castaneous, ca. 3 mm long, shorter than the floral disc, ovate, surfaces pilose at the apex, margins ciliate, apex acute. Floral bracts castaneous, ca. 2.5 mm long, linear, surfaces pilose at the apex, margins densely ciliate, apex acute. Staminate flowers ca. 2.5 mm long, sessile or pedicel ca. 0.5 mm long, pilose; sepals fused up to the median portion, castaneous to hyaline, linear to obovate, surfaces pilose at the apex, margins ciliate, apex acuminate; petals fused up to the median portion, without glands, castaneous to hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 3 mm long, sessile; sepals castaneous, obovate, surfaces pilose at the apex to glabrescent, margins ciliate, apex acuminate; petals developed, totally free, without glands, hyaline to castaneous, obovate, surfaces glabrous, margins ciliate, apex acuminate. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 0.5 mm longer than the nectariferous branches.
Selected material: Domingos Martins, 11.VII.2006, fl., *A.P. Fontana et al. 2233* (RB). Fundão, 4.V.2003, fl., *A.P. Fontana et al. 589* (MBML).

It differs from the other species of the genus by its completely fused scapes and petals of staminate flowers fused up to the median portion. The species can be distinguished from *Paepalanthus planifolius*, the morphologically most similar

species, by its elongated stem. Endemic to Brazil, the species is recorded from Espírito Santo and Minas Gerais (Tissot-Squalli 1997; BFG 2015). In Espírito Santo, it occurs in Pedra Azul State Park and Goiapaba-Açu Municipal Park, being recorded from high fields.

17. *Paepalanthus planifolius* (Bong.) Körn., in *Fl. bras.* (Mart.) 3(1): 413, pl. 52. 1863. Fig. 4a

Herbs 32.6–38.2 cm tall, stem short, restricted to rosette, up to 2 cm long. Leaves arranged in a rosette, 11.7–15.3 × 1–2 cm, lanceolate, pubescent to glabrescent on both surfaces, margins ciliate-pubescent to glabrescent, apex cuspidate to obtuse. Spathes 10.3–12 cm long, closed, surfaces pubescent, apex rounded to truncate. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, fused, 23–37.7 cm long, surfaces pubescent. Capitula dark castaneous, ca. 10 mm diam., hemispherical. Involucral bracts light castaneous to cream-colored, 2–3 mm long, shorter than the floral disc, elliptical to oblong, surfaces pubescent to glabrescent, margins ciliate, apex obtuse. Floral bracts castaneous to cream-colored, ca. 3 mm long, cuspidate to obovate, surfaces glabrous, margins ciliate, apex obtuse. Staminate flowers ca. 3 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused at the median portion, castaneous, obovate, surfaces glabrous, margins ciliate, apex cuspidate to obtuse; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 3 mm long, sessile; sepals castaneous, obovate, surfaces glabrous, margins ciliate, apex cuspidate to obtuse; petals developed, totally free, without glands, light castaneous, obovate, surfaces glabrous, margins ciliate, apex obtuse. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, three times longer than the nectariferous branches.

Selected material: Castelo, 13.V.1949, fl., *A.C. Brade 19811* (RB).

It differs from other species of the genus by the fused scapes, and from *Paepalanthus macropodus* by its short stem, restricted to the rosette. Endemic to Brazil, the species is recorded from Espírito Santo, Minas Gerais, Paraná, Rio Grande do Sul, Rio de Janeiro, Santa Catarina, and São Paulo (Ruhland 1903; Tissot-Squalli 1997; BFG 2015). In Espírito Santo, it occurs only at Forno Grande State Park in high fields.

18. *Paepalanthus tortilis* (Bong.) Mart., *Fl. bras.* (Mart.) 3(1): 354. 1863. Fig. 4b

Herbs 4–33.4 cm tall, stem elongated, not restricted to rosette, 0.5–7 cm long. Leaves arranged along a stem, 0.5–3.6 × 0.1–0.2 cm, lanceolate-linear, surfaces glabrescent, margins ciliate-hirsute to glabrescent, apex obtuse. Spathes 0.9–3.2 cm long, closed, surfaces pilose, apex obtuse. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 2.7–21.3 cm long, surfaces pilose to glabrescent. Capitula blackish, ca. 4 mm diam., spherical to conical. Involucral bracts black, ca. 1.5 mm long, shorter than the floral disc, ovate, surfaces glabrous, margins ciliate to glabrescent, apex acuminate. Floral bracts black, ca. 1 mm long, oblong to obovate, surfaces pilose to glabrescent, margins ciliate to glabrescent, apex mucronate. Staminate flowers ca. 1 mm long, pedicel ca. 0.4 mm long, with small trichomes; sepals fused at the base or totally free, greenish, obovate, surfaces pilose to glabrescent, margins ciliate to glabrescent, apex mucronate; petals fused into a tube, without glands, hyaline, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes papillose. Pistillate flowers ca. 1 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals black, obovate, surfaces pilose to glabrescent, margins ciliate, apex mucronate; petals developed, totally free, without glands, hyaline, obovate, pilose on both surfaces, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 0.2 mm longer than the nectariferous branches.

Selected material: Conceição da Barra, 6.IV.2017, fl., *L.E.F. Silva & I.M. Rollim 75* (R). Guarapari, 25.XI.2006, fl., *R.T. Valadares 339* (VIES). Jaguaré, 28.I.2014, fl., *W.O. Souza et al. 225* (VIES). Linhares, 7.XI.2014, fl., *L.E.F. Silva 40* (CVRD, RFA). Piuma, 14.I.1985, fl., *B. Weinberg & J. Bondon 697* (MBML). São Mateus, 29.VIII.2009, fl., *R. Coelho et al. 49* (SAMES, VIES). Vila Velha, 30.VI.2014, fl., *R.T. Valadares 1233* (VIES).

It is easily distinguished from other species of the genus by its blackish capitula. In South America, it occurs in Brazil, Colombia, and Venezuela. In Brazil, there are records from Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Maranhão, Minas Gerais, Paraíba, Piauí, Pernambuco, Rio Grande do Norte, Rio de Janeiro, Roraima, Rondônia, and Sergipe (Ruhland 1903; BFG 2015). In Espírito Santo, it occurs in Conceição da Barra

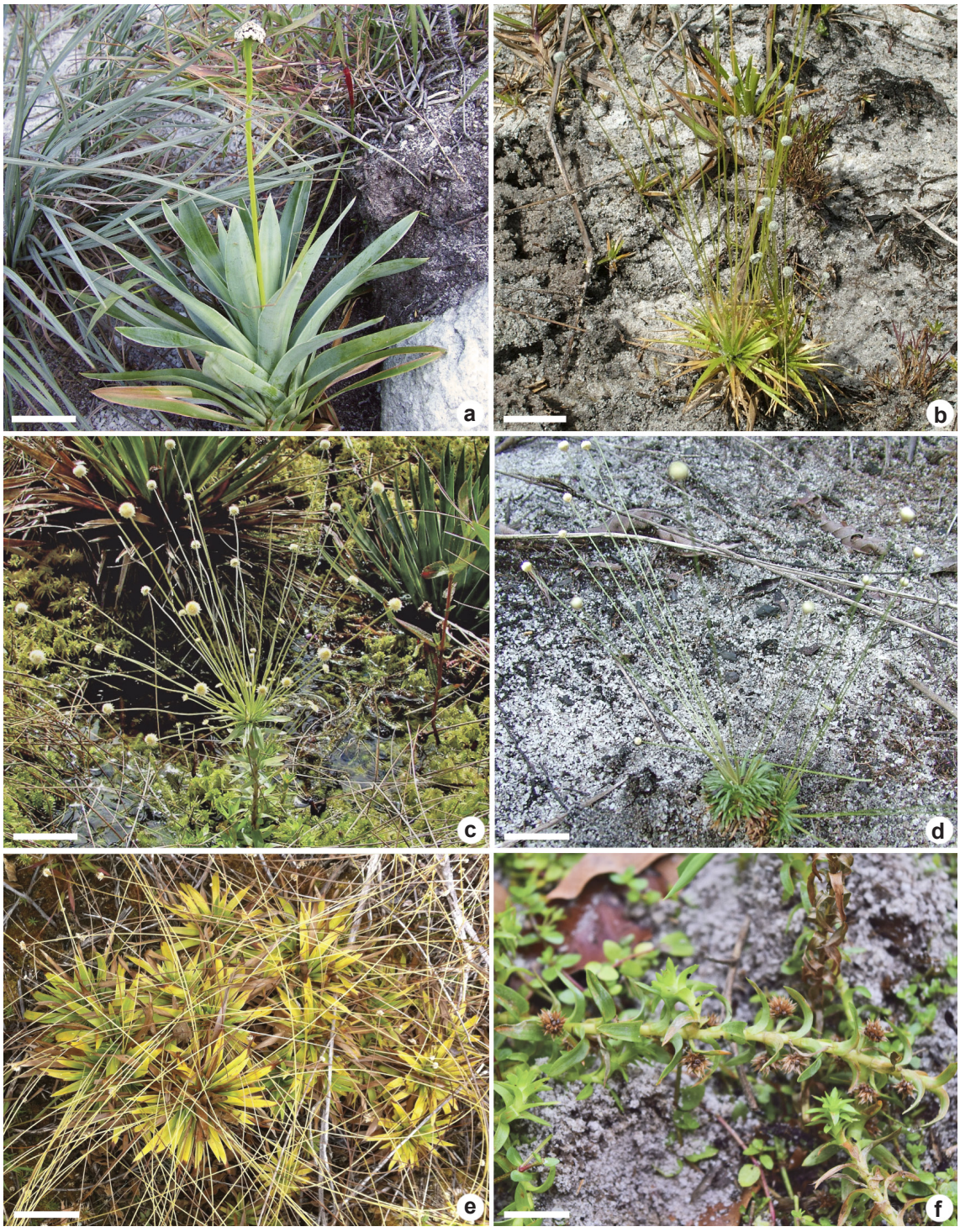

Figure 4 – a-f. Habit and habitat of Eriocaulaceae species in Espírito Santo – a. *Paepalanthus planifolius*; b. *Paepalanthus tortilis*; c. *Syngonanthus caulescens*; d. *Syngonanthus gracilis*; e. *Syngonanthus restingensis*; f. *Tonina fluviatilis*. Photos: a-e. Marcelo Trovó; f. Isis Rollim. Scale bars: a = 5 cm; b = 2.5 cm; c = 5 cm; d = 5 cm; e = 6 cm; f = 3 cm.

Environmental Protection Area, Itaúnas State Park, Paulo César Vinha State Park, and Vale Natural Reserve; it is very frequent in sand dunes, forming large populations.

19. *Syngonanthus caulescens* (Poir.) Ruhland, in Pflanzenr. (Engler) IV. 30 (Heft 13): 267, f. 38. 1903. Fig. 4c

Herbs 45–48.7 cm tall, stem elongated, not restricted to rosette, 4–26 cm long. Leaves arranged along a stem, 1.7–2.3 × 0.4–0.6 cm, lanceolate, pilose on both surfaces, margins ciliate to glabrescent, apex obtuse. Spathes 2.5–4 cm long, closed, surfaces pilose, apex obtuse. Scapessolitary or arranged in an terminal umbel, 6–21 cm long, surfaces pilose. Capitula cream-colored, ca. 4 mm diam., hemispherical. Involucral bracts cream-colored, 2–2.5 mm long, shorter than the floral disc, elliptical, surfaces glabrous, margins glabrous, apex acute. Floral bracts hyaline, ca. 2.5 mm long, elliptical, surfaces glabrous, margins glabrous, apex acute. Staminate flowers ca. 2 mm long, pedicel ca. 1 mm long, with long trichomes; sepals totally free or fused at the base, hyaline, elliptical, surfaces glabrous, margins glabrous, apex acute; petals fused up to the apical portion, without glands, hyaline, stamens 3, filaments fused to the corolla, anthers dorsifixed. Pistillate flowers ca. 2 mm long, sessile; sepals hyaline, free, elliptical, surfaces glabrous, margins glabrous, apex acute; petals developed, fused at the median-apical portion, without glands, hyaline, elliptical, surfaces glabrous, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches whole from the base, two times longer than the nectariferous branches.

Selected material: Conceição da Barra, 27.XI.2002, fl., *C.N. Fraga 954* (MBML, SPF).

It is easily distinguished from other species of *Syngonanthus* by its elongated stem supporting apical scapes. The species is widely distributed from Central to South America (Giulietti & Hensold 1990). In Brazil, there are records from Amazonas, Bahia, Distrito Federal, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Pernambuco, Rio Grande do Sul, Rio de Janeiro, Roraima, Santa Catarina, São Paulo, and Tocantins (Echternacht 2012; BFG 2015). In Espírito Santo, it occurs only at the Conceição da Barra Environmental Protection Area, where it is recorded in sand dunes.

20. *Syngonanthus gracilis* (Bong.) Ruhland, in Pflanzenr. (Engler) IV. 30 (Heft 13): 249. 1903. Fig. 4d

Herbs 7.4–29.7 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 0.4–2.8 × 0.1 cm, linear, sericeous to glabrescent on both surfaces, margins ciliate to glabrescent, apex obtuse. Spathes 1–2.8 cm long, closed, pilose on abaxial surface, apex acute. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 6.4–19.6 cm long, surfaces pilose to glabrescent. Capitula cream-colored, ca. 4 mm diam., hemispherical. Involucral bracts hyaline, ca. 2.5 mm long, inconspicuous, shorter than the floral disc, elliptical to obovate, surfaces glabrous, margins ciliate to glabrescent, apex obtuse. Floral bracts hyaline, ca. 2 mm long, narrowly elliptical, surfaces glabrous, margins glabrous, apex acute. Staminate flowers ca. 1.5 mm long, pedicel ca. 1 mm long, with long trichomes; sepals fused up to the median portion maximum, hyaline, elliptical, surfaces glabrous, margins glabrous, apex acute; petals fused up to the apical portion, without glands, hyaline, stamens 3, filaments fused to the corolla up to the apex, anthers dorsifixed. Pistillate flowers ca. 3 mm long, pedicel 0.5–1 mm long, with long trichomes; sepals hyaline, elliptical, surfaces glabrous, margins glabrous, apex acute; petals developed, fused up to the apical portion, without glands, hyaline, narrowly elliptical, surfaces glabrous, margins ciliate to glabrescent, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the apex, ca. 0.5 mm longer than the nectariferous branches.

Selected material: Conceição da Barra, 14.IV.2014, fl., *W.O. Souza et al. 339* (VIES). Guarapari, 10.VI.2006, fl., *M.L.L. Martins 1308* (VIES). Linhares, 7.XI.2014, fl., *L.E.F. Silva 41* (CVRD, RFA).

Plants are usually small, of gracile habit and having cream-colored capitula. There are records from Bolivia, Brazil, Uruguay, and Venezuela. In Brazil, the species is recorded from Amazonas, Bahia, Ceará, Distrito Federal, Espírito Santo, Goiás, Maranhão, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Paraná, Rio de Janeiro, Rondônia, Roraima, Santa Catarina, and São Paulo (Ruhland 1903; Echternacht 2012; BFG 2015). In Espírito Santo, it occurs in Conceição da Barra Environmental Protection Area, Itaúnas State Park, Paulo César Vinha State Park, and Vale Natural Reserve; it is frequent in sand dunes.

21. ***Syngonanthus restingensis*** Hensold & A.L.R.Oliveira, Phytotaxa 40: 2. 2012. Fig. 4e

Herbs 22.9–51.7 cm tall, stem short, restricted to rosette. Leaves arranged in a rosette, 6.5–21.4 × 0.5–1 cm, lanceolate, pilose on both surfaces when young to glabrescent, margins ciliate to glabrescent, apex obtuse. Spathes 3.9–7.5 cm long, closed, surfaces pilose to glabrescent, apex obtuse. Scapes arranged in leaf axils, solitary or arranged in an terminal cohort, free, 6.3–48.6 cm long, surfaces pilose. Capitula cream-colored, ca. 6–7.5 mm diam., hemispherical. Involucral bracts cream-colored, ca. 3 mm long, inconspicuous, shorter than the floral disc, ovate, surfaces glabrous, margins ciliate to glabrescent, apex acute. Floral bracts hyaline, ca. 2.5 mm long, narrowly elliptical to linear, surfaces glabrous, margins ciliate to glabrescent, apex acute. Staminate flowers ca. 2 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals totally free, castaneous to hyaline, elliptical, surfaces glabrous, margins glabrous, apex acute; petals fused up to the apical portion, without glands, castaneous to hyaline, stamens 3, filaments fused to the corolla at the base, anthers dorsifixed. Pistillate flowers ca. 3 mm long, sessile or pedicel ca. 0.5 mm long, with long trichomes; sepals castaneous to hyaline, elliptical, surfaces glabrous, margins glabrous, apex acute; petals developed, fused at the median portion, without glands, castaneous to hyaline, oblanceolate, surfaces glabrous, margins glabrous, apex acuminate. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the end of nectariferous branches, three times longer than the nectariferous branches.

Selected material: Guarapari, 27.VI.2006, fl., *M.L.L. Martins 1263* (VIES). Linhares, 7.XI.2014, fl., *L.E.F. Silva 34* (CVRD, RFA).

It differs from other species of the genus by its robust habit in length and width, often forming clumps of individuals growing in shaded areas and with lanceolate leaves. Endemic to Brazil, the species is recorded from Bahia, Espírito Santo, and Rio de Janeiro (Hensold *et al.* 2012; Silva & Trovó 2016). Until the floristic treatment of the Flora of Vale Natural Reserve (Silva & Trovó 2016), there was no record of this species to Espírito Santo. In the present study, it is also documented as occurring in Paulo César Vinha State Park; the species is recorded from sand dunes, forming dense populations.

22. ***Tonina fluviatilis*** Aubl., Hist. Pl. Guiane 2: 857. 1775. Fig. 4f

Herbs 7–59.8 cm tall, stem prostrate. Leaves arranged along a stem, 0.5–2 × 0.1–0.4 cm, lanceolate, sparsely pilose to glabrescent surfaces, margins hirsute-lanuginous to glabrescent, apex acuminate to acute. Spathes 0.5–1.5 cm long, open, surfaces glabrous or rarely pilose, apex acute. Scapes arranged in leaf axils, solitary, free, 0.1–0.8 cm long, surfaces pilose to glabrescent. Capitula castaneous, ca. 4 mm diam., hemispherical. Involucral bracts light castaneous, ca. 3 mm long, longer than the floral disc, elliptical to ovate, surfaces sparsely pilose to glabrescent, margins ciliate, apex acute to acuminate. Floral bracts castaneous, ca. 2.5 mm long, oblanceolate, surfaces pilose to glabrescent, margins ciliate to glabrescent, apex acuminate. Staminate flowers ca. 2 mm long, pedicel ca. 0.5 mm long, with long trichomes; sepals fused up to the apical portion and fused at the base, covering the petals, castaneous, free, elliptical to wide-elliptical, surfaces glabrous, margins glabrous, apex acuminate; petals fused up to the apical portion, without glands, hyaline, free, stamens 3, filaments not fused to the corolla, anthers dorsifixed, carpellodes diminutive. Pistillate flowers ca. 2.5 mm long, subsessile or pedicel ca. 0.5 mm long, pilose to glabrescent; sepals castaneous, free, ovate, surfaces glabrescent, margins ciliate, apex acuminate to acute; petals reduced to lobes with long trichomes or absent on fleshy anthophore, totally free, without glands, castaneous to hyaline, narrowly elliptical, surfaces with long trichomes, margins ciliate, apex acute. Gynoecium with stigmatic and nectariferous branches arising from the column at the same height, stigmatic branches bifid at the base, the same length as the nectariferous branches.

Selected material: Alegre, 24.VI.2008, fl., *A.P. Fontana et al. 5332* (MBML). Atílio Vivacqua, 26.IV.2007, fl., *L. Kollmann et al. 9717* (MBML). Cariacica, 7.III.1998, fl., *C.N. de Fraga & A.P.A. Lofêgo 375* (MBML, SPF). Guarapari, 8.IV.2017, fl., *L.E.F. Silva & I.M. Rollim 83* (RB). Linhares, 6.XI.2014, fl., *L.E.F. Silva 29* (CVRD, RFA). Santa Leopoldina, 14.IV.2008, fl., *A.P. Fontana et al. 4956* (MBML). Santa Maria de Jetibá, 19.XII.2007, fl., *L. Kollmann 10232* (MBML). Santa Teresa, 11.XII.2012, fl., *R.R. Vervloet et al. 1510* (MBML). Serra, 22.IV.1993, fl., *O.J. Pereira et al. 4534* (VIES).

It differs from other species of Eriocaulaceae due to its open spathes and pistillate flowers with reduced petals. There are records from several countries in the Americas: Brazil, Colombia,

Ecuador, Guyana, French Guiana, Mexico, Peru, Suriname, and Venezuela. In Brazil, there are records from Acre, Amazonas, Bahia, Ceará, Espírito Santo, Maranhão, Pará, Paraíba, Pernambuco, Piauí, Rio de Janeiro, São Paulo, and Tocantins (Ruhland 1903; Sano & Giulietti 2012; BFG 2015). In Espírito Santo, the species occurs in Paulo César Vinha State Park, Augusto Ruschi Biological Reserve, and Vale Natural Reserve; it is recorded along the margins of flooded areas, forming dense populations.

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Exsiccate list

Lutz A 1208 - R (11). **Andrade IR** 221 - SPF (1). **Andrade RC *et al.*** 43 - SAMES, VIES (14). **Araújo D & Maciel NC** 5601 - SPF (1). **Assis AA & Demuner MDS** 2005 - MBML (1). **Assis AM** 252 - VIES (10); 575 - VIES (3); 600 - VIES (14); 683 - VIES (3); 847 - VIES (8). **Assis AM *et al.*** 921 - MBML (22); 1053 - MBML (22); 2231 - MBML (3); 2241 - MBML (1); 2862 - VIES (1). **BW** 854 - R (22); 883 - SPF (5). **Bittencourt JAR & Lana W** - MBML4268 (1). **Brade AC** 19336 - RB (12); 19811 - RB (17); 19945 - RB (12). **Braga JMA & Silva AS** 3742 - RB (14). **Braga JMA *et al.*** 7304 - CVRD, RB, RFA (1). **Coelho RA *et al.*** 14 - SAMES, VIES (18); 49 - SAMES, VIES (18). **Colleta GD *et al.*** 292 - VIES (5). **Costa A** 335 - RB (5); 336 - RB (5). **Costa CG** - RB600843 (2). **Curso de taxonomia Vegetal** - VIES389 (1); - VIES381 (2); - VIES388 (14). **Devecchi MF *et al.*** 144 - SPF (22). **Duarte AP** 13978 - HB (1). **Duarte AP & Gomes IC** 3647 - RB (1). **Dutra SS *et al.*** 140 - VIES (2). **Farias GL** 98 - CVRD, RFA (1); 568 - SPF (5). **Farney C & Lima HC** 316 - RB (2). **Farney C *et al.*** 280 - RB (18); 4771 - RB, VIES (14). **Ferreira VBR** 57 - SAMES (14); 58 - SAMES (1); 78 - SAMES (1); 88 - SAMES (1); 90 - SAMES (14); 98 - SAMES (14); 109 - SAMES (1); 110 - SAMES (5); 136 - SAMES (5); 154 - SAMES (18). **Ferreira VF** 1851 - RB, SPF (12). **Fiaschi P *et al.*** 636 - SPF (18); 646 - SPF (2); 647 - SPF (3); 648 - SPF (22); 649 - SPF (14); 650 - SPF (1). **Flores TB & Romão GO** 1239 - MBML, RB (1); 1240 - MBML, RB, VIES (5). **Folli DA** 725 - CVRD, RFA, SPF (14); 736 - CVRD, RFA (1); 737 - CVRD, RFA (1); 738 - CVRD, RFA (1); 749 - CVRD, RFA (18); 1592 - CVRD, RFA (20); 1826 - CVRD, RFA (18); 1855 - CVRD, RFA, SPF (22); 1873 - SPF (5); 2402 - CVRD, RFA (21); 2937 - CVRD, RFA (10); 3465 - CVRD, RFA (14); 3892 - CVRD, RFA (5); 4231 - CVRD, RFA (22); 4794 - CVRD, RFA (18); 5085 - CVRD, RFA (1); 5289 - CVRD, RFA (5); 5318 - CVRD, RFA (21); 5580 - CVRD, RFA (18). **Fontana AP & Kollmann L** 7319 - MBML (9). **Fontana AP *et al.*** 589 - MBML (16); 2233 - RB (16); 4956 - MBML (22); 5332 - MBML (22). **Forzza RC *et al.*** 4991 - MBML, RB (15). **Fraga CN** 55 - MBML, SPF (18); 167 - MBML (5); 274 - MBML (18); 537 - MBML (18); 582 - MBML (4); 583 - MBML (1); 584 - MBML (18); 954 - MBML, SPF (19). **Fraga CN & Lofêgo APA** 346 - MBML (10); 348 - MBML (2); 351 - MBML (18); 364 - MBML, SPF (3); 375 - MBML, SPF (22). **Fraga CN *et al.*** 340 - SPF (5); 340 - MBML (21); 341 - SPF (5); 341 - MBML (21); 2575 - RB, SPF (20). **Giulietti AM** 1080 b - RB, SPF (1); 1081 - SPF (5); 1082 - SPF (20); 1083 - SPF (18); 1084 - SPF (10). **Giulietti AM *et al.*** 1045 - SPF (1); 1046 - SPF (14); 1047 - SPF (2). **Goldenberg R *et al.*** 2138 - RB (12). **Gomes JML** 87 - VIES (1); 88 - SPF, VIES (14); 1008 - VIES (22); 1112 - VIES (22); 2748 - VIES (2); 4793 - VIES (14); - VIES11410 (10). **Hatschbach G & Cervi AC** 51438 - SPF (14). **Hupp G *et al.*** 68 - MBML (22). **Inácio M** - MBML1511 (1). **Irwin HS** 2758 - R (8). **JMA & Silva AS** 3745 - RB, SPF (2). **JML** 1607 - VIES (18). **Kollmann L & Lopes RS** 11445 - MBML (1). **Kollmann L** 6069 - MBML (22); 10232 - MBML (22). **Kollmann L *et al.*** 9717 - MBML (22); 10303 - MBML, RB, SPF (12); 11599 - MBML, RB (12). **Krieger L** 18640 - SPF (5); 18642 - SPF40815 (7). **Krieger L & Sabino M** 18641 - SPF (6); *18642* - SPF151273 (18). **Lima HC** 1673 - RB (1). **Lima HC *et al.*** 1910 - RB (10). **Lima JCA** 4 - RB (20). **Lombardi JA *et al.*** 9654 - CVRD, RFA, SPF (1). **Lopes JC *et al.*** 225 - SPF (20); 252 - RB, SPF (22); 253 - SPF (18); 256 - RB, SPF (1). **Lopes LCM & Lobão AQ** 57 - SAMES, VIES (14); 58 - SAMES, VIES (18). **Lube GGK & Pereira OJ** 72 - VIES (14); 104 - VIES (1); 215 - VIES (3). **Luna Peixoto A *et al.*** 320 - RB (2). **Maas *et al.*** 9869 - CVRD, RFA (1). **Machado JO *et al.*** 107 - VIES (18); 179 - VIES (1). **Martinelli G** 779 - RB (15); 4966 - RB (10). **Martinelli G *et al.*** 8027 - RB (15); 10892 - RB (15); 11004 - RB (18); 12232 - RB (14). **Martins MLL** 1259 - VIES (18); 1263 - VIES (21); 1308 - VIES (20); 1315 - VIES (1). **Martins RFA *et al.*** 19 - SAMES, VIES (5); 155 - SAMES, VIES (1); 164 - SAMES (18); 246 - SAMES, VIES (1). **Matos FAR & Souza PF** 52 - MBML, SPF (18). **Mello-Silva R *et al.*** 1550 - SPF (1). **Menezes** 1332 - SPF (14); 1333 - SPF (10). **Monteiro D & Siqueira G** 732 - RB (5). **Monteiro MM *et al.*** 60 - SAMES (10); 63 - SAMES (14); 148 - SAMES, VIES (1); 174 - SAMES, VIES (14). **Morokawa R *et al.*** 402 - RB, SPF (10). **OAD** - R (8). **Oliveira AG** 1198 - SAMES (1). **Oliveira AG *et al.*** 81 - SAMES (10); 83 - SAMES, VIES (14); 329 - SAMES, VIES (1); 628 - SAMES (10); 629 - VIES (10). **Oliveira IR *et al.*** 15 - SAMES, VIES (18). **Pereira E** 9879 - HB (12). **Pereira OJ** 261 - VIES (3); 291 - VIES (2); 310 - SPF (3); 414 - VIES (1); 415 - VIES (18); 416 - VIES (3); 491 - VIES (14);

496 - VIES (2); 706 - SPF (1); 708 - SPF (3); 1069 - VIES (1); 1429 - VIES (10); 1690 - VIES (5); 2340 - VIES (3); 2755 - VIES (14); 2756 - VIES (10); 2798 - VIES (1); 2989 - VIES (5); 3192 - VIES (1); 3519 - VIES (1); 3546 - VIES (14); 3563 - VIES (5); 3738 - VIES (14); 3778 - VIES (5); 4127 - VIES (10); 4406 - VIES (10). **Pereira OJ & Assis AM** 5766 - VIES (22); 6099 - VIES (18). **Pereira OJ & Gomes JML** 1171 - VIES (10); 4446 - VIES (1); 4708 - VIES (18); 4709 - VIES (14); 4740 - VIES (10); 4745 - VIES (18). **Pereira OJ & JML** 4754 - VIES (10). **Pereira OJ & Zambom O** 5600 - VIES (18); 5601 - VIES (1); 5602 - VIES (5). **Pereira OJ *et al.*** 142 - VIES (1); 202 - VIES (5); 204 - SPF (5); 922 - VIES (3); 1428 - VIES (14); 1734 - VIES (14); 1789 - VIES (10); 1961 - VIES (14); 2145 - VIES (10); 2161 - VIES (5); 2744 - VIES (18); 2765 - VIES (18); 2769 - VIES (5); 2930 - VIES (5); 3002 - VIES (20); 3004 - VIES (18); 3545 - VIES (20); 3654 - VIES (5); 3777 - VIES (20); 3807 - VIES (1); 4078 - VIES (10); 4534 - VIES (22); 4653 - VIES (14); 4654 - VIES (1); 4668 - VIES (5); 4701 - VIES (10); 6172 - VIES (1); 6313 - VIES (14); 6323 - VIES (10); 6988 - VIES (20). **Pirani JR & Zappi DC** 1080 - RB, SPF (2). **Pirani JR *et al.*** 6060 - SPF (2). **Rando JG *et al.*** 164 - RB (5); 168 - RB, SPF (20); 173 - RB (1). **Rodrigues RS *et al.*** 398 - MBML (12). **Silva BR & Nadruz M** 1393 - RB (18). **Silva LA** 342 - VIES (3). **Silva LA & Valadares RT** 257 - VIES (14). **Silva LEF** 26 - CVRD, RFA (20); 27 - CVRD, RFA (5); 28 - CVRD, RFA (10); 29 - CVRD, RFA (22); 30 - CVRD, RFA (18); 31 - CVRD, RFA (1); 32 - CVRD, RFA (14); 34 - CVRD, RFA (21); 35 - CVRD, RFA (3); 36 - CVRD, RFA (14); 37 - CVRD, RFA (1); 38 - CVRD, RFA (5); 39 - CVRD, RFA (10); 40 - CVRD, RFA (18); 41 - CVRD, RFA (20); 51 - R, RB (22); 52 - R, RB (2). **Silva LEF & Rollim IM** 72 - R (14); 73 - RB (14); 74 - RFA (14); 75 - R (18); 76 - R (1); 77 - RFA (1); 78 - R (14); 79 - R (1); 80 - RB (14); 81 - R (2); 82 - RB (22); 83 - RB (9). **Silva LEF *et al.*** 43 - R, RB, RFA (12); 45 - B, NY, P, R, RB, SPF, VIES (9); 46 - R (9); 48 - R, RB (1); 49 - RB (3); 50 - R, RB (14). **Siqueira GS** 224 - CVRD, RFA (20). **Sobral M** 3987 - SPF (5); 4020 - SPF (18); 4097 - SPF (20); 4692 - SPF (3). **Souza FBC *et al.*** 69 - VIES (7); 81 - VIES (18). **Souza Silva S** 16 - RB (1). **Souza VC *et al.*** 23390 - RB, SPF (13); 23406 - RB, SPF (13). **Souza WO *et al.*** 86 - VIES (18); 143 - VIES (10); 225 - VIES (18); 339 - VIES (20); 340 - VIES (18). **Stehmann JR *et al.*** 4660 - CVRD, RFA (5); 4667 - CVRD, RFA (18); 4693 - CVRD, RFA (1); 4769 - CVRD, RFA (18). **Sucre D** 5588 - RB (22); 8315 - RB (10); 8385 - RB (1); 8390 - RB (14); 8399 - RB (3); 8413 - RB (18). **Trovó MLO** 256 - CVRD, RFA, SPF (10). **Trovó MLO *et al.*** 253 - CVRD, RFA, SPF (5); 254 - CVRD, RFA (20); 255 - SPF (1); 257 - CVRD, RFA, SPF (14). **Valadares RT** 339 - VIES (18); 1233 - VIES (18). **van den Berg C** 162 - SPF (14). **Vervloet RR *et al.*** 1510 - MBML (22). **Vinha PC** 1232 - VIES (10); 1266 - VIES (14); 1269 - VIES (1). **Weinberg B** 884 - SPF (5); 938 - MBML (3). **Weinberg B & Bondon J** 697 - MBML (18). **Weinberg B *et al.*** - MBML4267 (5). **Zikan** 9 - R (11).

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