



ECOSYSTEMS

A new dimerous flowered species of *Paepalanthus* (Eriocaulaceae) from the Chapada Diamantina (Bahia, Brazil)

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Abstract: In this manuscript we describe and illustrate a new species of *Paepalanthus* ser. *Dimeri* (Eriocaulaceae) endemic to the Chapada Diamantina, Brazil. The new species, *Paepalanthus pyatan* Picanço & Trovó, is distinguished from the other *Paepalanthus* by the following set of characters: robust habit, inflorescences arising at the top of lateral branches, capitula with ca. 2–3 cm in diameter, outer involucral bracts larger than the inner ones, and dimerous flowers. A detailed comparison with *P. niger*, the morphologically most similar species is provided. The new species is known from two unprotected and closely located subpopulations, and should be considered as endangered (EN). We also provide comments on the species anatomy, ecology and distribution, as well as distribution map, field photographs and detailed line drawings.

Key words: Anatomy, *Campos Rupestres*, Conservation, Paepalanthoideae, Poales, Taxonomy.

INTRODUCTION

The Brazilian *campos rupestres* vegetation is widely known for housing a high number of endemic species, many of those represented by populations restricted to a single or a few adjacent mountains (Alves et al. 2014). The Chapada Diamantina (Bahia state) is a unique region regarding plant biodiversity with many narrowly distributed species restricted to its *campos rupestres* (Gonçalves & Gonçalves 2023). This region indeed hosts a different flora from the rest of the Espinhaço Range, being designated as a distinct bioregion (Colli-Silva et al. 2019). Located in the northern part of the Espinhaço Range, the Chapada Diamantina is a center of Eriocaulaceae diversity hosting most of the 76 species occurring in the *campos rupestres* vegetation in Bahia (Flora e Funga do Brasil 2025). This area is especially relevant for

the family when considering the high number of endemic species (almost 25%), a number certainly underestimated (Giulietti et al. 2005, Giulietti & Miranda 2009, Gonçalves & Gonçalves 2023).

Paepalanthus is the species richest genus among the Brazilian Eriocaulaceae (Bánki et al. 2024, Stützel et al. 2024). *Paepalanthus* ser. *Dimeri* (Ruhland) Giul. is a group of morphologically and phylogenetically closely related plants, with many species occurring in Bahia and also in Minas Gerais and Goiás states (Trovó et al. 2013, 2017, Trovó 2018, Andrino et al. 2021). As pointed out by Trovó (2018) when detailing some of the species from Goiás, the circumscriptions of the taxa included in this group still need further clarification, especially those related to the *Paepalanthus elongatus* (Bong.) Körn. species complex.

In this context, we emphasize that the species related to *Paepalanthus* ser. *Dimeri* from the Chapada Diamantina have received minimal attention. Specimens identified as *P. elongatus* from the municipality of Piatã (Bahia), first called attention due to the unusual robust size of the vegetative and reproductive structures. After carefully analyzing dried specimens and living plants in their natural environment we propose that they represent a new species, firstly described here.

MATERIALS AND METHODS

The morphological description and comparisons reflect both living plants in their natural habitat, as well as specimens from the following herbaria: ALCB, BHCB, CEN, FURB, HUEFS, HEPH, IBGE, IAN, ICN, MBM, MG, R, RB, SP, SPF, UB, UFG, and UPCB (acronyms according to Thiers, updated continuously). In addition to field efforts and in person herbarium analysis, we conducted an extensive search in the following virtual collections: Jstor Plants, SpeciesLink, and Herbário Virtual Re flora. We adopt the morphological terminology of Radford et al. (1974) and Stützel & Trovó (2013), the species concept of Stuessy (1990), and the broad concept of *Paepalanthus* s.l. as delineated by Christenhusz et al. (2020) and Stützel et al. (2024). The measurements for *Paepalanthus niger* (Moldenke) Trovó derive from the protologue (Trovó 2018). We employed the GeoCat tool (Bachman et al. 2011) to estimate the Area of Occupation (AOO) and Extent of Occurrence (EOO) and the threat assessment, following the IUCN guideline criteria (IUCN 2024). We prepared the map layout using Qgis software, with the protected area layers downloaded from IBGE and ICMBio websites.

For the anatomical studies, we fixed samples of fully expanded leaves and scapes

of *P. pyatan* (W. Picanço, 560 – housed at R) and *P. niger* (W. Picanço, 369 – housed at R) in formaldehyde-acetic acid-ethanol (FAA 50) (Johansen 1940), and then stored in 70% ethanol with a few drops of glycerin. We made transversal and longitudinal freehand sections in the middle third of leaf laminae and scapes using razor blades – five leaves/scapes from at least three individuals sampled for each species. We stained the sections with basic Fuchsin and Astra Blue (Roeser 1962), mounted them on permanent slides with Entellan® (Merck, Darmstadt, Germany), and photomicrographed using a microscope (DM4000B, Leica, Wetzlar, Germany) coupled to a digital camera (DFC450, Leica, Wetzlar, Germany) and L.A.S. 2.0 software.

RESULTS AND DISCUSSION

Taxonomic treatment

Paepalanthus pyatan Picanço & Trovó sp. nov.
Type: Brazil, Bahia, Piatã, Estrada para Três Morros, acessada pela BA-560. Estrada de terra na primeira bifurcação à esquerda, sentido Três Morros, campo ca. 2 km a partir da estrada principal, próximo a uma fazenda, [Road to Três Morros, accessed via BA-560. Dirt road at the first bifurcation to the left, heading towards Três Morros, open field approximately 2 km from the main road, near a farm] 13°03'44"S 41°53'02"W, 1431 m, 08 July 2021, W. Picanço, 560 (Holotype R; isotypes ALCB, B, CEN, HUEFS, K, NY, OUPR, RB, SPF). Figs. 1 & 2.

Herbs 50–71 cm (Fig. 1a), solitary, rhizome present, aerial stem short, with usually horizontal growth. **Leaves** 25–39 × 0.3–0.4 cm, persistent, spirally alternate, pale-green to paleaceous when old, chartaceous, linear, erect, flat to rarely twisted, apex acute to rounded, venation inconspicuous, T-shaped short trichomes adpressed in both surfaces to glabrescent, mostly concentrated at the abaxial

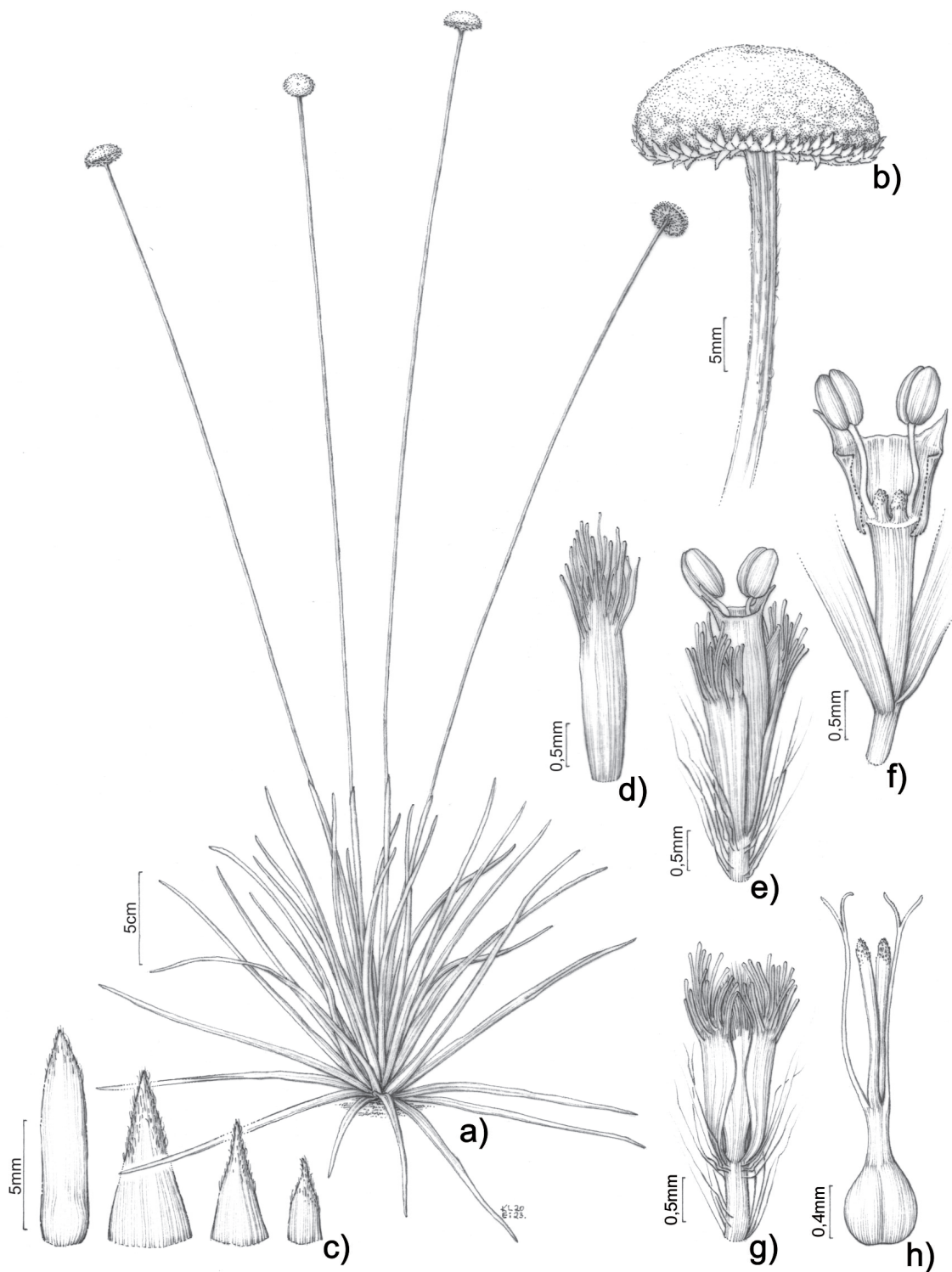


Figure 1. *Paepalanthus pyatan* Picanço & Trovó. a) habit. b) capitulum detail. c) involucral bracts, external (left) to internal series (right). d) floral bract. e) staminate flower. f) staminate flower with open corolla. g) pistillate flower. h) gynoecium.



Figure 2. *Paepalanthus pyatan* Picanço & Trovó. a–b) habitat in the Chapada Diamantina (Bahia) campos rupestres. c) habit. d) capitulum seen from below, evidencing the involucre bracts.

surface apex, margin sparsely ciliated with T-shaped trichomes, leaf sheath $4.2\text{--}5.4 \times 0.3\text{--}1.6$ cm, light brown, chartaceous, margin evident, paleaceous, chartaceous to membranaceous when young, with filamentous tangled trichomes adpressed to glabrescent, margins with T-shaped and filamentous trichomes to glabrescent.

Inflorescences axillary, each composed of a short axis covered by foliose bracts and containing a single terminal capitulum; spathes $27.0\text{--}30.5$ cm long, paleaceous, chartaceous, venation inconspicuous, with adpressed T-shaped trichomes to glabrescent, apex acuminate, glabrous; scapes $68\text{--}77$ cm long, multicostate, hirsute with T-shaped trichomes.

Capitula $1.8\text{--}2.9$ cm diam. (Fig. 1b), whitish to grayish when old, discoid to hemispherical when in fruit; involucre bracts in 11–15 series, the inner series slightly surpassing the floral disc (Fig. 1b, 2d), all series patent to recurved at the apex, adaxially glabrous; external series $7.6\text{--}12.3 \times 2.2\text{--}2.9$ mm (Fig. 1c), paleaceous at the base and blackish toward the apex, lanceolate to narrow oblong, apex acute, sericeous with adpressed trichomes to glabrescent, margin ciliate with tortuous trichomes to glabrescent; intermediate series $7.6\text{--}8.9 \times 2.2\text{--}5.2$ mm (Fig. 1c), paleaceous with blackish spots, margin and apex blackish, flat, lanceolate to ovate, apex acuminate to acute, glabrous on both surfaces,

rarely with deciduous trichomes at the abaxial surface, ciliated; inner series 3.1–6.0 × 1.9–4.5 mm (Fig. 1c), paleaceous to golden, with blackish spots, margin, flat to slightly concave, triangular, apex acute, glabrous on both surfaces, rarely with deciduous trichomes at the abaxial surface, ciliated; receptacle flat, densely pilose, with simple multicellular trichomes. **Flowers** dimerous, ca. 2050 per capitulum, ca. 1350 staminate and ca. 700 pistillate; floral bracts 2.6–3.3 × (0.5–)1.0–1.8 mm, blackish with a central yellowish stripe along the midrib, margin and apex yellowish, ovate to lanceolate, sometimes linear in the inner staminate flowers (Fig. 1d), apex acute to apiculate, pilose to glabrescent at the upper part of the abaxial surface apex, margin ciliated to glabrescent, clavate trichomes at the apex. **Staminate flowers** 3.3–3.5(–4.0) mm long (Fig. 1e, f); pedicel 0.2–0.6 mm long, with long trichomes; sepals 1.7–2.0 × 0.7–1.1 mm, free, blackish, navicular, elliptic to obovate, apex acute, pilose to glabrescent at the upper part of the abaxial surface apex, clavate trichomes at the ciliated apex; anthophore 1.1–1.4 mm long; corolla 1.0–1.5 mm long, tubular, membranaceous, hyaline with yellowish basis, with two acute lobes; stamens 1.7–2.0 mm long, filaments 1.3–1.4 mm long, anthers 0.4–0.6 mm long, ellipsoids; carpellodes ca. 0.4–0.5 × 0.2 mm, flat, papillose. **Pistillate flowers** 3.0–3.7 mm long (Fig. 1g); pedicel 0.7–1.0 mm long, with long trichomes; sepals 2.0–2.1 × 1.1–1.2 mm, free, dark brown to blackish with a central light brown stripe, navicular, elliptic to obovate, apex acute to acuminate, pilose at the upper part of the abaxial surface apex, ciliate, clavate trichomes at the ciliated apex; petals 2.1–2.6 × 0.6–0.9 mm, hyaline, elliptic, apex acuminate, pilose at the upper part of the abaxial surface, ciliate; staminodes inconspicuous; gynoecium 2.6–2.7 × 0.3–0.6 mm (Fig. 1h), ovary 0.5–0.6 × 0.3–0.6 mm, style ca. 1.1 mm long, nectariferous branches

ca. 0.8 mm long, flat, stigmatic branches ca. 0.9 mm long, bifid. **Fruit** loculicidal capsule 3.0–3.3 × 1.3–1.5 × 0.7–0.8 mm. Seeds (1)–2 per fruit, brown, ca. 0.7 × 0.6 × 0.5 mm, ellipsoid, micropilar end rounded, hilum end apiculate.

Recognition. *Paepalanthus pyatan* is distinguished from the other *Paepalanthus* by its robust habit, 50–71 cm tall, inflorescences arising at the top of lateral branches, capitula with 1.8–2.9 cm in diameter, outer involucral bracts larger than the inner ones, and dimerous flowers. As such, the species belongs to *P. ser. Dimeri*, mostly related to the *P. elongatus* species complex. Although the specimens of this new taxon were previously identified as *P. elongatus*, which historically includes a series of varieties described under this species, the morphologically most similar species is *P. niger* (previously recognized as *Paepalanthus elongatus* var. *niger* Moldenke), as both are robust herbs with at least the apex of the involucral bracts black. *Paepalanthus pyatan* differs from *P. niger* by its glabrescent leaves with indumentum composed only of adpressed and sparse T-shaped trichomes on both faces and margins (vs. densely pilose on the abaxial face to glabrescent, with filamentous trichomes, rarely T-shaped trichomes at the apex, margins densely ciliate to glabrescent with filamentous trichomes), glabrescent spathes, with adpressed, inconspicuous T-shaped trichomes (vs. densely pilose to rarely glabrescent, with filamentous trichomes), involucral bracts in 11–15 series (vs. 3–8), paleaceous involucral bracts with a black apex, lanceolate to narrowly oblong (vs. completely dark brown to black, deltoid to oblong), staminate flower sepals 1.7–2.0 mm long (vs. ca. 2.5 mm long), pistillate flower sepals ca. 2.0 mm long (vs. ca. 2.5 mm long), and pistillate flower petals elliptic (vs. ovate). It is also worth mentioning that *P. niger* is endemic to the Chapada dos Veadeiros region (Goiás state),

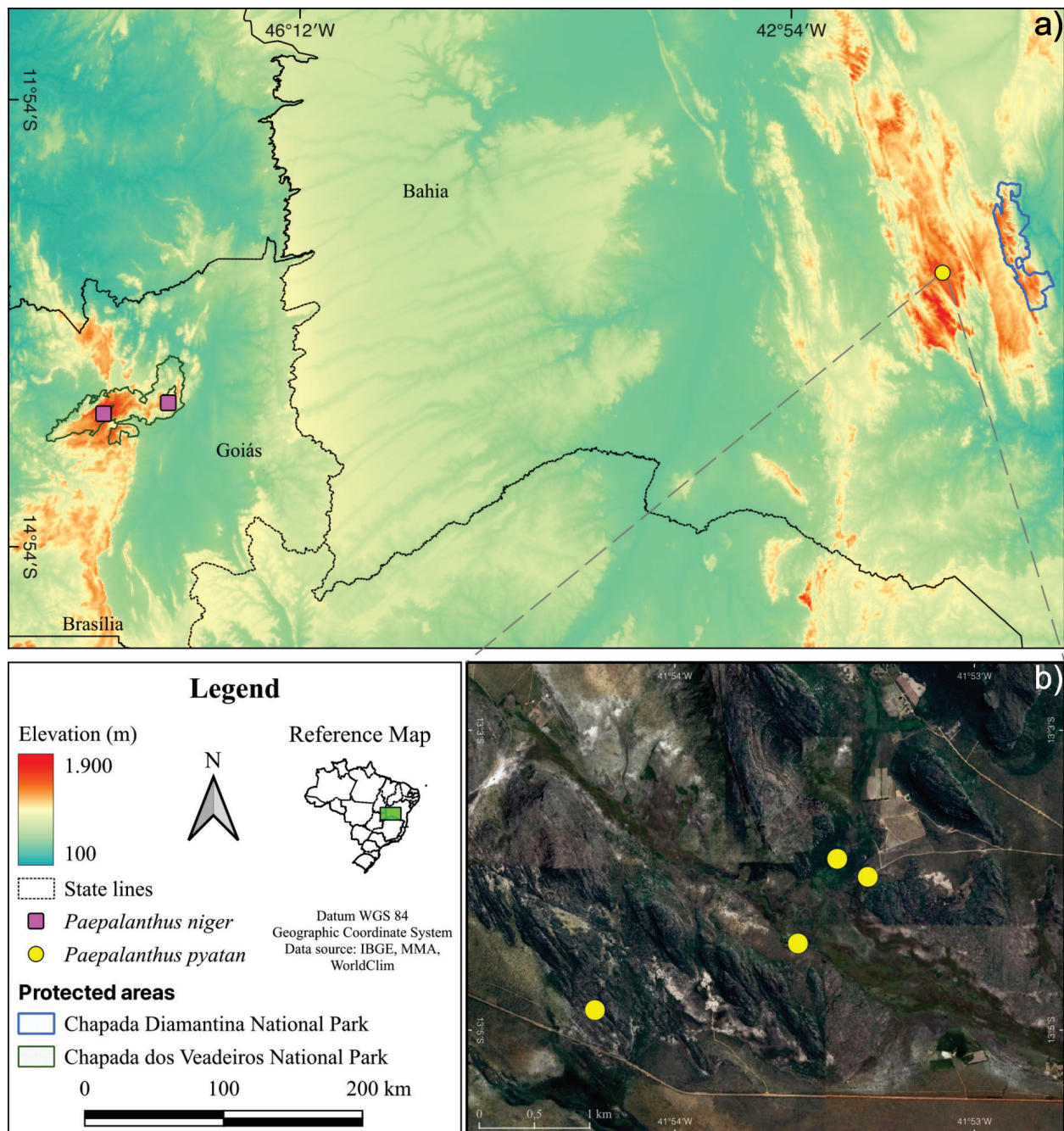


Figure 3. Geographical distribution of *Paepalanthus pyatan* Picanço & Trovó and *P. niger* (Moldenke) Trovó. a) distribution map of the new described species and morphologically most similar species. b) distribution map of the known records of *P. pyatan*.

over 600 km away from the Chapada Diamantina (Fig. 3a)

Specimens examined. Bahia: Piatã, Estrada para Inúbia. Campo rupestre ca. 31 km de Piatã. 15 Feb. 1987, R.M. Harley, A.M. Giuliatti, J.R. Pirani,

B.L. Stannard, I. Cordeiro & C. Kameyama, 24277 (K [image]!, SPF!); Piatã, Estrada para Inúbia. 13°04'24"S 41°54'24"W, alt: 1407 m, 1 July 2007, A. Rapini, R.F. Souza-Silva & M.L. Kawasaki, 1403 (HUEFS!); Piatã, Estrada para Inúbia, afloramento

na margem direita da estrada. 13°4'22"S 41°54'24"W, alt: 1415 m, 7 July 2021, W. Picanço, 557 (R!); Piatã, Pai Inácio. Três Morros. 13°03'38,6"S 41°53'11,2"W, alt.: 1300 m, 05 Nov. 1996, D.J.N. Hind, L.P.Q., H.P.B. & M.M.S., PCD4109 (ALCB!, HUEFS!, SPFI!); Piatã, Três Morros. 13°04'04"S 41°53'23"W, 03 Nov. 2009, J.G. Freitas, M. Del Rei, L.R. Senna & H.G. Benatti, 622 (HUEFS!).

Etymology. The epithet "Pyatan" derives from Tupi-Guarani language and means strong, vigorous (Carvalho 1987, Navarro 2013). In addition, it is a reference to the municipality of Piatã, where the species is endemic from.

Distribution, habitat & ecology. *Paepalanthus pyatan* is endemic to the Três Morros region in the municipality of Piatã, Chapada Diamantina (Bahia). It is known from two subpopulations distant from each other by ca. 2 km (Fig. 3b). *Paepalanthus pyatan* occurs in campos rupestres vegetation, growing over dry to well-drained sandy quartz soils with low organic components, those subject to flooding during the rainy season. A few individuals were also seen growing in sandy pockets directly on rocky crevices. The species is thus associated with open areas with predominance of small shrubs and grasses. From our personal observations, the type subpopulation has hundreds of individuals forming a single patch occupying a few hundred m². At the other collection site, we found only very few individuals growing sparsely on rocky outcrops. Only records of plants with developed fruits are known, all collected between July and November. The species probably produces flowers from February to July, since the specimen Harley et al., 24277 collected on 15th of February of 1987 contains an immature capitulum.

Preliminary conservation status. The species should be provisionally categorized as EN according to B1ab(ii,iii,iv), as it has an EOO of 0.75 km² and an AOO of 12 km². *Paepalanthus pyatan* is known from only two subpopulations,

separated by a hill, less than 2 km apart. In addition, it does not occur inside of any protected area, being surrounded by threats of habitat loss due to agricultural expansion, herbicide application, and fire setting for pasture maintenance (W. Picanço, pers. obs.). Piatã is one of the largest coffee producers in the Chapada Diamantina and has a reputation for producing specialty coffees, called "gourmet coffees" (A.N.S. Gonçalves, unpublished data). Furthermore, the *P. pyatan* subpopulations are surrounded by farms cultivating other crops as well as raising cattle.

Taxonomic notes. *Paepalanthus pyatan* is a unique species in the Chapada Diamantina region, being morphologically very different from all its congeneric sympatric species occurring in Bahia. The potentially sympatric species with the greatest morphological affinity to *P. pyatan* are *P. almasensis* Moldenke and *P. harleyi* Moldenke. Moldenke (1980) when describing these two species did not include them into any infrageneric category. Andrade et al. (2010), within their voucher specimens list, treated *P. almasensis* as belonging to *P. ser. Dimeri*. Indeed, the three species being discussed here share the main characters of *P. ser. Dimeri*, such as the presence of leaves in a basal rosette, a scape arising from an axillary inflorescence, with a single (or a few) terminal discoid capitulum, and dimerous flowers with bifid stigmatic branches (Ruhland 1903). Thus, along with *P. almasensis* and *P. harleyi*, *P. pyatan* belong to *Paepalanthus ser. Dimeri*, the infrageneric category that best accommodates these three species. Despite these general morphological similarities, *P. pyatan* is a much more robust species, both in terms of vegetative (plant and leaf size) and reproductive parts (inflorescences, especially the capitula).

Anatomical notes. Leaf laminae of *Paepalanthus pyatan* (Fig. 4a) and *P. niger* (Fig.

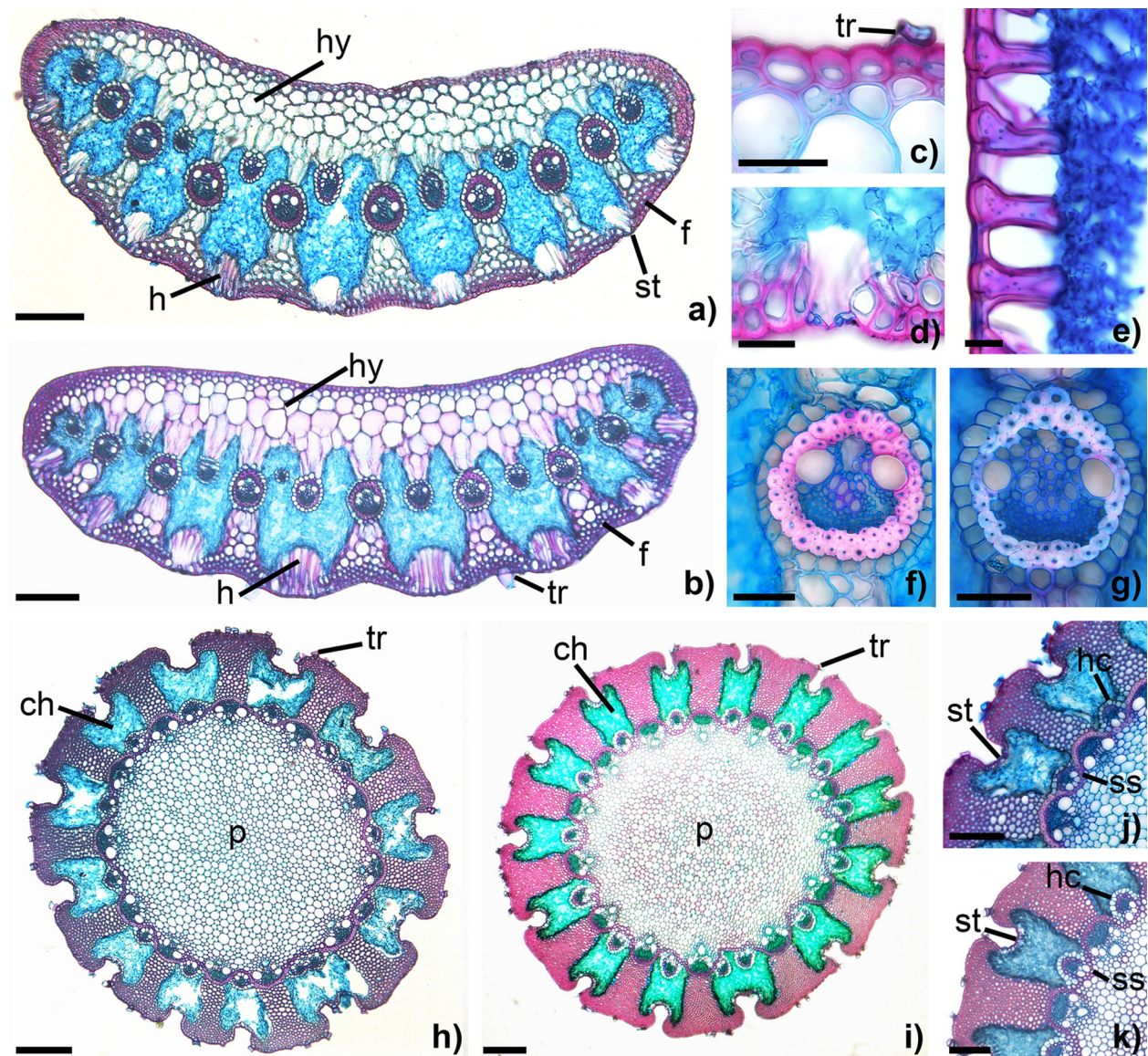


Figure 4. Anatomical details of leaf laminae and scapes of *Paepalanthus pyatan* Picanço & Trovó (W.L. Picanço 560 - R) and *P. niger* (Moldenke) Trovó (W.L. Picanço 369 - R), in cross (a–d, f–k) and longitudinal (e) sections. a–b) leaf laminae of *P. pyatan* and *P. niger*, respectively. c–d) details of epidermis in both adaxial and abaxial surfaces, respectively, of *P. pyatan*. e) detail of epidermal high cells of *P. pyatan*. f–g) details of vascular bundles of *P. pyatan* and *P. niger*, respectively. h–i) scapes of *P. pyatan* and *P. niger*, respectively. j–k) details of scapes of *P. pyatan* and *P. niger*, respectively. Labels: ch = chlorenchyma, f = fibers, h = high cells, hc = hyalinous cells, hy = hypodermis, p = pith, ss = sclerenchymatous sheath, st = stomata, tr = trichome. Scale bars: a, b, j, k = 200 μ m, c–g = 50 μ m, h–i = 300 μ m.

4b), in cross sections, share a single-layered epidermis covered by a thick and ornamented cuticle (Fig. 4c, d). Epidermal cells are isodiametric to radially elongated, thick-walled (Fig. 4c, d) and of similar size in both surfaces (Fig. 4a, b). In longitudinal sections, both species

show high epidermal cells (Fig. 4e). Stomata are located on the abaxial surface, restricted to the intercostal regions and leaf margins (Fig. 4a, b), at the same level or slightly below the level of other epidermal cells (Fig. 4d). T-shaped trichomes are sparsely distributed on both leaf

surfaces and margins (seen by remaining basal cells – Fig. 4b, c). The mesophyll consists of: adaxial 2–4 layers of thin to slightly thick-walled hypodermal cells; compact chlorenchyma, interrupted by bundle sheath extensions; and 2–3 layers of fibers abaxially, restricted to the costal regions (Fig. 4a, b). Vascular bundles are collateral and surrounded by a triple sheath in *P. pyatan* (Fig. 4f) and by a double sheath in *P. niger* (Fig. 4g). In *P. pyatan* the number of vascular bundles varies from 15 to 25, while in *P. niger* varies from 15 to 19. In both species, small and larger vascular bundles alternate; they are mostly at the same level in the mesophyll in *P. niger* (Fig. 4b) or the smaller are above the level of the larger in *P. pyatan* (Fig. 4a). Bundle sheath extensions are formed by slightly thick-walled cells, reaching both surfaces from the larger bundles and only the adaxial surface from the smaller ones (Fig. 4a, b). In cross section, the leaf margin is obtuse and formed by epidermis and 2–3 layers of fibers (Fig. 4a, b).

Scapes are cylindrical, and, in cross section, show 12 flat-salient ribs in *P. pyatan* (Fig. 4h) and 14 in *P. niger* (Fig. 4i). In cross section, the epidermis is single-layered and formed by isodiametric, thick-walled cells (Fig. 4j, k). Stomata are located along the sulcate intercostal strands (Fig. 4j, k). T-shaped trichomes occur along the costal regions (seen by remaining basal cells – Fig. 4h, i). The cortex shows radial organization, consisting of flat-salient costal regions with lignified cells alternating to intercostal strands of compact chlorenchyma (Fig. 4h–k). Vascular bundles are collateral and the number of outer and inner ones follows the number of ribs in both species studied; double inner bundles also occur in some specimens, as shown in Fig. 4h, i. The outer and inner bundles are separated by an undulating uniseriate sclerenchymatous sheath

(Fig. 4h–k) that surrounds the outer vascular bundles and partially covers the inner ones. The outer bundles are adjacent to the intercostal chlorenchyma strands and are delimited by an arc of hyalinous cells (Fig. 4j, k). The pith is wide, formed by thick-walled cells in *P. niger* (Fig. 4i) and slightly thick-walled cells in *P. pyatan* (Fig. 4h).

Despite the anatomical resemblance, *Paepalanthus pyatan* and *P. niger* can be differentiated by the number and distribution of vascular bundles and by the number of vascular bundle sheaths in leaves, and also by the number of ribs in scapes. In contrast with other species of *Paepalanthus* ser. *Dimeri* (Trovó et al. 2017), both species here studied shared some anatomical similarity with *P. modestus* Trovó, especially the leaf mesophyll showing hypodermis, the compact chlorenchyma interrupted by bundle sheath extensions, the presence of fibers abaxially, and scapes with salient ribs formed by lignified cells. *Paepalanthus pyatan* can be distinguished from *P. modestus* (Trovó et al. 2017) by the number and distribution of vascular bundles in the leaves, the presence of adaxial bundle sheath extension on marginal bundles, and specially the number of ribs on the scape.

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