

Uncovering hidden diversity: *Oldenlandia bahiana*, a neglected new species endemic to Brazil (Spermacoceae, Rubiaceae), revealed by integrative approach

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Abstract

Background and aims – *Oldenlandia* is a taxonomically complex and polyphyletic genus with approximately 160 pantropical species distributed across more than ten clades. In an ongoing integrative review of South American representatives, distinct morphological and ecological variation was detected among specimens previously assigned to *O. filicaulis*. This prompted the recognition and description of a new species, which is circumscribed here based on multiple lines of evidence.

Material and methods – Eighty herbarium specimens were analysed. Classical taxonomic techniques were employed, including type revision, and different databases were consulted. A principal component analysis based on 19 climatic and nine edaphic variables was conducted, together with the comparative analysis of micromorphological floral, carpological, and pollen characteristics was performed using optical and scanning electron microscopy. Line drawings, geographical records mapping, and a preliminary conservation assessment were also carried out.

Key results – The analysed specimens have a set of unique characteristics when compared with *O. filicaulis*, such as floral merosity, variation in the shape and size of calyx and corolla lobes, type and distribution of corolla indumentum, presence of a pubescent style (vs glabrous), number of pollen apertures, and variation in sexine ornamentation. Distribution patterns also differ: *O. filicaulis* occurs in Bahia, Ceará, and Piauí, whereas the differentiated specimens are recorded exclusively in the high-altitude rupestrian grasslands in Bahia.

Conclusion – The combined evidence supports the recognition of a new species. Further molecular phylogenetic studies are needed to clarify its placement within Spermacoceae and its relationships to other species of the genus, especially the South American taxa. This new species discovery reinforces the extraordinary diversity and endemism of the Brazilian rupestrian grasslands. An identification key for all *Oldenlandia* species occurring in Brazil is provided.

Keywords

Bahia, campos rupestres, Neotropics, pollen, seeds, taxonomy, rocky savanna, rupestrian grasslands

INTRODUCTION

Oldenlandia L. is a genus belonging to the Rubiaceae family, distributed across the tropics and subtropics, with most species found in the Old World (Bremekamp 1952;

Lewis 1962; Verdcourt 1976; Halford 1992; Neupane et al. 2009; Gibbons 2020). With an estimated number of 160 species worldwide (Bremekamp 1952; Lewis 1962; Verdcourt 1976; Halford 1992; Neupane et al. 2009; Gibbons 2020; POWO 2025), *Oldenlandia* is among

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the most taxonomically complex genera of tropical Rubiaceae. Authors such as Neupane et al. (2015) stated that the real number of species is difficult to estimate due to the taxonomic inconsistencies between *Oldenlandia* and other genera within the tribe Spermaceae. This tribe represents the largest herbaceous lineage within the Rubiaceae, comprising more than 1000 species and ca 86 genera (Groeninckx et al. 2009; Razafimandimbison and Rydin 2024). The genus *Oldenlandia*, along with *Hedyotis* L. and other smaller genera from the Asia-Pacific tropics, form the taxonomically challenging *Hedyotis*–*Oldenlandia* complex, comprising around 500 species (Groeninckx et al. 2009; Neupane et al. 2015). Members of this complex herbaceous to woody habits, small 4-merous flowers, bilobed stigmas, and dry bi-carpellate fruits with few to numerous tiny seeds (Neupane et al. 2009). Their circumscriptions and classification have always been problematic since their initial treatment by Linnaeus in his *Species Plantarum* (Linnaeus 1753), due to the highly variable morphological characters. This variability has long sparked taxonomic debates and contributed to persistent confusion surrounding generic limits within the complex (Fosberg and Sachet 1991; Dutta and Deb 2004; Chen and Taylor 2011; Guo et al. 2013; Neupane et al. 2015; Gibbons 2020). To further complicate the picture, recent molecular phylogenetic studies of Spermaceae (Guo et al. 2013; Neupane et al. 2015; Gibbons 2020) demonstrate that *Oldenlandia* is clearly polyphyletic, with its species appearing scattered or intermingled with otherwise morphologically well-defined genera in the phylogenetic tree, exposing a wide range of unexpected evolutionary relationships.

Despite most species under *Oldenlandia* are distributed in tropical Africa and Madagascar (Bremekamp 1952; Verdcourt 1976), six species are cited for South America (Anton and Zuloaga 2025; Flora e Funga do Brasil 2025): *Oldenlandia brachypetala* (Phil.) E.L.Cabral & Bacigalupo endemic to Chile; *O. dusenii* Standl. endemic from south Brazil; *O. salzmännii* (DC.) Benth. & Hook.f. ex B.D.Jacks. widespread in South America, naturalized in the states of Alabama and Florida of the USA; *O. corymbosa* L. adventive in South America, Central America, Antilles, and Mexico, native from tropical and subtropical regions of Asia and Africa; and *O. tenuis* K.Schum. and *O. filicaulis* K.Schum. from Brazil and Venezuela.

As part of a broader review of *Oldenlandia* in South America, we identified Brazilian specimens previously assigned to *O. filicaulis* that consistently differed in several diagnostic characters. All specimens originated from high-altitude rupestrian grasslands in Bahia, a biome locally known as campos rupestres and renowned for its exceptional richness and endemism (Conceição et al. 2016). Given the long-standing taxonomic instability in the *Hedyotis*–*Oldenlandia* complex and the extensive morphological variability within the genus, we used an integrative approach to evaluate the distinctiveness of these specimens. Here, we combine detailed comparative morphology, micromorphology, and multivariate

environmental analyses to assess their identity, leading to the recognition and description of a new species, alongside an updated circumscription of *O. filicaulis*.

MATERIAL AND METHODS

Taxonomic and morphological analyses

We consulted the original description of *O. filicaulis* and type specimens through online databases (e.g. Biodiversity Heritage Library 2025; IPNI 2025; JSTOR 2025; POWO 2025; speciesLink 2025; Tropicos 2025). The morphological analyses and species description were based on the analysis of 80 herbarium specimens. The herbaria of ALCB, CTES, BR, HUEFS, HUH, MO, NY, R, RB, SI, SPF, UEC, and US (acronyms according to Thiers 2025) were consulted in person and additional digital images from HVASF, K, and MBM were consulted online. Information concerning the habitat, flowering period, and qualitative characteristics, such as the flower colour, were obtained from the herbarium labels. The guidelines of the International Code of Nomenclature for algae, fungi, and plants (Turland et al. 2025) were followed.

For the morphological observations, dried specimens were rehydrated in warm soapy water and analysed under a stereomicroscope (SM) Leica MZ6 and measured using an electronic digital calliper (RoHS). For the scanning electron microscope (SEM) observation, fruits and seeds were mounted on gold-plated aluminium stubs and sputter coated with 20 nm of gold-palladium. In the case of flowers, they were first rehydrated with 5% neutral detergent for 72 h, then rinsed in tap water, and finally fixed in FAA (formol-alcohol-acetic acid: 5 mL formalin, 5 mL acetic acid, 90 mL 70% ethanol). They were subsequently dehydrated in an ascending series of acetone, critical-point dried with CO₂, and sputter coated with gold-palladium. SEM images were captured using a Zeiss Evo15 at CME-UNNE (Electron Microscopy Center of the Universidad Nacional de Nordeste). The morphological terms follow Stearn (1986) and the Systematic Association Committee for Descriptive Terminology (1962).

For the palynological analyses, pollen grains were acetolysed according to Erdtman's (1966) technique and mounted on glycerin jelly for light microscopy (LM) analysis. Conventional parameters (P = polar axis, E = equatorial axis, colpi length, exine wide) of at least 20 grains were measured using ImageJ (Rasband 2020) based on photographs taken under a LM Leica DM LB2 microscope equipped with a digital camera. The exine was analysed using SEM. Pollen terminology follows Punt et al. (2007). The vouchered specimens used for observations of reproductive micromorphology and palynology are detailed in Suppl. material 1.

Geographical distribution

We used the label data of 79 specimens, 16 of *O. filicaulis* and 63 of the new delimited species, whose identification

was exhaustively verified in earlier morphological-taxonomic analyses. All the materials used and label data are listed in Suppl. material 1. When geographic coordinates were not available, the specimens were georeferenced through Google Earth (2025), following the guidelines and tools for correct georeferencing by Chapman and Wieczorek (2020). The data and the maps were processed using QGIS v.3.10.8 (QGIS Development Team 2025).

Multivariate environmental analysis

Distribution data, including geographic coordinates of *O. filicaulis* specimens and potential representatives of the new taxon, were used for all analyses. Climatic variables were obtained from CHELSA v.2.1 (Karger et al. 2017; <https://chelsa-climate.org>), using the 19 bioclimatic variables at 0.5 arc-minute resolution, later aggregated to 2.5 arc-minutes. Edaphic variables were retrieved from ISRIC-SoilGrids (Hengl et al. 2017; <https://soilgrids.org>), and the arithmetic mean of the first two soil horizons (0–5 and 5–15 cm) was calculated per layer. All layers were resampled to 2.5 arc-minutes to match climatic variables. To reduce multicollinearity, variance inflation factors (VIF < 5) and Pearson correlations were calculated, retaining only non-redundant variables (Suppl. material 2). Environmental values were extracted at each occurrence point using the R package terra v.1.8-80 (Hijmans 2023).

Environmental differentiation among species was assessed using Principal Component Analysis (PCA) to visualize grouping patterns, one-way MANOVA with

the Pillai statistic to test for multivariate differences, and Linear Discriminant Analysis (LDA) to evaluate classification accuracy with leave-one-out (LOO) cross-validation. Environmental overlap was quantified as the proportion of intersection over the union of convex hulls from the first two PCA components. Analyses were conducted in RStudio v.4.5.2 (RStudio Team 2023) using the R packages MASS v.7.3-65 (Venables and Ripley 2002) for LDA, factoextra v.1.0.7 (Kassambara and Mundt 2020) for PCA visualization, ecospat v.3.2 (Broennimann et al. 2021) for environmental overlap, ade4 v.1.7-22 (Dray and Dufour 2023) for MANOVA, sf v.1.0-22 (Pebesma 2018) for spatial data handling, and ggplot2 v.4.0.1 (Wickham 2016) for plotting the figures.

Preliminary conservation status assessment

This analysis was based on the generated dataset for the geographical distribution (Suppl. material 1). We followed the categories and criteria of the IUCN Red List (IUCN 2012) and subsequent guidelines (IUCN Standards and Petitions Committee 2024). Due to the lack of sufficient information required by some criteria (e.g. number of mature individuals), we used especially criterion B, whose estimation is based on the geographic range (B1, EOO: extent of occurrence, and B2, AOO: area of occupancy). The EOO and AOO were calculated using GeoCAT (Bachman et al. 2011) with the default setting of 2 km wide cells (4 km² cell area), recommended by the IUCN (2024).

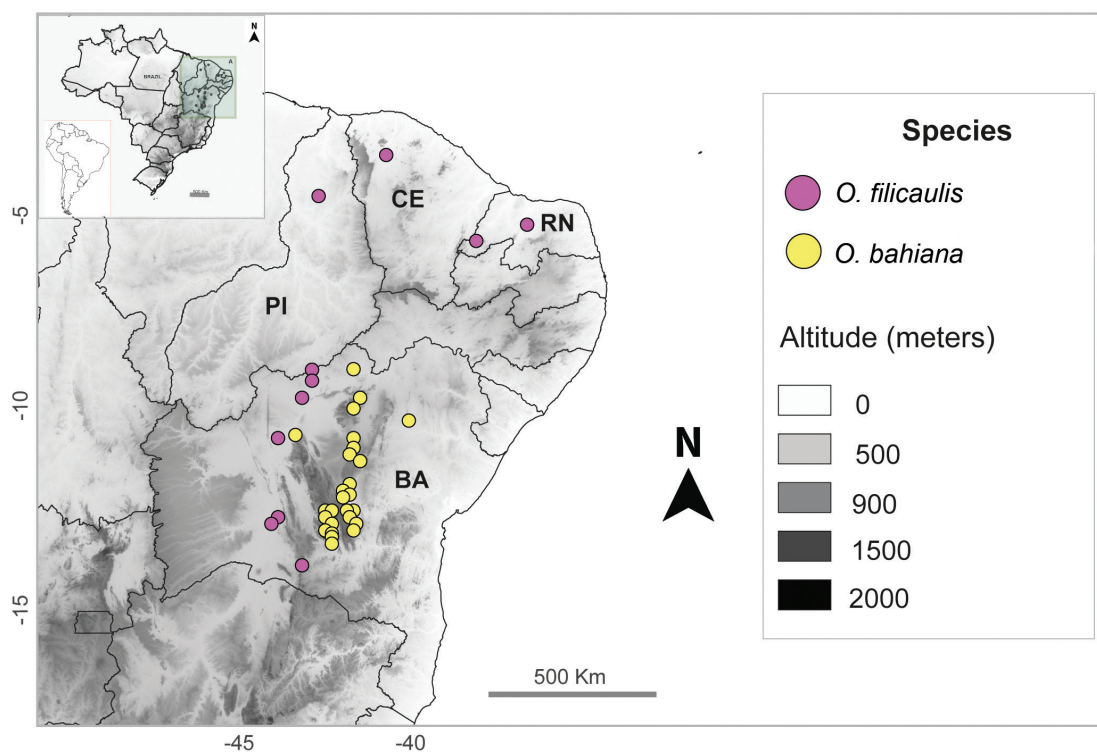


Figure 1. Map of the known distribution of the newly described species *O. bahiana*, and of the morphologically closely related species *O. filicaulis*. Abbreviations: BA = Bahia; CE = Ceará; PI= Piauí; RN = Rio Grande do Norte.

Table 1. Coefficients of the first linear discriminant function (LD1) and mean values of the environmental variables for the newly described *Oldenlandia bahiana* and its closely related *O. filicaulis*. Bold values indicate variables with the highest absolute coefficients, reflecting their stronger contribution to species discrimination. Abbreviations see Suppl. material 2.

Variable	Coefficient	Mean of <i>O. filicaulis</i>	Mean of <i>O. bahiana</i>
bdod	-0.110	137.66	123.94
bio15	-0.118	95.52	66.25
bio18	-0.003	141.71	368.97
bio19	-0.002	99.96	66.92
bio2	0.234	9.74	8.96
bio3	24.395	0.688	0.680
bio4	0.015	109.47	143.84
bio8	-0.464	26.60	21.55
cec	-0.022	152.42	156.58
cfvo	0.010	68.16	68.02
clay	-0.010	230.89	282.72
nitrogen	-0.008	119.55	194.36
phh2o	0.270	61.12	58.31
silt	0.002	211.53	186.56

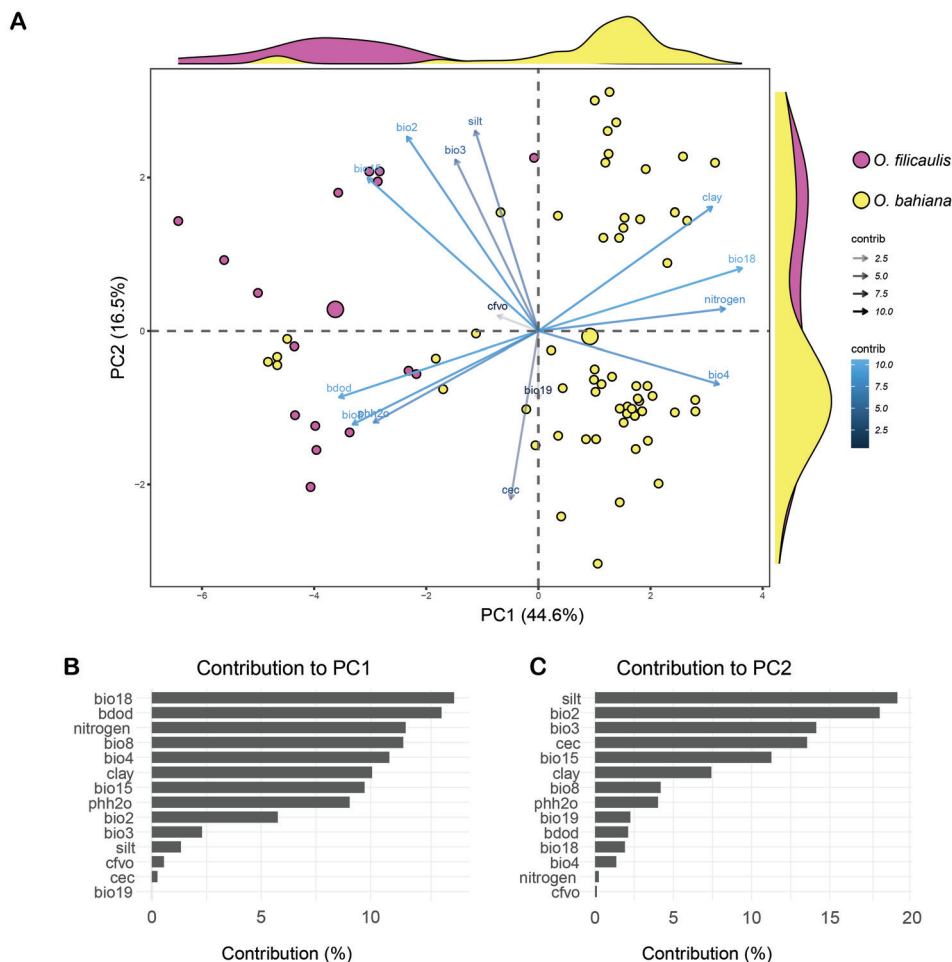


Figure 2. Principal component analysis (PCA) based on bioclimatic and edaphic variables. **A.** PCA biplot of environmental variables, where arrow length and colour indicate variable contribution to the first two principal components (PCA1 and PCA2). Points are coloured according to species identity. The density plots positioned above (PC1) and to the right (PC2) of the biplot represent the marginal distributions of observations along each component. **B–C.** Contributions of individual variables to PC1 and PC2, respectively. See Suppl. material 2 for abbreviations.

RESULTS

Our in-depth herbarium-based taxonomic analysis, specifically of the reproductive morphology, allowed us to clarify the identity of *Oldenlandia filicaulis* and delimit a new species. Their previous broader circumscription under the same species is mainly due to their shared slender habit, linear to narrowly elliptic leaves, and infundibuliform corollas. However, detailed reproductive morphological analyses revealed that the two species can be distinguished mainly based on floral and palynological characters (see Taxonomic treatment below).

The non-overlapping geographical distribution of these two species, which also occur in ecologically distinct habitats, also contribute to their differentiation (Fig. 1). *Oldenlandia filicaulis* is recorded for the Ceará, Bahia, Rio Grande do Norte, and Piauí States of Brazil. Most of the records correspond to the Bahia State, inhabiting in Caatinga sandy open areas or wet areas, often associated with riverbanks, between 175–840 m a.s.l. However, *O. bahiana* was only recorded for Bahia, mostly on the mountaintops of the Chapada Diamantina region, where it occurs in grasslands with sandy-clay soils between rocky outcrops between 850–3087 m a.s.l.

The multivariate analysis based on seven bioclimatic and seven edaphic variables also revealed clear patterns of differentiation between these two taxa. The results of Principal Component Analysis (PCA) showed that the first two components accounted for 61.1% of the total variance (Fig. 2A). The first principal component (PC1), which explains 44.6% of the total variance, was mainly associated with climatic and edaphic factors such as precipitation of the warmest quarter (bio18), bulk density (bdod), soil nitrogen, temperature of the wettest quarter (bio8), temperature seasonality (bio4), and clay content (Fig. 2B). The second component (PC2) explains 16.5% of the total variance, where silt content (silt), mean diurnal range (bio2), isothermality (bio3), and cation exchange capacity (cec) are the variables with the highest loading factors (Suppl. material 3), thus contributing most to the separation of distinct species (Fig. 2C). The multivariate analysis of variance (MANOVA) confirmed that the overall set of bioclimatic and edaphic variables differed significantly between *O. filicaulis* and the newly described species (Pillai's trace = 0.796, $F(14, 64) = 17.88$, $p < 0.001$). The Linear Discriminant Analysis (LDA) revealed a clear species separation based on the 14 environmental variables analysed, with a classification accuracy of 93.7% (LOO value, Leave-One-Out accuracy). The variables bio3, mean temperature of the wettest quarter (bio8), soil pH (phh2o), and bio2 contributed most to the differentiation (Table 1). The environmental overlap between *O. filicaulis* and the new species, calculated in the PCA-derived environmental space (PC1–PC2), was low (Schoener's D = 0.15).

TAXONOMIC TREATMENT

1. *Oldenlandia filicaulis* K.Schum. (Schumann 1889: 271)

Figs 3, 4A–I; Tables 2, 3

Type. BRAZIL – Bahia • “Facenda de Utinga, in Certão del Rio de S. Francisco”; 1839; *Blanchet* 2742; lectotype (**designated here**): NY [00132352]; isolectotypes: BR [BR0000005315550], F [F0069814F, F0069815F], K [K000015760, K000015761, K000470185], MO [MO-716950], U [U0098800].

Syntypes. BRAZIL • “in arenosis humidis ad praedium Serra Branca”; *C.F.P. von Martius* 2476; M [M0198389, M0198390] • “ad Villa de Barra”; *Blanchet* 2703; F [FOBN000014].

Description. Slender herb, 6–25 cm high. Stems filiform, erect, glabrous, sometimes with 2–4 elliptic leaves crowded at the base of the stem, 2–6.8 × 0.7–1.8 mm. Cauline leaves narrowly linear, 4.5–15.5 × 0.2–0.7 mm, subsessile, glabrous on both surfaces. Internodes 8–30 mm long. Stipules ca 0.2 mm long., triangular, colleter-tipped. Inflorescences terminal, flowers 1–3 in each leaf axil. Flowers 4-merous, heterostylous, pedicellate, peduncles 4–20 mm long. Calyx glabrous; hypanthium 0.5–1.2 mm long; lobes 4, transversely broadly triangular to ovate, acute, 0.1–0.5 mm long. Corolla white to lilac at the apex of corolla lobes, infundibuliform, 2.4–4.0 mm long, externally glabrescent, lobes 4, triangular to broadly triangular, 1.5–2.2 mm long. Stamens 4, adnate to throat of corolla tube; anthers oblong-linear, ca 0.5–0.6 mm long. Style glabrous, bifid. Long-styled morph (LS): corolla internally with simple trichomes from the apex of the corolla lobes to the upper third of the corolla tube; style exerted, 2.7–3.0 mm long, stigmatic branches 0.2–1.0 mm long; stamens included, 0.9–1.4 mm long. Short-styled morph (SS): corolla internally with simple trichomes from the middle of the corolla lobes to the middle of the corolla tube; style included, 1–1.55 mm long, stigmatic branches ca 0.8 mm long; stamens exerted, 3.5–4.0 mm long. Capsule loculicidal dehiscent, subglobose, 0.7–1.3 × 1.0–1.7 mm, glabrous. Seeds trigonous with concave lateral faces, 0.2–0.3 mm long, apical hilum, dark brown to nigrescent, reticulate-areolate on surface, polygonal areoles with straight walls.

Palynology. This species presents pollen grains released in monads, which are isopolar, 6(–7)-zonocolporate, small-sized ($P = 26.4\text{--}30.5\ \mu\text{m}$, $E = 26.5\text{--}30.6\ \mu\text{m}$ diam. in LS morph, and $P = 25.7\text{--}31.9\ \mu\text{m}$, $E = 25.9\text{--}30.6\ \mu\text{m}$ diam. in SS morph), mostly prolate-spheroidal ($P/E = 0.9\text{--}1$); the outline circular in polar view; ectocolpus long (18.2–23.2 μm long in LS morph, 17–22.5 μm long in SS morph); endoapertures are laterally fused to form an endocingulum; exine 1.8–2.7 μm thick, semitectate-bireticulate, muri 0.3–0.4 μm , lumina 0.3–0.6 μm , infrareticulum nanogranulate, and supracreticulum psilate at least in LS morph; the exine features in SS flowers

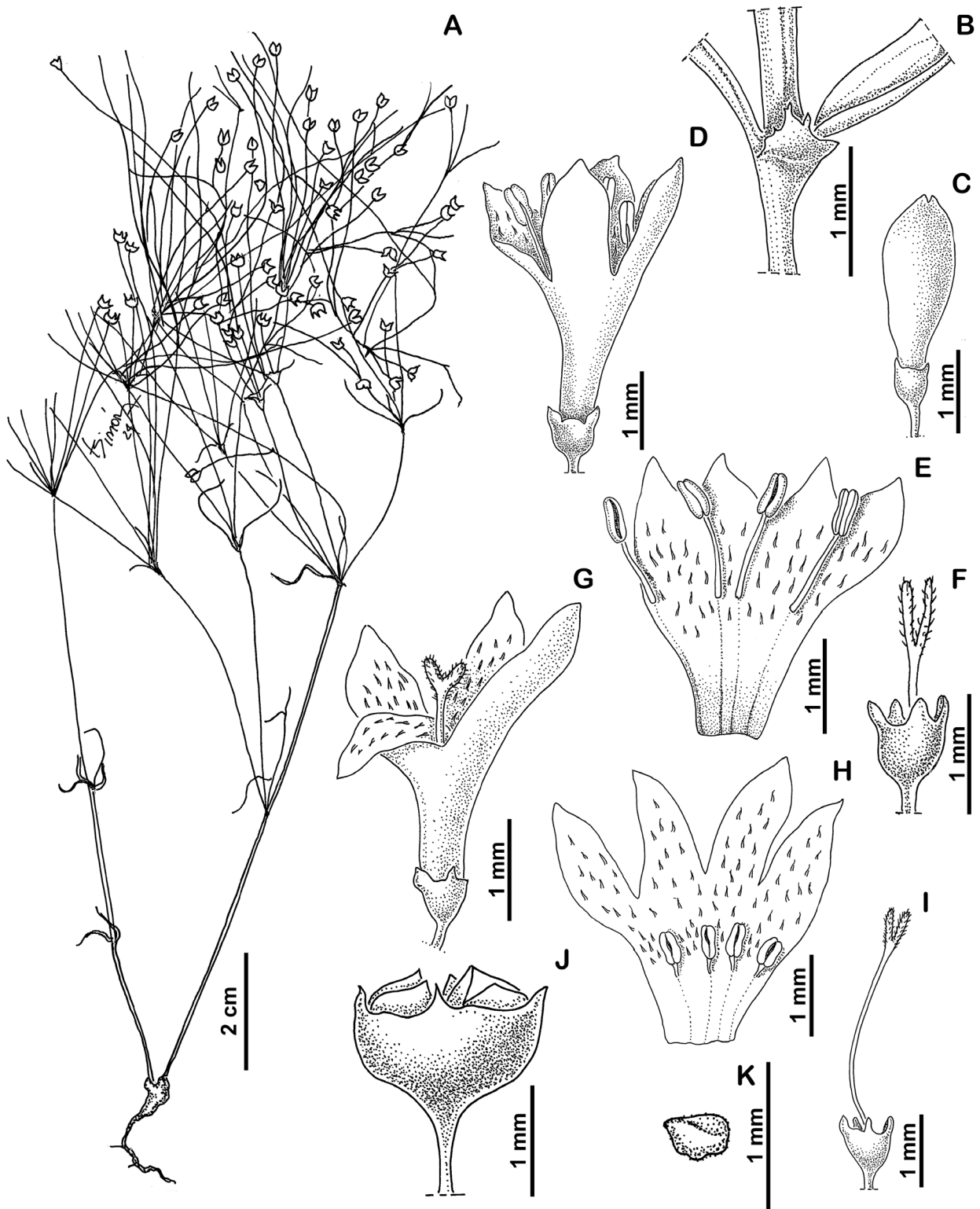


Figure 3. *Oldenlandia filicaulis*. A. Habit. B. Stipular sheath. C. Flower button. D–F. Short-styled flower. D. Flower. E. Corolla opened out. F. Hypanthium, calyx, and style. G–I. Long-styled flower. G. Flower. H. Corolla opened out. I. Hypanthium, calyx, and style. J. Fruit. K. Seed. A based on Blanchet 2742 (NY); B–C based on Miranda et al. 976 (HUEFS); D–K based on Passos et al. 378 (SPF). Illustrated by Mariela Nuñez Florentin and Laura Simón.

Table 2. Pollen morphology summary and comparison between the newly described *Oldenlandia bahiana* and its closely related *O. filicaulis*. Abbreviations: E = equatorial diameter; IR = infrareticulum; NC = number of colpi; LC = colpi length; LC/P = length of colpi compared with the polar axis (short = LC/Px100 < 40; medium = LC/Px100 between 40 and 60; long = LC/Px100 > 60); LS = long-styled; P = polar axis; SR = suprareticulum; SS = short-styled.

Characters	<i>Oldenlandia filicaulis</i>		<i>Oldenlandia bahiana</i>	
	LS morph	SS morph	LS morph	SS morph
P (µm)	26.4–(28.3)–30.5	25.7–(28.1)–31.9	19–(24.2)–26.8	21.6–(24.4)–26.2
E (µm)	26.5–(28.3)–30.6	25.9–(27.9)–30.6	20.4–(21.9)–25.4	21.8–(24.5)–27.2
P/E	0.93–(1)–0.99	0.91–(1)–1.07	0.9–(0.95)–1.1	0.9–(0.97)–1.1
NC	6–7	6–7	3	3
LC (µm)	18.2–(20)–23.2	17–(19.1)–22.5	12.5–(17.7)–19	15–(15.5)–19.3
LC/Px100 (%)	70.6 (long)	67.9 (long)	73.1 (long)	63.5 (long)
Exine thickness (µm)	1.8–(2.2)–2.5	1.8–(2.4)–2.7	1.3–(2)–2.4	1.7–(2.1)–2.5
Sexine	semitectate-bireticulate	?	semitectate-reticulate	semitectate-reticulate
Supraretectal elements	IR nanogranulate, SR psilate	?	psilate	nanospines
Voucher analysed	<i>Miranda 976</i> (HUEFS)	<i>Harley 21508</i> (ALCB)	<i>Hatschbach 47476</i> (CTES); <i>Conceição 434</i> (HUEFS)	<i>Sano 14427</i> (SPF); <i>Machado 241</i> (HUEFS)

are not confirmed (Fig. 4F–I). Further details about the pollen morphology are given in Table 2.

Distribution. Occurring in the states of Bahia, Ceará, Piauí, and Rio Grande do Norte in the Brazilian Northeast (Fig. 1).

Habitat and ecology. *Oldenlandia filicaulis* inhabits open, humid, and sandy sites of the Brazilian Caatinga, occurring between 175 and 840 m elevation. The Caatinga is a seasonally dry tropical vegetation mosaic composed mainly of deciduous thorny shrubs, herbs, and small trees, interspersed with areas of temporary wetlands and sandy depressions. These habitats experience pronounced seasonal variation in temperature and water availability, with long dry periods followed by short but intense rainy seasons. The sandy and periodically moist microhabitats where *O. filicaulis* grows likely provide suitable conditions for its establishment and persistence within an otherwise xeric matrix. Despite the environmental harshness of the Caatinga, these microhabitats support a distinctive flora adapted to hydric stress and seasonal fluctuations, many of which are narrow endemics currently threatened by overgrazing, deforestation, and land-use change (Leal et al. 2005; Silva et al. 2017).

Phenology. Flowering and fruiting from January to August.

Etymology. The epithet refers to the filiform and slender stems.

Preliminary IUCN conservation assessment. *Oldenlandia filicaulis* has an Extent of Occurrence (EOO) of 417,271 km² and an Area of Occupancy (AOO) of 64 km² (kml file available on <https://figshare.com/s/540a790fd79bce7f2bcf>). So far, the species is known only from the states of Bahia, Ceará, Rio Grande do Norte, and Piauí, in north-eastern Brazil, where it inhabits open, humid, and sandy sites within the Caatinga phytogeographic domain, at elevations below 840 m.

Based on the first parameter (EOO), the species would qualify as Least Concern (LC), while the smaller AOO places it in a higher risk category of Endangered (EN). However, the large EOO suggests that *O. filicaulis* has a relatively broad and discontinuous distribution within the Caatinga, without evidence of severe fragmentation or a marked reduction in its range. Moreover, it has been collected in several localities in recent years, indicating that populations remain extant across different regions. Consequently, the category Least Concern (LC) better reflects the current situation of the species. The Caatinga seasonally dry forests face multiple environmental threats, including deforestation, overgrazing, agricultural expansion (mainly for extensive cattle ranching and maize and cotton crops), firewood extraction, and progressive desertification (Silva et al. 2017; Fernandes et al. 2020). These activities have caused the loss of more than 40% of the original vegetation cover and severe soil degradation (MapBiomias Brasil 2024). Nevertheless, *O. filicaulis* occurs in open, humid, sandy environments that are often less directly affected by the most intensive forms of land conversion associated with mechanized agriculture. This may confer some tolerance or persistence capacity under moderate habitat disturbance. Although general threats to the Caatinga (such as deforestation, loss of native vegetation cover, and climate change) should continue to be monitored, there is currently no evidence of a significant decline in the distribution or abundance of this species. Therefore, considering its wide geographic distribution, recent collections in different areas, and apparent population stability, *O. filicaulis* is preliminarily assessed as of Least Concern (LC).

Additional specimens examined. BRAZIL – Bahia • Pilão Arcado: Carnaúba. Ca. 15 Km Oeste de Pilão Arcado; 9°59'43"S, 42°31'12"W; 18 Mar. 2006; fb., fl., fr.; *Miranda et al. 976*; HUEFS • Bom Jesus da Lapa: Km 9 da

estrada Jua/Chapada Grande, Km 33 a esquerda da BR-430 Bom Jesus da Lapa/Riacho de Santana; 13°23'12"S, 43°08'07"W; 527 m; 15 Mar. 2002; fb., fl., fr.; *Ribeiro et al.* 262; HUEFS [HUEFS000016811] • Remanso: Camino de Pau Ferro para Faz, Jibóia; 9°37'S, 42°19'W; 27 Feb. 2000; fb., fl., fr.; *Passos et al.* 378; SPF [SPF154935] • Remanso; Dec. 1996; fb., fl., fr.; *Ule* 7419; K [K000015763]; Serra do Açurúa, Lagoa Itaparica 10 Km W of the São Inácio Xique-Xique road at the turning 13.1 Km N of São Inácio; 11°01'S, 42°46'W; 300–400 m; 26 Feb. 1977; fb., fl., fr.; *Harley et al.* 19118; K [K000015793] • Remanso: Comunidade dos Negros, Fazenda do Campo Verde; 9°26'07"S, 42°17'49"W; 465 m; 4 Jul. 2000; fb., fl., fr.; *Silva et al.* 443; K [K001136477] • Bom Jesus da Lapa: Estrada de terra para Juá; 13°09'52"S, 43°08'28"W; 12 Jan. 2008; fb., fl., fr.; *Rapini et al.* 1483; HUEFS [HUEFS000016946] • Rio de Contas, Caminho para Lagoa Nova; 13°47'42"S, 41°46'44"W; 490 m; 5 Feb. 1997; fb., fl., fr.; *Guedes et al.* 5138; K [K000012310] • Brejinho das Ametistas; 14°16'00"S, 42°31'34"W; 840 m; 10 Jan. 2006; fb., fl., fr.; *Santos et al.* 565; HUEFS [HUEFS000017261] • Mun. Casa Nova, Beira da estrada; 9°16'13"S, 41°12'53"W; 25 May 2009; fb., fl., fr.; *Oliveira et al.* 4117; HVASF [HVASF21376] • Estrada Petrolina-Remanso, a 78 Km de Petrolina; 25 Apr. 1971; fb., fl.; *Heringer et al.* 352; K [K000015764] • Basin of the Upper São Francisco River. Just beyond Calderão, ca. 32 Km NE from Bom Jesus da Lapa; 13°10'S, 43°13'W; 500 m; 18 Apr. 1980; fb., fl., fr.; *Harley et al.* 21508; ALCB. – **Ceará** • Mun. Sobral, EMBRAPA, Fazenda Crioula; 27 Apr. 2001; fb., fl., fr.; *Souza* 595; NY [02684506]. – **Piauí** • Campo Maior; 04°59'54"S, 42°07'33"W; 175 m; 3 Apr. 2004; fb., fl., fr.; *Barros* 10; HUEFS [HUEFS000015333]. – **Rio Grande do Norte** • Francisco Dantas, Fazenda Sacramento; 6°04'S, 38°09'W; 6 Jul. 1984; fb., fl., fr.; *Santino de Assis* 403; RB [RB00349498] • Itajá, BR 304 Sentido Assu/Itajá. Entrada no Km 125 para a RN 118 sentido Itajá/São Rafael. Entrada aproximadamente 2,70 Km a esquerda em uma propriedade de uma Britadeira; 5°40'56"S, 36°48'42"W; 105 m; 8 Aug. 2011; fb., fr.; *Roque et al.* 1198; HUEFS [HUEFS000015468].

Notes. The specimen *Blanchet* 2742 (NY00132352) is here selected as lectotype because it is well-preserved, complete, with flowers and several mature fruits, and has a label with the handwritten annotation “Fazenda de Utinga, in Certao del Rio de S. Francisco, Brasil prop. Legit. Blanchet N° 2742. 1839”. It also has a handwritten annotation “corolla 1.5-1.8 mm long”. In the Northeast region of Brazil, this species is often confused with *O. tenuis*, due to the slender-stemmed habit. Steyermark (1988) carried out a detailed analysis of both taxa, and mainly differentiated *O. filicaulis* (description based on the examined isosyntypes) from *O. tenuis* by the opposite stem branching with numerous axes (vs stem branching alternate, irregular, with relatively few axes), leaves 0.1–0.3 mm wide (vs leaves 0.5–1.0 mm wide), and the heterostylous flowers with infundibuliform corollas (vs homostylous flowers with broadly cylindrical corolla).

2. *Oldenlandia bahiana* Nuñez Florentin, **sp. nov.**

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Figs 4J–Z, 5; Tables 2, 3

Type. BRAZIL – **Bahia** • Abaira, Serra da Tromba, ápice da Serra; 13°16'54"S, 41°47'15"W; 1520 m; 24 Oct. 1999; *Conceição A.S. et al.* 434; holotype: HUEFS [sheet number 41219]; isotypes: K [K000265125, K001136476].

Diagnosis. *Oldenlandia bahiana* is similar to *O. filicaulis* in the slender habit, plant height, the narrowly linear leaves, and heterostylous flowers, but it differs from it by the 5-merous flowers (vs 4-merous); 0.6–1.5 mm long, triangular calyx lobes (vs 0.1–0.5 mm long, transversely broadly triangular to ovate calyx lobes); whitish to yellowish corolla (vs corolla white to lilac at the apex of corolla lobes); flabelliform corolla lobes (vs triangular to broadly triangular corolla lobes); longer capsule (1–3.3 vs 1–1.7 mm long); seeds with papillate testa (vs reticulate-areolate testa); 3-aperturate pollen grains, with reticulate exine, psilate in the LS morph, and nanospinulate in SS morph (vs 6-aperturate pollen grains, with bireticulate exine, infrareticulum nanogranulate, and suprareticulum psilate in LS morph).

Description. Slender herb, 13–36 cm high. **Stems** filiform, erect, glabrous, very branched at the base. **Leaves** narrowly linear, 4.5–23.1 × 0.1–0.7 mm, subsessile, glabrous on both surfaces. **Internodes** 7.8–56.5 mm long. **Stipules** ca 0.2 mm long, triangular, colleter-tipped. **Inflorescences** terminal, flowers 1–3 in each leaf axil. **Flowers** 5-merous, heterostylous, pedicellate, peduncles 1.8–11.5 mm long. **Calyx** glabrous; hypanthium 1–2 mm long; lobes 5(–6), triangular, 0.6–1.5 mm long. **Corolla** whitish to yellowish in the centre of the corolla tube, infundibuliform, 3.3–5.8 mm long, externally glabrous, lobes 5, flabelliform, 0.5–1.7 mm long. **Stamens** 5, adnate to the throat of the corolla tube; anthers oblong-linear, ca 0.5–1.2 mm long. **Style** pubescent, bifid. **Long-styled morph (LS):** corolla internally with a fringe of moniliform trichomes in the middle of the corolla tube; style included or slight sub-exserted, 3.0–5.7 mm long, stigmatic branches 0.3–1.0 mm long; stamens included, 1.5–2.8 mm long. **Short-styled morph (SS):** corolla internally with a fringe of moniliform trichomes from almost the base of the corolla lobes to the base of the corolla tube; style included, 0.9–2.6 mm long, stigmatic branches ca 0.8 mm long; stamens included or slightly sub-exserted, 3.1–5.0 mm long. **Capsule** loculicidal dehiscent, subglobose, 1.2–2.1 × 1.0–3.3 mm, glabrous. **Seeds** trigonous, 0.4–0.5 mm long, apical hilum, dark brown to nigrescent, papillate on surface.

Palynology. This new species release the pollen grains in monads, which are isopolar, 3-zonocolporate, small-sized (P = 19–26.8 µm, E = 20.4–25.4 µm diam. in LS morph, P = 21.6–26.2 µm, E = 21.8–27.2 µm in SS morph), mostly oblate-spheroidal (P/E = 0.95–1.1); the outline circular in polar view; ectocolpus long (12.5–19 µm long in LS morph, and 15–19.3 µm in SS morph); endoapertures are laterally fused to form an endocingulum; exine 1.3–2.5 µm thick,

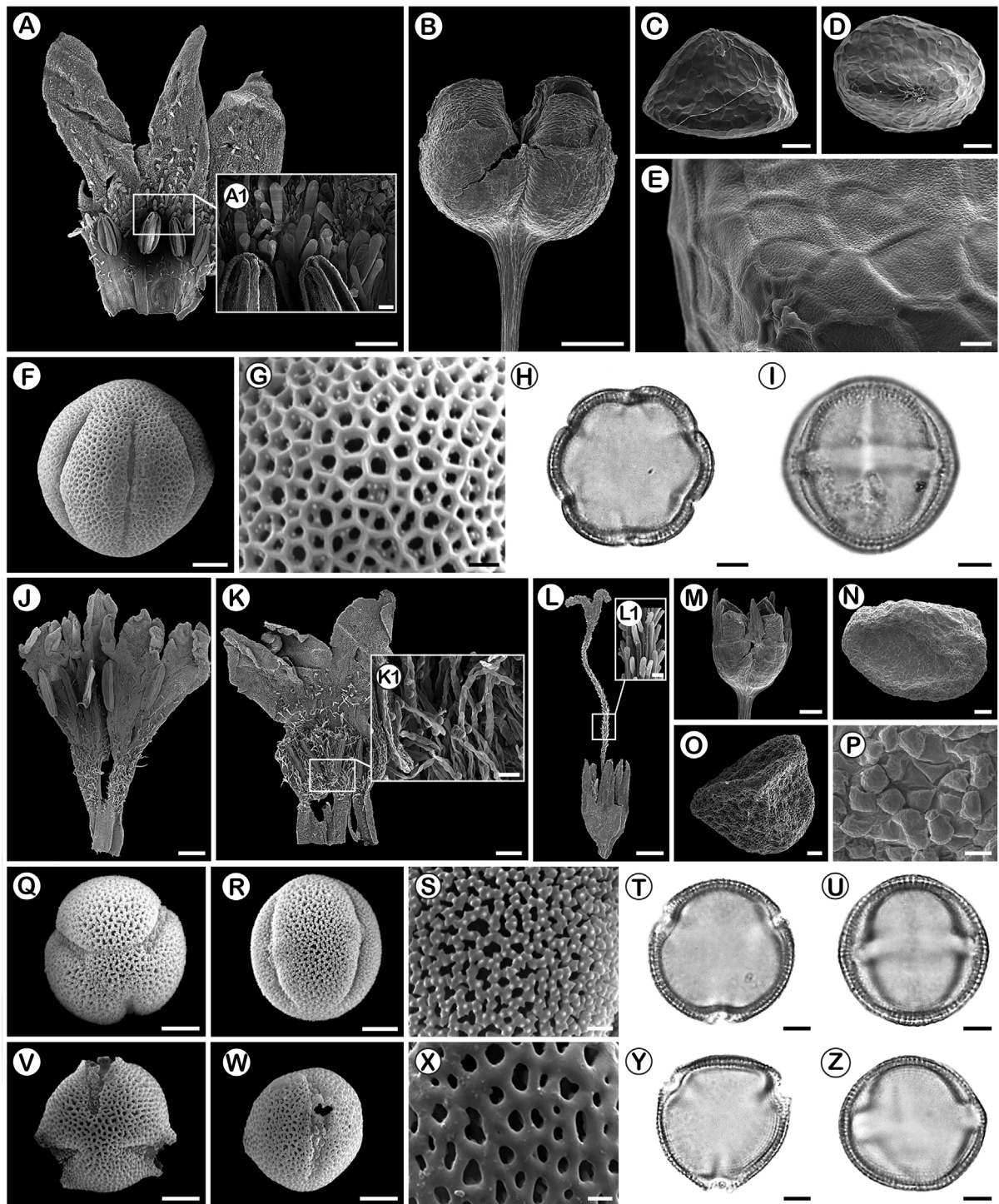


Figure 4. Reproductive micromorphological characters and pollen morphology of *O. filicaulis* (A–I) and *O. bahiana* (J–Z) based on SEM observations (A–G, J–S, V–X), and LM observations (H–I, T–U, Y–Z). A. Corolla opened out (LS morph). A1. Detailed of the inner corolla indumentum. B. Dehiscent fruit. C–E. Seeds. C. Lateral view. D. Apical view, with the punctiform hilum in the centre. E. Detailed of the exotesta. F–I. Pollen. F, I. Equatorial view (LS morph). G. Detailed of the exine (LS morph). H. Polar view (SS morph). J. Corolla opened out (SS morph). K. Corolla opened out (LS morph). K1. Detailed of the inner corolla indumentum. L. Hypanthium, calyx, and style (LS morph). L1. Detailed of the pubescent style. M. Dehiscent fruit. N–P. Seeds. N. Lateral view. O. Apical view, with the punctiform hilum in the centre. P. Detailed of the exotesta. Q–U. Pollen of the SS morph. V–Z. Pollen of the LS morph. Q, T, V, Y. Polar view. R, U, W, Z. Equatorial view. S, X. Detail of the exine. Scale bars: A–B, J–K, M = 500 μ m; A1, C–D, K1–L1, N–O = 50 μ m; E, P = 10 μ m; F, H–I, Q–R, T–U, V–W, Y–Z = 5 μ m; G, S, X = 1 μ m. A–A1, F–G, I based on Miranda et al. 976 (HUEFS); B–E based on Passos et al. 378 (SPF); H based on Harley et al. 21508 (ALCB); J based on Machado 241 (HUEFS); K–L1 based on Furlan et al. 1599 (RB); M–P, X–Z based on Hatschbach 47476 (CTES); Q–U based on Sano et al. 14427 (SPF); V–W based on Arbo et al. 7477 (CTES).

semitectate-reticulate, muri 0.4–1.0 mm, lumina 0.7–1.6 mm, psilate in LS morph; and semitectate-reticulate, muri 0.2–0.5 mm, lumina 0.4–0.9 mm, with nanospines < 1 µm long, uniformly distributed in SS flowers (Fig. 4Q–Z). Further details about the pollen morphology are given in Table 2.

Distribution. Endemic to Bahia State, Brazil (Fig. 1).

Habitat and ecology. This new taxon inhabits rupestrian grasslands at elevations ranging from 850 to 3087 m, occurring in sandy-clay soils among rocky outcrops in transitional areas between the Cerrado and Caatinga. Rupestrian grasslands are ancient mountaintop vegetation mosaics characterised predominantly by herbaceous and sub-shrub vegetation associated with rocky quartzite, sandstone or ironstone outcrops, alongside sandy, stony, and waterlogged grasslands. They occur in elevated areas ranging from 900 to over 2000 m a.s.l., principally in the Espinhaço Range in the states of Bahia and Minas Gerais. This vegetation type experiences extreme fluctuations in temperature and water availability, leading to a large number of microclimates that support diverse plant communities. These rupestrian fields contain high levels of endemic species and lineages that are currently facing various threats, such as opencast mining, anthropogenic burnings, wood extraction, and invasive species (Alves et al. 2014; Silveira et al. 2016; Zappi et al. 2017).

Phenology. It flowers and sets fruits all year long.

Etymology. The epithet refers to the distribution of the species, which is endemic to the state of Bahia.

Preliminary IUCN conservation assessment. *Oldenlandia bahiana* has an Extent of Occurrence (EOO) of 64,969 km² and an Area of Occupancy (AOO) of 212 km² (.kml file available on <https://figshare.com/s/2d7ad3e816134192132e>). The species is endemic to the state of Bahia, Brazil, where it occurs in rupestrian grasslands between 850 and 3087 m a.s.l., on sandy-clayey soils among rocky outcrops, in transition zones between the Cerrado and Caatinga. Most known records correspond to collections made between the years 1979 and 2010, while only 10 records are known from the last decade (2011–2025). This pattern may reflect a reduction in recent sampling effort or a decline in detectability of active populations. Nevertheless, the species has a relatively large EOO and occurs in several localities in northern Bahia, suggesting that it may be underrepresented in herbarium collections rather than truly restricted in its distribution. According to the IUCN criteria, the EOO would place *O. bahiana* in the Least Concern (LC) category, while the reduced AOO could suggest a higher risk category (EN). However, considering that the species occupies a relatively wide area, that its habitats remain in largely natural condition in several sites, and that there is no clear evidence of population decline, it is proposed to classify it as Near Threatened (NT). This category reflects that, if pressures from agricultural expansion, recurrent fires, and alteration of rupestrian grasslands continue, the species could soon qualify for a higher threat category.

Additional specimens examined (paratypes). BRAZIL – Bahia • 20 km S de Xique-Xique, camino a Santo Inácio; 11°01'S, 42°43'W; 500 m; 19 Jan. 1997; fr.; *Arbo et al.* 7477; CTES • Mun. Abaíra, Riacho Taquara; 13°15'S, 41°55'W; 1650–1800 m; 24 Feb. 1992; fb., fl., fr.; *Laesoe & Sano H52307*; RB, SPF [SPF91338] • Mun. Abaíra, Campo de Ouro Fino (cima); 13°15'S, 41°54'W; 1700–1800 m; 16 Jan. 1992; fb., fl., fr.; *Nic Lughadha & Queiroz 50769*; MO [MO-1628731], SPF [SPF90550] • Mun. Abaíra, Serra do Atalho, complexo serra da tromba, campo entre serra do atalho e serra da tromba; 18 Apr. 1994; fb., fl., fr.; *Melo et al.* 999; HUEFS [HUEFS000015648] • Mun. Abaíra, 9 Km N de Catolés, caminho de Ribeirão de Baixo a Platã, Serra do Atalho: descida para os gerais entre Serra do Atalho e a Serra da Tromba; 13°02'S, 41°50'W; 1400–1450 m; 10 Jul. 1995; fb., fl., fr.; *Queiroz et al.* 4391; ALCB • Mun. Abaíra, Catolés, Catolés de Cima, Bem Querer, trilha para o Tijuquinho; 13°16'07"S, 41°54'36"W; 1663 m; 1 Nov. 2016; fb., fl., fr.; *Oliveira et al.* 662; RB • Mun. Andaraí, rodovia BA-142, sentido Mucugé - Andaraí; 12°56'34"S, 41°17'28"W; 856 m; 25 Aug. 2022; fb., fl., fr.; *Siqueira Filho & Fagundes 4540*; HVASF [HVASF24518] • Mun. Araci, Bela Vista, tabuleiro de Areia Branca; 10°39'S, 39°44'W; 25 Mar. 2004; fb., fl., fr.; *Moraes 636*; HUEFS [HUEFS000011385] • Mun. Campo Formoso, Abreus, estrada para o povoado Cercadinho; 10°08'19"S, 41°05'46"W; 950 m; 30 Mar. 2022; fb., fl., fr.; *Siqueira Filho et al.* 4409; HVASF [HVASF24235] • Mun. Gentio do Ouro, Sto. Inácio; 3 Dec. 1980; fb., fl., fr.; *Furlan et al.* 360; SPF [SPF22448] • Mun. Gentio do Ouro, alrededores de Santo Inacio y hasta 9 Km al N, camino a Xique-Xique, Serra do Acurua; 11°05'S, 42°44'W; 500–550 m; 27 Nov. 1992; fb., fl.; *Arbo et al.* 5336; SPF [SPF85200] • Mun. Lençóis; 12°34'S, 41°23'W; 500–600 m; 3 Apr. 1980; fb., fl., fr.; *Noblick 1787*; HUEFS [HUEFS000017351] • Mun. Lençóis, Chapadinha; 12°27'72"S, 41°29'38"W; 3087 m; 25 Aug. 2002; fl., fr.; *Junqueira & Andrade 110*; HUEFS [HUEFS000017171] • Mun. Lençóis, Serra da Chapadinha, Chapadinha; 12° 27'44"S, 41°26'23"W; 920 m; 24 Feb. 1995; fb., fl., fr.; *Melo et al.* 1728; ALCB, SI, SPF [SPF104875] • Mun. Lençóis, Chapadinha. Gerais da Chapadinha, trilha para o córrego de Água Doce; 12°27'01"S, 41°25'03"W; 700 m; 26 Apr. 1995; fb., fl., fr.; *Costa et al.* 1816; ALCB, K, SI, SPF [SPF104400] • Mun. Lençóis, Mucugezinho-caminho do oásis do Chapadão, antiga Toca da Rede até pedra do Pato; 5 Apr. 1997; fb., fl., fr.; *Koch et al.* 678; UEC [UEC045733] • Mun. Lençóis, Chapada Diamantina, próximo ao Mucugezinho; 12°33'S, 41°23'W; 10 Jul. 2004; fb., fl., fr.; *Guedes et al. s.n.*; ALCB • Mun. Lençóis, Chapada Diamantina, estrada entre Tanquinho e Estiva; 12°18'S, 41°21'W; 840 m; 15 Dec. 2005; fb., fl., fr.; *Conceição et al.* 1621; HUEFS [HUEFS000011430] • Mun. Morro do Chapéu, Cidade das Pedras; 11°40'18"S, 41°01'05"W; 9 Dec. 2006; fr.; *Guedes et al.* 12951; ALCB • Mun. Morro do Chapéu, Serra da Babilonia; 11°07'S, 41°16'W; 26 Aug. 1981; fb., fl., fr.; *Gonçalves 131*; RB • Mun. Morro do Chapéu, Morrão; 1200 m; 16 Jul. 1979; fr.; *Hatschbach & Guimarães 42401*;

US [02358595] • Mun. Morro do Chapéu, Duas Irmãs, c. 15 Km de Morro do Chapéu na estrada do feijão (BA 052) sentido Irecê; 11°33'07"S, 41°17'17"W; 1145–1190 m; 30 Jan. 2003; fb., fl., fr.; França et al. 4113; HUEFS

[HUEFS000015513] • Mun. Morro do Chapéu: Fazenda Guariba, nascentes do Rio Salitre; 11°26'09"S, 41°11'29"W; 1066 m; 1 Jul. 2007; fb., fl., fr.; Melo et al. 4916; HUEFS [HUEFS000015603] • Mun. Morro do Chapéu, Serra das

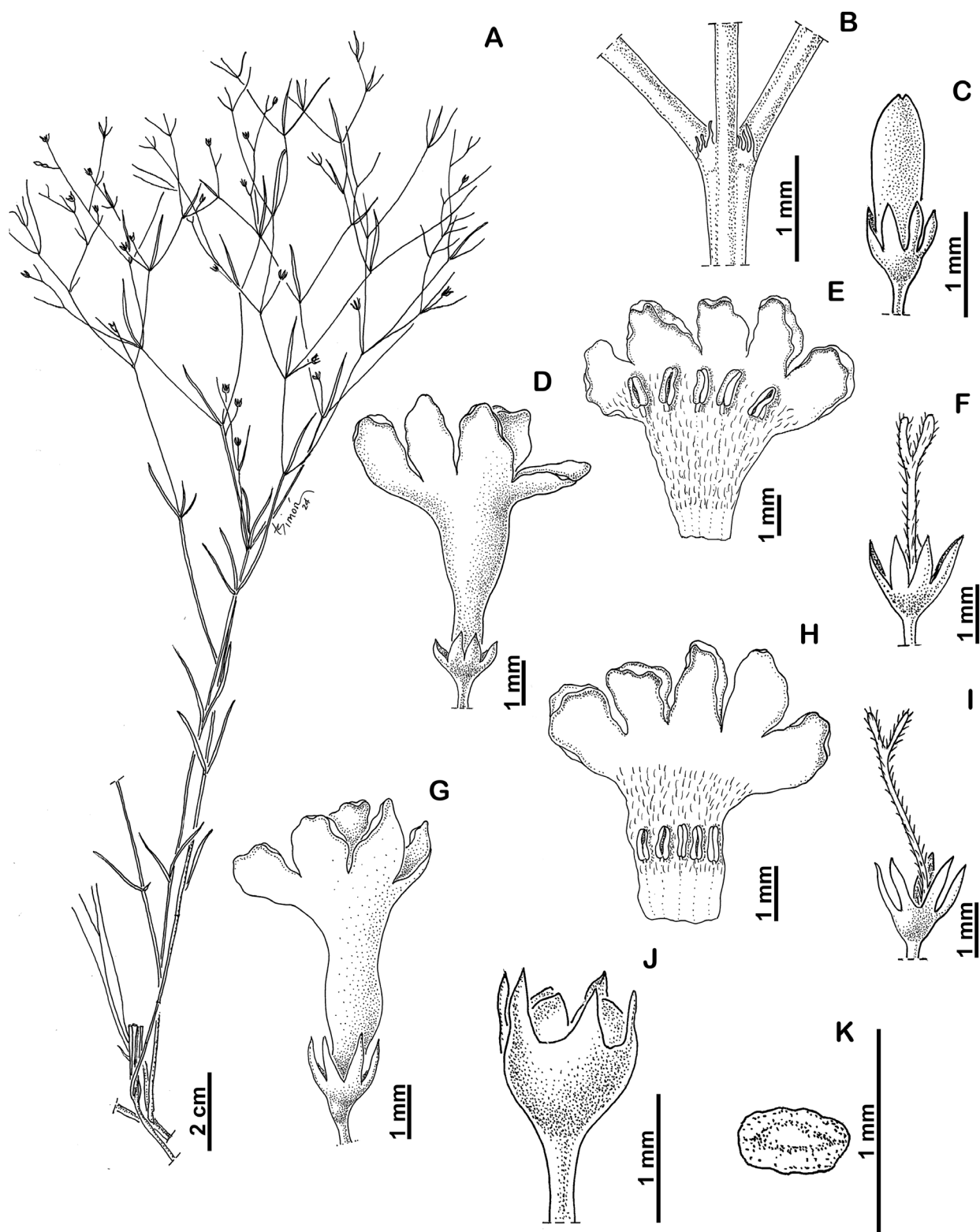


Figure 5. *Oldenlandia bahiana*. A. Habit. B. Stipular sheath. C. Flower button. D–F. Short-styled flower. D. Flower. E. Opened corolla. F. Hypanthium, calyx, and style. G–I. Long-styled flower. G. Flower. H. Corolla opened out. I. Hypanthium, calyx, and style. J. Fruit. K. Seed. A–C, J–K based on Hatschbach 47476 (CTES); D–F based on Sano et al. 14427 (SPF); G–I based on Harley et al. 26988 (SPF). Illustrated by Mariela Nuñez Florentin and Laura Simón.

Guaribas, afloramento de arenito; 11°26'18"S, 41°12'01"W; 1105 m; 17 Jun. 2004; fb., fl., fr.; *Souza & Ramos 941*; HUEFS [HUEFS000015693] • Mun. Mucugé, arredores; 950 m; 15 Jun. 1984; fb., fl., fr.; *Hatschbach & Kummrow 47909*; MBM [MBM159141] • Mun. Mucugé, 5 Km S.; 22 Jan. 1984; fb., fl., fr.; *Hatschbach 47476*; CTES • Mun. Mucugé, Serra de São Pedro; 1100–1280 m; 17 Dec. 1984; fl., fr.; *Lewis et al. 7064*; SPF [SPF36864] • Mun. Mucugé, Pedra Redonda, entre o rio Preto e rio Paraguaçu; 12°57'00"S, 41°24'27"W; 1070 m; 15 Jul. 1996; fb., fl., fr.; *Bautista et al. 3624*; ALCB, SPF [SPF123861] • Mun. Mucugé, Chapada Diamantina, trilha para a Cachoeira do Tiburtino; 2 Dec. 2006; fb., fl., fr.; *Roque et al. 1507*; ALCB • Mun. Mucugé, Chapada Diamantina, Trilha para as Andorinhas; 12°59'32"S, 41°20'29"W; 8 Jul. 2006; fl., fr.; *Roque et al. 1396*; ALCB • Mun. Mucugé, estrada nova Andaraí-Mucugé, a 3–4 Km de Mucugé; 8 Sep. 1981; fb., fl., fr.; *Furlan et al. 1599*; RB, SPF [SPF18976] • Mun. Mucugé, estrada Mucugé-Guine, a 5 Km de Mucugé; 7 Sep. 1981; fb., fl., fr.; *Furlan et al. 1940*; SPF [SPF18736] • Mun. Mucugé, Campo defronte ao cemitério; 7 Sep. 1981; fb., fl., fr.; *Giulietti et al. 1399*; SPF [SPF18311] • Mun. Mucugé, about 2 Km, along Andaraí road; 12°59'S, 41°21'W; fb., fl., fr.; *Harley et al. 20625*; SPF [SPF20093] • Mun. Mucugé, 3–5 Km N da cidade, em direção a Palmeiras, próximo ao Rio Moreira; 13°00'21"S, 41°23'22"W; 20 Feb. 1994; fb., fl., fr.; *Harley et al. 14295*; SPF [SPF94969] • Mun. Mucugé, Parque Municipal de Mucugé, Projeto Sempre Viva, trilha para o Tiburtino; 13°00'81"S, 41°37'12"W; 26 Jan. 2018; fb., fl., fr.; *Carvalho et al. 534*; ALCB [ALCB067258] • Mun. Mucugé, Parque Municipal de Mucugé, trilha do Tiburtino; 12°59'47"S, 41°20'29"W; 933 m; 9 Jun. 2004; fb., fl., fr.; *Souza et al. 876*; HUEFS • Mun. Mucugé, Parque Municipal de Mucugé, trilha do Tiburtino; 13°00'81"S, 41°37'12"W; 24 Jan. 2018; fl., fr.; *Carvalho et al. 642*; ALCB [ALCB066424] • Mun. Mucugé, Parque Municipal de Mucugé, trilha para o Rio Cumbuca; 12°59'52"S, 41°20'34"W; 937 m; 10 Jun. 2004; fb., fl., fr.; *Souza 890*; HUEFS [HUEFS000015108] • Mun. Mucugé, subida para Serra da Tesoura; 13°07'50"S, 41°20'53"W; 1264 m; 5 Aug. 2004; fb., fl., fr.; *Borba et al. 1901*; HUEFS [HUEFS000016676] • Mun. Mucugé, estrada na saia para Palmeiras; 12°59'50"S, 41°23'07"W; 26 Oct. 2014; fb., fl., fr.; *Carmo et al. 252*; UEC [UEC181442] • Mun. Palmeiras; 12°27'S, 41°28'W; 9 Sep. 2005; fb., fl., fr.; *Souza et al. 1423*; MO [MO-2218197], SPF [SPF176938] • Mun. Palmeiras, afloramento rochoso, lado oposto ao Mucugezinho; 12°27'52"S, 41°25'09"W; 759 m; 28 Dec. 2006; fr.; *Neves 157*; HUEFS • Mun. Palmeiras, Pai Inácio; 12°27'20"S, 41°28'15"W; 1100 m; 27 Dec. 1994; fl.; *Guedes et al. 1405*; HUEFS • Mun. Palmeiras, Parque Nacional da Chapada Diamantina, Morro Mãe Inácia; 12°27'S, 41°28'W; 1100 m; 15 Apr. 2005; fl., fr.; *Cardoso et al. 397*; HUEFS • Mun. Palmeiras, Barraca do Peié; 12°34'S, 41°23'W; 22 Aug. 2009; fb., fl., fr.; *Brito & Marques 130*; HUEFS [HUEFS000012738] • Mun. Piatã, Chapada Diamantina, Estrada para Inúbia,

Campo cerrado; 13°04'S, 41°53'W; 1 Aug. 2012; fb., fl., fr.; *Scatinga et al. 104*; UEC [UEC058948] • Mun. Piatã, Chapada Diamantina, caminho para os Três morros, Ponto 04; 13°04'48"S, 41°53'39"W; 1391 m; 2 May 2009; fb., fl., fr.; *Guedes et al. 14811*; ALCB • Mun. Piatã, Chapada Diamantina, caminho para Inúbia; 13°04'39"S, 41°54'16"W; 1367 m; 14 Jun. 2014; fb., fl., fr.; *Guedes et al. 21819*; ALCB • Mun. Piatã, Beira do rio de Contas; 13°07'23"S, 41°46'06"W; 1206 m; 18 Apr. 2014; fb., fl., fr.; *Melo et al. 12624*; HUEFS [HUEFS000079584] • Mun. Piatã, Estrada Piatã-Inúbia a ca. 25 Km NW de Piatã, Serra do Atalho; 13°04'48"S, 41°55'59"W; 1450 m; 23 Feb. 1994; fb., fl., fr.; *Sano et al. 14427*; MO [MO-1628732], SPF [SPF95369] • Mun. Rio de Contas, Pico das Almas, Chapada Diamantina; 13°31'02"S, 41°56'33"W; 1495 m; 18 Jan. 2003; fb., fl., fr.; *Andrade et al. 189*; HUEFS • Mun. Rio de Contas, Cachoeira da Fraga do rio Brumado, arredores da cidade; 13°35'S, 41°48'W; 900–1000 m; 24 Nov. 1988; fb., fl., fr.; *Harley et al. 26988*; SPF [SPF79305], US [02358592] • Mun. Rio de Contas, Estrada para a Cachoeira do Fraga, no Rio Brumado, a 3 Km do Município de Rio de Contas; 22 Jul. 1981; fb., fl., fr.; *Furlan et al. 1712*; SPF [SPF18584] • Mun. Rio de Contas, Pico das Almas; 14 Dec. 1984; fb., fl.; *Stannard et al. 6937*; SPF [SPF36737] • Mun. Rio de Contas, trilha para Campo do Queiroz, Pico das Almas; 24 Mar. 2000; fb., fl., fr.; *Moraes & Aona 477*; UEC [UEC112554] • Mun. Rio de Contas, 4 Km ao N de Rio de Contas; 13°32'S, 41°46'W; 1000 m; 21 Jul. 1979; fb., fl., fr.; *Mori et al. 12401*; US [02358594] • Mun. Rio de Contas, Serra das Almas, trilha para o Pico das Almas, entrada pelo povoado de Brumadinho; 13°30'57"S, 41°56'43"W; 17 Jan. 2016; fb., fl., fr.; *Carmo et al. 410*; UEC [UEC181443] • Mun. Rio de Contas, Salto do Fraga; 1100 m; 6 Apr. 1992; fb., fl., fr.; *Hatschbach & Barbosa 56677*; MBM [MBM154875] • Mun. Rio de Contas, Pico das Almas, Trilha para o campo do Queiroz; 13°30'52"S, 41°56'54"W; 1493 m; 23 Feb. 2004; fb., fl., fr.; *Harley et al. 54934*; HUEFS [HUEFS000015378] • Mun. Umburanas, Delfino, estrada para Campo Formoso; 10°21'49"S, 41°11'44"W; 925 m; 28 Jun. 2004; fb., fl., fr.; *Machado 241*; HUEFS • Mun. Xique-Xique, Próximo a Xique-Xique; 11°06'S, 42°43'W; 500 m; 24 Jun. 1996; fr.; *Guedes et al. 3020*; SPF [SPF115916], US [02358593].

Notes. The specimens of this species were originally identified as *O. filicaulis* because both species look superficially similar, especially in terms of habit and leaf dimensions and shape. However, the two taxa clearly differ in floral microcharacters, capsule dimensions, exotesta patterns, and pollen characters related to apertures and sexine patterns (Tables 2, 3). The specimen *Queiroz 4391* (HUEFS000016721) was cited by Zappi et al. (2003) as *Oldenlandia* aff. *filicaulis* in the checklist of the vascular plants of Catolés, Chapada Diamantina. We have analysed and confirmed its identity as *Oldenlandia bahiana*. The specimen *Laessoe & Sano H52307* (RB, SPF91338) was originally recorded as *Oldenlandia campestris* Zappi & Bridson nom. nud., a name not effectively published.

Table 3. Comparison between the newly described *Oldenlandia bahiana* and its closely related *O. filicaulis* based on floral and carpological features. Abbreviations: LS = long-styled morph. SS = short-styled morph.

Character	<i>Oldenlandia filicaulis</i>	<i>Oldenlandia bahiana</i>
Flower merosity	4	5(-6)
Hypanthium length	0.5–1.2 mm	1–2 mm
Calyx lobes shape	transversely broadly triangular to ovate, acute	triangular
Calyx lobes length	0.1–0.5 mm	0.6–1.5 mm
Floral pedicel length	4–20 mm	1.8–11.5 mm
Corolla colour	white to lilac at the apex of the corolla lobes	whitish to yellowish in the centre of the corolla tube
Corolla lobes shape	triangular to broadly triangular	flabelliform
Corolla lobes length	1.5–2.2 mm	0.5–1.7 mm
Inner corolla indumentum	LS morph: trichomes from the apex of the corolla lobes to the upper third of the corolla tube	LS morph: fringe of trichomes in the middle of the corolla tube
	SS morph: trichomes from the middle of the corolla lobes to the middle of the corolla tube	SS morph: fringe from almost the base of the corolla lobes to the base of the corolla tube
Corolla trichomes	simple	moniliform
Style indumentum	glabrous	pubescent
Stamens in SS morph	exserted	included or slight sub-exserted
Capsule length	1–1.7 mm	1–3.3 mm
Seeds length	0.2–0.3 mm	0.4–0.5 mm
Seeds exotesta	reticulate-areolate, polygonal areoles with straight walls	papillate

Key to the *Oldenlandia* species occurring in Brazil (adapted from Flora e Funga do Brasil 2025)

1. Herbs, creeping, radican at nodes 2
- Herbs erect, prostrate 3
2. Inflorescences 2–3-flowered cymes, terminal and pseudoaxillary; corolla 4–8 mm long, with a fringe of trichomes in the corolla tube or at corolla throat; capsule loculicidally from apex, glabrous or puberulous; seeds 0.4–5.0 mm long, trigonous *O. salzmännii*
- Inflorescences 1-flowered; corolla 10–12 mm long, with a broad fringe of trichomes in the corolla tube, from the tube base to the distal portion of the corolla tube; capsule septicial dehiscence, pubescent; seeds 0.8–1.0 mm long, obovoid, slightly rounded *O. dusenii*
3. Leaves elliptic, narrowly elliptic to narrowly ovate *O. corymbosa*
- Leaves narrowly elliptic to filiform-acicular 4
4. Flowers homostylous; corolla 1.8–2 mm long, broadly cylindrical *O. tenuis*
- Flowers heterostylous; corolla 2.4–5.8 mm long, infundibuliform 5
5. 4-merous flowers; calyx lobes 0.1–0.5 mm long, transversely broadly triangular to ovate; corolla white to lilac at the apex, 1.5–2.2 mm long, the lobes triangular to broadly triangular; capsules 1–1.7 mm long; seeds with reticulate-areolate testa; pollen 6-aperturate, exine bireticulate, infrareticulum nanogranulate, and supareticulum psilate in LS morph *O. filicaulis*
- 5-merous flowers; calyx lobes 0.6–1.5 mm long, triangular; corolla whitish to yellowish at the tube, 0.5–1.7 mm long, the lobes flabelliform; capsules 1–3.3 mm long; seeds with papillate testa; pollen 3-aperturate, exine reticulate, psilate in LS morph *O. bahiana*

DISCUSSION

The environmental niche analyses indicate that *O. filicaulis* and the newly described species *O. bahiana* occupy largely distinct ecological spaces with minimal overlap, consistent with the PCA and LDA results, which reveal a clear separation in environmental conditions. The PCA1 represents a combined climatic–soil gradient that distinguishes *O. filicaulis*, typically associated with warmer, more seasonally variable regions with nitrogen-

rich and denser soils, from *O. bahiana*, which occurs in more humid settings characterized by lower soil bulk density and more stable temperatures regimes. The PCA2, influenced primarily by soil texture and microclimatic variability, reflects additional edaphic differentiation between the two species. Collectively, these patterns demonstrate that both taxa occupy distinct ecological niches shaped by climatic and soil factors, supporting their taxonomic independence. This conclusion is reinforced

by consistent morphological and micromorphological evidence.

Variation in floral merosity (i.e. the number of organs within whorls) constitutes a morphologically and systematically important character within angiosperms, as it reflects both deep evolutionary processes and potential functional adaptations. Changes in merosity are often associated with shifts in floral symmetry, developmental pathways, and pollination syndromes, indicating that this character integrates relevant phylogenetic and ecological information (Ronse Decraene and Smets 1994; Naghiloo and Classen-Bockhoff 2016). In Rubiaceae, flowers are predominantly pentamerous, although a transitions toward tetramery have occurred repeatedly across nearly all tribes (Robbrecht 1988). Within Spermaceae, merosity is highly conservative in the *Hedyotis*–*Oldenlandia* complex, where tetramerous flowers predominate. In this context, one of the main differences between the *Oldenlandia* species examined here concerns floral merosity: *O. filicaulis* consistently produces tetramerous flowers, whereas *O. bahiana* presents pentamerous flowers. This shift is particularly informative, as it challenges the traditional perception of merosity as a largely invariant character within *Oldenlandia* and highlights the taxonomic complexity of the genus, especially among South American taxa. Further studies addressing the developmental mechanisms underlying shifts in merosity, as well as their phylogenetic and ecological significance within *Oldenlandia* and across Spermaceae, together with integrative taxonomic studies of South American representatives of the genus, will be essential to reach robust evolutionary conclusions.

In an overall appearance, both taxa are very similar, sharing a slender habit, linear to narrowly elliptic leaves, and infundibuliform corollas. Nevertheless, *O. bahiana* can be readily distinguished by its floral and palynological features, including the number, shape, and size of calyx and corolla lobes; type and distribution of indumentum; pubescent style; pollen aperture number; and sexine ornamentation. These traits are consistent across multiple populations and correspond to their ecological segregation. The integrative use of morphological, micromorphological, and environmental data thus provided a clear delimitation, overcoming the historically obscured species boundaries within the group.

Interestingly, the re-examination of the specimen Souza 1423 (HUEFS), previously identified as *O. filicaulis* and included in the molecular phylogenetic analysis of Carmo et al. (2022), indicates that it actually corresponds to *O. bahiana* as circumscribed here. This reassessment helps to explain the previously reported instability of the phylogenetic position of this taxon and supports its recognition as a distinct evolutionary lineage within Spermaceae. Nevertheless, comprehensive molecular analyses including both species, together with a broader South American representation of *Oldenlandia* and allied taxa, are still required to fully resolve their phylogenetic relationships.

The discovery of *O. bahiana* adds to the growing body of evidence indicating that Brazilian rupestrian grasslands (campos rupestres) harbour exceptionally high, yet still incompletely documented, plant diversity. Rubiaceae is among the ten richest families in this biome (Silveira et al. 2016), and the identification of a previously overlooked endemic species underscores both the uniqueness of this flora and the continued need for integrative taxonomic approaches to refine our understanding of biodiversity in these highly specialized habitats.

CONCLUSION

Our results support the recognition of *Oldenlandia bahiana* as a distinct species based on consistent morphological, palynological, and ecological evidence. Although further molecular phylogenetic data are needed to confirm its placement within Spermaceae and its relationships to other *Oldenlandia* species, the combined lines of evidence clearly distinguish it from *O. filicaulis*. This study highlights the value of integrative approaches, combining morphology, micromorphology, and environmental data, in effectively resolving long-standing taxonomic uncertainties and revealing hidden diversity.

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SUPPLEMENTARY MATERIALS

Supplementary material 1

Materials used for geographical/conservation analyses, morphology, and palynology, with indication of species, voucher information, and original geographical coordinates. The analyses performed on each material are highlighted with an X. <https://doi.org/10.5091/plecevo.178429.suppl1>

Supplementary material 2

Climatic and edaphic variables initially considered in the study, including their full names, abbreviations, type, description, conventional units. The variables selected for the final analysis after collinearity reduction (VIF < 5) are indicated with an asterisk (*).

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Supplementary material 3

Loading values for PCoA1 and PCoA2. Higher values that contribute most to the formation of each coordinate axis are indicated with an asterisk (*). See Suppl. material 2 for abbreviations.

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