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Two ornamental species of *Cryptanthus* (Bromeliaceae, Bromelioideae) on the brink of extinction: a new species and its congener from the 19th century

ELTON M. C. LEME[1,7,*], EDUARDO P. FERNANDEZ[2,8], ANDRÉ P. FONTANA[3,9], PEDRO S. DE ALMEIDA[4,5,10] & RAFAELA C. FORZZA[1,6,11]

[1] *Jardim Botânico do Rio de Janeiro, Diretoria de Pesquisas, Rua Pacheco Leão, 915, Rio de Janeiro, RJ, Brazil*
[2] *Jardim Botânico do Rio de Janeiro, Centro Nacional de Conservação da Flora, Rua Pacheco Leão, 915, Rio de Janeiro, RJ, Brazil*
[3] *Universidade Federal do Vale do São Francisco, Núcleo de Ecologia e Monitoramento Ambiental-NEMA, Campus Ciências Agrárias, Petrolina, PE, Brazil*
[4] *Laboratory of Palynology, Department of Botany, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro, RJ, Brazil*
[5] *Laboratory of Plant Anatomy, Department of Botany, Institute of Biosciences, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves nº 9500, Porto Alegre, RS, Brazil*
[6] *Instituto Chico Mendes de Conservação da Biodiversidade. Parque Nacional do Descobrimento, Prado, BA, Brazil*
[7] *leme@tjrj.jus.br; https://orcid.org/0000-0003-4712-9832*
[8] *efernandez@jbrj.gov.br; https://orcid.org/0000-0003-3162-0061*
[9] *andrepaviotti@yahoo.com.br; https://orcid.org/0000-0002-4622-1656*
[10] *pedro.schwambach@ufrj.br; https://orcid.org/0000-0003-2042-3687*
[11] *rafaela.forzza@icmbio.gov.br; https://orcid.org/0000-0002-7035-9313*
[*] *Author for correspondence: leme@tjrj.jus.br*

Abstract

The authors describe and illustrate a new species of *Cryptanthus*, *C. pataxoanus*, found within the Monte Pascoal National and Historical Park, and present new data on its closest morphological relative, *C. beuckeri*, both endemic to the Atlantic Forest of the state of Bahia, Brazil, and assessed as Critically Endangered (CR). The new taxon represents one of the most ornamental discoveries in recent years due to its marbled foliage, with contrasting greenish-yellow and dark green colors, which is similar to *C. beuckeri*. The main differences between *C. pataxoanus* and its closest relative include leaf blades not petiolate or the basal ones sometimes subpetiolate, the much broader portion of the blades distinctly longer, the narrower sepals covered by brown-centered trichomes, and petals without glandulose trichomes. The discovery of the new species results from cooperative work with the Pataxó indigenous community living in *Barra Velha* and *Barra Velha do Monte Pascoal* Indigenous Lands, located within the boundaries of the Monte Pascoal National and Historical Park. It symbolizes the inexhaustible richness of the Brazilian biodiversity in general and the Atlantic Forest of southern Bahia in particular, despite its current coexistence with high levels of threat.

Key words: Atlantic Forest, Monte Pascoal National and Historical Park, morphology, taxonomy

Introduction

Cryptanthus Otto & Dietrich (1836: 298) is a genus of Bromeliaceae Jussieu (1789: 49), subfamily Bromelioideae, endemic to southeastern and northeastern Brazil, currently assembling 70 species (Gouda *et al*., cont. upd.). It is associated with low-altitude habitats ranging from hygrophilous to drier Atlantic Forest, Restinga vegetation of coastal plains, as well as inland riparian forests and drier environment of the Caatinga vegetation (Leme *et al*. 2017, 2020).

Its terrestrial or saxicolous species are andromonoecious, bearing compound or, rarely, pseudosimple, sessile, and shortly corymbose inflorescences with inconspicuously stipitate basal/outer flower fascicles, petals unappendaged, usually white, rarely green or greenish, basally connate at the base for 1/7–1/3 of their length, and 4–8 times longer than wide; pollen sulcate, reticulate, spherical, with the sulcus completely covered by exine elements forming a net; stigma of the conduplicate-patent type; fruits distally with the attached sepals soon decaying, and seeds comparatively large and few in number—usually 2–10, rarely to 30 per fruit (Leme *et al*. 2017, 2020).

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One of the most iconic members of the genus is *Cryptanthus beuckeri* Morren (1880: 241), a very ornamental species introduced into European horticulture in the 19th century by a grower from Antwerp, Belgium, M. S. De Beucker, based on plants received from Brazil without exact data of origin (Morren 1880). According to the author, *C. beuckeri* is strongly appreciated by its charming marbled foliage resembling *Ronnbergia morreniana* Linden & André (1874: 120), and is differentiated from all its congeners by the distinctly petiolate leaves. A color painting of *C. beuckeri* was later provided by Morren (1881), along with a more detailed description. Two specimens from Morren's living collection were preserved in the herbarium of Liège, Belgium (3 June 1885), and in the Royal Botanic Gardens, Kew, England (10 December 1886).

Despite being very popular in cultivation, the typical *Cryptanthus beuckeri*, as portrayed by Morren (1891: plate XVII), remained for over a century without a precise field origin. As a consequence, all field collected specimens of *Cryptanthus* with strongly petiolate leaves, even without the distinctive marbled foliage highlighted in the original description and in Morren's painting, have received the identification of *C. beuckeri* mainly in herbaria. This clear trend was somewhat weakened in the current century by the publication of new species with distinct petioles, like *C. santosii* Leme & E.H.Souza (*in* Souza & Leme 2021: 186), *C. teretifolius* Leme (2002: 15), and *C. walkerianus* Leme & L.Kollmann (*in* Leme *et al.* 2014: 83). Nevertheless, more recent taxonomic studies have still failed to distinguish the typical *C. beuckeri*, with its eye-catching marbled leaves, from congeners with completely green or glaucous, concolorous leaves (*e.g*., Ferreira 2021).

Concerning these *Cryptanthus beuckeri* looking species, a phylogeny and character evolution study of the genus *Cryptanthus*, then considered in a broad sense, performed by Cruz *et al.* (2017) revealed that six specimens identified as *C. beuckeri* due to their distinctly petiolate leaves, from geographically different populations, are non-monophyletic. The analysis indicated that these *C. beuckeri* looking taxa are not at all phylogenetically related to each other, as they were recovered in different clades and subclades. They concluded that petiolate leaves may have arisen several times in the evolution of the genus (Cruz *et al.* 2017), which could also mean we are dealing with a complex of cryptic species distinguishable from each other by subtle characteristics (*e.g.*, leaf anatomy, trichomes, anthers, pollen, and stigma morphology, seeds morphoanatomy) that need to be better understood and explored.

The Brazilian Atlantic Forest is recognized as one of the most important biodiversity hotspots of the world due to its high diversity of flora and fauna, comprising numerous endemic species, most of which are under some degree of threat (Fonseca *et al*. 2004). Along the Atlantic Forest territory, the so-called Coastal Forest of southern Bahia, encompassing the Monte Pascoal National and Historical Park, is considered a hot-point within a hotspot based on its amazing diversity of species and endless source of novelties brought to light by science (Martini *et al*. 2007, Ostroski *et al*. 2020), including several species of *Cryptanthus.*

The discovery of new species in this region of the Atlantic Forest, as well as in other Brazilian biomes, is very often potentialized by the field assistance and knowledge sharing of experienced collectors, local residents, and traditional communities. Gradually, the increased interaction between scientists and local communities, with the exchange of experiences and information, has accelerated such discoveries (*e.g*. Gonella *et al*. 2015, Leme *et al.* 2023, Leme *et al*. 2025). This is the case of the very ornamental new species presented here, which exhibits a marbled leaf pattern typical of the eye-catching *C. beuckeri*. It was discovered during the opening of a new trail for the Monitora Program of the *Instituto Chico Mendes de Conservação da Biodiversidade* (*Programa Nacional de Monitoramento da Biodiversidade*; Cronemberg *et al.* 2023) inside the Monte Pascoal National and Historical Park by members of the Pataxó community collaborating with the administration of this federal protected area (Fig. 1).

Material and methods

Taxonomic sampling. The new species was collected in its natural habitat during field activities within the Monte Pascoal National and Historical Park, in the Atlantic Forest region of southeastern Bahia, conducted in collaboration with the Pataxó indigenous community settled in *Barra Velha* and *Barra Velha do Monte Pascoal* Indigenous Lands. Due to its very small population consisting of less than 50 individuals, one specimen was collected in flower, studied, illustrated, and then herborized, but a segment of the basal portion of the plant stem was removed for propagation in Refúgio dos Gravatás, a private collection located in Teresópolis, Rio de Janeiro state. Additionally, a second specimen (*R.C. Forzza 13513*) was collected and introduced into the living collection of the Rio de Janeiro Botanical Garden for further studies and conservation, following the guidelines recommended by the article 9 of the Convention on Biological Diversity for *ex situ* conservation (1993). In addition to the analysis of herbarium specimens, live specimens

of *Cryptanthus beuckeri* provided by the respective collectors were cultivated and, after flowering, as indicated in the exsiccates, were used for comparison with the new species.

FIGURE 1. **A**. General view of the well-preserved Atlantic Forest around the Monte Pascoal Hill, which gives its name to the Monte Pascoal National and Historical Park**,** where *C. pataxoanus* was discovered. **B**. A group of Pataxó indigenous people working in cooperation with the Park Administration, responsible for opening the trail where the new species was discovered. In the foreground, Hayô Pataxó (Yuris Santana do Couto). **C**. Poytãg Pataxó (André de Oliveira) photographing details of the new species. Photos: C. Rodrigues (**A**); Hayô Pataxó (**B)**; Tanara Pataxó (**C**).

Morphological descriptions and illustrations are based on living fertile material observed under a stereomicroscope before herborization. Descriptive terminology follows Smith & Downs (1979) and Leme *et al.* (2017), with adaptations suggested by Scharf & Gouda (2008). Photographs were taken as indicated in the captions. Specimens were pressed and dried following Fidalgo & Bononi (1984) and deposited in the herbarium RB. The herbaria CEPEC, K, LG, MO, NY, RB and TEPB [acronym following Thiers (cont. upd.)] were consulted to verify the existence of similar specimens or those related to its closer relative, *Cryptanthus beuckeri*. Latin abbreviations used in nomenclature follow the Madrid Code (Turland *et al.* 2025) and Hawksworth (2010).

Pollen analysis. Pollen samples from fresh flowers at the beginning of anthesis of *C. pataxoanus* were collected and stored on filter paper in a dry place. For Scanning Electron Microscope (SEM) investigation, pollen was rehydrated for a few minutes with water to obtain the turgescent pollen state. The material was dehydrated in 2.2-dimethoxypropane and critical-point dried (Halbritter, 1998). Samples were mounted on stubs using double-sided sticky tape, sputter-coated with gold, and analyzed with a Zeiss Evo MA10 scanning electron microscope. Descriptive terminology follows Halbritter & Hesse (1993), Punt *et al*. (2007), and Halbritter *et al*. (2018). Pollen images of *C. beuckeri* were provided by H. Halbritter (University of Vienna).

Geographic distribution maps and extinction risk assessment. Species distribution mapping and extinction risk assessment were conducted following the IUCN Red List Categories and Criteria (IUCN 2012) and the guidelines of the IUCN Standards and Petitions Committee (IUCN 2024). Distribution maps were produced in in QGIS (QGIS Association, 2024). Spatial parameters, including Extent of Occurrence (EOO), Area of Occupancy (AOO), number of locations and/or putative subpopulations were estimated using the Geospatial Conservation Assessment Tool (GeoCAT, Bachman *et al.* 2011) with its default IUCN Guidelines settings and used to infer conservation status. To quantify land-use composition within EOO and AOO, overlay analyses were performed (Jordão *et al*. 2022) by intersecting EOO and AOO shapefiles with historical land use and vegetation cover data from MapBiomas—Land Use and Land Cover (1985–2025) at 20 m spatial resolution. Additional analyses incorporated land-use and land-cover dynamics and fire frequency data for the period 1985–2025. All spatial datasets were obtained from the MapBiomas Project and correspond to the year 2024 (MapBiomas 2025a, 2025b). Analyses were conducted using the UTM coordinate system with the WGS-84 datum, and all MapBiomas land-use classes, including natural and anthropogenic features, were considered (MapBiomas 2025a, 2025b).

Taxonomy

Cryptanthus pataxoanus Forzza & Leme, ***sp. nov***. (Figs. 2–3)

Diagnosis:—This new species can be distinguished from its morphologically closest relative, *Cryptanthus beuckeri*, by the leaf blades not petiolate or the basal ones sometimes subpetiolate, with subpetioles gradually merging into the much broader distal portion (*vs*. always distinctly petiolate, with petioles strongly contrasting with the much broader distal portion); the much broader portion of the blades longer (20–30 cm *vs*. 10–20 cm long); sepals with narrower lobes (*vs*. 2–2.5 mm *vs.* 3.5–4 mm wide) covered by distinctly brown-centered trichomes (*vs*. trichomes white); and petals without glandulose trichomes (*vs*. adaxially bearing glandulose trichomes).

Type:—BRAZIL. Bahia: Porto Seguro, Parque Nacional e Histórico do Monte Pascoal, *ca*. 121 m elev., 16º52’17” S, 39º23’34” W, 15 September 2025, *N. Umburanas et al. 141*, cult. *E. Leme 10840* (holotype RB!).

Description:—***Plants*** short caulescent, 10–15 cm long, propagating by elongate shoots produced near the base of the inflorescence. ***Leaves*** 7 to 9 in number, suberect before anthesis and nearly spreading at anthesis, laxly arranged and forming an open rosette; ***sheath*** inconspicuous, subtrapeziform, greenish, corrugated, densely and coarsely white lepidote abaxially, adaxially glabrescent; ***blade*** narrowly oblanceolate to lanceolate, distinctly narrowed toward the base, not petiolate or the basal ones sometimes subpetiolate, 20–30 × 4.5–5.6 cm (subpetiole included), thinly coriaceous, pale greenish-yellow with irregular, subdense, more or less transversal, dark green spots in a marbled pattern, abaxially densely and coarsely white lepidote with trichomes obscuring blade color, adaxially glabrous, apex acuminate, shortly caudate, slightly to distinctly recurved, margins straight to slightly if at all undulate, canaliculate near the much narrowed base, flat toward the apex, densely spinulose; ***spines*** triangular, green, antrorsely uncinate, 0.3–1 mm long, 1–3 mm apart; ***subpetiole*** gradually merging into the much broader distal portion, distinctly shorter than the length of the broader distal portion, 3–8 × 1.7–2.2 cm, margins densely spinulose. ***Inflorescence*** (fertile part) sessile, shortly corymbose, *ca*. 2.5 cm long, *ca*. 1.5 cm in diameter, once branched at the base and bearing a simple,

small central head of densely arranged staminate flowers; ***primary bracts*** resembling the leaves; ***flower fascicles*** *ca*. 3 in number, inconspicuous, sessile, the basal ones *ca*. 25 × 10 mm (petals excluded), with *ca*. 2 perfect flowers; ***floral bracts*** narrowly lanceolate, acute and apiculate, membranaceous, 9–13 × 3–4 mm, whitish, subdensely white lepidote near the apex with fimbriate trichomes, entire to remotely denticulate near the apex, those of the flower fascicles carinate, nearly equaling the middle of the sepals, those of apical simple head of flowers ecarinate, to equaling the middle of the sepals. ***Flowers*** sessile, odorless, the perfect ones *ca*. 34 mm long, the staminate ones *ca*. 28 mm long (both with the petal extended); ***sepals*** *ca.* 16 mm long, connate at the base for *ca*. 9 mm, greenish-white, densely and coarsely lepidote with brown-centered, fimbriate trichomes, lobes narrowly ovate-lanceolate to elliptic-lanceolate, acuminate, apiculate, *ca*. 7 × 2.5 mm, symmetrical, obtusely if at all carinate, margins irregularly crenulate-denticulate, with fimbriate trichomes, those of the staminate flowers *ca*. 12 mm long, connate at the base for *ca*. 6 mm, lobes narrowly lanceolate, long acuminate, *ca*. 6 × 2 mm; ***petals*** (staminate flowers included) narrowly spathulate, apex acute to acuminate, exceeding the stamens but spreading-recurved at anthesis and exposing them, 21–26 × 3–4 mm, white, weakly connate at the base for 6–8 mm, bearing 2 conspicuous callosities at the base of the free lobes, without papillae; ***filaments*** 16–18 mm long, adnate to the petal tube and free above it; ***anthers*** 2.5–4 mm long, dorsifixed at 2/5 of its length above the base, base distinctly bilobed, apex obtusely apiculate; ***pollen*** spherical, large-sized, 55–65 µm in diameter (longest axis), sulcate, with a broad sulcus, with reticulate, elongated and interconnected exine elements forming a network covering the whole aperture (diffuse sulcus type), margins not distinct, exine reticulate (lumina width >1 µm), lumina broad, polygonal to rounded, muri narrow; ***stigma*** conduplicate-patent, lobes narrow, *ca*. 3 mm long, *ca*. 0.8 mm wide, white, margins scalloped, without papillae; ***ovary*** of the perfect flowers narrowly subclavate, trigonous, *ca*. 8 × 4.5 mm, greenish, subdensely and coarsely white lepidote with shortly fimbriate trichomes, of the staminate flowers subcylindrical, trigonous, *ca*. 7 × 2.3 mm; ***epigynous tube*** lacking in the perfect flowers, inconspicuous in the staminate flowers; ***placentation*** subapical; ***ovules*** few, obtuse. ***Fruits*** not seen.

Distribution and habitat:—*Cryptanthus pataxoanus* is known exclusively from its type locality, where a single, small subpopulation was recorded (Fig. 1 C, 2 A, B). The species occurs within the Monte Pascoal National and Historical Park (Fig. 1), in the municipality of Porto Seguro, southern Bahia state, northeastern Brazil. It grows as a terrestrial bromeliad in the organic litter layer (Fig. 2 A), under the shaded conditions provided by a well-preserved canopy of Dense Ombrophilous Atlantic Forest.

Etymology:—The name of this new species honors the Pataxó indigenous people. They belong to the Macro-Jê linguistic family and have a long history of resistance, facing challenges such as reclaiming their traditional lands and promoting the value of their culture since the 16th century. The Pataxó predominantly inhabit the extreme south of Bahia, which includes the area of the Monte Pascoal National and Historical Park where the *Barra Velha* and *Barra Velha do Monte Pascoal* Indigenous Lands are located. They maintain strong traditions, such as the Patxohã language, rituals (like the Awê), and the use of body paintings that serve as cultural identifiers, in addition to promoting the conservation of the environment within their traditional natural territory.

Distinctive characters:—*Cryptanthus pataxoanus* is morphologically closely related to *C. beuckeri*, due to the similar coloration and marbled pattern of the leaf blades (Fig. 2), as well as the shape and dimension of the sepals. However, this new species differs from it by the short caulescent habit ([Fig. 3 A] *vs*. acaulescent or nearly so [Fig. 4 B, C, E]), propagating by elongate shoots (*vs*. short shoots), leaf blades not petiolate or the basal ones sometimes subpetiolate (Fig. 2 B, C), with subpetioles gradually merging into the much broader distal portion (*vs*. always distinctly petiolate with petioles strongly contrasting with the much broader distal portion (Fig. 4 B, C, E), subpetioles 3–8 × 1.7–2.2 cm, densely spinulose (*vs*. petioles 5–18 × 0.5–1 cm, spinulose to entire mainly toward the distal end), the much broader portion of the blades 20–30 cm long (*vs*. 10–20 cm long), margins densely spinulose (Fig. 3 B) with spines 0.3–1 mm long (*vs*. subdensely to laxly spinulose, spines to *ca*. 0.4 mm long, to entire), floral bracts of the fascicles (Fig. 3 K) about equaling the middle of the sepals (*vs*. shorter, slightly exceeding the ovary [Fig. 4 I]), sepals with lobes narrowly ovate-lanceolate to elliptic-lanceolate (*vs*. ovate lanceolate), narrower (2–2.5 mm *vs.* 3.5–4 mm wide), with distinctly brown-centered trichomes ([Fig. 3 F] *vs*. trichomes white [Fig. 4 G]), petals of the perfect flowers smaller (21–26 × 3–4 mm *vs*. 30–31 × 5–5.5 mm), without glandulose trichomes ([Fig. 3 M] *vs*. adaxially bearing glandulose trichomes mainly on the basal callosities [Fig. 4 O]).

The challenge of comparing *Cryptanthus pataxoanus* with its closest relative, *C. beuckeri*, lies in the fact that, despite being widely disseminated in cultivation since it was introduced into horticulture at the end of the 19th century (Morren 1881 [Fig. 4 A]), very few herbarium specimens have well-documented field origins. Only three full documented populations are known from the county of Camacan (Camacã), Bahia state, one collected in 1994 (*Matos Silva 3062*) and the other two in 2007 (*Fontana 13.613* [Fig. 5 B, D, E] and *J.E. dos Santos s.n.*), which were introduced into cultivation and field documented by photographs (Fig. 4).

FIGURE 2. *Cryptanthus pataxoanus* (*Umburanas 141*): **A, B**. Details of the population at the type locality. **C**. Habit. Photos: S. Caram (**A**, **B**); E. Leme (**C**).

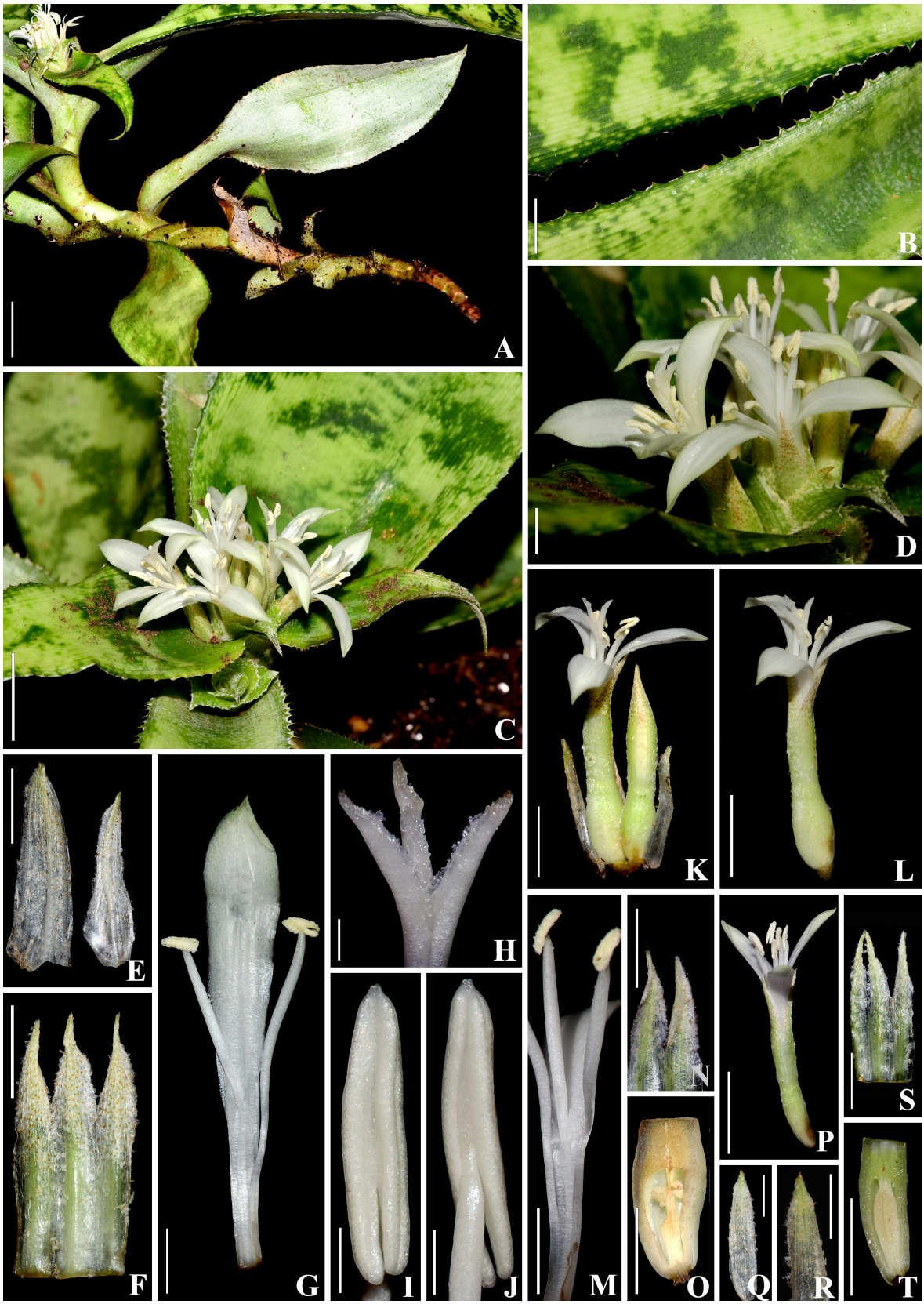

FIGURE 3. *Cryptanthus pataxoanus* (*Umburanas 141*): **A**. Elongate stem. **B**. Details of the marginal spines. **C**. Inflorescence. **D**. Details of the inflorescence. **E–O**. Perfect flower. **E**. Floral bracts of the basal fascicles. **F**. Sepals. **G**. Petal and stamens. **H**. Stigma. **I**. Frontal view of the anther just before anthesis. **J**. Abaxial view of the anther just before the anthesis. **K**. Basal fascicle. **L**. Flower. **M**. Basal portion of the petal and stamens. **N**. Details of the apex of the sepals. **O**. Longitudinal cross section of the ovary. **P–T**. Staminate flower: **P**. Flower of the inner portion of the inflorescence. **Q**. Floral bract. **R**. Details of the apex of the sepal. **S**. Sepals. **T**. Longitudinal cross section of the ovary. Photos: E. Leme. Bars: **A** = 2 cm; **B**, **C**, **K**, **L**, **P** = 1 cm; **D–G, M–O, Q–T** = 5 mm; **H–J** = 1 mm.

FIGURE 4. *Cryptanthus beuckeri*: **A**. Original plate published in *Belgique Horticole* (1881) by E. Morren. **B–D**. *Leme 7341*. **B**, **C**. Habit. **D**. Details of the inflorescence. **E**. Habit (*Leme 8973*). **F–O.** *Leme 9802*. **F**. Detail of the inflorescence. **G**. Sepals of the perfect flowers. **H**. Stamens and pistil. **I**. Basal fascicle. **J**. Petals. **K**. Stigma. **L**. Adaxial view of the anther. **M**. Abaxial view of the anther. **N**. Longitudinal section of the ovary. **O**. Adaxial view of the basal portion of the petal with callosities and glandular trichomes. Photos: E. Leme. Bars: **B**, **C**, **E**, **F** = 2 cm; **D** = 10 mm; **G–J** = 5 mm; **K–O** = 2 mm.

Such a fully field-documented specimens have provided new information on the habitat and morphological variation of *Cryptanthus beuckeri* inside its natural population, which was observed as a terrestrial species on the organic litter of a secondary, poorly conserved fragment of Atlantic Forest (Fig. 5 A). Despite being uniform and predominant in its typical marbled leaf pattern (Fig. 5 B, D), some color variation was documented, being represented by a beautiful leaf variegation of dark green irregular longitudinal stripes interspersed with pale creamy-green stripes (Fig. 5 E).

Considering the available data, the typical *C. beuckeri* inhabits the Atlantic Forest fragments about 10 to 20 km south of the city of Camacan, at elevations ranging from 120 to 208 m, about 65 km from the ocean. Their populations are about 150 km apart, in a straight line, from the known population of *C. pataxoanus*, which, in turn, is situated closer to the ocean, about 35 km inland in a straight line.

Specimens examined of *Cryptanthus beuckeri*:—BRAZIL. Without exact place, 3 June 1885, *cult. E. Morren s.n*. (LG); *ibidem,*10 December 1886, cult. Kew Gardens (K); Bahia, Camacan, Vinhático, propriedade Sr. Baieta, 15º35'31.1" S, 39º31'33.1" W, 208 m elev., 18 October 2007, *A.P. Fontana et al. 13613*, cult. *E. Leme 7341* (RB); *ibidem*, Fazenda Duas Lagoas, October 2007, *J.E. dos Santos s.n*., cult. *E. Leme 8973* (RB); *ibidem*, cult. *E. Leme 9710* (RB); *ibidem*, cult. *E. Leme 9802* (RB); Camacan, Fazenda Jerusalém, entrada à direita no km 15 da estrada Camacan a Faz. Ventania (BR-101), sede da fazenda no final do ramal à esquerda, 25 August 1994, *L.A. Matos Silva et al. 3062* (CEPEC, MO, NY, TEPB).

Pollen analysis:—Bromelioideae exhibits considerable pollen diversity (Halbritter & Till 1998, Halbritter 1992, Heller *et al*. 2015, Leme *et al*. 2017, 2021, 2022), with sulcate, bi-, tri-, tetra-, and pantoporate pollen grains reported. In early-divergent Bromelioideae, sulcate pollen grains are predominant (Schulte & Zizka 2008), and members of the "cryptanthoid complex" have exclusively this type of pollen (Leme *et al*. 2017, 2022). Within this complex of genera, *Cryptanthus* presents a unique and very characteristic pollen grain (Leme *et al*. 2017), and *C. pataxoanus* and *C. beuckeri* exhibit the diagnostic features described for the genus. However, evident differences in specific characteristics of pollen grain ornamentation among these species are observed, which are useful for distinguishing them from one another.

Pollen of *Cryptanthus pataxoanus* (Fig. 6 A–C) is sulcate, reticulate (lumina width >1 μm), large (55–65 μm in diameter along the longest axis). Turgescent pollen is oblate-spheroidal (P/E ≈ 1) and amb is spherical. The sulcus is broad, without distinct margins (Fig. 6 A), and extends over up to half of the distal pollen surface. The sulcus is ornamented with reticulate, elongated and interconnected exine elements forming a network that covers the entire aperture (diffuse sulcus type, Fig. 6 A). The reticulum is heterobrochate, with larger and more rounded lumina (Fig. 6 B, C) compared to those of *C. beuckeri* (Fig. 6 E, F). On the other hand, the muri of the *C. beuckeri* reticulum are thicker (Fig. 6 C *vs*. Fig. 6 F). In both species some lumina smaller than 1 μm occur interspersed among the larger lumina of the reticular mesh (Fig. 6 C *vs*. Fig. 6 F). In *C. beuckeri,* however, these smaller lumina and more abundant (Fig. 6 F).

Preliminary IUCN conservation assessments:—Although the broader region of the extreme southern Bahia Atlantic Forest has been relatively well surveyed botanically, especially for bromeliads, no additional records of *Cryptanthus pataxoanus* are known to date (Fig. 7). It is restricted to a vegetation type that represents one of the most fragmented and historically deforested components of the "Hileia Baiana", as the Atlantic Forest of southern Bahia is known, in a physiognomic comparison to the Amazonian Hylaea. Despite occurring within a strictly protected area, the only known subpopulation is subject to ongoing and documented anthropogenic pressures.

The Monte Pascoal National and Historical Park is partially covered by extensive areas of pasture and a few dense urban areas (Fig. 7), which increase the incidence of direct or indirect threats the upon single known subpopulation of this new species. These include illegal selective logging, habitat degradation associated with mule trampling used for clandestine timber extraction (Fig. 8 C–F), specifically at the track where *Cryptanthus pataxoanus* was detected, and canopy tree fall, which can directly alter the sensitive microhabitat conditions required by this terrestrial, shade-dependent species. Although the site is located well apart from the park's main visitor trails, clear evidence of illegal logging activities has been recorded in the surrounding area (Fig. 8 C–F), indicating the need to improve protection enforcement in this part of the park.

In addition, *Cryptanthus pataxoanus* presents high ornamental potential, a characteristic that significantly increases its vulnerability to illegal collection. Bromeliads with restricted distributions and showy foliage are frequently targeted for the ornamental plant trade, and the existence of a single known subpopulation heightens the risk that illegal harvesting for commercial purposes could rapidly impact the entire global population. Given that the species is known from only one site, its Extent of Occurrence (EOO) is equal to its Area of Occupancy (AOO), both estimated at 4 km², following the IUCN-recommended minimum grid size. Based on the spatial concentration of threats and the lack of evidence for

additional occurrences, the species is considered to occur at a single location. There is an inferred and ongoing decline in EOO, AOO, and habitat extent and quality, and a putative decline in the number of subpopulations and mature individuals (estimated of less than 50), driven primarily by habitat degradation and potential illegal collection. Based on this, *C. pataxoanus* qualifies as Critically Endangered (CR) under criterion B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v).

FIGURE 5. **A**. General view of the fragmented, poorly conserved Atlantic Forest in the region of Vinhático, municipality of Camacan, Bahia State, where a population of the typical *Cryptanthus beuckeri* was found. **B**. Detail of the population of *C. beuckeri* (*Fontana 13613*). **C**. The collectors of *C. beuckeri*: from left to right, standing, João E. dos Santos (Joãozinho), Mr. Baieta (landowner), and André P. Fontana; and kneeling in front, Kaio A. Brahim. **D**. Detail of some plants with longer leaves. **E**. Leaf variation within the same population with individuals bearing longitudinally striped leaves. Photos: A.P. Fontana (A, B, D, E); M. Bocayuva (C).

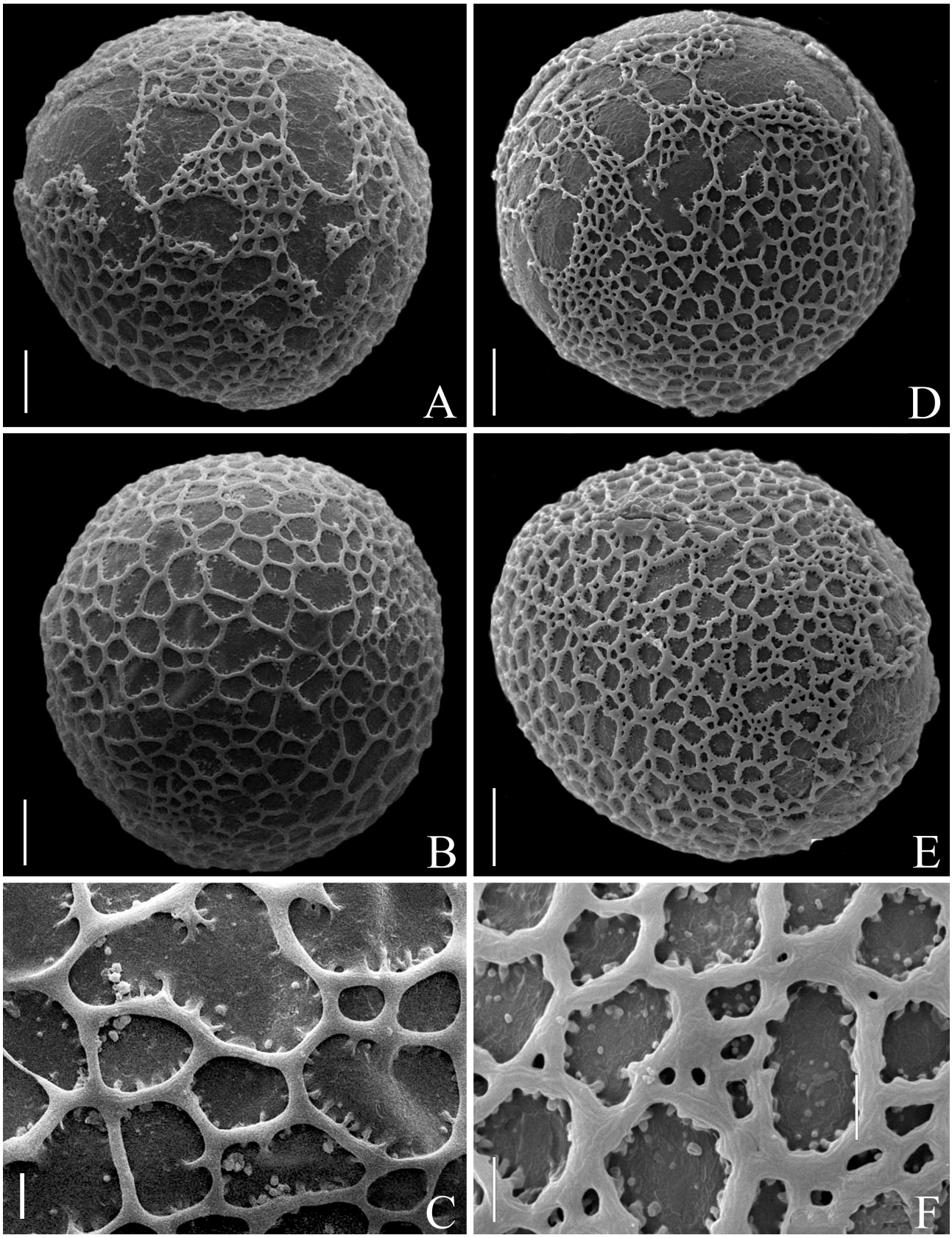

FIGURE 6. Pollen. **A–C**. *Cryptanthus pataxoanus* (*Umburanas 141*). **A**. Distal polar view: sulcus covered with reticulate, elongated, and interconnected exine elements forming a network (diffuse sulcus type). **B**. Proximal polar view: reticulum. **C**. Details of the reticulum with narrow muri. **D**–**F**. *Cryptanthus beuckeri* (*Leme 7341*). **D.** Distal polar view: sulcus covered with reticulate, elongated and interconnected exine elements forming a network (diffuse sulcus type). **E.** Proximal polar view: reticulum. **F.** Details of the reticulum with thick muri. Photos: P.S. de Almeida (**A–C**); H. Halbritter (**D–F**). Bars: **A**, **B**, **D**, **E** = 10 µm; **C**, **F** = 2 µm.

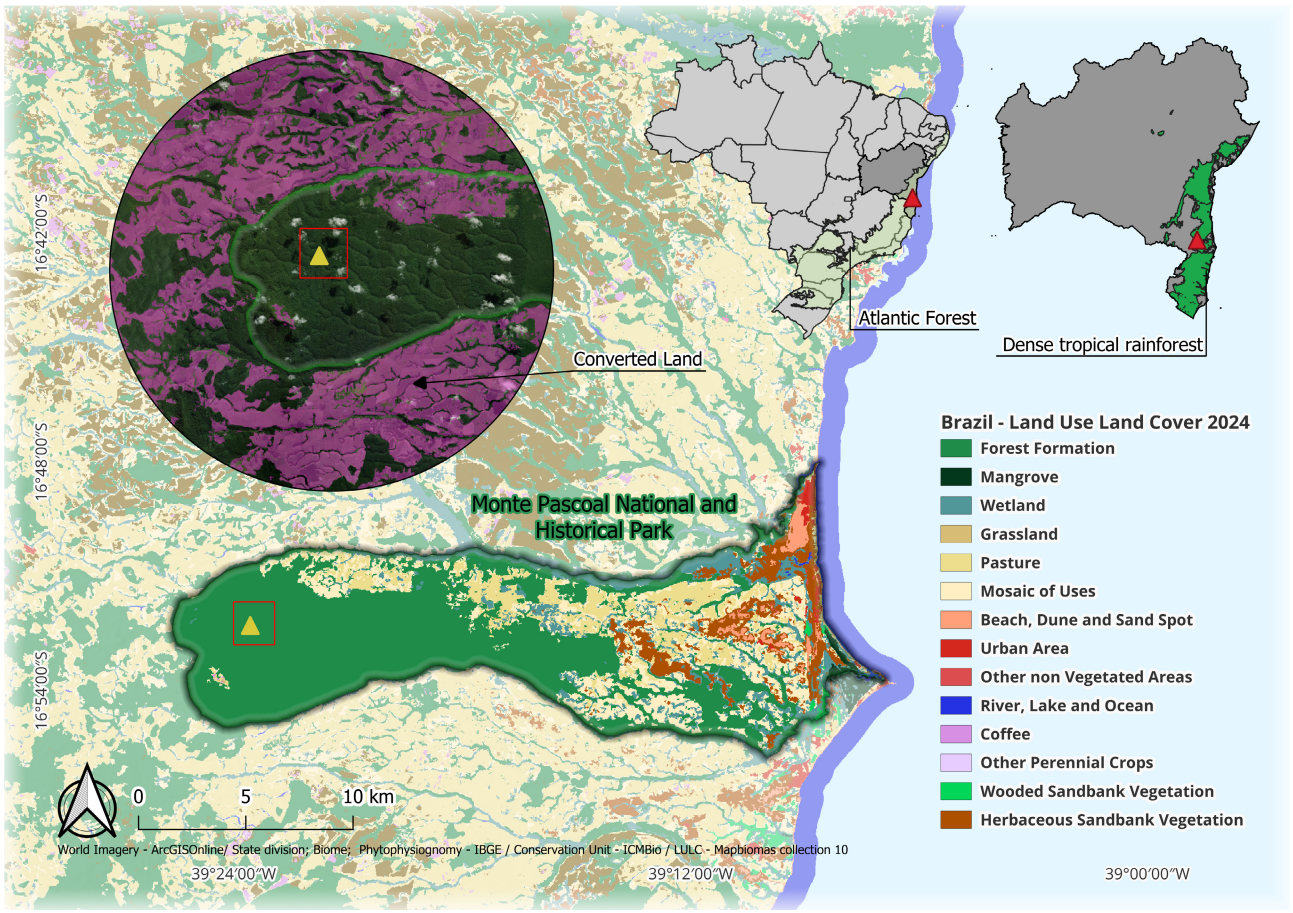

FIGURE 7. Map of the geographic distribution of *Cryptanthus pataxoanus*, highlighting different land uses and vegetation types. Red triangles indicate the type locality within Brazil (left) and the State of Bahia (right). Yellow triangles indicate the type locality in more detail within the boundaries of the Monte Pascoal National and Historical Park.

Concerning *Cryptanthus beuckeri*, the closest relative of *C. pataxoanus*, the previously mentioned broad concept historically adopted for the species resulted in a geographical distribution considered equally wider in the lowland Atlantic Forest remnants of southern Bahia and Espírito Santo states. Based on this wider assumed distribution, the species was previously assessed as Near Threatened (NT) due to declining subpopulations, habitat loss and fragmentation, and illegal collection for ornamental purposes, which were already causing population reduction and regional extinction events (Moraes & Messina 2012). However, we adopted here a more restricted circumscription of *C. beuckeri*, following its original concept, which means that all specimens previously attributed to this species from Espírito Santo and other areas of southern Bahia are no longer considered conspecific. As currently delimited, *C. beuckeri* is restricted exclusively to the municipality of Camacan, southern Bahia state, Brazil, and is known from only three collection sites, of which only one has precise geographic coordinates (Fig. 9).

Cryptanthus beuckeri is a highly ornamental species. Its striking marbled foliage continues to make the species particularly attractive to collectors, significantly increasing the risk of illegal plant poaching from the wild. Currently, all known subpopulations occur exclusively within private forest remnants located on three farms, with no confirmed records inside formally protected areas. Field monitoring indicates that the population is declining, primarily due to habitat degradation and direct disturbance. Cattle have begun to enter remaining forest patches, causing trampling and altering forest structure (Santos, pers. comm.), while illegal logging continues to reduce habitat quality. The municipality of Camacan has a long history of cocoa cultivation under "cabruca systems", in which cacao is planted under the shade of trees in the Atlantic Forest. Although these agroforestry systems retain canopy cover, they have severely degraded the forest understory, virtually eliminating the terrestrial herb layer required for the persistence of this species. Subsequent land-use changes, including cattle ranching and cultivation of coffee and rubber trees, have further intensified habitat degradation.

FIGURE 8. **A**. Watercolor by the botanical artist Paulo Ormindo, depicting *Cryptanthus pataxoanus*. **B**. Presentation of the *C. pataxoanus* and the original watercolor depicting the species during the ceremony commemorating the 64th anniversary of the creation of the Monte Pascoal National and Historical Park, as well as the reopening of the Visitor Center, by the Pataxó indigenous people who participated in the discovery. **C–F**. Illegal selective logging and habitat degradation associated with mule trampling used for clandestine timber extraction inside the park. Photos: R.C. Forzza (**B**); C. Rodrigues (**C**, **D**, **E**, **F**).

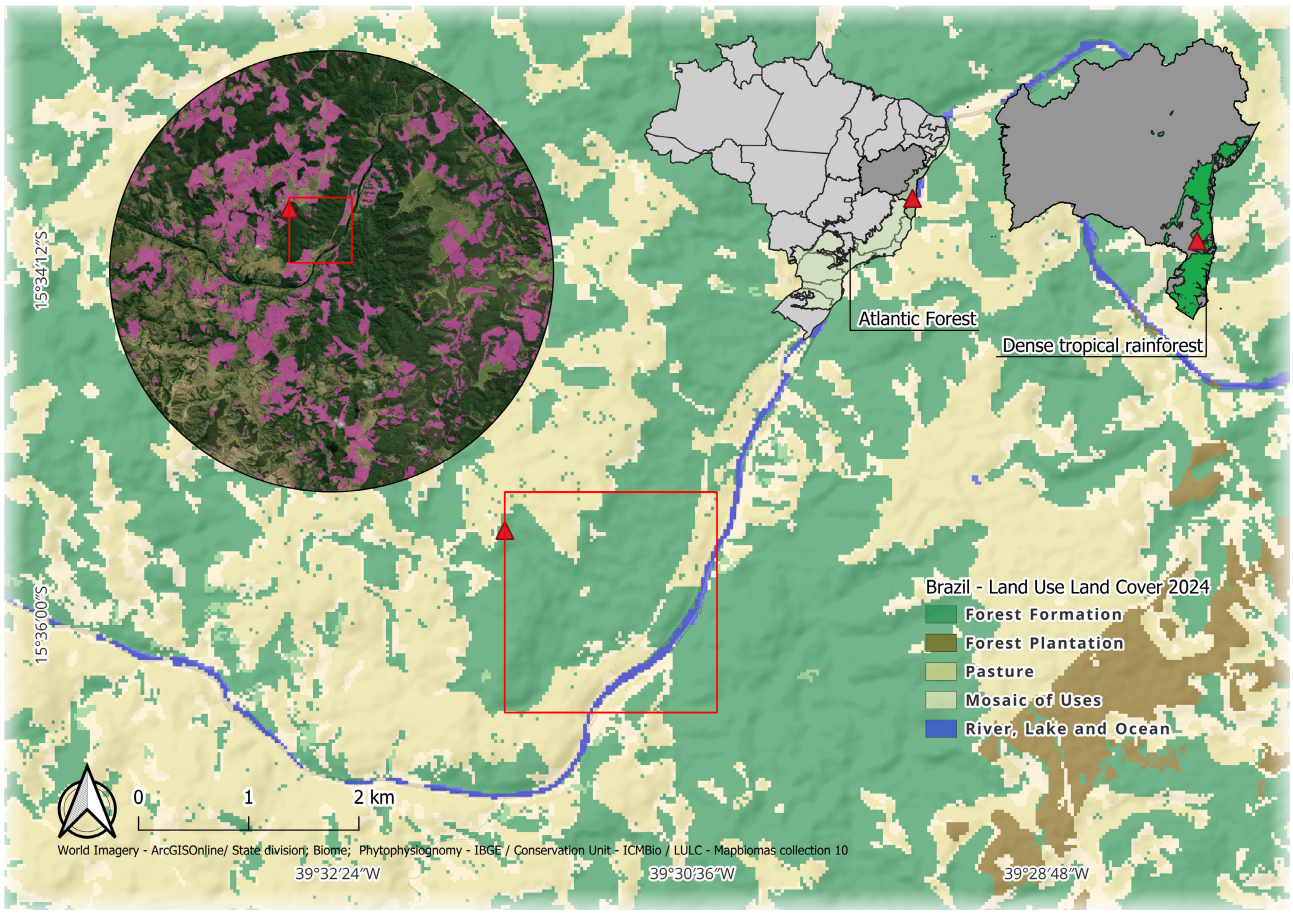

FIGURE 9. Map of the geographic distribution of *Cryptanthus beuckeri*, highlighting different land uses and vegetation types. Red triangles indicate the locality where the species was rediscovered, in the municipality of Camacan, and its location in the State of Bahia (above left) and in Brazil (above, towards the center). The squares outlined in red show in more detail the region where the species currently occurs and its location.

Given that *Cryptanthus beuckeri* in a strict sense is known from only three sites, effectively concentrated within a very small area and subject to spatially coherent threats, it is considered to occur at one single location (IUCN, 2025). Owing to the lack of precise coordinates for most records, the Extent of Occurrence (EOO) is considered equal to the Area of Occupancy (AOO), both estimated at 4 km², using the IUCN standard minimum grid size. There is a continuing inferred decline in EOO, AOO, and habitat extent and quality, and a continuing decline in the number of subpopulations due to reported local extinction events. Additionally, a decline in the number of mature individuals is inferred, driven by habitat degradation and illegal collection for ornamental purposes. Based on its extremely restricted distribution, occurrence at less than five locations, absence from protected areas, and ongoing declines in EOO, AOO, habitat quality, subpopulations, and number of mature individuals, *C. beuckeri* qualifies as Critically Endangered (CR) under criterion B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v).

Conclusion

It is amazing that the Monte Pascoal region, which constitutes the first piece of land sighted by the Portuguese caravels when they arrived on the Brazilian coast more than 500 years ago, still reveals striking novelties for science. The discovery of *Cryptanthus pataxoanus* within a federal protected area, as well as the new data obtained on its closer relative *C. beuckeri*, a species that remained without field information for over a century, highlight the importance of the so-called citizen science as a relevant tool to reduce the gap between society and academia. This approach makes scientific knowledge more accessible, particularly by involving citizens, such as the Pataxó indigenous people (Figs. 1 B, C, 8 B), in the scientific process from collaborating in data collecting to formulating questions and developing research in co-creation (Bonney *et al.* 2016, Vohland *et al.* 2021, Callaghan *et al.* 2021, Leme *et al.* 2023, Cronemberg

et al. 2023). On the other hand, such discoveries also represent the immense biodiversity yet to be unveiled in regions considered "hot-points within hotspots," and recommends efforts from all sectors of society to ensure that these wonders of the Brazilian Atlantic Forest do not disappear in the coming years.

Beyond their immediate taxonomic and ecological relevance, these discoveries contribute to a broader and long-standing debate in conservation science: whether biodiversity must first be fully known in order to be protected, or whether protection itself is a prerequisite for meaningful knowledge generation. The evidence presented here strongly supports the latter. Had the remnants of Atlantic Forest surrounding Monte Pascoal not been protected decades ago, despite incomplete biological inventories and limited understanding of their full species richness, there would have been no opportunity today to document new species, rediscover poorly known taxa, or unravel their evolutionary and ecological relationships.

In this sense, the apparent conundrum between "knowing to conserve" and "conserving to know" becomes increasingly clear. Protection creates the temporal and spatial conditions necessary for discovery. Protected areas act as repositories of biological potential, safeguarding not only known species, but also those yet to be described, which are very frequently, already threatened (Brown *et al*. 2023).

The case of *Cryptanthus pataxoanus* illustrates that conservation decisions made under uncertainty are not only justified but essential, as they enable future generations to advance scientific understanding that would otherwise be irreversibly lost. Finally, the continued unveiling of biodiversity in the Monte Pascoal region reinforces the notion that areas considered "hot points within hotspots" demand sustained and collective commitment from all sectors of society. Scientific research, participatory approaches, and effective conservation policies must operate in synergy to ensure that the remaining fragments of the Brazilian Atlantic Forest persist long enough to be studied, understood, and valued. Protecting nature, therefore, is not the end point of knowledge, but the condition that makes knowledge possible.

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