

Distribution of four Bromeliaceae species in the state of Amapá, eastern Amazon, Brazil

Distribuição de quatro espécies de Bromeliaceae no estado do Amapá, na Amazônia Oriental, Brasil

Distribucion de cuatro especies de Bromeliaceae em el estado de Amapá, em la Amazonia Oriental, Brasil

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ABSTRACT

Knowledge about the geographic distribution of Bromeliaceae in the Eastern Amazon still presents significant gaps, especially in the state of Amapá. This study aimed to document new geographic distribution records of four bromeliad species in the state of Amapá. Field expeditions were conducted in areas of terra firme forest, floodplain (várzea), ombrophilous forest, and mangroves, complemented by analyses of specimens deposited in herbaria and taxonomic revisions based on specialized literature. As a result, we present new geographic records for *Aechmea lingulata* (L.) Baker, *Aechmea aquilega* (Salisb.) Griseb., *Billbergia pyramidalis* (Sims) Lindl., and *Bromelia goeldiana* L.B.Sm. Descriptions of the species, as well as ecological and distributional data, are provided, accompanied by photographic records.

Keywords: Amazon flora, biodiversity conservation, floristic inventory.

RESUMO

O conhecimento sobre a distribuição geográfica de Bromeliaceae na Amazônia Oriental ainda apresenta lacunas significativas, especialmente no estado do Amapá. O estudo teve como objetivo resgitar novas distribuições geográficas de quatro espécies de bromélias no estado do Amapá. Foram realizadas expedições de campo entre áreas de floresta de terra firme, várzea, ombrófila, manzegal, complementadas por análises de espécimes depositados em herbários e por revisões taxonômicas com base em literatura especializada. Como resultado, apresentamos novos registros geográficos para *Aechmea lingulata* (L.) Baker, *Aechmea aquilega* (Salisb.) Griseb., *Billbergia pyramidalis* (Sims) Lindl., e *Bromelia goeldiana* L.B.Sm. São fornecidas a descrição das espécies, dados ecológicos e de distribuição, acompanhados de registros fotográficos.

Palavras-chave: conservação da biodiversidade, flora amazônica, inventário florístico.

RESUMEN

El conocimiento sobre la distribución geográfica de Bromeliaceae en la Amazonía Oriental aún presenta importantes lagunas, especialmente en el estado de Amapá. El estudio tuvo como objetivo registrar nuevas distribuciones geográficas de cuatro especies de bromelias en el estado de Amapá. Se llevaron a cabo expediciones de campo en áreas de bosque de tierra firme, várzea, bosque ombrófilo y manglar, complementadas con el análisis de especímenes depositados en herbarios y revisiones taxonómicas basadas en literatura especializada. Como resultado, presentamos nuevos registros geográficos para *Aechmea lingulata* (L.) Baker, *Aechmea aquilega* (Salisb.) Griseb., *Billbergia pyramidalis* (Sims) Lindl. y *Bromelia goeldiana* L.B.Sm. Se proporcionan descripciones de las especies, así como datos ecológicos y de distribución, acompañados de registros fotográficos.

Palabras clave: conservación de la biodiversidad, flora amazónica, inventario florístico.

1 INTRODUCTION

Bromeliaceae Juss. has a cosmopolitan distribution, except for *Pitcairnia feliciana* (A. Chev.) Harms and Mildbraed, which occurs on the west coast of the African continent (Smith; Downs 1974). The family constitutes an important angiosperm group in terms of morphological varieties, species richness, and ecological diversity in the Neotropical region (Givnish *et al.*, 2011). It encompasses approximately 3,140 species distributed among 58 genera (Gouda *et al.* [cont. updated]), diversified into perennial herbaceous plants occupy terrestrial, epiphytic, and rupicolous habitats (Smith; Downs, 1974).

Species of Bromeliaceae are herbaceous plants, generally rhizomatous, with simple, lanceolate leaves arranged in a rosette, often forming a central reservoir or phytotelm that retains water and nutrients. The inflorescences are usually racemose and positioned at the center of the

rosette, bearing flowers with three petals and an ovary ranging from superior to inferior, with axial placentation. The fruits are of two types, capsules or berries, with seeds that may be winged, plumose, or lacking appendages (Smith; Downs, 1974, 1977, 1979; Kubitzki, 1998; Benzing, 2000).

The state of Amapá, located in northern Brazil, is a repository of botanical richness characterized by a distinct fusion of Amazonian and Guianan influences. In Amapá, there are 13 genera and 38 species of the family Bromeliaceae: *Aechmea* Ruiz & Pavón, *Ananas* Mill., *Araeococcus* Brongn., *Billbergia* Thunb., *Bromelia* L., *Catopsis* Griseb., *Disteganthus* Lem., *Guzmania* Ruiz & Pav., *Lemeltonia* Barfuss & W. Till, *Pitcairnia* L'Hér., *Tillandsia* L., *Vriesea* (Regel) E. Morren, and *Werauhia* L.R. Grant (Flora e Funga do Brasil, 2025).

Species are frequently found in Amazonian ecosystems, occurring in open vegetation, common name, “rasas”, pastures, secondary pastures, and flooded forests, known with “igapó” (Wanderley, Martins, 2007). Here, we present updated records of four species with confirmed occurrences in the state. These collections contribute to expanding the known records of the family in Amapá, reinforcing the need for continuous floristic surveys to better understand the composition and distribution of the regional flora.

2 THEORETICAL FRAMEWORKS

Bromeliaceae Juss. is a family of angiosperms typical of the Neotropical region, exhibiting a wide diversity of habitats, as well as morphological and ecological variation acquired throughout its evolutionary history. Despite its vast extent, the Amazon rainforest remains poorly known floristically, with estimates indicating that approximately 10% of the world's total biodiversity is concentrated in this region (Burger, 2020). Major gaps in geographic knowledge and the limited number of herbarium collections hinder accurate mapping of plant distribution and biodiversity, making it challenging to identify areas of endemism and to develop appropriate strategies for the conservation and sustainable use of local biota (Hopkins, 2007).

The Northern Region of Brazil harbors 171 species of Bromeliaceae (Flora e Funga do Brasil, 2025), with emphasis on studies conducted in the states of Amazonas, Pará, and Amapá. In Amazonas, a survey by Ribeiro *et al.* (1999) cataloged seven genera and 13 species in the Adolpho Ducke Forest Reserve, while Sousa and Wanderley (2007) provided a complete

description of *Aechmea rodriguesiana* (L.B.Sm.) L.B.Sm. from the same reserve.

In the state of Pará, several studies have contributed to the knowledge of the family. De Mello *et al.* (2012) recorded 40 species of Bromeliaceae in the Volta Grande of the Xingu River. Quaresma and Jardim (2012) identified four genera and eight epiphytic Bromeliaceae species in the Ilha do Combú Environmental Protection Area, and Quaresma and Jardim (2013) documented the diversity, phytosociology, and spatial distribution of seven epiphytic Bromeliaceae species in a floodplain forest within the same area. Additionally, Koch *et al.* (2013) conducted a floristic–taxonomic study in the Caxiuanã National Forest (FLONA), identified four genera and five species.

In surveys conducted in dry restinga forest and floodplain (várzea) forest within the Algodal–Maiandeuá Environmental Protection Area, Quaresma and Jardim (2014) recorded only one Bromeliaceae species. Koch *et al.* (2015) carried out an inventory in the Volta Grande do Xingu, identifying seven genera and 20 species of Bromeliaceae. Monteiro and Forzza (2016) studied the flora of the cangas of the Serra dos Carajás, recording six genera and 13 species. Koch *et al.* (2016) described a new Bromeliaceae species from the Brazilian Amazon.

Costa Neto (2006) conducted a biological inventory in the Lakes region of the state of Amapá, identifying seven species. Funk *et al.* (2007) recorded 20 species of Bromeliaceae in the Guiana Shield, which includes the state of Amapá.

The state of Amapá, located in northern Brazil, is a repository of botanical richness characterized by a distinctive fusion of Amazonian and Guianan influences. In Amapá, there are 13 genera and 38 species of the family Bromeliaceae: *Aechmea* Ruiz & Pavón., *Ananas* Mill., *Araeococcus* Brongn., *Billbergia* Thund., *Bromelia* L., *Catopsis* Griseb., *Disteganthus* Lem., *Guzmania* Ruiz & Pav., *Lemeltonia* Barfuss & W. Till, *Pitcairnia* L'Hér., *Tillandsia* L., *Wallisia* (Regel) E. Morren, *Werauhia* L.R. Grant (Flora e Funga do Brasil, 2025). Species are frequently found in Amazonian ecosystems, occurring in shallow vegetation, grassland, secondary grassland, and flooded forest (Igapó) (Sousa; Wanderley, 2007). Here, we present updated records of four species with confirmed occurrences in the state. These collections contribute to expanding the known records of the family in Amapá, reinforcing the need for continuous floristic surveys to better understand the composition and distribution of the regional flora.

Aechmea Ruiz & Pavón., stands out as the largest and most diverse genus within Bromelioideae, with more than 244 species (Gouda *et al.* [cont. updated]) distributed throughout

the tropical Americas (Smith; Downs 1979). In the state of Amapá, the genus is represented by 12 species: *Aechmea bromeliifolia* (Rudge) Baker, *Aechmea bromeliifolia* (Rudge) Baker var. *bromeliifolia*, *Aechmea egleriana* L.B.Sm., *Aechmea egleriana* var. *major* L.B.Sm., *Aechmea fernanda* (E. Morren) Baker, *Aechmea huebneri* Harms, *Aechmea lingulata* (L.) Baker, *Aechmea longifolia* (Rudge) L.B.Sm. & M.A.Spencer, *Aechmea melinonii* Hook., *Aechmea mertensii* (G.Mey) Schult. & Schult.f., *Aechmea polyantha* E. Pereira & Reitz, *Aechmea setigera* Mart. & Schult. & Schult.f., *Aechmea tocantina* Baker and *Aechmea vallerandii* (Carrière) Erhardt, Götz & Seybold. These species occur in inundated forest (igapó), terra firme forest, floodplain forest (várzea), Amazonian campinarana, rock outcrop vegetation, ombrophyllous forest (tropical rain forest), and riverine forest and/or gallery forest ecosystems (Flora and Funga do Brasil, 2025).

Billbergia Thunb., comprising 63 species (Gouda *et al.* [cont. updated]) distributed from Central America to southern South America (Smith; Downs, 1979). In the state of Amapá, the genus is represented by two species, *Billbergia brachysiphon* L.B.Sm., *Billbergia brachysiphon* L.B.Sm var. *brachysiphon* and *Billbergia violaceae* Beer. These species are found in a range of ecosystems, including terra firme forest, ombrophyllous forest (tropical rain forest), Riverine Forest and/or gallery forest, inundated forest (Igapó), seasonal evergreen forest (Flora e Funga do Brasil, 2025).

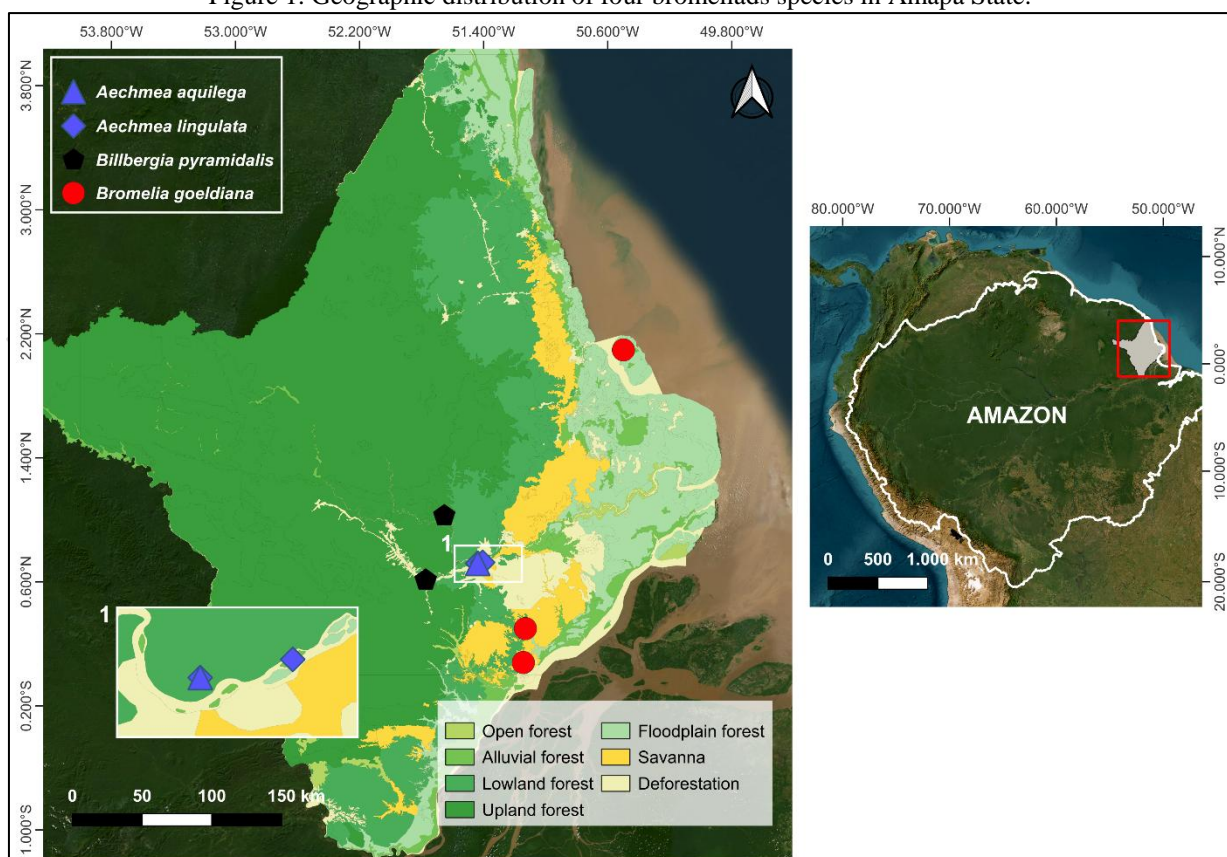
Bromelia L., currently comprises 70 species and is distributed throughout the neotropical region, with Brazil, especially the Cerrado, being a center of specific diversity for the genus, the species are taxonomically grouped into three subgenera: *Bromelia* Mez, *Distiacanthus* Baker and *Karatas* Adans., in the state of Amapá, the genus is represented by one species, *Bromelia morreniana* (Regel) Mez which is found in the Seasonal Evergreen Forest ecosystem (Flora e Funga do Brasil, 2025).

3 METHODOLOGY

Collections were conducted in the state of Amapá, located in the eastern portion of the Brazilian Amazon. According to the Köppen climate classification, the dominant climate is the region is Am (Costa *et al.*, 2013a). During the field expedition carried out in municipalities of the state of Amapá, *Aechmea lingulata* (L.) Baker (0°43'12.8"N 51°26'13.3"W) 68 m above sea

level., and *Aechmea aquilega* (Salisb.) Griseb. (0°43'35.0"N 51°24'20.6"W) 75 m above sea level, were recorded in the municipality of Porto Grande. *Billbergia pyramidalis* (Sims) Lindl. (1°01'40.6"N 51°39'11.1"W) 135 m above sea level, was recorded in the municipality of Ferreira Gomes (0°36'44.2"N 51°46'22.3"W) 70 m above sea level, and in the Cupixi region, within the municipality of Porto Grande. Additionally, *Bromelia goeldiana* L.B.Sm. was recorded in the Ariri district, municipality of Macapá (0°17'57.5"N 51°07'47.3"W) 16 m above sea level, at Km 09 (0°04'48.0"N 51°08'35.0"W), 13 m above sea level and in the Maracá-Jipioca Ecological Station (2°.05'50.08"N -50°.29'51.11"W) 11 m above sea level (Figure 1).

Figure 1. Geographic distribution of four bromeliads species in Amapá State.



Source: Authors, 2025.

Bromelia material was found, collected, herborized, and georeferenced according to standard techniques for botanical samples (Fidalgo; Bononi, 1989). subsequently, the images were processed using the GNU Image Manipulation Program (GIMP) 2.10.18 in order to isolate the plants against a black background, adjust the color balance, and remove possible image artifacts (e.g., leaves, branches, soil). The specimens were deposited in the HAMAB herbarium

(acronyms according to Thiers, 2022 continually updated). The descriptions were based on the herbal material examined. Additionally, online databases were consulted to verify records of bromeliad species in the national territory (Flora e Funga do Brasil, 2025). The map was prepared using QGIS v. 3.24.2 (QGIS Development Team 2021).

4 RESULTS AND DISCUSSIONS

The state of Amapá harbors a moderate diversity of bromeliads, mainly due to its location near the Amazon biome and the Guiana Shield, which is characterized by Amazonian lowlands below 250 m in elevation (Hoekstra *et al.*, 2010). However, the diversity of bromeliads in the Amazonian lowlands is assumed to be underestimated due to limited sampling in the region (Zizka *et al.*, 2019); therefore, additional niches for bromeliads may exist.

Aechmea aquilega (Salisb.) is a plant approximately 90 cm tall. (Figure 2 C-D) Leaves are coriaceous, erect to slightly arching; the leaf sheath well developed, 5–6 cm long; the blade measures 40–72 × 4–5 cm, green with yellow-green tonal variation, lanceolate, with an acuminate apex and an elliptic base; margins serrate–aculeate, bearing antrorse spines 2–5 mm long. The peduncle is erect, 45–65 cm long, peduncular bracts conspicuous, 7–13.5 × 2–3.5 cm, lanceolate, with an acuminate apex, and colored from pink to magenta. The inflorescence is 12–20 cm long, paniculate-pyramidal, with branches alternately spiraled. Flowers are sessile, congested, and arranged in fascicles; floral bracts measure 2–2.5 × ca. 1 cm, are ovate, partially cover the ovary, range from yellow-green to pink or magenta, and have an acuminate and pungent apex. Sepals 1.7–3 cm long, asymmetric, carinate, yellow-green, with a mucronulate apex. Petals 3.3–3.5 cm long, slightly spatulate, orange, with an acute apex.

Widely distributed in South America, with additional records from Costa Rica and Jamaica (Kew, 2023), the species occurs mainly in the Amazon and the Atlantic Forest, with most records concentrated in the state of Bahia, northeastern Brazil (Siqueira-Filho; Leme, 2006; Tomaz, 2019; Flora e Funga do Brasil, 2025).

In the state of Amapá, more than 20 individuals were observed. The species was recorded in dense tropical terra firme forest, growing preferentially as an epiphyte along forest gap edges and on emergent trees, but also occurring terrestrially in well-drained environments. It inhabits both primary forest formations and secondary regenerating areas, indicating some tolerance to

disturbance. Its ecology is associated with the formation of foliar tanks that retain water and promote microhabitats for small organisms. Flowering mainly during the rainy season, from December to March and fruiting takes place from May to July.

Aechmea lingulata (L.) Baker is a plant approximately 110 cm tall (Figure 2 A-B). Leaves are coriaceous, erect to slightly arching; the leaf sheath is brown-vinaceous, $16,5 \times 10,5$ cm; the blade measures $50-100 \times 3-5$ cm, green with yellow-green tonal variation, lanceolate, with an apex that is acute to rounded or apiculate and abruptly triangular, and an elliptic base; margins are serrate, with an apical spine approximately 1.0 cm long. The scape is erect, greenish, 31.0–57.0 cm long; scape bracts papyraceous, cream to vinaceous. The inflorescence is compound of a panicle of spikes. Primary bracts are membranaceous, vinaceous, with entire margins, spreading, lanceolate, 3.0–7.0 cm long, and gradually decrease in size toward the apex. Floral bract are coriaceous and inconspicuous, exposing nearly the entire ovary, they are green, oval, and asymmetrical. Flowers are sessile, 1.0–1.2 cm long. Sepals are free, greenish, asymmetrical. Petals free, white, 7.5–8.0 mm long and approximately 2.5 mm wide, with an obtuse to attenuate apex.

The species has a wide geographic distribution, occurring in Costa Rica, the Bahamas, the Virgin Islands, the Windward Islands, the Leeward Islands, Venezuela, Trinidad, Tobago, Suriname, French Guiana, and Brazil (Smith; Downs, 1979). It occurs mainly in the Atlantic Forest and has been recorded in the Brazilian states of Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Bahia, São Paulo, Rio de Janeiro, and Espírito Santo, where it grows as an epiphyte or terrestrial plant in forested areas, restinga vegetation, campo rupestre, and caatinga.

In the state of Amapá, *A. lingulata* was observed as five individuals, growing on an isolated, partially submerged tree in the middle of the Araguari River. Its ecology is associated with the formation of foliar tanks that retain water and promote microhabitats for small organisms. Flowering occurs from August to October, with fruiting from October to November. The flowers present a strong, sweet fragrance.

Bromelia goeldiana LBSm., is a plant approximately 120 m tall (Figure 2 G-H). Leaves are coriaceous, erect to recurved; the sheath is broad, with amplexicaul bases; the blade measures $50-100 \times 3-6$ cm, linear to sub-oblongate, green to grayish green, with margins armed with robust, recurved spines. The scape is robust, erect, densely lepidote, and bears scaly bracts that

are red to pink. The inflorescence is spicate and dense, with closely spaced, sessile flowers. Floral bracts are ovate, acuminate, and usually shorter than the sepals. Flowers are zygomorphic; sepals measure $1.3\text{--}2.1 \times 0.5\text{--}0.9$ cm, are ovate, coriaceous, greenish-white, with an obtuse apex. Petals are bluish-purple to violet, $2.5\text{--}3.5$ cm long, with basal appendages that are fimbriate or scale-like.

The native distribution of this species extends from Venezuela to Brazil (Amazonas). It is a perennial plant that grows mainly in the wet tropical biome (Kew, 2025). It is distributed in the Northern Region of Brazil, with records from dense forest environments and disturbed terra firme areas (Flora e Funga do Brasil, 2025).

In the state of Amapá, more than 35 individuals were observed, and the species is common in clearings and edges of secondary forests, as well as in mangrove areas. Due to its dense rosette and foliage forming a tank, it supports a diversity of organisms, including anurans (Sanchez *et al.*, 2019). Flowering occurs mainly from December to March, with fruiting extending until June.

Billbergia pyramidalis (Sims) Lindl., is a plant approximately 50 cm tall (Figure 2 E-F). Leaves coriaceous, erect to recurved; the sheath measures $10\text{--}18 \times 4.5\text{--}7.2$ cm; the blade is $25\text{--}40 \times 3\text{--}6$ cm, lanceolate, with an acute to apiculate apex and margins bearing prickles. The inflorescence is a dense spike with 6–20 flowers, measuring $5\text{--}18 \times 3.3\text{--}10$ cm; lower floral bracts similar to those of the scape, while upper bracts are suberulate, covering 1/3 to 1/2 of the inflorescence. Flowers are sessile to subsessile and actinomorphic; the pedicel is absent; sepals are oblong to obovate, pink, floccose, $1.5\text{--}2 \times 0.6\text{--}1$ cm, with an obtuse-oblique apex; petals are spatulate, recurved, $4.3\text{--}4.6 \times 0.9$ cm, red-purple or with blue apex, rarely yellow with blue apex.

The native range of this species extends from the Windward Islands to northern and eastern Brazil (Smith; Downs, 1979). It is an epiphyte that grows primarily in the wet tropical biome (Kew, 2025). Its ecology is associated with the formation of foliar tanks that retain water and promote microhabitats for small organisms.

In the state of Amapá, two individuals were observed. The species occurs on tall trees, and collection was only possible because the individuals had fallen to the ground. Flowering occurs between November and February, and fruiting between January and March.

Figure 2. A–B: *Aechmea lingulatooides* — A) habit; B) flower details. C–D: *Aechmea aquilega* — C) inflorescence; D) habit. E–F: *Billbergia pyramidalis* — E) inflorescence; F) flower details. G–H: *Bromelia goeldiana* — G) habit; H) fruit details.



Source: Authors, 2025.

5 CONCLUSIONS

This study aimed to document new geographic records of species of the family Bromeliaceae in the state of Amapá, contributing to the reduction of knowledge gaps regarding the flora of the Eastern Amazon. Based on field expeditions, analyses of herbarium specimens, and a taxonomic review of the specialized literature, new occurrence records were confirmed for *A. lingulata* (L.) Baker, *A. aquilega* (Salisb.) Griseb., *B. pyramidalis* (Sims) Lindl., and *B. goeldiana* L.B.Sm.

The results expand the understanding of the geographic distribution of these species, provide new data on their habitats and phenological periods, and reinforce the importance of the state of Amapá as a relevant area for bromeliad diversity within the Amazon region. This study also highlights the fundamental role of continued floristic surveys as tools for advancing taxonomic knowledge and supporting the development of effective biodiversity conservation strategies.

Thus, the data presented represent a significant contribution to regional botany, providing a foundation for future research on the biogeography, ecology, and conservation of Bromeliaceae in the Amazon.

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