Acta Botanica Brasilica, 2024, 38: e20230162
doi: https://doi.org/10.1590/1677-941X-ABB-2023-0162

Original Article

Alstroemeria maranhensis (Alstroemeriaceae): A new species from the Cerrado of Brazil

Alessandro Wagner Coelho Ferreira[1], Wagner Ribeiro da Silva Junior[2], Maycon Jordan Costa da Silva[3,*], Miguel Sena de Oliveira[3], Marta Camargo de Assis[4]

[1]Universidade Federal do Maranhão, Department of Biology, Graduate Program in Biodiversity and Conservation, São Luís, MA, Brazil.
[2] Universidade Estadual do Maranhão, Graduate Program in Biodiversity, the Environment and Health, Caxias, MA, Brazil.
[3] Universidade Federal Rural da Amazônia, Museu Paraense Emílio Goeldi, Graduate Program in Biological Sciences – Tropical Botany, Bélem, PA, Brazil.
[4]Retired researcher, Campinas, SP, Brazil.
*Corresponding author: mayconjordan40@gmail.com

ABSTRACT

We describe, discuss and illustrate *Alstroemeria maranhensis*, a new species from the Cerrado domain in south-central Maranhão State, Brazil. We also provide a distribution map, a photographic plate and taxonomic comments. The new species is morphologically similar to *A. viridiflora,* though differs by having predominantly white flowers (*vs*. reddish or yellowish in *A. viridiflora*), falcate lower outer tepals (*vs*. not falcate) and obovate-spatulate lower inner tepal with attenuate and flat base (*vs*. spatulate without attenuate and/or flat base).

Keywords: *Alstroemeria viridiflora*, endemism, flora of Maranhão, Liliales, taxonomy

Introduction

Alstroemeria L. is a Neotropical genus of the family Alstroemeriaceae Dumort., order Liliales Perleb, with about 66 species restricted to South America, occurring in Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay and Peru (Tropicos 2023). Studies on Brazilian *Alstroemeria* species began with Schenk (1855) and Baker (1877; 1888) and were continued by Ravenna (2000), Assis (2001; 2002; 2003; 2004a; b; 2006; 2007; 2009a; b) and Assis and collaborators (Assis & Mello-Silva 2002; Assis *et al*. 2014a; b; Assis & Mello-Silva 2016; Assis *et al.* 2023). Based on these recent revisions regarding Alstroemeriaceae from Brazil, the doubtful species of *Alstroemeria* were synonymized and several others were described; thus updating information on Brazilian species and serving as a basis for further research (Assis 2001; Assis *et al*. 2023; Flora e Funga do Brasil 2023).

In Brazil, there are around 40 species of *Alstroemeria*, distributed across five domains: the Amazon (two species), the Caatinga (five species), the Cerrado (22 species), the Atlantic Forest (22 species) and the Pampa (three species). The majority of these occur in more than one domain, mainly in the Cerrado and the Atlantic Forest (Assis 2001; Assis *et al*. 2023; Flora e Funga do Brasil 2023). There are species of *Alstroemeria* that occur in two or more domains in Brazil, as is the case of *Alstroemeria plantaginea* Mart. ex Schult. & Schult.f., which occurs in the Cerrado, Caatinga and the Atlantic Forest (Flora e Funga do Brasil 2023). However,

Received November 16, 2022; Accepted February 16, 2024
Editor-in-Chief: Thaís Elias Almeida; Associate Editor: Paulo Sano

How to cite:
Ferreira AWC, Junior WRS, Silva MJC, Oliveira MS, Assis MC. 2024. *Alstroemeria maranhensis* (Alstroemeriaceae): A new species from the Cerrado of Brazil. Acta Botanica Brasilica 38: e20230162.
doi: https://doi.org/10.1590/1677-941X-ABB-2023-0162

there are also species restricted to one single domain such as *Alstroemeria longistaminea* Martius ex Schult. & Schult.f., *Alstroemeria piauhyensis* Gardner ex Baker and *Alstroemeria stramonia* M.C.Assis & Mello-Silva, all of these, endemic to the Caatinga (Assis & Mello-Silva 2016; Assis *et al*. 2023; Flora e Funga do Brasil 2023).

The northeastern region of Brazil has six species of *Alstroemeria*, which are distributed in the domains of the Amazon (western Maranhão), Cerrado, Caatinga and Atlantic Forest (Assis *et al*. 2023; Flora e Funga do Brasil 2023). Despite these recent contributions, there are still many areas of Brazil that lack samplings of *Alstroemeria* species. This shortage of samplings is evident in the state of Maranhão, in the northeastern region of Brazil, where there is only one correctly identified specimen of *Alstroemeria*: *A. amazonica* Ducke, which was collected in 1949 in an area of *carrascal* vegetation (land with woody vegetation) in the municipality of Imperatriz (J.M. Pires & G.A. Black 1683a, 06/08/1949 (IAN 050265)) (Assis *et al*. 2023; Flora e Funga do Brasil 2023).

To expand the knowledge of *Alstroemeria* in Maranhão, we carried out field expeditions and found a population of *Alstroemeria* that were morphologically distinct from other species of the genus. Here, we propose it as a new species and present a diagnosis of the morphological description, a table comparing the new and related species, some ecological and morphological comments, a map of the collection site, photographic plates, a preliminary threat category of the new species and an identification key comparing this new species with its most morphologically similar congeners.

Materials and Methods

Study area

Maranhão has three domains, namely the Amazon (35%), Cerrado (64%) and Caatinga (1%), with ecotonal areas between them (Spinelli-Araujo *et al*. 2016). The climate is of the Am type, according to the Köppen classification. The average temperature is 26.1 °C and the annual precipitation is between 1,250-1,500 mm. The study was carried out in the central-southern portion of Maranhão, in the northeastern region of Brazil, in areas of the Cerrado, where the rainy season occurs between November and April and the dry season between May and October (IBGE 2022; IBAMA 2013; Saraiva *et al*. 2020). We visited the following five municipalities in the Cerrado of Maranhão: Fortaleza dos Nogueiras, Formosa de Serra Negra, Novas Colinas, Riachão and São Pedro dos Crentes. *Alstroemeria maranhensis, sp. nov*. was collected at Fazenda Recanto das Águias, in the municipality of Fortaleza dos Nogueiras (Fig. 1).

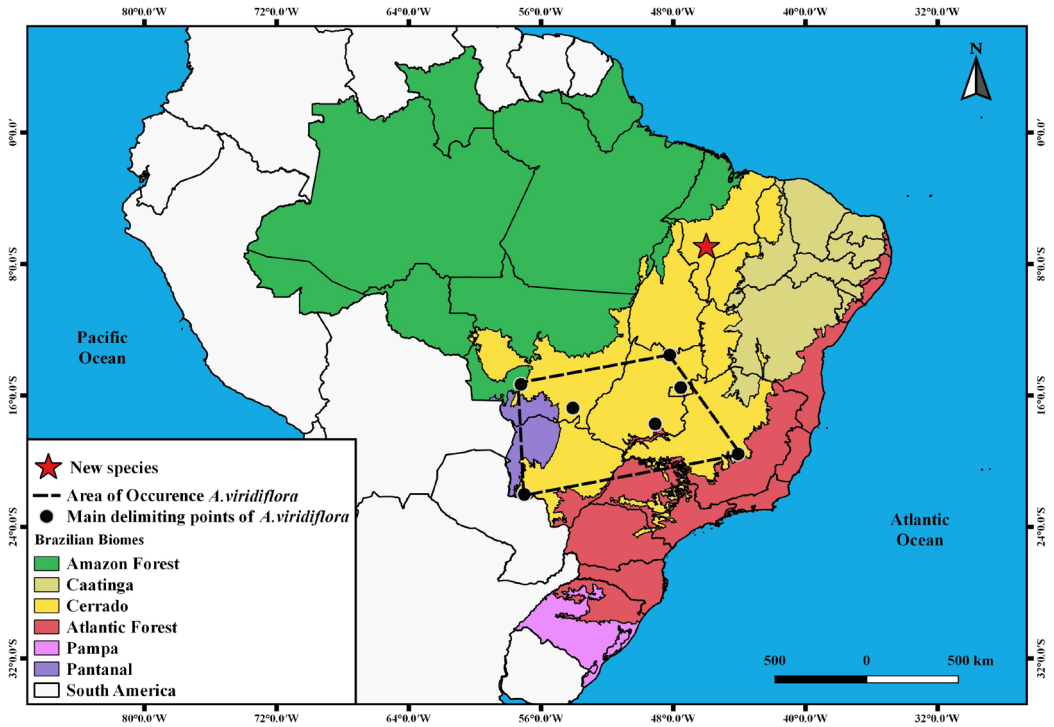

Figure 1. *Alstroemeria maranhensis* collection site in the central-southern portion of the state of Maranhão (Cerrado vegetation), in the municipality of Fortaleza dos Nogueiras, northeastern region of Brazil. The red star indicates the type locality (A.W.C. Ferreira 528 & M.J.C. Silva). The map also includes the main collection points for *A. viridiflora*, the most similar species to *A. maranhensis*, delimiting its geographic distribution in Brazil and indicating the minimum distance between them, which is approximately 1,000 kilometers in a straight line.

Data collection

The studies were carried out monthly, between January and March 2022 and January and March 2023, totaling six expeditions, each lasting eight days. The specimens observed in the field were duly photographed. Flowers were preserved in 70% alcohol to aid identification and description**.** Stereo microscope images were used to obtain details about the morphology of the flowers and other vegetative and reproductive features. The species was described based on the specialized literature of *Alstroemeria* from Brazil (Assis 2001; 2002; 2003; 2004a; b; 2006; 2007; 2009a; b; Assis & Mello-Silva 2002; Assis *et al*. 2014; Assis *et al*. 2014; Assis & Mello-Silva 2016; Assis *et al*. 2023). *Alstroemeria* species similar to this new taxon were studied in specialized literature, mainly in Assis (2001; 2002), Assis & Mello-Silva (2002), Assis *et al*. (2023) and their specimens were consulted at the herbaria ASE, BHCB, CEN, CEPEC, EAC, ESA, HEP, HUEFS, IAC, IPA, MAR, MBM, MG, NY, SLUI, SP, SPF, UB, UEC, UFS and VIC, herbarium acronyms according to Thiers (2023). Exsiccates of the *Alstroemeria* species most closely related to *A. maranhensis* were also consulted via online herbaria (Flora e Funga do Brasil 2023, speciesLink 2023). However, these were restricted to those specimens with images that had been identified by specialists. We also consulted the protolog of the species most closely related to *A. maranhensis*, i.e., *A. viridiflora* (Warming 1872), for further details of the comparison. To describe the species, we used the measurements of the smallest fertile individual found in the field (with only two white flowers) and those of the largest fertile individual (with seven white flowers). Collected specimens were herborized. We also observed and recorded information on 30 individuals of the same population that were either in flower or fruiting to get an idea of the proportion of the number of flowers, floral color shades, types of fruits and seeds and other characteristics. One of the individuals with pinkish-white flowers was herborized after flowering again in cultivation. Author names follow Brummitt & Powell (1992). Habit, habitat, flowering season, flower duration, fruit set and seeds were also studied.

Collected materials were herborized following Fidalgo & Bononi (1984) and deposited in the Rosa Mochel herbarium (SLUI), located at the State University of Maranhão (UEMA) in São Luís, Maranhão state. The geographic distribution of *Alstroemeria* species from Brazil was consulted based on the online database Flora e Funga do Brasil (2023).

The location map of *Alstroemeria maranhensis* was created using QGIS software v.2.18.12 (QGIS Development Team 2020), with the SIRGAS 2000 datum. This map also included plots with the geographic coordinates of the exsiccates of the main specimens of *A. viridiflora* Warm. in adjacent areas, as it is a similar species to *A. maranhensis*. Thus, we sought to portray the limits of the geographical distribution of *A. viridiflora* in Brazil and the shortest distance between it and *A. maranhensis*. The preliminary conservation status of *A. maranhensis* was assessed based on the categories and criteria of the International Union for Conservation of Nature (IUCN 2012).

Results and Discussion

Taxonomic treatment

Alstroemeria maranhensis M.C.Assis & A.W.C.Ferreira *sp. nov*. (Figs. 2 A-K and 3 A-F).

Type

BRAZIL, Maranhão, Fortaleza dos Nogueiras, Riacho Castanhão, afluente do Rio das Neves, fazenda Recanto das Águias, 06°57'26"S, 046°08'29"W, A.W.C. Ferreira 528 & M.J.C. Silva, fl. and fr., (flores brancas), 21/02/2022, (SLUI).

Paratypes

BRAZIL, Maranhão, Fortaleza dos Nogueiras, Riacho Castanhão, afluente do Rio das Neves, fazenda Recanto das Águias, 06°57'26"S, 046°08'29"W, A.W.C. Ferreira 529 & M.J.C. Silva, fl., (flores brancas), 21/02/2022, (SLUI). Idem, Riacho Castanhão, afluente do Rio das Neves, fazenda Recanto das Águias, 06°57'26.9"S, 046°08'29"W, A.W.C. Ferreira 823, fl., floração em cultivo, (flores branco-rosadas), 30/06/2022, (SLUI).

Diagnosis

Alstroemeria maranhensis is similar to *A. viridiflora*, though it differs due to the reproductive stem leaves being wide-elliptical (*vs*. only narrow-elliptical in *A. viridiflora*), white or pinkish-white flowers (*vs*. reddish or yellowish flowers in *A. viridiflora*), apiculate or caudate apex of outer tepals (*vs*. mucronate apex in *A. viridiflora*)**,** obovate-spatulate upper outer tepal, 4.0-4.2 × 0.9-1.0 cm (*vs*. spatulate, 4.3-4.7 × 0.9-1.3 cm in *A. viridiflora*); lower outer tepals smaller (4-4.2 × 0.9-1.0 cm) than those of *A. viridiflora* (4.3-4.7 × 0.9-1.3 cm), falcate lower outer tepals, 3.4-3.6 × 0.9-1.1 cm (*vs*. not falcate, 3.3-4 × 0.8-1.3 cm in *A. viridiflora*), apex of inner tepals apiculate or caudate (*vs*. acuminate apex in *A. viridiflora*), upper inner tepals slightly falcate (*vs*. not falcate in *A. viridiflora*), obovate-spatulate lower inner tepal, with base attenuate and flat, 2.7-2.9 × 0.6-0.7 cm (*vs*. spatulate to obovate-spatulate, without base attenuate and not flat, 4.3-4.7 × 0.9-1.3 cm in *A. viridiflora*), vinaceous, irregular rounded macules and predominance of longitudinal veins (outer and inner tepals) (*vs*. vinaceous-spotted (outer tepals); vinaceous-spotted and variegated (inner tepals) in *A. viridiflora*) and globose capsule, 1.5-2.5 × 1.2-1.7 cm (*vs*. ovoid capsule, 1.5 × 1.5 cm in *A. viridiflora*).

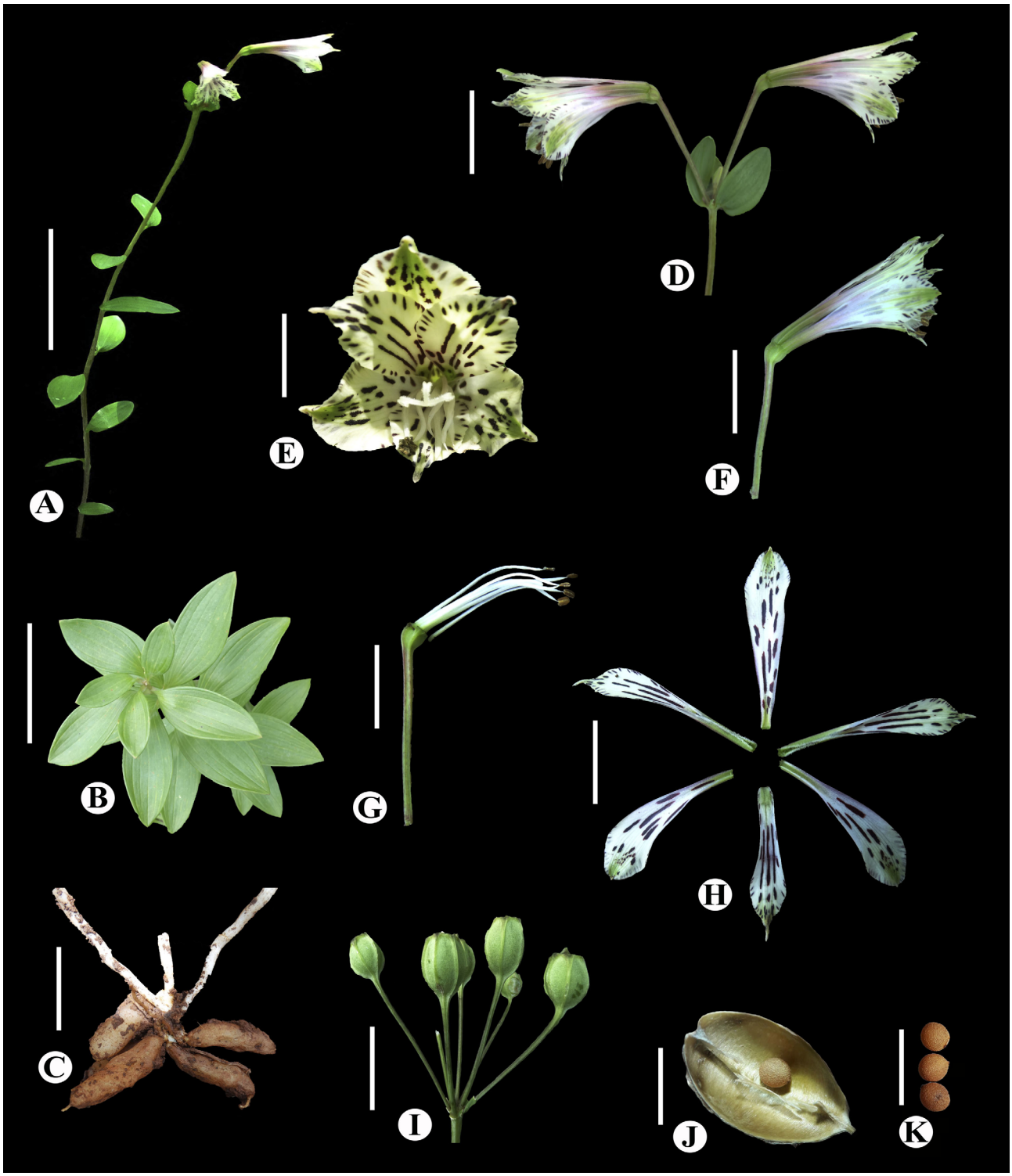

Figure 2. *Alstroemeria maranhensis*. A. General view of the reproductive stem with two flowers at the apex. B. Vegetative stem seen from above and showing the spiral arrangement of the leaves. C. Fleshy roots (below) from which the reproductive and vegetative stems emerge (above, in white shades). D. Detail of the flowers at the apex of the reproductive stem. E. Flower in front view. F. Flower in side view. G. Floral peduncle, base of the ovary and stamens. H. Floral parts of the outer and inner tepals. I. Immature fruits at the top of the reproductive stem. J. Open fruit with a seed inside. K. Detail of spherical seeds. Scale bars: A (15 cm); B (10 cm); C (5 cm); D, E, F, G, H, I (2 cm); J, K (1 cm). Photographs: A.W.C. Ferreira.

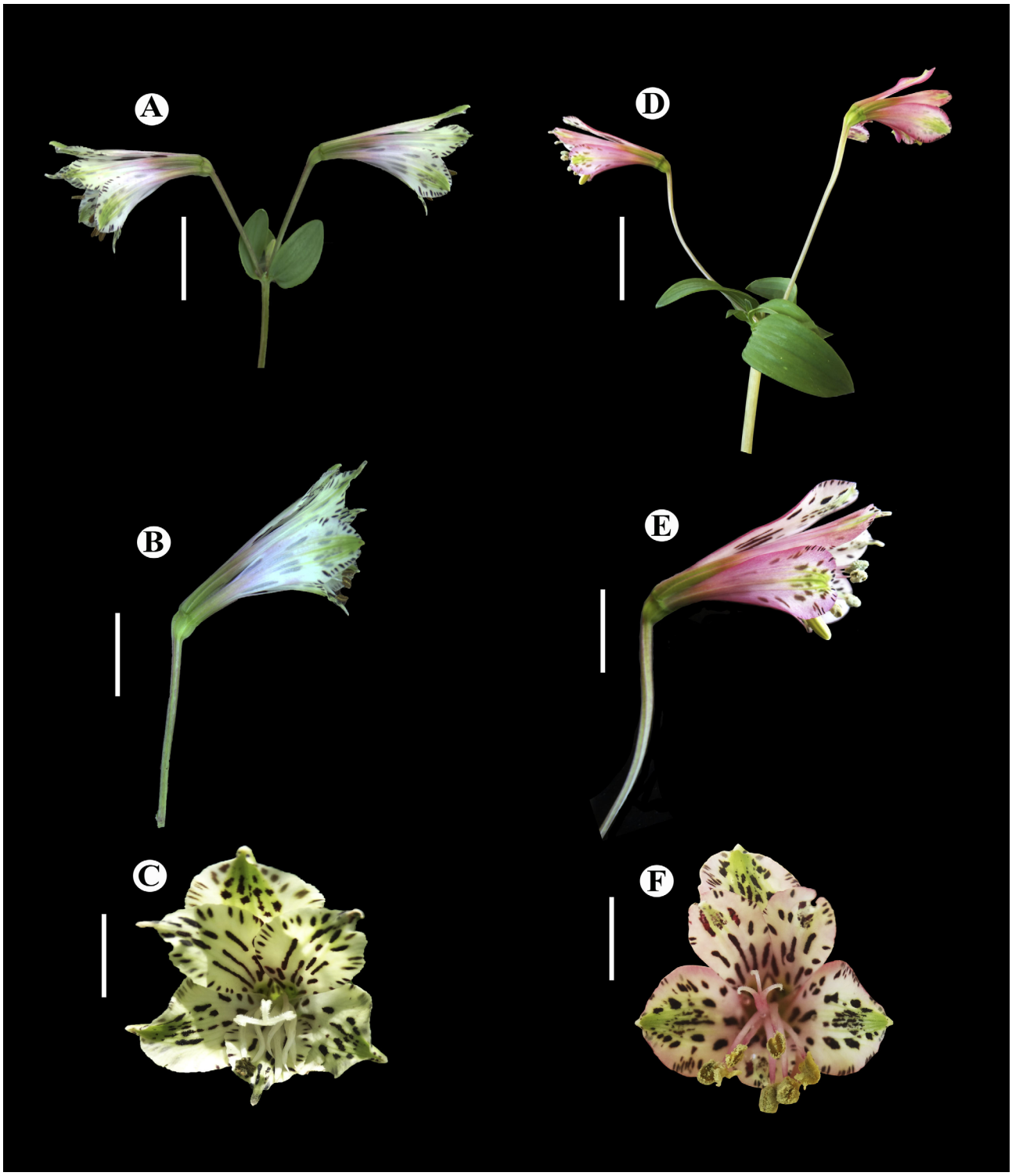

Figure 3. *Alstroemeria maranhensis*. Comparison between white (left) and pinkish-white (right) flowers. A and D (inflorescence in lateral view); B and E (flowers in side view); C and F (flowers in front view). Scale bars: A, B, D, E (1.5 cm); C, F (1.0 cm). Photographs: A.W.C. Ferreira.

Description

Erect to slightly leaning terrestrial herb. **Rhizome** inconspicuous, cylindrical, from which the vegetative and reproductive stems and roots emerge. **Storage roots** 8-15, fleshy, 1.7-5.5 cm long × 0.7-1.4 cm wide, light beige, cylindrical-fusiform to long-ovoid, surface somewhat irregular, apex rounded, from which one to two cylindrical, thin and elongated roots arise. **Vegetative stem** 46-80 cm long × 0.3-0.5 cm wide, cylindrical, glabrous, green. **Leaves of the vegetative stem** chartaceous, distributed along the stem, 13-24, resupinate, 3-9.7 cm long × 0.7-1.4 cm wide, of varying sizes, the largest in the median portion and the smallest at the base and top of the stem, alternate, sessile, non-amplexicaule, margin entire, wide-elliptical, apex acute, base attenuate; adaxial and abaxial surfaces glabrous, slightly papillose adaxial surface, the adaxial surface has slightly grooved fusiform ribs and the abaxial surface has slightly prominent ribs. **Reproductive stem** 75-130 cm long × 0.4-0.6 cm wide, cylindrical, glabrous, green, epidermis generally has hyaline membranous scales that are concentrated in the lower half and, to a lesser extent, in the upper half, including the surface of the fruits. **Leaves of the reproductive stem** chartaceous, sparsely distributed along the stem, 9-14, resupinate, 2-4.7 cm long × 0.6-1.9 cm wide, of varying sizes, the largest in the median portion and the smallest at the base and top of the stem, alternate, sessile, non-amplexicaule, margin entire, wide-elliptical, apex rounded, base attenuate, both surfaces glabrous, slightly papillose adaxial surface, fusiform veins slightly grooved on the adaxial surface and slightly prominent on the abaxial surface. Inflorescence in simple, apical umbel. **Foliose bracts** at the base of the summit, 2-4, 0.3-2.2 cm long × 0.2-1.0 cm wide, chartaceous, glabrous, elliptical to narrow-elliptical. **Flowers** 2-7, horizontal, at an angle of approximately 45° with pedicel, white or pinkish-white, 4.1-4.6 cm long, odorless, campanulate, tepals 6, free; pedicel angular, longitudinally grooved, straight to slightly curved, green and slightly pink at the edges, glabrous, 3.5-5.2 cm long × 0.15-0.2 cm wide. **Outer tepals** 3, similar, white, inner and outer surfaces glabrous; inner surfaces have smaller and larger (elongated) reddish-brown (vinaceous), irregularly rounded macules and a predominance of longitudinal, vinaceous veins, greenish on the inner and outer surfaces of proximal and distal regions; similar morphology to each other, apex apiculate or caudate, without papillae, base attenuate and canaliculate, distal margins crenulate or not crenulate; **one upper outer tepal**, (4.0-4.2 cm long × 0.9-1.0 cm wide), obovate spatulate, not falcate, sparsely papillate at the proximal edge of the canaliculate region; **two lower outer tepals** (3.4-3.6 cm long × 0.9-1.1 cm wide), spatulate or obovate spatulate, falcate, smaller than the upper outer tepal, sparsely papillate at the proximal edges of the canaliculate region; **inner tepals** 3, similar, inner and outer surfaces glabrous, white, inner surfaces with smaller and larger (elongated), reddish-brown (vinaceous), irregularly rounded macules and predominance of longitudinal, vinaceous veins, greenish on inner and outer surfaces of proximal and distal regions; apex apiculate or caudate, distal margins crenulate; **two upper inner tepals** (4.2-4.4 cm long × 0.7-0.8 cm wide), spatulate or obovate spatulate, slightly falcate, base canaliculate, with papillae at the canaliculate edges; **one lower inner tepal** (2.7-2.9 cm long × 0.6-0.7 cm wide), obovate spatulate, base attenuate not canaliculated, flattened, not falcate, sparsely papillate at the edges of the proximal third. **Stamens** 6, included; free filaments, cylindrical, 2.9-3.1 cm long × 0.1 cm wide, glabrous on 80% of the length of the distal region and pilose on the 20% of the proximal region, complanate at the base and subulate at the apex, curved about 30 degrees down in the distal third. **Anthers** pseudobasifixed, light brown, oblong, flattened, 0.35 cm long × 0.2 cm wide. **Stigma** trifid, recurved, papillose, 0.2 cm long; style included, triagonal, glabrous, 3.0-3.2 cm long × 0.15 cm wide, ovary inferior. **Capsule** loculicidal, 6-sided, globose, 1.5-2.5 cm high × 1.2-1.7 cm wide, apex ridged (0.2-0.3 cm long). **Seed** spherical, beige, surface with flattened circular papillae, 0.3 cm high × 0.3 cm wide.

Habitat

Alstroemeria maranhensis can be found in open shrub areas of the Cerrado, on rocky soil, amid vegetation. About 30 individuals were observed in an area of approximately one hectare. These individuals were either completely exposed to the sun or partially shaded by the adjacent vegetation.

Distribution and domains

Alstroemeria maranhensis appears to be endemic to an area of open shrub Cerrado, in the valley of the Castanhão creek, an affluent of the Rio das Neves, at Recanto das Águias farm, municipality of Fortaleza dos Nogueiras, Maranhão state, northeastern Brazil (Fig. 1). Other rocky outcrops in Fortaleza dos Nogueiras and neighboring municipalities (Formosa de Serra Negra, Novas Colinas, São Pedro dos Crentes and Riachão) were examined, but no other individuals of *A. maranhensis* were found. In Fortaleza dos Nogueiras, at a different location, we observed *A. maranhensis* and, in the referenced municipalities in its surroundings, we observed specimens of another species of *Alstroemeria*: *A. amazonica* Ducke, which is very distinct from *A. maranhensis* due to the presence of red flowers and leaves of the reproductive stem that are concentrated at the apex of the stem (Assis 2001; Assis *et al*. 2023). Specimens of *A. viridiflora*, the species that is most morphologically similar to *A. maranhensis*, were not observed in these places. *A. viridiflora* is endemic to Brazil and occurs in the central-western (in the Federal District, Goiás, Mato Grosso do Sul, Mato Grosso) and southeastern regions (in Minas Gerais) (Flora e Funga do Brasil 2023). Although these two species occur only in Cerrado areas of Brazil, *A. viridiflora* has not yet been recorded in Maranhão nor

in any neighboring state (Flora e Funga do Brasil 2023). This fact also indicates that *A. maranhensis* is a distinct species and not a regional variation of *A. viridiflora*. This geographic distribution of *A. maranhensis* is more restricted than that of *A. viridiflora*, thus indicating local endemism. The specimen of *A. viridiflora* (M. C. Assis *et al*. 368 (MBM 295898)) that was closest to Fortaleza dos Nogueiras, where *A. maranhensis* was collected, is from the municipality of Minaçu, Goiás state. The straight-line distance between these locations is about 1,000 km (Fig. 1). Likewise, the other two species, with some morphological similarities to *A. maranhensis* (*A. longistaminea* Mart. ex Schult. & Schult.f. and *A. plantaginea* Mart. ex Schult. & Schult.f.), in addition to having fewer characteristics in common (Table 1), also have distinct geographic distributions, and to date have not been registered in Maranhão (Flora e Funga do Brasil 2023). *A. longistaminea* is endemic to the Caatinga domain (states of Bahia, Ceará, Paraíba, Pernambuco, Piauí, Sergipe) (Flora e Funga do Brasil 2023). *A. plantaginea* is endemic to Brazil, but with a wider distribution, occurring in the Caatinga, Cerrado and Atlantic Forest domains, throughout the northeastern and southeastern regions of Brazil (state of Bahia, Minas Gerais and São Paulo) (Flora e Funga do Brasil 2023).

Table 1. Diagnostic morphological comparison between *Alstroemeria maranhensis* and other morphologically similar species. The characteristics of the related species were based on Assis (2001) and Assis & Mello-Silva (2016). In bold, the main distinguishing characteristics of *A. maranhensis* to the most morphologically similar species.

Characteristics/species	*A. maranhensis*	*A. viridiflora*	*A. plantaginea*	*A. longistaminea*
1. Vegetative leaf arrangement and morphology	distributed along the stem, wide-elliptical	distributed along the stem, wide-elliptical	concentrated in the distal third of the stem, oblong-lanceolate	sparsely distributed along the stem, elliptical
2. Reproductive leaf arrangement and morphology	sparsely distributed along the stem, **wide-elliptical**	sparsely or concentratedly distributed along the stem, narrow-elliptical	sparsely or concentratedly distributed in the proximal or median region of the stem, linear-lanceolate or elliptical	sparsely distributed along the stem, elliptical to spatulate
3. Vegetative leaf texture	chartaceous	chartaceous	chartaceous or coriaceous	membranaceous
4. Reproductive leaf texture	chartaceous	chartaceous	chartaceous or leathery	membranaceous
5. Flowers	horizontal**, white or pinkish-white;**	horizontal, reddish or yellowish	horizontal, orangish-red	pendular, yellowish-green or pinkish-green
6. Outer tepals (comparison between the upper outer tepal and the two lower outer tepals)	similar, **apex apiculate or caudate**, the upper, **obovate-spatulate,** not falcate **(4.0-4.2 × 0.9-1.0 cm**) the two lower, spatulate or obovate-spatulate, **falcate** (**3.4-3.6 ×** 0.9-1.1 cm)	similar, apex mucronate, the upper, spatulate, not falcate (4.3-4.7 **×** 0.9-1.3 cm) the two lower, spatulate, not falcate (3.3-4 **×** 0.8-1.3 cm)	similar, apex mucronate, the upper, obovate-spatulate (2.2-3.8 × 0.8-1.1 cm) the two lower, obovate-spatulate, not falcate (2.0-3.4 × 0.7-1.1 cm)	similar, apex acuminate or apiculate, the upper, elliptical to obovate (2.2-3.9 × 0.8-1.8 cm) the two lower, elliptical to obovate, not falcate (2.3-3.8 × 0.6 -1.8 cm)
7. Inner tepals (comparison between the two upper inner tepals and the lower inner tepal)	similar, **apex apiculate or caudate**, the two upper, spatulate or obovate-spatulate, **slightly falcate** (4.2-4.4 **×** 0.7-0.8 cm) the lower obovate-spatulate, **base attenuate and flat**, not falcate (**2.7-2.9 × 0.6-0.7 cm**)	similar, apex acuminate the two upper, spatulate or obovate-spatulate, not falcate (4.2-4.5 **×** 0.6-1.1 cm) the lower spatulate to obovate-spatulate, base not flat, not falcate (3.6-3.8 **×** 0.5-0.9 cm)	similar, apiculate, apex acute or acuminate, the two upper, oblong-spatulate (1.9-3.7 × 0.5-1.0 cm) the lower oblong-spatulate (3.1 × 1.2 cm)	equal, apex acuminate to apiculate, upper and lower inner tepals of the same size, spatulate (2.3-6.0 **×** 0.4-0.6 cm)
8. Pattern of macules on the outer and inner tepals	vinaceous, **irregularly rounded macules and predominance of longitudinal vinaceous veins (outer and inner tepals)**	vinaceous-spotted (outer tepals); vinaceous-spotted and variegated (inner tepals)	without spots (outer tepals); vinaceous-spotted or stained (inner tepals)	vinaceous-striped (outer and inner tepals)

Additional examined material of morphologically similar species:

Alstroemeria viridiflora

Distrito Federal

Brasília: Reserva Ecológica de Águas Emendadas, elev. 1150 m, 19/1/1983 (fl.), C. M. Maury 355 (HEPH)

Goiás

Campinaçu: Estrada para a balsa e Niquelândia, 29/1/1997 (fl.), M. C. Assis et al. 414 (CEN, SPF);

Goiânia: estrada de Goiânia para Bela Vista, 10/2/1986 (fl.), A. M. Carvalho & C. F. M. Delphim 2251 (CEPEC);

Minaçu: Estrada Minaçu-Usina, próximo à guarita, 28/1/1997 (fl., fr.), M. C. Assis et al. 368 (MBM 295898, NY 910706); No dique 2, 30/1/1997 (fl., fr.), M. C. Assis et al. 440 (CEN, SPF, UEC); Estrada para Colinas, 30/I/1997 (fl., fr.), M. C. Assis et al. 442 (CEN, SPF, UEC);

Morrinhos: Rod. para Caldas Novas, 28/1/1976 (fl), G. Hatschbach & Ramamoorthy 38160 (MBM);

Pirenópolis: Alto da Serra dos Pirineus, na base dos Três Picos, 11/12/1970 (fl.), J. A. Rizzo & A. Barbosa 5801 (SPF); Silvania: s.d. (fl.), A. H. Salles 1524 (HEPH).

Mato Grosso

Barra do Garça: Fazenda Brasil, 26/3/1997 (fl), G. F. Árbocz et al. 3633 (ESA);

Porto Estrela: Fazenda Salobrinha, 14/5/1995 (fl.), G. Hatschbach et al. 62778 (MBM);

Rio Verde (Lucas do Rio Verde): Sete Quedas, 9/2/1974 (fl.), G. Hatschbach 33966 (MBM);

Rondonópolis: Serra da Petrovina, 14/2/1975 (fl.), G. Hatschbach et al. 36158 (MBM 36060);

Mato Grosso do Sul

Caracol: em Cerrado, 10/2/1993 (fl.), G. Hatschbach et al. 58874 (MBM).

Minas Gerais

Matosinhos: A.P.A. Carste de Lagoa Santa, Fazenda Cauaia, 19/1/1996 (fl.), Brina, A.E.; Costa, L.V. s.n. (BHCB 36359).

Alstroemeria longistaminea

Bahia

Cachoeira: Vale dos rios Paraguaçu e Jacuípe, mata do rio Jacuípe, 8/1980 (fl, fr), L. Scardino et al. 574 (CEPEC; HUEFS);

Feira de Santana: Campus da UEFS, BR 116, 1/8/1986 (fl.), L. P. Queiroz 940 (CEPEC);

Ceará

Quixerê: Chapada do Apodi, Manga Grande, 03/5/2000 (fl.) Lima-Verde, L. W. et al. 801 (EAC 37955);

Paraíba

Campina Grande: na margem do caminho, na cerca, 24/6/1935 (fl.), Pickel, B. 3839 (IPA 6541);

Pernambuco

Buíque: Em Capoeira, 30/7/1955 (fl.), D. Andrade-Lima 552108 (IPA); Estrada para Catimbal, 19/6/1994 (fl.), A. M. Miranda et al. 1760 (SP);

Caruaru: Faz. Caruaru, em área aberta, 10/9/1971 (fl.), D. Andrade-Lima 716715 (IPA);

Serra Talhada: Serra da Carnaubeira, 22/5/1971 (fl.), Acad. Bras. Ciênc. 842 (IPA); 5/1971 (fl.), E. P. Heringer et al. 843 (UB);

Piauí

Guaribas: PARNA Serra das Confusões, Baixão, 14/5/2008 (fl.), Castro, A. S. F. 2059 (EAC 43560);

Sergipe

Itabaianinha: 29/8/1974 (fr.), G. Viana s.n. (UFS 51);

Nossa Senhora da Glória: Fazenda Olhos d'Água, 28/8/1997 G. Viana 1997 (ASE);

Simão Dias: Lagoa Seca, 5/7/1986 (fl.), G. Viana 1527 (UFS).

Alstroemeria plantaginea

Bahia

Piatã: Serra do Santana, 13°15'S 41°44'W, 22/9/1992 (fl), W. Ganev 1161 (SPF);

Minas Gerais

Augusto de Lima: Serra do Cabral, 20/III/1994 (fl.), C. M. Sakuragui et al. s.n. (ESA, SPF 97490);

Belo Horizonte: Serra do Curral, 20°06'00"S 43°59'34"W, 04/2000 (fl.), A. A. F. C. Tombolato 11/2000 (IAC, SPF, UEC);

Caeté: Serra da Piedade, elev. 1700 m, 24/2/1987 (fl.), D. C. Zappi et al. s.n. (SPF 46871);

Catas Altas: Serra do Caraça, Colégio do Caraça, elev. 1300 m, 15/11/1980 (fl.), R. R. Ferreira et al. 64 (VIC);

Diamantina: Mendanha: Rio Jequiti, 14/4/1973 (fl.), W. R. Anderson 8874 (SPF);

Santana do Riacho: 19°08'17"S 43°41'41"W, 5/3/1998 (fl.), M. C. Assis et al. 545 (SPF);

São Tomé das Letras: Pico do Gavião, 21/2/1999 (fl., fr.), M. C. Assis et al. 588 (SP, SPF, UEC);

São Paulo

Atibaia: Pedra Grande, 12/5/1936 (fl.), F. C. Hoehne & A. Gehrt s.n. (SP 35309, SPF); 1/10/1996, M. C. Assis & J. Dutilh 325 (SPF);

Jundiaí: Serra do Japi, 22/11/1996 (fl.), M. C. Assis et al. 329 (SPF, UEC);

Santa Rita do Passa Quatro: A.R.I.E. Cerrado Pé de Gigante, 47°34'S 21°36'W, 3/1/1996 (fl.), M. A. Batalha 831 (SPF).

Etymology

The specific epithet maranhensis is related to the place of collection: Maranhão state, in the northeastern region of Brazil. For this species, we suggest the vernacular (popular) name "white alstroemeria of Maranhão (in Portuguese: alstroeméria branca do Maranhão)", since the genus Alstroemeria in Brazil is popularly known as "alstroeméria". Despite regional variability, vernacular names are often useful in identifying and popularizing botanical species, and it is suggested that vernacular names be used for new species as well (Marinho & Scatigna 2022).

Flowering and fruiting

Alstroemeria maranhensis blooms between January and March, during the rainy season in the Cerrado of Maranhão, which runs from November to April. The flowers usually open simultaneously and last between five and seven days, at which point the tepals begin to change from a slightly pinkish-white to a reddish color, and then fall off. In the observed population, about 75% of the individuals have white and slightly pink flowers and 25% have pinkish-white flowers (Fig. 3 A-F). The fruits take between two and three months to develop and mature (Fig. 2I) and the seeds are spherical and have a surface that has rounded and flattened papillae (Fig. 2 J, K). When under cultivation, flowering occurred in June (2022).

Preliminary conservation status

Due to its restricted occurrence (< 1 hectare) and the small number of individuals found (about 30), it was not possible to obtain information on its extent of occurrence (EOO) and area of occupation (AOO). Therefore, according to the criteria established by the International Union for Conservation of Nature (IUCN 2012), *A. maranhensis* should be considered data deficient (DD). However, the vulnerability and the need to preserve this only known population, which occurs in a Cerrado area threatened by human activities, needs to be highlighted (Santos et al. 2021, Matosak et al. 2022).

Comments

In general comparison, *A. maranhensis* is highly similar to *A. viridiflora* in regards to its vegetative and reproductive stems, horizontal flowers, morphology of outer and inner tepals, and occurrence restricted to the Brazilian Cerrado (Assis 2001, Assis *et al*. 2023). The main differences between *A. maranhensis* and *A. viridiflora* are the following: reproductive stem leaves wide-elliptical (*vs*. only narrow-elliptical in *A. viridiflora*), white to slightly pinkish-white flowers (*vs*. reddish or yellowish flowers in *A. viridiflora*), falcate lower outer tepals (*vs*. not falcate in *A. viridiflora*), and lower outer tepals smaller (4-4.2 × 0.9-1.0 cm) than those of *A. viridiflora* (4.3-4.7 × 0.9-1.3 cm) (Tab. 1). The upper outer tepal of *A. maranhensis* is about 32% longer (4-4.2 cm long) than its lower inner tepal (2.7-2.9 cm long). In *A. viridiflora* something similar occurs, but the upper outer tepal is about 16% longer (4.3-4.7 cm long) than the lower inner tepal (3.6-3.8 cm long). In addition, another difference between these two species is that, in *A. maranhensis,* the adaxial and abaxial surfaces of the leaves of the reproductive and vegetative stems are always glabrous; whereas, in *A. viridiflora*, they can be glabrous or slightly pilose (Assis *et al*. 2023). *A. maranhensis* also has a reproductive stem that is similar to that of *A. longistaminea*, but the flowers of the latter are orangish-red (*vs*. white to slightly pinkish-white in *A. maranhensis*). The floral morphology of *A. maranhensis* is also similar to that of *A. plantaginea*; however, the flowers of the latter are pendant, greenish-yellow to pinkish-green (*vs*. horizontal and white to slightly pinkish-white in *A. maranhensis*) (Tab. 1).

In the same region in which *Alstroemeria maranhensis* was found, we also observed *A. amazonica*, a species typical of Amazonian areas (Flora e Funga do Brasil 2023), though which is very distinct from *A. maranhensis* due to the presence of red flowers and leaves of the reproductive step being concentrated at the apex (Assis 2001; Assis *et al*. 2023). This region of coexistence of *A. maranhensis* and *A. amazonica* is situated in a transition to Cerrado, which reinforces the fact that in Maranhão there are ecotonal areas between the Amazonia and Cerrado domains.

After flowering between January and March (rainy season), *Alstroemeria maranhensis* bears fruit in about 60% of individuals, at the same time that the leaves of the vegetative stem begin to turn yellow. After flowering and fruiting, the vegetative and reproductive stems disappear, leaving only the underground part, i.e., the rhizome and the fleshy nutrient-storing roots (Fig. 2C). This survival strategy is related to the fact that this region of the Cerrado of Maranhão has a dry season between July and December. In the following rainy season, first, the vegetative stem emerges from the soil and then the reproductive stem emerges. Although it develops upright, over time, the action of wind and gravity often cause the vegetative stem to lean and occasionally touch the ground or surrounding vegetation. The reproductive stem can also present this behavior, mainly due to the weight of the fruits. The leaves of the vegetative and reproductive stems are of different sizes and are arranged alternately and spirally along the stem, increasing the incidence of sunlight on the leaf blades and decreasing the shading of the upper leaves on the lower leaves (Fig. 2B). It was common to observe herbivory in the leaves of the vegetative and reproductive stems and, in some individuals, they had been consumed. This characteristic of the leaves being palatable to herbivores is one of the factors that possibly hinder the storage and preservation of *Alstroemeria* specimens in herbaria (Assis 2001).

Recent studies have shown the floristic potential in Maranhão, though there is also a lack of botanical studies. These studies cite new species (Scatigna *et al*. 2019; Guarçoni

et al. 2020b; Santos *et al*. 2020) and new records for the flora of Maranhão (Ferreira *et al*. 2017; Ferreira *et al*. 2018; Guarçoni *et al*. 2018; Ferreira *et al*. 2019a, 2019b; 2019c; Salazar-Ferreira *et al*. 2020; Silva *et al*. 2020; Silva Junior *et al*. 2020; Guarçoni *et al*. 2020a; Gomes *et al*. 2021; Oliveira *et al*. 2021; Pessoa *et al*. 2022; Silva *et al*. 2022). This new species of *Alstroemeria* is further evidence that we need to increase our efforts in floristic studies in Maranhão. Basic taxonomic investigations, which include filling sampling gaps, are urgent and essential to provide information for environmental preservation policies in the Brazilian Cerrado areas that have been suppressed by human activities (Santos *et al*. 2021, Matosak *et al*. 2022).

Identification key to Alstroemeria maranhensis and morphologically similar species.

1. Leaves of the vegetative stem concentrated in the distal third – 2

1'. Leaves of the vegetative stem distributed along its entire length – 3

2. Flowers horizontal, orangish-red; outer tepals without spots, obovate-spatulate, apex mucronate; inner tepals vinaceous-spotted or stained, oblong-spatulate, apiculate, apex acute or acuminate – *A. plantaginea*

2'. Flowers pendant, yellowish-green or pinkish-green; outer tepals vinaceous-striped, elliptical to obovate, apex acuminate or apiculate; inner tepals vinaceous-striped, spatulate, apex acuminate to apiculate – *A. longistaminea*

3. Leaves of the reproductive stem only narrow-elliptical; flowers horizontal, reddish, pink or yellowish; outer tepals vinaceous-spotted, spatulate and not falcate, apex mucronate; inner tepals vinaceous-spotted and variegated, spatulate or obovate-spatulate and not falcate, apex acuminate – *A. viridiflora*

3'. Leaves of the reproductive stem wide-elliptical; flowers horizontal, white or pinkish-white; outer tepals with irregular rounded vinaceous macules and predominance of longitudinal vinaceous veins, spatulate or obovate-spatulate, falcate (the two lower outer tepals), apex apiculate or caudate; inner tepals with irregularly rounded vinaceous macules and predominance of longitudinal vinaceous veins, spatulate or obovate-spatulate (two upper slightly falcate and the lower, obovate-spatulate, base attenuate and flat, not falcate); apex apiculate or caudate – *A. maranhensis*

Acknowledgments

The authors thank the Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão (FAPEMA) (Universal Call, processes 00430/2015 and 01312/2019), the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (Universal Call, process 402943/2021-0) and Fundação Amazônia de Amparo a Estudos e Pesquisas (FAPESPA/MPEG/FADESP) (Training of Human Resources for the Development of Science in the Amazon) for granting the scholarship to one of us (M.S. Oliveira). We also thank the curators and collaborators of the herbaria who helped by providing access to their collections. We are also grateful to the owner of the Recanto das Águias farm, Aleandro Gonçalves Passarinho, for granting us permission to conduct research on his property, to the reviewer of the text in English and to the reviewers of the text and the editor for their suggestions and corrections.

Authors' Contributions

AWCF: contributed writing (original draft), supervision and project administration; WRSJ: contributed writing (review & editing) and investigation; MJCS: contributed writing (review & editing) and investigation; MSO: contributed Writing (review & editing) and investigation; MCA: contributed Writing (review & editing) and Supervision.

Conflict of Interest

We declare that there are no conflicts of interest (personal, scientific, commercial, political, or financial) in this manuscript.

References

Assis MC. 2001. *Alstroemeria* L. (Alstroemeriaceae) do Brasil. PhD Thesis, Universidade de São Paulo, Brazil.

Assis MC. 2002. Novas espécies de *Alstroemeria* L. (Alstroemeriaceae) de Minas Gerais, Brasil. Revista Brasileira de Botânica 25: 177-182. doi: 10.1590/s0100-84042002000200006 .

Assis MC. 2003. Duas novas espécies de *Alstroemeria* L. (Alstroemeriaceae) para o Brasil. Acta Botanica Brasilica 17: 179-182. doi: 10.1590/S0102-33062003000200002.

Assis MC. 2004a. Alstroemeriaceae no estado do Rio de Janeiro. Rodriguésia 55: 5-15.

Assis MC. 2004b. New species of *Alstroemeria* L. (Alstroemeriaceae) from Brazilian savannas. Novon 14: 17-19.

Assis MC. 2006. A new species of *Alstroemeria* (Alstroemeriaceae) from Pará, Brazil. Brittonia 58: 267-269.

Assis MC. 2007. Flora do Estado de Goiás e Tocantins – Coleção Rizzo: Alstroemeriaceae. Vol XXXVI.. Goiânia, Universidade Federal de Goiás.

Assis MC. 2009a. A new species of *Alstroemeria* (Alstroemeriaceae) from Brazil. Novon 19: 145-149. doi: 10.3417/2007073.

Assis MC. 2009b. Alstroemeriaceae. In: Giulietti AM, Rapini A, Andrade MJG, Queiroz LP, Silva JMC (eds.). Plantas raras do Brasil. Belo Horizonte, Conservation International. p. 47.

Assis MC, Mello-Silva R. 2002. Flora da Serra do Cipó, Minas Gerais: Alstroemeriaceae. Boletim de Botânica Universidade de São Paulo 20: 49-52. doi: 10.11606/issn.2316-9052.v20i0p49-52.

Assis MC, Moraes L, Kutschenko D, Serrano T. 2014. Alstroemeriaceae In: Martinelli G, Messina T, Santos Filho L (eds.). Livro Vermelho da Flora do Brasil – Plantas Raras do Cerrado. Rio de Janeiro, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, CNCFlora. p. 46.

Assis M C, Mello-Silva R. 2016. *Alstroemeria* (Alstroemeriaceae) in the caatinga of Brazil, with a new species. Phytotaxa 282: 19-27.

Assis MC, Prange CK, Lopes JC, Mello-Silva R. 2023. *Alstroemeriaceae*. https://floradobrasil.jbrj.gov.br/FB4277/. 18 Apr. 2023.

Baker JG. 1877. On the Brazilian species of *Alstroemeria*. Journal of Botany 15: 259-287.

Baker JG. 1888. Handbook of Amaryllidaceae. London, George Bells & Sons.

Brummitt RK, Powell CE. 1992. Authors of plant names. A list of authors of scientific names of plants, with recommended standard form of their names including abbreviations. Kew, Royal Botanic Gardens. https://www.tdwg.org/standards/plant-names-authors/

Ferreira AWC, Oliveira MS, Silva EO, Campos DS, Pansarin ER, Guarçoni EAE. 2017. *Vanilla bahiana* Hoehne and *Vanilla pompona* Schiede (Orchidaceae, Vanilloideae): Two new records from Maranhão state, Brazil. Check List 13: 1131-1137. doi: 10.15560/13.6.1131. 13 Apr. 2023.

Ferreira AWC, Calió MF, Silva Junior WR *et al*. 2018. First record of *Voyria caerulea* Aubl. (Gentianaceae), a mycoheterotrophic plant, in Maranhão state, northeastern Brazil. Check List 14: 833-837. doi: 10.15560/14.5.833.

Ferreira AWC, Oliveira MS, Silva Junior WR *et al*. 2019a. New occurrences of small aquatic duckweeds (Araceae, Lemnoideae) in Maranhão state, northeastern Brazil. Check List 15: 1153-1160. doi: 10.15560/15.6.1153.

Ferreira AWC, Oliveira MS, Engels ME, Pessoa E. 2019b. Found in Brazil again! Expanding the distribution of *Maxillaria aureoglobula* Christenson (Orchidaceae, Maxillariinae) and a key to the species of *Maxillaria* sect. *Rufescens* Christenson from Brazil. Check List 15: 1107-1112. doi: 10.15560/15.6.1107.

Ferreira AWC, Lima GP, Silva MJC, Almeida Junior EB. 2019c. Geographic range extension of *Rapatea paludosa* Aubl. (Rapateaceae) to Maranhão state, northeastern Brazil. Check List 15: 921. doi: 10.15560/15.5.911.

Fidalgo O, Bononi VLR. 1984. Técnicas de coleta, preservação e herborização de material botânico. São Paulo, Instituto de Botânica.

Flora e Funga do Brasil. 2023. Programa REFLORA. http://floradobrasil.jbrj.gov.br/. 13 Apr. 2023.

Gomes GS, Ferreira AWC, Silva MJC, Conceição GM, Pessoa EM. 2021. Taxonomic study of *Epidendrum* L. (Laeliinae-Orchidaceae) in the state of Maranhão, Northeastern Brazil. Rodriguésia 72: e01492020.

Guarçoni EAE, Costa AF, Silva EO, Ferreira AWC, Oliveira MS. 2018. New records of *Tillandsia* L. (Bromeliaceae, Tillandsioideae) for Maranhão state, Brazil. Check List 14: 951-959. doi: 10.15560/14.6.951.

Guarçoni EAE, Sousa JDS, Ferreira AWC, Silva Junior WR, Oliveira MS, Silva EO. 2020a. New occurrence records of Bromeliaceae for the state of Maranhão, northeastern Brazil. Check List 16: 1575-1580. doi: 10.15560/16.6.1575.

Guarçoni EAE, Saraiva RVC, Ferraz TM. 2020b. *Dyckia maranhensis* (Bromeliaceae, Pitcairnioideae), A new species from the Cerrado of Maranhão, northeastern Brazil. Systematic Botany 45: 47-52. doi: 10.1600/036364420X15801369352289.

IBAMA – Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis. 2013. Plano operativo de prevenção e combate aos incêndios florestais do Parque Nacional da Chapada das Mesas. http://www.ibama.gov.br/phocadownload/prevfogo/planos_operativos/plano_operativo_parna_da_chapada_das_ mesas.pdf. 18 Apr. 2023.

IBGE – Instituto Brasileiro de Geografia e Estatística. 2022. Cidades e Estados. https://www.ibge.gov.br/cidades-e-estados/ma.html. 12 May 2023.

IUCN – International Union for Conservation of Nature. 2012. Red List categories and criteria. Version 3.1. 2nd edition. https://www.iucnredlist.org/. 18 Apr. 2023.

Marinho LC, Scatigna AV. 2022. A good practice: Why we should suggest vernacular names for new plant species. Bionomina 31: 109-114. doi: 10.11646/bionomina.31.1.7.

Matosak BM, Fonseca LMG, Taquary EC, Maretto RV, Bendini HDN, Adami M. 2022. Mapping deforestation in Cerrado based on hybrid deep learning architecture and medium spatial resolution satellite time series. Remote Sensing 14: 209. doi: 10.3390/rs14010209.

Oliveira MS, Ferreira AWC, Oliveira HC, Pessoa E. 2021. Orchids in the central region of eastern Maranhão, Brazil. Rodriguésia 72: e02582019. doi: 10.1590/2175-7860202172057.

Pessoa E, Silva MJC, Oliveira MS, Silva Junior WR, Ferreira AWC. 2022. An updated checklist reveals strong incongruences with previous studies: Insights after revisiting a regional orchid list. Acta Botanica Brasilica 36: e2020abb0487.

QGIS Development Team. 2020. QGIS Geographic Information System. http://qgis.osgeo.org/. 18 Apr. 2023.

Ravenna P. 2000. New or interesting Alstroemeriaceae-I. Onira 4: 33-46.

Santos D, Saraiva RVC, Ferraz TM, Arruda ECP, Buril MT. 2020. A threatened new species of *Ipomoea* (Convolvulaceae) from the Brazilian Cerrado revealed by morpho-anatomical analysis. PhytoKeys 151: 93-106. doi: 10.3897/phytokeys.151.49833.

Santos GL, Pereira MG, Delgado RC *et al*. 2021. Degradation of the Brazilian Cerrado: Interactions with human disturbance and environmental variables. Forest Ecology and Management 482: 118875.

Salazar-Ferreira M, Gonella PM, Guarçoni EAE. 2020. New records of *Utricularia* (Lentibulariaceae) for the state of Maranhão, Brazil. Check List 16: 121-125. doi: 10.15560/16.1.121.

Saraiva RVC, Leonel LV, Reis FF *et al*. 2020. Cerrado physiognomies in Chapada das Mesas National Park (Maranhão, Brazil) revealed by patterns of floristic similarity and relationships in a transition zone. Anais da Academia Brasileira de Ciências 92: e20181109. doi: 10.1590/0001-3765202020181109.

Scatigna AV, Brandão CM, Colletta GD *et al*. 2019. *Dizygostemon riparius* (Plantaginaceae, Gratioleae), A new species from Maranhão, northeastern Brazil. Willdenowia 49: 177-186. doi: 10.3372/wi.49.49206.

Schenk A. 1855. Alstroemerieae. In: Martius CFP, Eichler AW (eds.). Flora Brasilica. New York, Verlag von J. Cramer. Vol. III (Part 1). p. 166-180.

Silva EO, Azevedo MAM, Ferreira AWC, Sobral MEG. 2020. Rediscovery and new records of *Passiflora auriculata* Kunth and *P. cisnana* Harms (Passifloraceae) in Brazil. Check List 16: 441-450. doi: 10.15560/16.2.441

Silva Junior WR, Ferreira AWC, Ilkiu-Borges AL, Fernandes RS. 2020. Ferns and lycophytes of remnants in Amazônia Maranhense, Brazil. Biota Neotropica 20: e20200972. doi: 10.1590/1676-0611-bn-2020-0972

Silva MJC, Pansarin ER, Pessoa E *et al*. 2022. Synopsis of Orchidaceae from Fazenda Sete Irmãos: A fragment of Amazon Forest in Northwestern Maranhão, Brazil. Rodriguésia 73: e02172020.

SpeciesLink. 2023. Electronic database. https://specieslink.net/. 18 Apr. 2023.

Spinelli-Araujo L, Bayma-Silva G, Torresan FE, Victoria D, Vicente LE, Bolfe EL, Manzatto C. 2016. Conservação da Biodiversidade do Estado do Maranhão: cenário atual em dados geoespaciais. Jaguariúna, Embrapa Meio Ambiente.

Tropicos. 2023. Missouri Botanical Garden. https://tropicos.org/. 18 Apr. 2023.

Thiers B. 2023. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.rg/science/ih/. 18 Apr. 2023.

Warming E. 1872. Symbolae ad floram Brasiliae Centralis cognescendam (*Alstroemeria viridiflora*: part XIII: 118-119). In: Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn. Part XIII. p. 109-131.