

## Confirmed record of *Bacopa sessiliflora* (Benth.) Edwall (Plantaginaceae) in the Brazilian Cerrado

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**Abstract.** *Bacopa sessiliflora* (Benth.) Edwall (Plantaginaceae) is an aquatic herb that inhabits the banks of watercourses in the Neotropics. In this study, we confirmed the occurrence of the species in the Cerrado following a field collection on the banks of the Preto River, in eastern Maranhão state, Brazil, and the study of herbarium materials. A morphological description, illustrations, phenological data, and a distribution map of *B. sessiliflora* are provided. The new data highlight the importance of permanent protected areas, especially riverbanks, as crucial habitats for increasing our understanding of plant biodiversity in Maranhão.

**Key words.** Gratioleae, Lamiales, Maranhão, riparian vegetation, taxonomy

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### INTRODUCTION

*Bacopa* Aubl. (Plantaginaceae) is the largest genus of the tribe Gratioleae (Souza and Giulietti 2009), comprising approximately 60 species distributed predominantly in the tropical and subtropical regions, especially in the New World (Tippary et al. 2024). The greatest species richness is found in the wetlands of South America (~70% of the diversity), but *Bacopa* is also well represented in Africa and North America (Scatigna et al. 2022; Tippary et al. 2024). There are 29 species in Brazil, eight of which are endemic to the country (Souza 2020). In Maranhão, 14 species are cited in the literature (Souza et al. 2020; Pestana et al. 2023).

The genus *Bacopa* shows great variation in the habit and life form of its species (Gonzalez-Socoloske et al. 2020), covering a variety of humid environments, from palustrine (amphibious plants) and fully aquatic (emergent, submerged, and floating plants) (Souza and Giulietti 2009; Scatigna et al. 2022; Pestana et al. 2023). The main diagnostic characteristics for identifying *Bacopa* include a calyx composed of three wider outer sepals, surrounding two narrower inner sepals; sepals that are generally subequal, rarely equal to subequal; and anthers with parallel or convergent, contiguous thecae (Pennell 1946; Souza and Giulietti 2009). However, these characteristics, although distinctive, are not synapomorphies of *Bacopa* (Scatigna et al. 2022). The only morphological synapomorphy of the genus is the presence of anthers with parallel or convergent thecae; that is, the anthers are not separated by the arms of the connective (Scatigna et al. 2022).

*Bacopa sessiliflora* (Benth.) Edwall is a common species in the Neotropics, occurring in Central America (Belize, Costa Rica, Cuba, Guatemala, Honduras, Jamaica, Nicaragua, and Panama), North America (Mexico and Dominican Republic), and South America (Brazil, Colombia, Ecuador, Guyana, French Guiana, Trinidad and Tobago, Suriname, and Venezuela) (POWO 2024). In Brazil, the species is currently reported in the Amazon and Caatinga biomes (*sensu* IBGE 2019; Flora e Funga do Brasil 2024). However, recent fieldwork resulted in the collection of the species within the boundaries of the Cerrado biome (*sensu* IBGE 2019). In this context, we confirm the first record of *Bacopa sessiliflora* in the Brazilian Cerrado, including a morphological description, phenological and habitat data, a distribution map, and illustrations of the species. In addition, we discuss the importance of preserving the Brazilian Cerrado, highlighting the need for additional



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studies, especially in Permanent Preservation Areas (PPAs), such as riparian forests and other watercourses, which are often neglected in floristic studies.

## METHODS

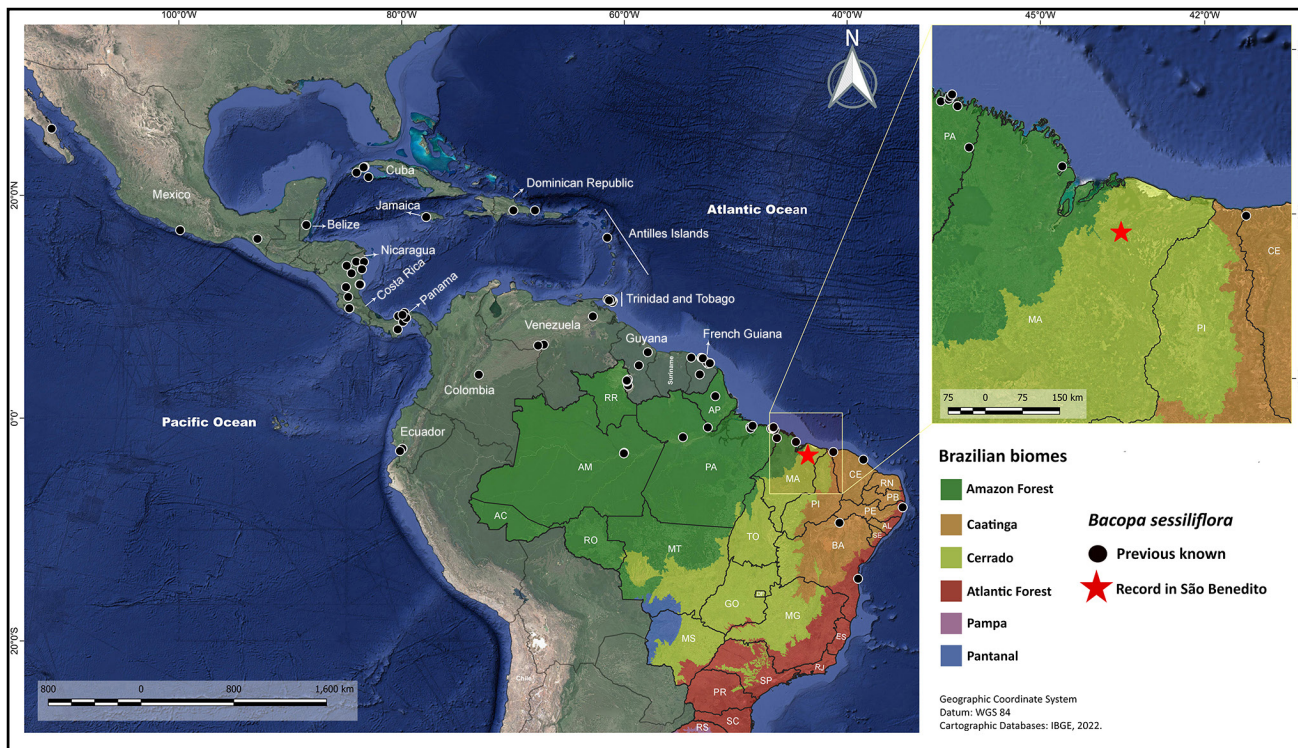
The specimen of *Bacopa sessiliflora* used in the present study was collected during a field expedition in January 2024 along the banks of the Preto River, São Benedito do Rio Preto municipality, state of Maranhão, Brazil (Figure 1F). The botanical material was herborized following the methods of Fidalgo and Bononi (1989) and identified based on the taxonomic treatment of *Bacopa* for Brazil by Souza (2020), as well as consulting specialized literature (Pennell 1946; Souza and Giulietti 2009). Vouchers of the collected samples were deposited at Centro de Ciências Agrárias e Ambientais herbarium (CCAA), at the Federal University of Maranhão, Chapadinha, Brazil.

The description provided here is based on the specimen collected. The morphological terminology used in the species description follows Souza and Giulietti (2009). Data on the species distribution was obtained from the GBIF (2024), Flora e Funga do Brasil (2024), and SpeciesLink (CRIA 2024) databases, from which we extracted the georeferenced records to produce the species' occurrence map (see supplementary material), prepared using QGIS v. 3.34.3 (Qgis Development Team 2023; Figure 2). For the illustration of the species, samples were preserved in 70% alcohol and examined with a stereomicroscope (Figure 3). Phenological and habitat data was obtained through field observations and supplemented with information on the labels of the samples consulted on the mentioned platforms.

The general characterization of the Cerrado followed Ribeiro and Walter (2008), a regional classification whose phytophysionomies of this biome can be described in grassland, savanna, and forest formations. In this classification, the phytophysionomy of the riparian forest is inserted in the forest formations of the Cerrado biome (Ribeiro and Walter 2008; IBGE 2019), within an ecotone of savanna and seasonal tropical forest (IBGE 2012).

**Figure 1.** *Bacopa sessiliflora*. **A.** Habit. **B.** Glandular punctuations on the leaf blade. **C.** Branch. **D.** Axillary flower in lateral view. **E.** Roots. **F.** Habitat.





**Figure 2.** Global distribution map of *Bacopa sessiliflora*. Black circles = previous known records; red star = record in São Benedito. Map preparation: Rafael F. Oliveira.

## RESULTS

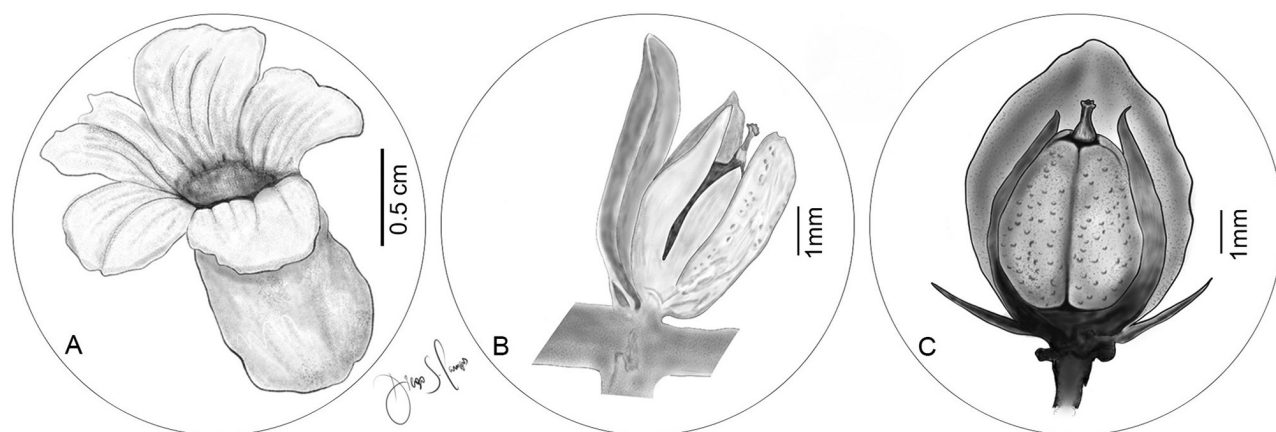
***Bacopa sessiliflora* (Benth.) Edwall**, Bol. Commiss. Geogr. Estado de São Paulo 13: 175. (Edwall 1897).  
 Basionym: *Herpestis sessiliflora* Benth., Compan. Bot. Mag. 2: 58. (Bentham 1836).  
 Figures 1–3

**Examined material.** BRAZIL – MARANHÃO • Município de São Benedito do Rio Preto, Margem do Rio Preto; 03°20'19"S, 043°31'34"W; 13 m elev.; 13.I.2024; M. Pestana, N. Durval & A. Barroso 58 leg.; CCAA 4436.

**Identification.** Herbs, 9.5–24 cm tall, amphibious. **Roots** 4 cm long, fibrous, unbranched. **Stem** erect, glabrous, branched, quadrangular, rigid; internodes 0.5–3.5 cm. **Leaves** 1.2–3.9 × 0.3–0.6 cm, opposite, sessile, oblanceolate, base attenuated, semiamplexicaule, apex acute, margin serrate, glabrous, both sides with small brownish punctate glands; midvein adaxially canaliculate, abaxially conspicuous. **Flowers** small, inserted in the floral axils, 2 per axil, opposite, sessile, rare subsessile; the pedicel ca. 1 mm long in fruit; bracteoles 2, ca. 1.5 mm, opposite, linear to lanceolate, apex acute, inserted at the base of the calyx. **Calyx** green, glabrous, glandular-punctate; external sepals 3.4–4.8 × 0.15–0.25 mm, obovate, apex rounded or acute; internal sepals 2.1–2.6 × 0.5–0.8, lanceolate, apex acute, slightly shorter than the external sepals. **Corolla** zygomorphic, white, pentamerous; tube glabrous, glandular-punctate and pale yellow externally, ca. 1 cm; stamens 4, filet cylindrical, inserted in the center of the tube; anthers yellow, round; stigma plane, broad, recurved; stigma ca. 1 mm, eglandular, slightly bilobed; ovary 1.3 mm long, glandular-punctate. **Capsule** globose, 2.4–2.7 × 2.2–1.8 mm, apex obtuse, dark, tegument rigid; seeds numerous, ca. 0.3 mm, dark brown.

**Comments.** *Bacopa sessiliflora* is characterized by its herbaceous habit, quadrangular and glabrous branches, leaves with numerous glandular dots on each surface, and serrated margins in the upper half of the blade; the corolla is pentamerous, the flowers axillary, predominantly sessile, white, and with four stamens; the calyx is green, surrounded by two external sepals and two internal sepals, each unequal (Souza and Giulietti 2009). Souza (2020) notes that *B. sessiliflora* shares morphological similarities with *Bacopa imbricata* (Benth.) Pennell, differing primarily in the arrangement of flowers on the stems. In *B. sessiliflora*, the flowers are more spaced, contrasting with *B. imbricata*, where they are closer together, giving them a congested appearance.

In addition to the record in São Benedito do Rio Preto, we noted a previous collection identified as *B. sessiliflora* in the Cerrado of Maranhão (*N. Mota* 2782; RB 759845), from the municipality of Primeira Cruz, approximately 170 km from our collection at São Benedito do Rio Preto. However, although the RB 759845 record was identified as *B. sessiliflora* by a specialist, its duplicate housed in the UEC herbarium



**Figure 3.** *Bacopa sessiliflora* **A.** Corolla. **B.** Calyx. **C.** Fruit. Drawing: Diego S. Campos.

under number 207760, also identified by a specialist in the group, is annotated as *Bacopa angulata* (Benth) Edwall. In fact, when checking the field observations on the labels of these records, the specimens are annotated as having a pink corolla with a white fauces, which corresponds to *B. angulata* as opposed to *B. sessiliflora*, which has a totally white corolla.

Other factors that suggest the identification of the sample as *B. angulata* refer to some morphological characters observed in RB 759845, for example, the presence of winged branches, leaves with a linear shape, and a long pedicel (>0.3 cm) on the fruits, which is in line with the description of this species in Souza (2020). Moreover, *B. angulata* shows a preference for seasonal lakes on the coast of Maranhão, being frequently documented on beaches on the eastern coast of the state and occasionally recorded on the western coast, where it was categorized as an annual plant (Guterres et al. 2019; CRIA 2024). In the region where *B. sessiliflora* was found, *B. angulata* is not a common species, being recorded only in neighboring municipalities, where it occurs is amphibious or emergent in seasonal flooded open fields (Pestana et al. 2024; CRIA 2024).

**Phenology.** In São Benedito do Rio Preto, was collected with flowers and fruits in January. In other localities, there are collections records from February to November.

**Vernacular name.** In some regions of Brazil it is known as “pataqueira” (Souza and Giulietti 2009).

## DISCUSSION

The biomes of Maranhão may present transitional aspects due to its border positioning between two large biomes, the Cerrado and the Amazon (Saraiva et al. 2020). Under these conditions, it is common for heterogeneous environments to occur in terms of abiotic and biotic environmental filters; there is the presence of low altitudes where biogeographical barriers in the distribution of species can be overcome and there can be greater exchanges between elements of adjacent vegetation. In fact, results from floristic research have filled in gaps regarding the geographic distribution of species in the biomes of Maranhão (Saraiva et al. 2020; Pestana et al. 2022, 2024; Oliveira et al. 2022).

In the state of Maranhão, *Bacopa sessiliflora* is found in the Restinga areas of the Amazon and in the Cerrado of eastern Maranhão, predominantly inhabiting riverbanks and watercourses, at 17–63 m a.s.l.. In São Benedito do Rio Preto, *B. sessiliflora* occurs along the banks of the Preto River, growing in flooded sandy soils in the phytophysognomy of riparian forest, in the portion of the herbaceous-shrub stratum. The expansion of the geographic distribution of *B. sessiliflora*, including occurrence in the Cerrado of Maranhão in riparian forests, emphasizes that these forest physiognomies close to river courses have an important role as corridors, connecting Amazonian vegetation to these Cerrado physiognomies (Oliveira-Filho and Ratter 1995).

In addition to their botanical peculiarities, riparian forests provide fundamental ecosystem services for the conservation of life, maintaining hydrological cycles through ecosystem-support functions (Suzuki et al. 2022). Moreover, these areas play an important role in reducing impacts on aquatic biota and are directly related to the quality of water for human and animal use (Lima and Zakia 2009). According to the new Brazilian Forestry Code, marginal zones of all perennial and intermittent watercourses, excluding ephemeral ones, are designated as Permanent Preservation Areas (PPAs) from the edge of the channel of the regular riverbed (Brasil 2012). This classification gives legal and environmental importance to the areas where *B. sessiliflora* is found. Despite their designation as PPAs, most of these areas in Brazil often do not receive the necessary attention in botanical studies.

Efforts to understand the plant biodiversity of these regions are limited, as floristic and taxonomic studies are predominantly focused on state or national parks (e.g. Athiê-Souza et al. 2018; Araújo et al. 2020; Hammes et al. 2021; Santos et al. 2021). The scarcity of studies on PPAs not only represents a deficit in scientific knowledge but also increases the risk of underestimating the importance and vulnerability of these environments, especially in the Brazilian Cerrado, considered the cradle of Brazil's waters (Padovesi-Fonseca et al. 2015; Latrubesse et al. 2019) and historically neglected in terms of actions aimed at its preservation (Bastos et al. 2023).

To emphasize the importance of these studies, we note that *B. sessiliflora* coexists with a recently described species, *Dizygostemon riparius* Scatigna & Colletta, which was also collected on the banks of the Rio Preto in São Benedito do Rio Preto (Scatigna et al. 2019), close to where *B. sessiliflora* was collected. This highlights the importance of studies and field collections in the Permanent Preservation Areas of the Cerrado. These efforts are essential for advancing our understanding and conservation of plant biodiversity in these regions.

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## ADDITIONAL INFORMATION

### Conflict of interest

The authors declare that no competing interests exist.

### Ethical statement


No ethical statement is reported.

### Author contributions

Conceptualization: MCAP, CNDD, AMB. Data curation: MCAP, MCCB, VFF. Investigation: MCAP, AMB, CNDD, NPFA, MCCB. Methodology: MCAP, RFO, MCCB. Resources: MCAP, RFO, CNDD, AMB, NPFA, MCCB, VFF, DSC, RVCS. Supervision: RVCS. Visualization: MCAP, RFO, DSC. Writing – original draft: MCAP, RFO, CNDD, AMB, NPFA, MCCB, VFF, DSC, RVCS. Writing – review and editing: MCAP, RFO, CNDD, AMB, NPFA, RVCS.

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### Data availability

Geographic coordinates of *Bacopa sessiliflora* utilized in this study are available in figshare (<https://doi.org/10.6084/m9.figshare.25139195>).

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