



Stachytarpheta lajedicola (Verbenaceae), a new species from the Caatinga of Minas Gerais state, Brazil: the first report of the genus in limestone outcrops

Pedro Henrique Cardoso^{1*} , Gabriel Barros da Silva² , Pablo Hendrigo Alves de Melo³ ,
Luiz Menini Neto⁴  and Marcelo Trovó⁵ 

Received: March 06, 2023
Accepted: July 27, 2023

ABSTRACT

Stachytarpheta is one of the largest genera of Verbenaceae, found mainly in the *campos rupestres* of Brazil. We describe a new species, *Stachytarpheta lajedicola*, and report for the first time the occurrence of the genus in limestone outcrops. The new species is endemic to the Caatinga domain, northern Minas Gerais state, growing in an open karst formation of the municipality of Matias Cardoso, locally known as *Lajedão*. Its main diagnostic characteristics are the branches with well-developed longitudinal edges, leaves with attenuate to caudate apex, and inflorescences with linear bracts, exceeding the calyx in length. We provide a detailed description, illustrations, photographs, a geographic occurrence map, and comparisons with the morphologically similar species. *Stachytarpheta lajedicola* may be considered Critically Endangered (CR), and the biological importance of *Lajedão* and the conservation of the new species are discussed.

Keywords: conservation, Duranteae, endemism, gervão, karst.

¹ Universidade Federal do Rio de Janeiro, Programa de Pós-graduação em Ciências Biológicas (Botânica), Museu Nacional, Departamento de Botânica, Quinta da Boa Vista, 20940-040, Rio de Janeiro, RJ, Brazil.

² Universidade Estadual de Feira de Santana, Departamento de Ciências Biológicas, Programa de Pós-Graduação em Botânica, 44036-900, Feira de Santana, BA, Brazil.

³ Instituto Federal de Educação, Ciência e Tecnologia de Minas Gerais. Campus Avançado Piumhi, Piumhi, MG, Brazil.

⁴ Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas, Departamento de Botânica, Herbário Leopoldo Krieger, 36036-900, Juiz de Fora, MG, Brazil.

⁵ Universidade Federal do Rio de Janeiro, Departamento de Botânica, Av. Carlos Chagas Filho 373, Cidade Universitária, 21941-590, Rio de Janeiro, RJ, Brazil.

* Corresponding author: pedro.cardoso@ecologia.ufjf.br

Introduction

Stachytarpheta Vahl is a monophyletic genus recognized within Verbenaceae by the terminal inflorescences, androecium with two fertile stamens and two staminodes, capitate stigma, pollen with verrucose exine, and fruit divided into two cluses (Atkins 2005; Marx *et al.* 2010; O’Leary *et al.* 2012). The genus is the largest within the tribe Duranteae, with ca. 120 species distributed in the Neotropical Region (Cardoso *et al.* 2021). *Stachytarpheta* species are popularly known as “Gervão”, “Gervão-Roxo”, “Bluetop”, “Snake Weed”, “Rattail”, “Blue Snake Weed”, and “Bastard Vervain” (Munir 1992; Atkins 2005).

The distribution of *Stachytarpheta* species is more similar to *Lippia* L. (Lantaneae) than to the other four genera of Duranteae. The Neotropical genera *Bouchea* Cham., *Duranta* L., and *Recordia* Moldenke are centered in humid forests, while *Chascanum* E.Mey. is endemic to the Old World (Marx *et al.* 2010). *Lippia* and *Stachytarpheta* have diversified in the South American Dry Diagonal, mainly in the Cerrado domain (Marx *et al.* 2010; Salimena *et al.* 2020; Cardoso *et al.* 2021). Both are important components of the Brazilian flora, and their species are notably well-represented in *campos rupestres* (rocky outcrops) and *cerrados* (savannas), especially in the Espinhaço Range, states of Bahia and Minas Gerais (Atkins 2005; Cardoso & Salimena 2020; Salimena & Cardoso 2020).

During the ongoing taxonomic work on the Brazilian *Stachytarpheta*, while examining several herbarium collections, a new species was discovered in limestone outcrops of the Caatinga domain. It is here described, illustrated, and compared with its morphologically most similar congeners. The Caatinga is exclusive to Brazil, with an original area of 863,752 km², and is one of the world’s largest and most biodiverse tropical drylands; however, its biological richness has been neglected (Albuquerque *et al.* 2012; de Queiroz *et al.* 2017; Silva *et al.* 2017; Araújo *et al.* 2022). Furthermore, Bystriakova *et al.* (2019) emphasize the need for further studies documenting the plant diversity on limestone outcrops in South America, considering the vulnerability of karst vegetation to threats such as mining and climate change. In this context, the discovery of the new *Stachytarpheta* species expands our knowledge of plant diversity in limestone outcrops, as no species of the genus had been documented in this type of environment (Atkins 2005; Cardoso & Salimena 2020), while also highlighting the floristic importance of the heterogeneous, rich, and interesting Brazilian Caatinga (Leal *et al.* 2005; Albuquerque *et al.* 2012; Araújo *et al.* 2022)

Materials and methods

The new species was discovered based on the examination of dried specimens deposited at CESJ, HUEFS, and HRCB

herbaria, analysis of the relevant taxonomic literature, and comparisons with morphologically similar species. Its circumscription followed the morphological species concept (Cronquist 1978; Zachos 2016). For comparisons between similar species, we examined several *Stachytarpheta* specimens housed at BHCB, CEN, CESJ, HUEFS, R, RB, SP, SPF, and UB herbaria, as well as high-quality digital images available online in the databases of REFLORA (reflora.jbrj.gov.br/) *speciesLink* (<https://www.splink.org.br/>), and JSTOR Global Plants (<https://plants.jstor.org/>). Acronyms of the herbaria follow Thiers (2023, continuously updated). Verbenaceae species found in the same area as the new species were identified through specialized literature (Moroni & O’Leary 2019; Salimena & Cardoso 2020) and consultation with an expert taxonomist (F. Salimena).

Morphological characters were examined by careful observation of the specimens with the help of a stereomicroscope. The descriptive terminology follows Harris and Harris (2003), Atkins (2005), and Gonçalves and Lorenzi (2007). The measurements are presented whenever possible as minimums and maximums values. Data on habitat, altitude, and fertile period were obtained from exsiccate labels. The geographic distribution map of the new species was prepared based on the specimen occurrence spreadsheets using the software QGIS ver. 3.8. Preliminary conservation status assessment follows the IUCN (2012, 2022), with an Area of Occupancy (AOO) based on 2 × 2 km grids.

Results

Taxonomy

Stachytarpheta lajedicola P.H.Cardoso **sp. nov.** (Figs. 1, 4C).

Type: Brasil, Minas Gerais, Matias Cardoso, Horizonte do Gama, “Lajedão”, 14°53’03”S - 43°45’27”W, 12 March 2016, P.H.A. Melo *et al.* 4786 (holotype CESJ; isotypes HRCB, HUEFS).

Diagnosis: The new species is most similar to *Stachytarpheta bicolor* Hook.f. and *S. quadrangula* Nees & Mart. but differs by its branches with well-developed light brown edges, lanceolate leaves, attenuate or caudate at apex, and linear bracts, longer than the calyx.

Description: **Shrubs** ca. 2 m tall; multi-branched, erect, branches striate, with well-developed longitudinal edges, light brown, tetragonal, strigose, puberulent to glabrescent, nodes hirsute. **Leaves** decussate, sometimes with smaller leaves in the same axil as adult leaves, petioles 0.5–0.7 cm long, strigose; leaf blade 5.5–9 × 1.6–2.4 cm, lanceolate, conduplicate, sub-coriaceous, slightly discolored, apex attenuate to caudate, base cuneate, decurrent into petiole, sessile glands present, margin serrate, ciliate, slightly revolute, adaxial and abaxial surfaces strigose, trichomes leaving evident scars when shed, veins prominent abaxially. **Spikes** 17–30 cm long, 2–2.4 cm wide including the open corollas,



Stachytarpheta lajedicola (Verbenaceae), a new species from the Caatinga of Minas Gerais state, Brazil:
the first report of the genus in limestone outcrops



Figure 1. *Stachytarpheta lajedicola*. **A**- Branch with inflorescence. **B**- Detail of the branch, showing the well-developed edge. **C**- Leaf abaxial surface, showing margin and veins. **D**- Leaf adaxial surface, detail of the pubescence. **E**- Leaf abaxial surface, detail of the pubescence. **F**- Detail of the inflorescence, showing rachis, bracts, and flowers. **G**- Bract, abaxial surface. **H**, **I**- Calyx dissected, showing the teeth, external and internal view, respectively. **J**- Corolla dissected, showing the androecium and internal pubescence of the tube. **K**- Gynoecium. **L**- Detail of the stigma. **M**- Fruit. (P.H.A. Melo *et al.* 4786, illustrated by Klei Sousa).

0.4–0.6 cm wide excluding the open corollas, terminal, cylindrical, rachis visible, strigose, puberulent to glabrescent; **floral bracts** 1.6–2 cm long, linear, membranous, longer than the calyx, green, apex acuminate or caudate, abaxial surface strigose or puberulent, adaxial surface glabrous, margin ciliate. **Flowers** sessile, spirally arranged; **calyx** 1.4–1.7 cm long, slightly embedded in the rachis, tubular, erect, green, externally puberulent, along the veins strigose, 4-toothed adaxially, with 1 very long sinus abaxially, teeth equal, tips acuminate, up to 0.2 cm long; **corolla** blue or blue-purple, infundibular, zygomorphic, tube 3.3–3.5 cm long, straight or slightly curved, with glandular-pedicellate trichomes externally, limb 5-lobed, lobes equal, ca. 0.2 cm in diam., glandular-pedicellate trichomes in the upper part, throat densely strigose, with a dense and long ring of trichomes just above the ovary, where the tube is very narrowed; androecium composed by 2 fertile stamens and 2 staminodes, inserted at the top of the corolla tube, included, thecae divergent; gynoecium reduced to a single functional carpel, 2-locular, 1 ovule per locule, ovary ca. 0.5 cm long, style filiform, exerted, stigma capitate. **Fruit** 0.6–0.8 cm long, narrow obloid, lightly brown, apex slightly beaked, stylopodium deciduous, with attachment scar, outer surface smooth to slightly striate, with a thin and flat commissure, totally covered by the persistent calyx, splitting into two cluses when ripe.

Paratype: Brasil, Minas Gerais, Matias Cardoso, *Lajedão*, Sítio de Raimundo Gato, 14°52'59"S - 43°45'30"W, 23 June 2017, M.M.T. Cota 958 (HUEFS).

Distribution and ecology: *Stachytarpheta lajedicola* occurs in the municipality of Matias Cardoso, northern Minas Gerais state, in the Caatinga domain, found in a limestone outcrop locally known as *Lajedão* (Fig. 2). It grows in an open karst formation, in 489–505 m altitude, and was collected with flowers and fruits in March and June.

The *Lajedão* constitutes a karst area of the Bambuí Group (IEF 2008). In these outcrop islands, the rock is either exposed or covered by shallow, poor, alkaline soils, in an environment with high temperatures, intense solar incidence, and strong water restriction (IEF 2008). These rocks can reach up to 30 m high, forming a deeply rugged terrain, with steep columns, deep crevices and fissures, usually associated with underground drains, and small labyrinthine caves (IEF 2008). The crevices accumulate sand in the dry season and water in the rainy season (IEF 2008). Different types of vegetation are found, such as forest, open karst formation, and aquatic vegetation (IBGE 2012; Melo *et al.* 2013). The deciduous forest can be observed on the limestone massifs, related to the presence of epikarst, that is, places where there is soil covering the rock or filling its gaps (Fig. 3A-C); open karst formation occurs in parts where

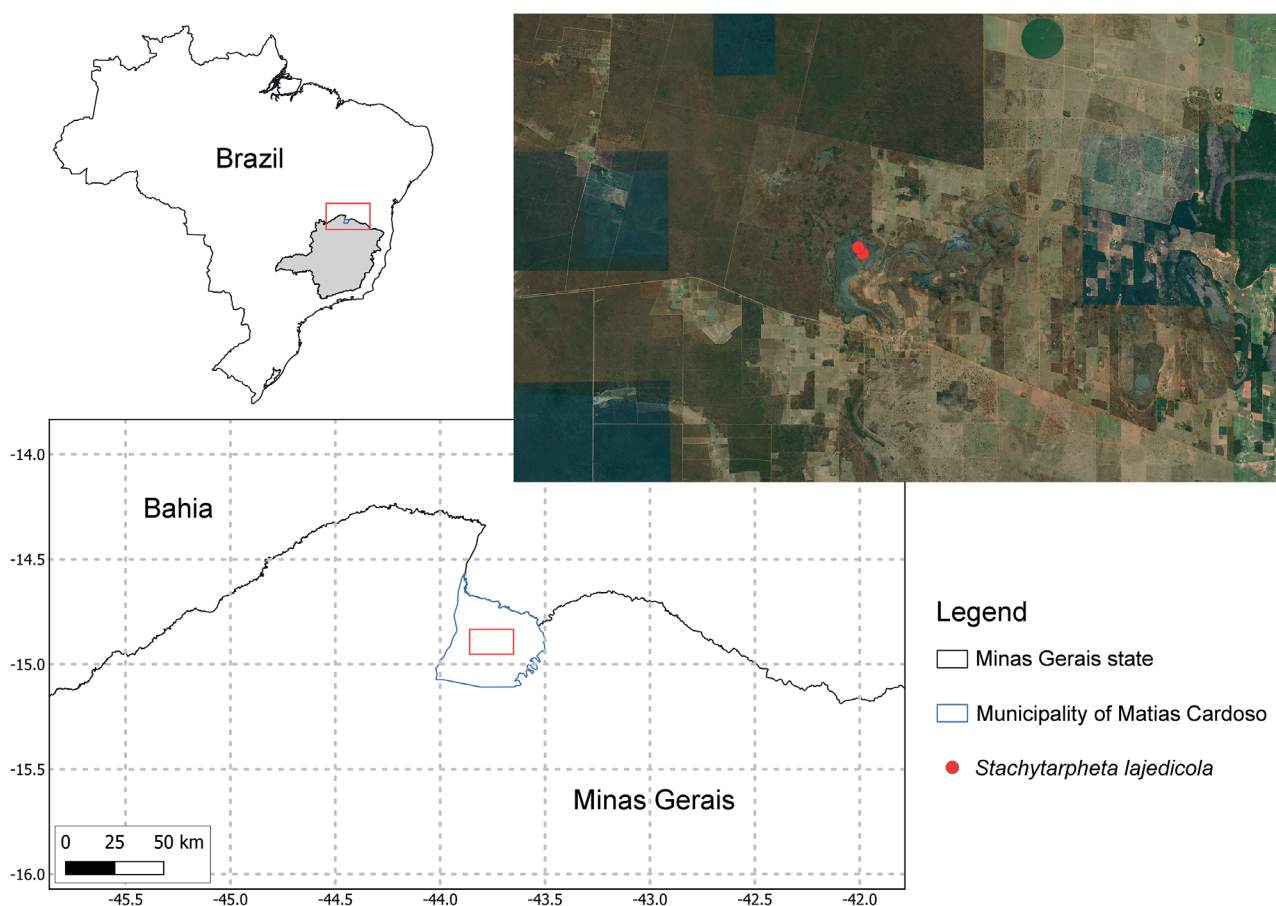


Figure 2. Occurrence geographic map of *Stachytarpheta lajedicola* in Brazil.



Stachytarpheta lajedicola (Verbenaceae), a new species from the Caatinga of Minas Gerais state, Brazil:
the first report of the genus in limestone outcrops

no soil covers or fills limestone interstices (Fig. 3D-E); and aquatic vegetation refers to hydrophytic species established in water environments without a current, such as sinkholes or seasonally flooded crevices (Fig. 3F).

In the *Lajedão* of Matias Cardoso, two other Verbenaceae species typical of limestone outcrops are found, *Bouchea agrestis* Schauer (P.H.A. Melo 6672), and *Lippia subracemosa*

Mansf. (P.H.A. Melo 4780) (Fig. 4 A and B), collected in 2016 and 2017, although the first species does not have its occurrence recorded for the state of Minas Gerais (Moroni & O'Leary 2019).

Preliminary conservation assessment: The Matias Cardoso municipality is located in a region of great biological importance, the so-called *Polígono das Secas* (Drought



Figure 3. Phytophysionomies of the *Lajedão* of Matias Cardoso, Caatinga of Minas Gerais, Brazil. **A-C** - Transitional zones between limestone outcrops and forest. **D, E** - Open karst formation. **F** - Aquatic vegetation. Photos by Pablo Hendrigo Alves de Melo.

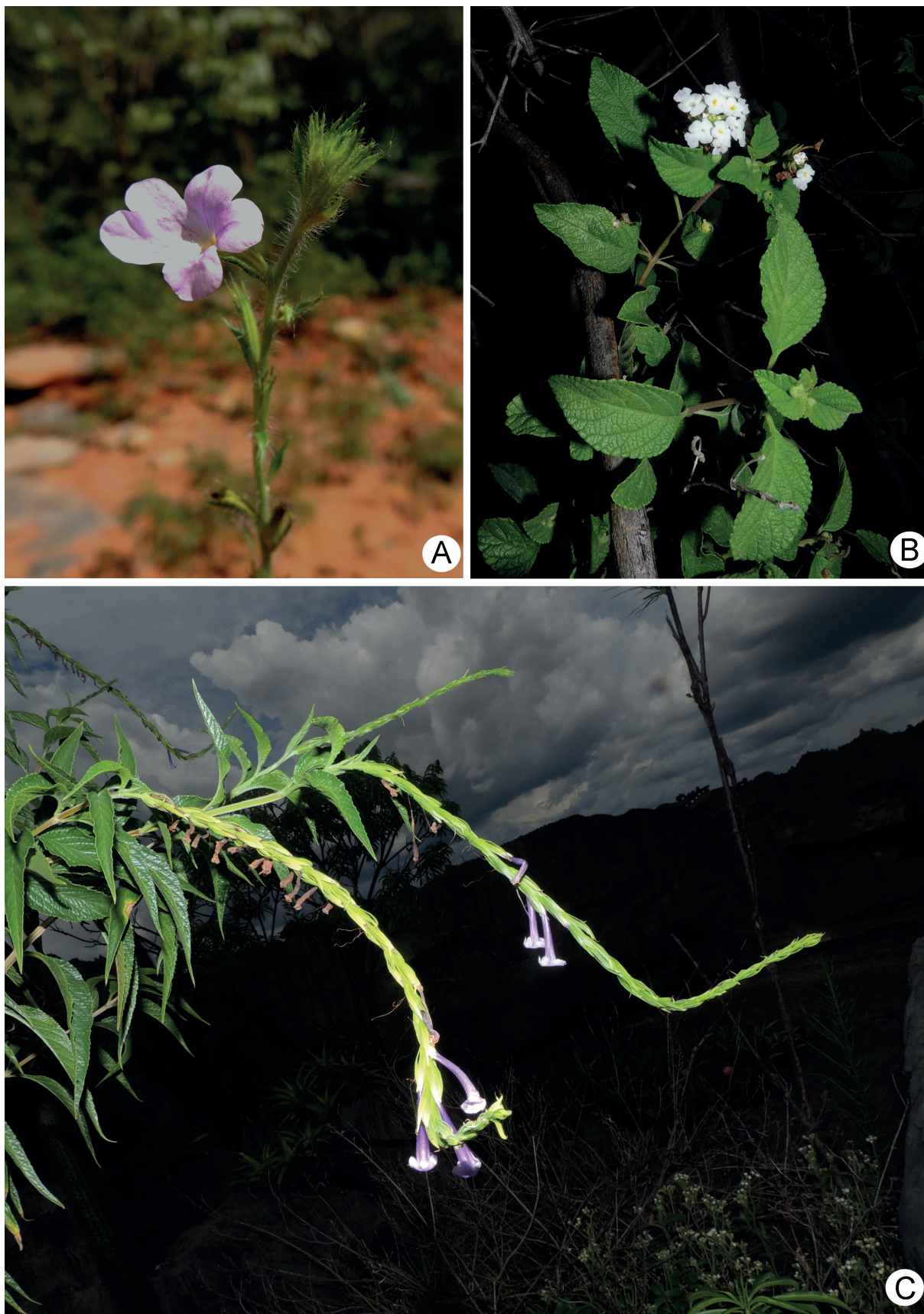


Figure 4. Species of Verbenaceae found in the *Lajedão* of Matias Cardoso, Minas Gerais, Brazil: **A-** *Bouchea agrestis*. **B-** *Lippia subracemosa*. **C-** *Stachytarpheta lajedicola*. Photos by Pablo Hendrigo Alves de Melo.



***Stachytarpheta lajedicola* (Verbenaceae), a new species from the Caatinga of Minas Gerais state, Brazil:
the first report of the genus in limestone outcrops**

Polygon), a semi-arid region known for the fragility of its ecosystems (Drummond *et al.* 2005; Magalhães *et al.* 2009; Fonseca *et al.* 2017). Three strictly protected areas (Lagoa do Cajueiro State Park, Verde Grande State Park, and Jaíba Biological Reserve), and an area managed for sustainable use (Lajedão Environmental Protection Area) were created in the region, which are home to different types of habitats, to protect the local biodiversity of the municipality (IEF 2008; Anjos 2016).

Around the Lajedão Environmental Protection Area, where the new species occurs, there are many rural properties with cattle raising, rock extraction, and removal of plants for ornamental cultivation, in addition to the human-induced fire that frequently devastate the region (IEF 2008; Anjos 2016). *Stachytarpheta lajedicola* is confined to a small area, AOO < 10 km², and is threatened by human activities that reduce habitat quality, while also facing the possibility of extinction by stochastic events. Thus, according to the parameters of IUCN (2012, 2022), it can be considered Critically Endangered (CR) B2ab(i, ii, iii).

Etymology: The epithet is a reference to the exclusive occurrence of the new species in the limestone outcrops, called *lajedos* by the local population of Matias Cardoso municipality. The word *lajedo* results in the name of the area (*Lajedão*, or “big *lajedo*”) and the Environmental Protection Area.

Morphological affinities: *Stachytarpheta lajedicola* has inflorescences 0.4–0.6 wide excluding the open corollas, calyx slightly embedded in the rachis, and corolla tube longer

than 3 cm. These characteristics are shared with *S. bicolor*, *S. glandulosa* S. Atkins, *S. quadrangula*, and *S. scaberrima* Cham., all of which occur in the Caatinga domain (Cardoso & Salimena 2020). However, *S. lajedicola* differs by the leaves with attenuate to caudate apex and the linear bracts, 1.6–2 cm long, longer than the calyx. Table 1 summarizes the main differences among these species.

Walpers (1845) was the first to subdivide *Stachytarpheta* into two sections. *Stachytarpheta* sect. *Stachytarpheta* is defined by the narrow inflorescences with calyces deeply embedded in the rachis, while *S.* sect. *Melananthus* (Pohl) Walpers by the more robust inflorescences with calyces not embedded in the rachis (Walpers 1845). *Stachytarpheta lajedicola*, *S. bicolor*, *S. glandulosa*, *S. quadrangula*, and *S. scaberrima* have calyx slightly embedded in the rachis, and narrow inflorescences, but excluding the open corollas, which are very long. These characteristics demonstrate a gradient between *S.* sect. *Stachytarpheta* and *S.* sect. *Melananthus*. Therefore, their position within these groups is difficult, although *S. quadrangula* and *S. scaberrima* were included in *S.* sect. *Stachytarpheta* by Walpers (1845).

Regarding the classification of Atkins (2005), *Stachytarpheta lajedicola* can be included in the *Quadrangula* informal group, which does not include *S. glandulosa* (treated as *Incertae sedis*), but encompasses *S. coccinea* Schauer, *S. speciosa* Pohl ex Schauer, and *S. trispicata* Nees & Mart. These latter three species have robust inflorescences wider than 1 cm excluding the open corollas, and calyx not embedded in the rachis, thus not resembling the new species (Atkins 2005).

Table 1. Comparison between *Stachytarpheta lajedicola* and morphologically similar species.

Feature	<i>S. lajedicola</i>	<i>S. bicolor</i>	<i>S. glandulosa</i>	<i>S. quadrangula</i>	<i>S. scaberrima</i>
Edges of the branches	well-developed, with light brown edge	undeveloped	undeveloped	undeveloped, with black edge	undeveloped, sometimes with black edge
Petiole length	shorter than 1 cm	shorter than 1 cm	1–2.2 cm	shorter than 1 cm	shorter than 1 cm
Sessile glands in the petiole	absent	absent	numerous (>30)	absent	absent
Leave shape	lanceolate	ovate	ovate	ovate	ovate
Leave apex	attenuate to caudate	acute	obtuse	acute or obtuse	acute or obtuse
Lave base	cuneate	cuneate or attenuate	truncate or obtuse	cuneate or attenuate	cuneate or attenuate
Bract lenght	1.6–2 cm	1–1.6 cm	0.15–0.3 cm	0.4–1 cm	1.2–1.7 cm
Bract shape	linear	triangular	ovate-triangular	triangular	oblong or narrowly triangular
Length of the bract in relation to the calyx	longer	shorter	shorter	shorter	shorter
Calyx lenght	1.4–1.7 cm	1.2–1.8 cm	0.8–1 cm	1.2–1.7 cm	1.6–2 cm
Corolla tube lenght	3.3–3.5 cm	3–3.5 cm	2–2.3 cm	1.7–2.5 cm	3–4.2 cm
Corolla collar	blue or blue-purplish	blue or blue-purplish	blue-purplish	blue or blue-purplish	red
Distribution (Brazilian states)	Minas Gerais	Alagoas and Bahia	Bahia	Bahia and Minas Gerais	Bahia and Minas Gerais



Discussion

Limestone outcrops are known to host a high number of endemic species, which tend to be highly specialized and tolerant to extreme conditions (shallow soils, high temperatures and solar incidence, and low availability of water) (Espírito Santo *et al.* 2018, Bystriakova *et al.* 2019). However, such species are uncompetitive, and quite vulnerable to environmental disturbances (Espírito Santo *et al.* 2018). Approximately 5% of the Brazilian territory is constituted by limestone outcrops, which unfortunately are frequently isolated by urban and agricultural areas and are under immense pressure from commercial mining interests (Espírito Santo *et al.* 2018; Marques *et al.* 2020; Batista *et al.* 2022). Few species of Verbenaceae are found in limestone outcrops in Brazil, including *Aloysia virgata* (Ruiz & Pav.) Juss., *Bouchea agrestis*, *Lantana achyranthifolia* Desf., *Lippia origanoides* Kunth, *Lippia subracemosa* (Salimena *et al.* 2020). However, there is currently no study that provides a comprehensive and taxonomic verified occurrence list.

The flora of the Lajedão Environmental Protection Area (with an area of ca. 12,000 ha) was considered poorly studied according to the management plan (IEF 2008). Among the collected angiosperm species, some were identified as new geographic distribution records for the state of Minas Gerais, indicating the need for additional collections and floristic studies (IEF 2008). No species of Verbenaceae were recorded in this survey (IEF 2008).

The present contribution reports the first occurrence of *Stachytarpheta* in limestone outcrops. *Stachytarpheta lajedicola* was collected recently, in 2016 and 2017. Thus, this discovery highlights the biological importance of the Lajedão, an area that has already revealed another new species, *Stemodia perfoliata* Scatigna & V.C.Souza, Plantaginaceae (Scatigna *et al.* 2018). The presence of these endemic species aggregates information that can help to strengthen environmental protection policies, especially considering that the municipality of Matias Cardoso is part of one of the ten priority areas for conservation in Caatinga of Minas Gerais state (Fonseca *et al.* 2017).

Acknowledgments

This study is part of the first author's doctoral thesis, developed in the Programa de Pós-graduação em Ciências Biológicas (Botânica) of the Universidade Federal do Rio de Janeiro, with a scholarship from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq 141837/2020-9). The authors are grateful to Dr. Nilber Gonçalves da Silva for help with botanical Latin. Special thanks to Dr. Pedro L.R. de Moraes and Dr. Vinícius Dittrich, curator of the HRCB and CESJ herbaria, respectively. M.T. is supported by the Alexander von Humboldt Foundation (BRA/1139098), FAPERJ (E-26/202.708/2019—JCNE), and CNPq (Pq-2 grant, 306758/2019-9).

References

- Albuquerque UP, Lima-Araújo E, El-Deir ACA *et al.* 2012. Caatinga revisited: Ecology and conservation of an important seasonal dry forest. *The Scientific World Journal*: 205182. doi: 10.1100/2012/205182
- Anjos AR. 2016. Onde repousa o berço das Gerais: Reflexões e perspectivas acerca da preservação do patrimônio cultural em Matias Cardoso-MG. MSc Thesis, Universidade Federal de Uberlândia, Brasil.
- Araújo HF, Garda AA, Silva WADG, Nascimento NFF, Freitas-Mariano E, Silva JMC. 2022. The Caatinga region is a system and not an aggregate. *Journal of Arid Environments* 203: 104778. doi: 10.1016/j.jaridenv.2022.104778
- Atkins S. 2005. The genus *Stachytarpheta* (Verbenaceae) in Brazil. *Kew Bulletin* 60: 161-272.
- Batista JA, Ferreira VL, Alves CI, Stehmann JR. 2022. A new species of *Habenaria* (Orchidaceae, Asparagales) and a checklist of Orchidaceae from limestone outcrops of Brazil. *European Journal of Taxonomy* 828: 16-44. doi: 10.5852/ejt.2022.828.1855
- Bystriakova N, Alves de Melo PH, Moat J, Lughadha EN, Monro AK. 2019. A preliminary evaluation of the Karst flora of Brazil using collections data. *Scientific Reports* 9: 17037. doi: 10.1038/s41598-019-53104-6
- Cardoso PH, O'Leary N, Olmstead RG, Moroni P, Thode V. 2021. An update of the Verbenaceae genera and species numbers. *Plant Ecology and Evolution* 154: 80-86. doi: 10.5091/plecevo.2021.1821
- Cardoso PH, Salimena FRG. 2020. *Stachytarpheta* in Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB15189>. 26 Dec. 2022.
- Cronquist A. 1978. Once again, what is a species? In: Knutson LV (ed.). *Biosystematics in agriculture*. Montclair, Alleheld Osmun. p. 3-20.
- de Queiroz LP, Cardoso D, Fernandes MF, Moro MF. 2017. Diversity and evolution of flowering plants of the caatinga domain. In: Silva JMC, Leal IR, Tabarelli M (eds.). *Caatinga: The largest tropical dry forest region in South America*. Cham, Springer. p. 23-63. doi: 10.1007/978-3-319-68339-3_2
- Drummond GM, Martins CS, Machado ABM, Sebaio FA, Antonini Y. 2005. *Biodiversidade em Minas Gerais, um atlas para sua conservação*. 2nd. edn. Belo Horizonte, Fundação Biodiversitas.
- Espírito Santo FS, Bitencourt C, Ribeiro PL, Rapini A. 2018. Two new species of *Marsdenia* (Apocynaceae) from limestone outcrops in Brazil. *Willdenowia* 48: 109-116. doi: 10.3372/wi.48.48107
- Fonseca CR, Antongiovanni M, Matsumoto M, Bernard E, Venticinque EM. 2017. Conservation opportunities in the Caatinga. In: Silva JMC, Leal IR, Tabarelli M (eds.). *Caatinga*. Cham, Springer. p. 429-443. doi: 10.1007/978-3-319-68339-3_17
- Gonçalves EG, Lorenzi H. 2007. *Morfologia vegetal: Organografia e dicionário ilustrado de morfologia das plantas vasculares*. Nova Odessa, Instituto Plantarum.
- Harris JG, Harris MW. 2003. *Plant identification terminology: An illustrated glossary*. 2nd. edn. Spring Lake, Spring Lake Publ.
- IBGE – Instituto Brasileiro de Geografia e Estatística. 2012. *Manual técnico da vegetação brasileira: Sistema fitogeográfico, inventário das formações florestais e campestres, técnicas e manejo de coleções botânicas, procedimentos para mapeamentos*. 2nd. edn. Rio de Janeiro, IBGE- Diretoria de Geociências. v. 39. https://ww2.ibge.gov.br/home/geociencias/recursosnaturais/vegetacao/manual_vegetacao.shtm. 26 Dec. 2022.
- IEF – Instituto Estadual de Florestas. 2008. *Plano de manejo da área de proteção ambiental Lajedão, Matias Cardoso, MG. Minas Gerais, Universidade Federal de Lavras*.
- IUCN – International Union for Conservation of Nature and Natural Resources. 2012. *IUCN Red List Categories and Criteria*. 2nd. edn. Cambridge, IUCN. Version 3.1.
- IUCN – International Union for Conservation of Nature and Natural Resources. 2022. *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 14. Prepared by the Standards and Petitions Subcommittee, IUCN, Gland. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>. 26 Dec. 2022.



***Stachytarpheta lajedicola* (Verbenaceae), a new species from the Caatinga of Minas Gerais state, Brazil:
the first report of the genus in limestone outcrops**

- Leal IR, da Silva JMC, Tabarelli M, Lacher Jr TE. 2005. Changing the course of biodiversity conservation in the Caatinga of northeastern Brazil. *Conservation Biology* 19: 701-706. doi: 10.1111/j.1523-1739.2005.00703.x
- Magalhães SCM, Afonso PCS, Cleps Jr J. 2009. O Norte de Minas Gerais e a gestão comunitária da água. *Revista Cerrados (Unimontes)* 7: 23-39.
- Marques D, Iglesias DT, Fonseca R, Nakajima JN. 2020. *Heterocypselia brachylepis* (Compositae: Vernoniae: Dipterocypselinae), a new species from the Brazilian dry forest. *Kew Bulletin* 75: 32. doi: 10.1007/s12225-020-09890-8
- Marx H, O'Leary N, Yuan Y, Lu-Irving P, Tank D, Múlgura ME, Olmstead R. 2010. A molecular phylogeny and classification of Verbenaceae. *American Journal of Botany* 97: 1647-1663. doi: 10.3732/ajb.1000144
- Melo PHA, Lombardi JA, Salino A, Carvalho DAD. 2013. Composição florística de angiospermas no carste do alto São Francisco, Minas Gerais, Brasil. *Rodriguésia* 64: 29-36.
- Moroni P, O'Leary N. 2019. Insights into the systematics of tribe Duranteae (Verbenaceae): A taxonomic revision of the new world genus *Bouchea*. *Annals of the Missouri Botanical Garden* 104: 355-399. doi: 10.3417/2019383
- Munir AA. 1992. A taxonomic revision of the genus *Stachytarpheta* Vahl (Verbenaceae) in Australia. *Journal of the Adelaide Botanic Garden* 14: 133-168.
- O'Leary N, Calviño CI, Martínez S, Lu-Irving P, Olmstead RG, Múlgura ME. 2012. Evolution of morphological traits in Verbenaceae. *American Journal of Botany* 99: 1778-1792. doi: 10.3732/ajb.1200123
- Salimena FRG, Cardoso PH. 2020. *Lippia* in Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. <https://floradobrasil.jbrj.gov.br/FB15170>. 27 Dec. 2022.
- Salimena FRG, O'Leary N, Cardoso PH *et al.* 2020. Verbenaceae in Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. <https://floradobrasil.jbrj.gov.br/FB246>. 27 Dec. 2022.
- Scatigna AV, Souza VC, Simões AO. 2018. *Stemodia perfoliata* (Plantaginaceae): A 200 year old new species from the Caatinga of Minas Gerais, Brazil. *Brittonia* 70: 252-256. doi: 10.1007/s12228-017-9518-9
- Silva JMC, Leal IR, Tabarelli M. 2017. Caatinga: The largest tropical dry forest region in South America. Switzerland, Springer.
- Thiers B. 2023, continuously updated. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>. 29 Sep. 2022.
- Walpers WG. 1845, *Synopsis Verbenacearum, Myoporinearum, Selaginearum, Stilbinearum, Globulariearum et Plantaginearum*. *Repertorium Botanices Systematicae* 4. Leipzig, Sumtibus Friderici Hofmeister.
- Zachos FE. 2016. *Species concepts in biology: Historical development, theoretical foundations and practical relevance*. Wien, Austria, Springer Cham.

