



Stigmatodon medeirosii, a new hyperepilithic bromeliad (Tillandsioideae) from granitic inselbergs of Minas Gerais, Brazil

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Abstract

Stigmatodon medeirosii (Bromeliaceae, Tillandsioideae), a new hyperepilithic species, restricted to vertical rock walls of the inselbergs of eastern Minas Gerais, in the medium Rio Doce River basin, southeastern Brazil, is described and illustrated. Diagnostic characters and affinities of the new species are discussed, accompanied by notes on its ecology, geographic distribution, and conservation status. The new species is most similar to *S. fontellanus* and *S. lemeanus* from Espírito Santo state but distinguished by a set of vegetative and reproductive characters. Following the criteria of the IUCN Red List, *S. medeirosii* is to be assessed as Vulnerable (VU), reinforcing the need for attention to the conservation of inselbergs and associated vegetation in eastern Minas Gerais.

Key words: Atlantic Forest, conservation, rock-climbing bromeliad, rock outcrops, Vrieseinae

Introduction

Stigmatodon Leme, G.K.Br. & Barfuss (Barfuss *et al.* 2016: 56) currently comprises 34 species (Gouda *et al.* 2023), 16 of which were recently segregated from *Vriesea* Lindley (1843: 11) and added to the genus or newly described (Couto *et al.* 2020a, 2020b, 2022, 2023a, 2023b; Leme *et al.* 2022). The genus occurs exclusively on rock outcrops (inselbergs and *campos rupestres*) in eastern Brazil and can be characterized by the semi-xeromorphic to xeromorphic, coriaceous, and usually triangular leaves with truncate margins; the stamens usually positioned in two groups of three on each lateral side of the corolla; and the stigma of the tubo-laciniate type (I and II) and sometimes of the convolute-blade type and its variations (Barfuss *et al.* 2016, Couto *et al.* 2022, Leme *et al.* 2022). In its current circumscription (Couto *et al.* 2022), two morphological groups are recognized: (1) *S. limae* (Smith 1970: 181) D.R. Couto & A.F. Costa *in* Couto *et al.* (2022: 354) group and (2) *Stigmatodon s.str.* (*sensu* Barfuss *et al.* 2016). Species of the *S. limae* group can be found on both inselbergs and *campos rupestres*, can be either epilithic, hyperepilithic and saxicolous, or rarely epiphytic on *Vellozia* Vandelli (1788: 32) trunks, and present three different stigma types, i.e. tubo-laciniate type II, convolute-blade (the vriseoid type II), and convolute-blade type III (stigmatodontoid type III) (Leme *et al.* 2022). In contrast, species belonging to *Stigmatodon s.str.* are hyperepilithic, exclusively inhabit vertical rock walls of inselbergs, and present tubo-laciniate stigma type, being such group the focus of this work.

All 23 species of *Stigmatodon s.str.*, are highly specialized in growing on vertical and bare rock walls of inselbergs (inclination above 70°), and they never appear on more gentle slopes (Couto *et al.* 2023c). The vascular plants that are restricted to these vertical walls have been termed hyperepilithic and have their center of diversity in the dome-shaped inselbergs of the Atlantic Forest in southeastern Brazil (Couto *et al.* 2023c). Due to this habitat specificity of *Stigmatodon s.str.* species, these plants were called “rock-climbing bromeliads” (Couto *et al.* 2023b). Due to the difficult access to these vertical habitats, their flora is still little known, and neglected in ecological studies in inselberg vegetation from Brazil (e.g. Meirelles *et al.* 1999; de Paula *et al.* 2015; Pinto-Junior *et al.* 2020; Couto *et al.* 2021), with rare exceptions (Carauta & Oliveira 1984). This fact justifies great efforts to describe the hidden biodiversity in these poorly explored environments.

The Atlantic Forest is a biodiversity hotspot (Myers *et al.* 2000), and inselbergs are an important element of this ecosystem in eastern Brazil, being mainly concentrated in the area termed “Sugarloaf land”, from Rio de Janeiro to southern Bahia states, including Espírito Santo and eastern Minas Gerais (de Paula *et al.* 2020). These granitic or gneissic monoliths are covered by lithophyte vegetation that is distinct from the surrounding forest matrix, harboring many endemic taxa, but also acting as ecological refugia for many forest species, such as vascular epiphytes (Couto *et al.* 2016; Francisco *et al.* 2023). The steep relief around inselbergs, generally with many rock blocks, also hindered the drastic deforestation that took place in the Atlantic Forest domain, protecting small forest fragments and their biota from human actions, mainly agricultural activities. Despite the relevance of inselbergs and their surroundings for the maintenance of some of the last fragments of native vegetation, these environments are still poorly protected, especially in eastern Minas Gerais state.

During field expeditions related to the project “Biodiversity, Conservation and Perspectives for the Study of Rupicolous Ecosystems in the Atlantic Forest”, of the Programa de Capacitação Institucional—PCI/ National Institute of the Atlantic Forest (INMA—Santa Teresa, Espírito Santo, Brazil), in inselbergs of Minas Gerais state, a new rock-climbing species of *Stigmatodon* was found. The new species has strongly concave and gibbous floral bracts, smooth at anthesis, and is morphologically similar to *Stigmatodon fontellanus* (Leme & Brown 2004: 6) Leme, G.K.Br. & Barfuss (in Barfuss *et al.* 2016: 57) and *Stigmatodon lemeanus* D.R.Couto, A.P.Fontana & Fraga (Couto *et al.* 2023b: 217). In this work, this new taxon is described, and illustrated, its conservation status is assessed, and its taxonomic affinities are discussed.

Methods

Morphological data were obtained through the study of herbarium specimens and of fresh material collected by the authors during fieldwork on inselberg vegetation in Minas Gerais state, southeastern Brazil. Descriptions and illustrations are based on both living and dried material, studied using a stereomicroscope; the descriptive terminology followed general botanical terminology (Stearn 1973, Radford 1986), and terminology specific for the family (Smith & Downs 1977), with the modifications suggested by Scharf & Gouda (2008) and Barfuss *et al.* (2016). Voucher specimens were dried and pressed according to Fidalgo & Bononi (1984) and deposited at MBML and R herbaria (acronyms following Thiers 2023, continuously updated).

The preliminary conservation status was assessed according to the IUCN Red List categories and criteria (IUCN 2022), and the extent of occurrence (EOO) and area of occupancy (AOO) analysis were obtained with the GeoCat tool (Bachman *et al.* 2011), using the standard parameters for the calculation of AOO. The distribution map was prepared with QGIS software (QGIS Software Team 2023) using layers obtained from IBGE (2023), ICMBio (2023), and SISEMA (2023).

Taxonomy

Stigmatodon medeirosii D.R. Couto & Gonella, *sp. nov.* (Figures 1–3)

This new species is most similar to *Stigmatodon fontellanus* and *S. lemeanus*, differing mainly by the distinctly larger size when flowering [70–80(–140) cm *vs.* 50–70 cm tall]; wider sheath (9–10 cm *vs.* 6–8.5 cm); the acute and apiculate, cymbiform leaf blade apex (*vs.* acute or acuminate-caudate, flat), wider leaf blade at the base (5–7.5 cm *vs.* 2–4.5 cm); by the distinctly longer peduncle (60–66 cm *vs.* 25–42 cm); by the longer main axis internodes [(12–)15–20 mm *vs.* 8.5–12 mm long]; by the more floriferous inflorescences (supporting up to 40 flowers *vs.* up to 20); and by the longer petals (40–45 cm *vs.* 36–39 cm long).

Type:—BRAZIL. Minas Gerais: Santa Rita do Itueto, Pedra de Santa Rita (inselberg), epilithic on vertical rock wall, 19°22'S, 41°22'W; 780 m elevation, 19 April 2022, (flowered in cultivation in September 2022), *D.R. Couto 6327, L. Medeiros, D. Cordeiro & P.M. Gonella* (holotype MBML!).

Description:—*Plant* epilithic, heliophyte, 70–80 (–140) cm tall when flowering, propagating by basal shoots. *Leaves* 20–25 in number, rosulate, thick coriaceous, forming a funnellform rosette; *sheath* elliptic, 8–14 × 9–10 cm, densely and minutely castaneous lepidote on both sides; *blade* triangular, canaliculate toward the base, flat toward the apex, suberect, 16.5–18.5 cm long, 5–7.5 cm wide at the base, completely covered on both sides with a dense layer of white-cinereous trichomes partially obscuring the purple-green color of the blades, trichomes forming inconspicuous

white crossbands on both sides, with an evident purple line along the margins, apex acute and apiculate, cymbiform, generally straight, margins truncate, 0.7–0.8 mm thick. *Peduncle* suberect, 60–66 cm long, 7.5–8 mm in diameter, green and usually with wine spots, glabrous, smooth at anthesis; *peduncle bracts* the basal ones subfoliaceous, the upper ones ovate, apex acuminate, 30–40 × 23–30 mm, erect, laxly disposed, exceeding or shorter than internodes, densely white lepidote, green near the base and wine toward the apex, smooth at anthesis. *Inflorescence* (fertile part) simple, ascending, 14–23 cm long, apex obtuse before and at anthesis, 13 (–40)-flowered; *main axis* tetra-angled, smooth at anthesis, sulcate when dry, green, glabrous, internodes (12–) 15–20 mm long; *floral bracts* broadly ovate to suborbicular, strongly concave and gibbous, apex acute, (18–)24–28 × 26.5–37 mm, distinctly shorter than the sepals, glabrous at the base and densely white lepidote toward the apex, ecarinate, secund with the flowers before and at anthesis, coriaceous and thicker near the base, smooth, green near the base and wine toward the apex at anthesis. *Flowers* 55–60 mm long, nocturnal, with a garlic odor, not producing any mucilage at anthesis, distichous, laxly disposed and distinctly secund at anthesis; *pedicel* 10–15 mm long, 10 mm in diameter at the distal end, stout, green, glabrous; *sepals* broadly ovate, apex obtuse, 20–30 × 20–26 mm, greenish-wine, glabrous, coriaceous, thicker toward the base, ca. 3.5 mm thick; *petals* obovate, apex rounded and emarginate, recurved near the apex at anthesis, 40–45 × 20–23 mm, greenish-white, thicker toward the base, bearing 2 appendages at the base; *appendages* 11–11.4 × 3–3.5 mm, spatulate, basally adnate to the petals for 4–4.5 mm, apex long acuminate; *corolla* campanulate, 30–32 mm in diameter; *filaments* free, complanate, ca. 22 × 1.5 mm wide, white; *anthers* 8.5–8.7 mm long, dorsifixed near the base, base bilobed, apex obtuse, arranged three on each lateral side of the corolla at anthesis; *ovary* superior, ca. 5.6 mm long; *style* ca. 24 mm long, cylindrical, included in the corolla, green; *stigma* tubo-laciniate I, margins denticulate, ca. 1.2 mm in diameter, green; *ovules* caudate. *Capsules* ellipsoid, 50–65 mm long, 10–13 mm diameter, apex apiculate; *seed* 25–29 mm long, fusiform, brown; *basal coma* 18–21 mm long, beige; *apical coma* 3–4.6 mm, beige.

Phenology:—Collected with fruits in September (*in situ*), and flowers in March and April (in cultivation).

Distribution, habitat, and ecology:—*Stigmatodon medeirosii* is so far only known from the municipality of Santa Rita do Itueto, eastern Minas Gerais state, southeastern Brazil (Fig. 2). The plant is a hyperepilitic heliophile, growing on the bare and vertical rock wall (Fig. 3A, B) in Atlantic Forest inselberg, at about 800 m elevation. In the type locality, *S. medeirosii* forms a monodominant population, with many young individuals, which at long distances resemble species of the genus *Tillandsia* (Fig. 3A). The Pedra de Santa Rita forms a mosaic of seasonal forest and inselberg vegetation, surrounded by pasture areas for livestock, agricultural activities (mainly coffee plantations), and small Atlantic Forest fragments.

Preliminary conservation status:—Vulnerable [VU: D2]. *Stigmatodon medeirosii* is only known from its type locality, at the Pedra de Santa Rita, presenting an AOO of 4 km² (EOO can not be calculated as it is known from a single record). Such value of AOO, combined with its single known location and the continuing decline of habitat quality, falls within the thresholds for Critically Endangered (CR), based on criterion B2 (area of occupancy). However, population isolation and fragmentation are natural conditions in inselbergs flora, thus evaluations of plant distribution in these ecosystems probably yield overestimated values of AOO and EOO (Leme *et al.* 2022; Couto *et al.* 2023b). The Pedra de Santa Rita is included in the *Área de Proteção Ambiental Municipal* (Municipal Environmental Protection Area) of Santa Rita do Itueto, a protected area of sustainable use that aims to conserve biodiversity and its natural resources. Nevertheless, the area lacks clear delimitation and infrastructure, as well as protection efforts, with the main threats to the area being the presence of cattle and the unregulated practice of enduro of the motorcycle (motocross) along trails and over the rock vegetation, causing the destruction of vegetation islands over the rock and erosion, leading to the decline of habitat quality. *Stigmatodon medeirosii*, however, occurs on vertical rock walls that are not directly affected by those threats.

Consequently, we estimate the human impact to be neither high nor continuous specifically to this taxon. Due to the apparent rarity and very narrow distribution (a single location and AOO < 20 km²), this species is prone to the effects of stochastic events in the near future, such as impact from climbers or severe climate alterations, such as intenser droughts. Therefore, we suggest it be assessed as Vulnerable under the criteria VU D2.

The medium Doce River basin region in eastern Minas Gerais, near the type locality (Conselheiro Pena, Alvarenga, Pocrane), forms impressive inselbergs landscapes that are still unexplored botanically, such as the Palestina Complex (Fig. 2B). Further research in this region may result in new records of *S. medeirosii*, leading to a reassessment of its conservation status.

Etymology:—The specific epithet “*medeirosii*” honors Lucian Medeiros, from Santa Rita do Itueto, Minas Gerais, a young enthusiast of the bromeliads and orchids who has contributed to the discovery of many of the new species found in the region in the past few years, including this one. Lucian and his family live by growing specialty coffees in the region, and never measured efforts to guide us in Pedra de Santa Rita and Serra do Padre Ângelo. Through his efforts, we managed to collect this new species on a rock wall that was difficult to access.

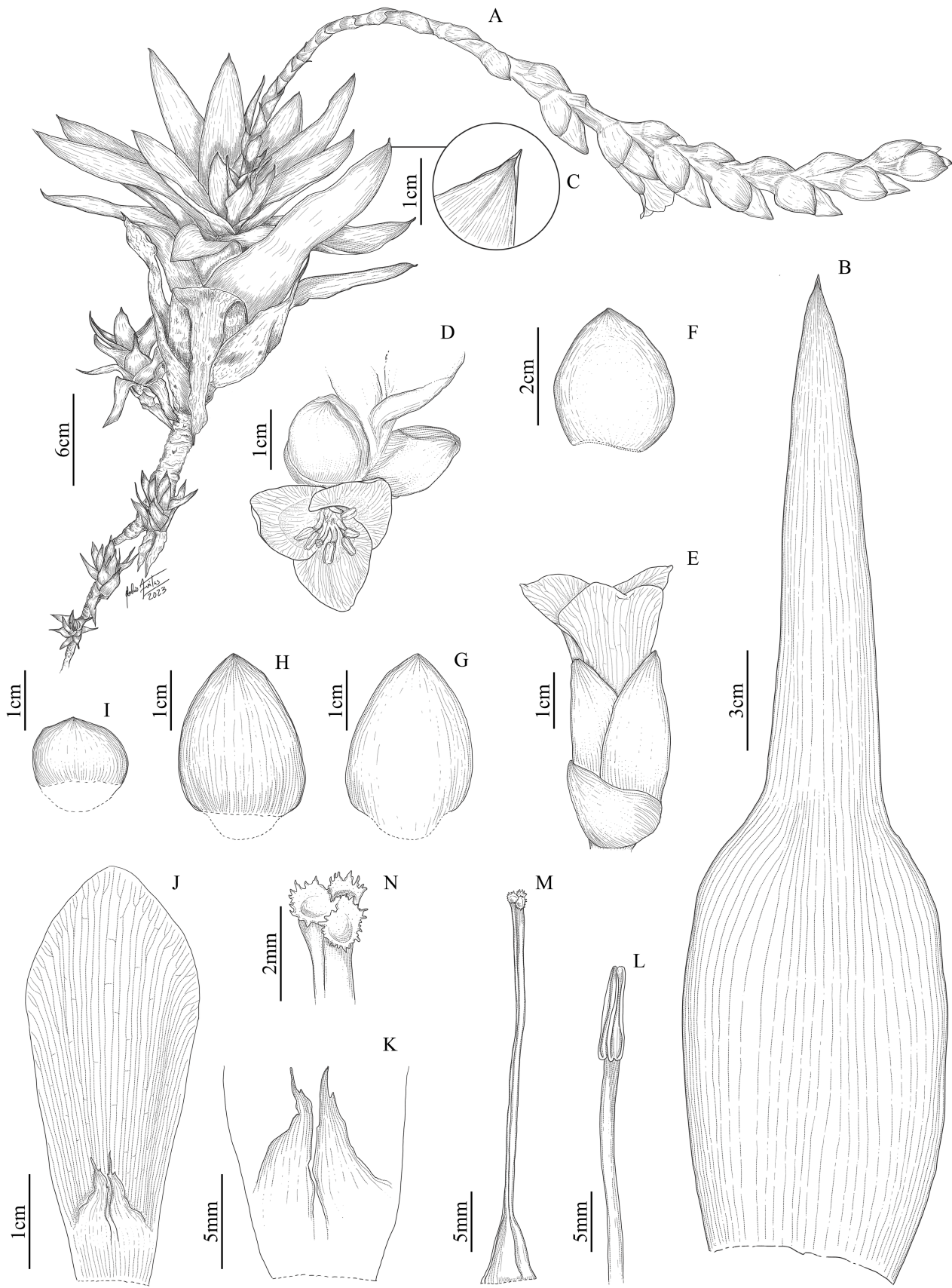


FIGURE 1. *Stigmatodon medeirosii*. **A.** Habit. **B.** Leaf. **C.** Detail of the blade's cymbiform apex. **D.** Flower, frontal view with detail of the stamens arranged in two groups of three on each lateral side of the corolla. **E.** Flower, lateral view. **F.** Peduncle bract. **G.** Floral bract, adaxial side. **H.** Floral bract, abaxial side. **I.** Floral bract, detail of the thickest part at the base. **J.** Petal with two basal appendages. **K.** Basal appendages, details. **L.** Stamen. **M.** Pistil. **N.** Stigma tubo-laciniate. From the holotype *D.R. Couto 6327* (MBML). Drawn by Joelcio Freitas.

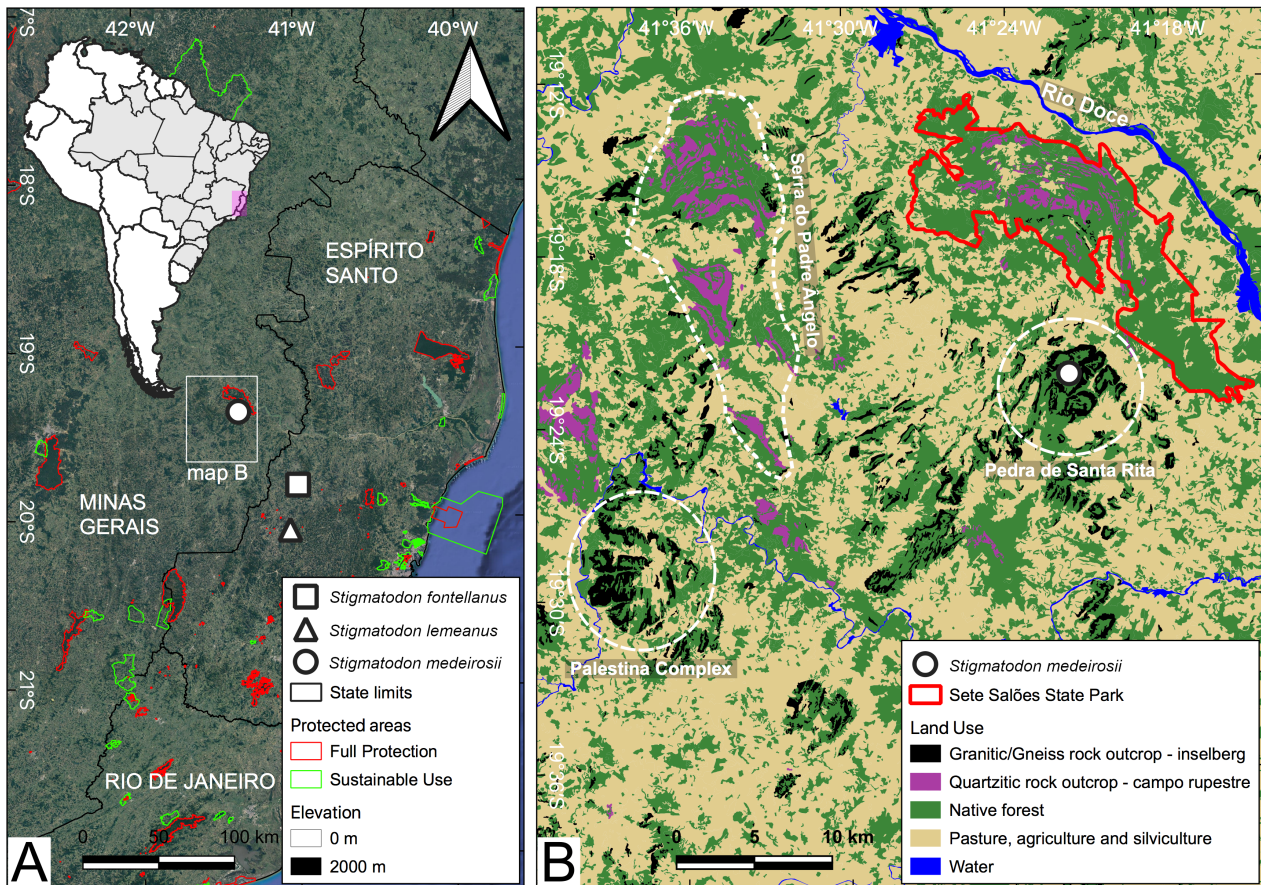


FIGURE 2. Distribution maps. **A.** distribution of *Stigmatodon medeirosii* and the putative closest taxa, *S. fontellanus* and *S. lemeanus* in Atlantic Forest inselbergs, southeastern Brazil. **B.** land use in the medium Doce River where *S. medeirosii* occurs and the main landmarks of the region.

Additional specimen examined (paratype):—BRAZIL. Minas Gerais: Santa Rita do Itueto, Pedra de Santa Rita (inselberg), epilithic on vertical rock wall, 19°22'S, 41°22'W, 780 m elevation, 19 April 2022, (fr.), *D.R. Couto 6325*, *L. Medeiros, D. Cordeiro & P.M. Gonella* (R!).

Discussion:—This new species is a member of *Stigmatodon goniorachis* complex (Manhães 2021), which includes species with strongly concave and gibbous floral bracts, thicker at the base, green to wine colored, and smooth at anthesis (not corrugate-sulcate at anthesis). *Stigmatodon medeirosii* is morphologically related to *S. fontellanus*, a species endemic to inselbergs from the municipality of Laranja da Terra, in the northwest of Espírito Santo state (Fig. 2A), distant about 65 km from the type locality of *S. medeirosii*. The new species can be distinguished from *S. fontellanus* by the thick coriaceous leaves (*vs.* subcoriaceous), by the longer leaf blade (60–66 cm *vs.* 39–48 cm); the ovate peduncle bracts (*vs.* ovate-lanceolate), with acuminate apex (*vs.* obtuse-apiculate), which are larger (30–40 × 23–30 mm *vs.* 21–23.5 × 14–16 mm); by the obtuse-acuminate or apiculate floral bracts (*vs.* obtuse-emarginate), wider (26.5–37 mm *vs.* ca. 18 mm); longer flowers (56–60 mm *vs.* ca. 40 mm long), the longer pedicel (10–15 mm long *vs.* ca. 7 mm); sepals broadly ovate (*vs.* elliptic), with obtuse apex (*vs.* emarginate), slightly larger (20–30 × 20–26 mm *vs.* ca. 20 × 17 mm), and by the appendages basally adnate to the petals for 4–4.5 mm (*vs.* 6 mm), in addition to the characters cited in the diagnosis.

The new species is also similar to *Stigmatodon lemeanus*, a species endemic to inselbergs in the mountainous region of Espírito Santo, distant about 84 km from the type locality of *S. medeirosii*. The new species can be distinguished by the suberect peduncle (*vs.* suberect to patent); green floral bracts near the base and wine toward the apex at anthesis (*vs.* entirely green); flower without mucilage at anthesis (*vs.* producing translucent mucilage at anthesis); sepals broadly ovate (*vs.* obovate), which are shorter (20–30 mm *vs.* 30–35 mm long); and by the longer capsules (50–65 mm *vs.* 39–45 mm long), in addition to the characters cited in the diagnosis.

Recent research on the flora of the granitic/gneissic inselbergs of the medium Doce River basin has yielded the description of several new species (e.g. Leme *et al.* 2017; Goldenberg *et al.* 2022; Campos-Rocha *et al.* 2022). These

inselbergs are surrounded by *campos rupestres* of the João Pinto Geological Formation, which are rich in endemics, especially from the Bromeliaceae family (see Leme & Kollmann 2013; Leme *et al.* 2014; Leme 2015, 2017; Leme *et al.* 2017, 2020, 2022, 2023; Couto *et al.* 2023a), in addition to Asteraceae (e.g. Loeuille & Pirani 2016, Oliveira *et al.* 2022), Begoniaceae (Kollmann & Gonella 2021), Droseraceae (Gonella *et al.* 2015), Eriocaulaceae (Andrino & Gonella 2021), Lythraceae (Cavalcanti *et al.* 2022), Melastomataceae (Goldenberg *et al.* 2022), Passifloraceae (Mezzonato-Pires *et al.* 2021), to mention a few.

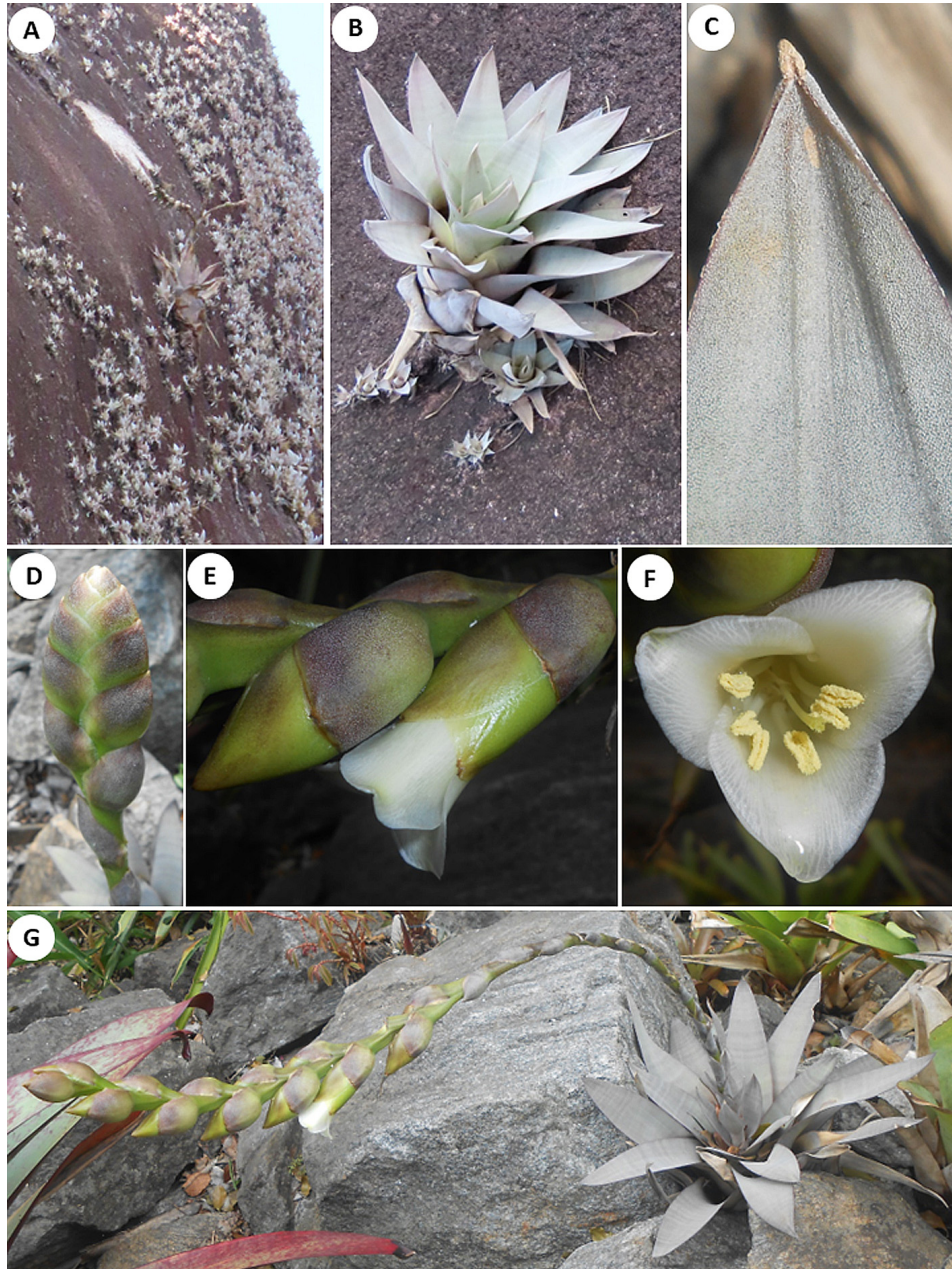


FIGURE 3. *Stigmatodon medeirosii*. **A.** Plants *in situ* at the type locality, inhabiting a vertical wall with many young individuals, that resemble species of *Tillandsia*. **B.** Individuals grow on vertical and bare rock walls without having roots intruding on the substrate, which characterizes the hyperepilitic life form. **C.** Detail of the cymbiform apex of the leaf blade. **D.** Inflorescence before anthesis. **E.** Lateral view of the flower and floral bract. **F.** Frontal view of the flower. **G.** View of the flowering individual in cultivation. (Photographs by D.R. Couto).

These data reinforce the relevance of the “João Pinto Biodiversity Center”, which is surrounded by several inselbergs unexplored by science, where we recorded the only known population of *S. medeirosii*. The proximity of inselbergs and quartzitic *campos rupestres* of this region is unique in Brazil, and further research could help elucidate how the biota of these ecosystems interact in such complex geological and edaphic conditions.

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