



## Two new species of *Mikania* Willd. (Asteraceae: Eupatorieae) from Minas Gerais State, Brazil

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### ABSTRACT

*Mikania* is a pantropical genus of Asteraceae with ca. 450 species distributed mainly in South America. Although most of its species occur in forested phytophysionomies, significant richness is found in the mountaintop grasslands known as *campos rupestres* in Brazil. Recent botanical exploration of *campos rupestres* areas outside their core distribution, namely Serra do Padre Ângelo, Pico da Aliança, and Sete Salões State Park, all located in the eastern part of the state of Minas Gerais and within the Atlantic Forest phytogeographic domain, led to the description of several new plant species. After fieldwork and study of herbarium specimens, we recognize two new species of *Mikania* endemic to Pico da Aliança and Serra do Padre Ângelo. *Mikania semirii* is related to *Mikania phaeoclados* and differs by leaf indumentum, subinvolucral bract shape and size and position on the peduncle. *Mikania funkiae* is related to *Mikania glauca* and *Mikania obtusata*, and differs by the petiole length, leaf shape, texture, and margins. We provide full descriptions, illustrations, distribution maps, composite color figures, preliminary conservation status assessments, and comments on the taxonomy and ecology of these two species. These findings highlight the continued importance of floristic and taxonomic work on the rich eastern Brazilian flora.

**Keywords:** Asteraceae, *Campos rupestres*, Compositae, critically endangered, *Mikania*, Mikaniinae, Neotropical flora, taxonomy

### Introduction

*Mikania* is a pantropical genus of Asteraceae with around 450 species distributed mainly in South America (King & Robinson 1987; Robinson *et al.* 2009; Godoy *et al.* 2017). It is the largest genus of tribe Eupatorieae and the only

member of subtribe Mikaniinae. *Mikania* has traditionally been recognized as a natural group, mostly due to its conserved morphology. Most species have lianescent habit, capitula with a variously positioned subinvolucral bract, four involucral bracts and four florets in each capitulum, and five-ribbed cypselae, rarely ten-ribbed (Ritter & Miotto 2005; Hind & Frisby 2014; Contro & Nakajima 2017).

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Although *Mikania* is mostly distributed in forested environments, 41 of the 198 species currently recognized in Brazil (Ritter *et al.* 2020) occur in *campos rupestres* (highland rocky fields). This phytophysiognomy is associated to sandy soils and rock outcrops in the Espinhaço Range (ER), a mountain chain extending over 1,000 km in a North-South axis along the central portion of the States of Minas Gerais and Bahia (Giulietti *et al.* 1997; Alves & Kolbeck 2010; Fernandes 2016). The ER is situated in the ecotone among three phytogeographical domains: the Atlantic Forest to the east, the Caatinga to the north, and the Cerrado to the west. Other large disjunct areas of *campos rupestres* are found within the Cerrado domain in western Minas Gerais and in the State of Goiás, within the Amazon Forest domain, mainly in the State of Pará, and in isolated patches in the State of Mato Grosso do Sul and in eastern Bolivia (Fernandes 2016; Silveira *et al.* 2016; Zappi *et al.* 2019; Miola *et al.* 2021).

Recently, smaller disjunct patches of *campos rupestres* were discovered on quartzitic outcrops that are entirely inserted in the Atlantic Forest phytogeographic domain (Gonella *et al.* 2015; Lopes *et al.* 2016; Siniscalchi *et al.* 2016; Mello-Silva 2018). These areas located in the Rio Doce valley in eastern Minas Gerais, namely Serra do Padre Ângelo, Pico da Aliança, and Sete Salões State Park, possess some floristic elements related to the ER (Siniscalchi *et al.* 2016; Mello-Silva 2018; Andrino & Gonella 2021; Antar *et al.* 2021a), but also to the granitic inselbergs typically found in the surrounding Atlantic Forest (Antar *et al.* 2021b; Mezzonato-Pires *et al.* 2021). With an increasing number of taxonomic novelties described in recent years, these areas corroborate the elevated species richness and endemism of the *campos rupestres* (Giulietti *et al.* 1997; Fernandes 2016; Colli-Silva *et al.* 2019), but also highlight the botanical sampling deficit in Brazil. Biological knowledge shortfalls, mainly related to taxonomy and geographical distribution of species (the Linnean and Wallacean shortfalls, respectively; Lomolino 2004), have been identified in recent times; their effects and the spatial accuracy of biodiversity documentation in the Atlantic Forest domain have been recently discussed and analyzed by Colli-Silva *et al.* (2020).

In the present work, we describe two new species of *Mikania* endemic to the *campos rupestres* of Pico da Aliança (1440 m a.s.l.) and Pico do Padre Ângelo (1550 m a.s.l.) in the State of Minas Gerais, which were identified after recent botanical expeditions in these areas. We provide full descriptions, illustrations, and preliminary conservation assessments, as well as taxonomic and ecological comments for each species.

## Materials and methods

The morphological descriptions were based on herbarium specimens studied in the following herbaria: BHCB, MBML, RB, and SPF (acronyms according to Thiers, continuously updated). Fieldwork was carried out in Serra do Padre

Ângelo and Pico da Aliança from 2013 to the present. A 10-60 × magnification stereomicroscope was used to analyze morphological features of the specimens, with measurements based on rehydrated or dry herbarium material. Terminology follows Harris & Harris (2001) for general morphology and Hickey (1973) for leaf shape, as well as King & Robinson (1987), Ritter & Miotto (2005), Oliveira *et al.* (2016) and Antar *et al.* (2021c) for Asteraceae-related terms.

The Geospatial Conservation Assessment (GeoCAT) tool (Bachman *et al.* 2011) was used along with IUCN (2012) criteria to infer conservation status. The IUCN default values were used for Extent of Occurrence (EOO) and Area of Occupancy (AOO) analyses in GeoCAT. The distribution map was produced in QGIS version 3.14.15 (QGIS Development Team 2020) using layers downloaded from FBDS (2021), IBGE (2021) and SISEMA (2021).

## Results

### Taxonomic treatment

***Mikania semirii*** C.T.Oliveira & Antar, *sp. nov.* (Figs. 1, 2, 3)

Type: BRAZIL. Minas Gerais. Conselheiro Pena. Pico do Padre Ângelo. Cume do pico. 19° 19' 15" S, 41° 34' 43" W, 1500 m, 3/VIII/2014, C.T. Oliveira *et al.* 1000 (holotype SPF, isotypes to be distributed to ALCB, BHCB, CEN, HUEFS, HUFU, K, G, M, MBM, NY, P, RB, US, W)

*Mikania semirii* resembles *Mikania phaeoclados* as both share the climbing habit and ovate leaves with cordate or rounded base and serrate margins, but differ in leaf indumentum (adaxially glabrous except for pubescent or glabrescent primary and secondary veins with simple curved trichomes, abaxially glabrescent with scattered, small simple trichomes in *M. semirii* vs. adaxially strigose, abaxially tomentose), shape and position of subinvolucral bracts (4.0-6.1 × 2.2-3.0 mm, elliptic, located below the capitulum in *M. semirii* (Fig. 2C) vs. 1.6-2.6 × 0.6-0.9 mm, oblong-lanceolate, located at the base of the peduncle) and peduncle size (sessile to 1 mm long in *M. semirii* vs. 1.1-3.5 mm long).

Perennial vines; stems ± cylindrical, canaliculate, villous, with long, curved, simple, uniseriate, entangled, eglandular trichomes, becoming cylindrical, striate and glabrescent when older, nodes expanded. Leaves opposite, petiole 2.6-8.9 mm long, pubescent to villous with simple curved eglandular trichomes, blade 3.1-6.0 × 1.9-3.0 cm, chartaceous, ovate or wide ovate, apex acute, with a mucro *ca.* 0.5 mm long, base cordate or rounded, sometimes unequal, margins ciliate with long simple eglandular trichomes, revolute to slightly revolute, entire near base to 1/3 of leaf, upper 2/3 serrulate, with 4-9 swollen, acuminate teeth, venation actinodromous, main vein and secondary veins slightly

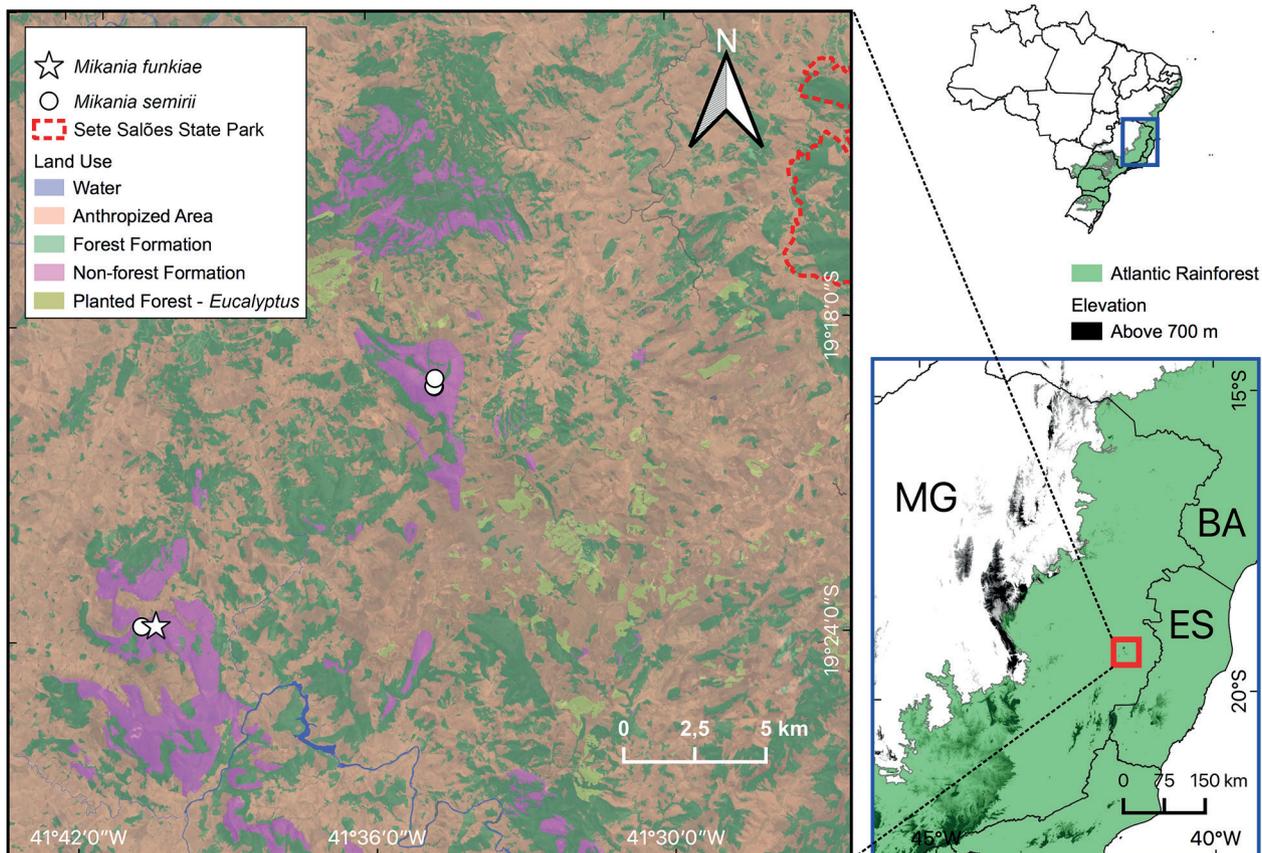


prominent, adaxial surface glabrous except for pubescent or glabrescent primary and secondary veins with simple curved trichomes, mostly near base, abaxial surfaces glabrescent with scattered small, simple trichomes. Capitulescence a terminal thyrsoid, sessile to subsessile, peduncles *ca.* 1 mm long, villous with curved trichomes; subinvolucral bracts 1, 4.0-6.1 × 2.2-3.0 mm, elliptic, apex acute or rounded, ciliate, just below capitulum. Capitula discoid, 7.3-8.0 mm long; involucre cylindrical, 2.1-2.7 mm diam.; involucral bracts 4, 5.7-6.9 × 1.3-1.7 mm, whitish or pinkish, 2 inner bracts slightly larger than 2 outer, persistent, oblong or narrow obovate, stiffly chartaceous, apex obtuse, ciliate, venation parallel, ± conspicuous. Florets 4, bisexual, fertile; corolla 4.7-5.1 mm long, white, tube 1.4-2.0 mm long, always longer than limb, limb 1.6-2.1 mm long, lobes 5, 1.1-1.4 × 0.8-0.9 mm, deltoid, apex shortly acuminate or acute, divergent relative to tube, incurved; anthers 1.4-1.6 mm long, straw-colored to vinaceous, apical anther appendages ovate, apex acute, base rounded; style 6.7-7.4 mm long, style branches 2.5-3.2 mm long, papillose. Cypselae 3.0-3.5 × 0.8-0.9 mm, carbonized, sparsely glandular-punctate, mostly near apex and base, 5-ribbed, ribs white, ciliate with twin hairs; carpodium present, annuliform, pale, glabrous; pappus bristles *ca.* 40, persistent, uniseriate, barbellate,

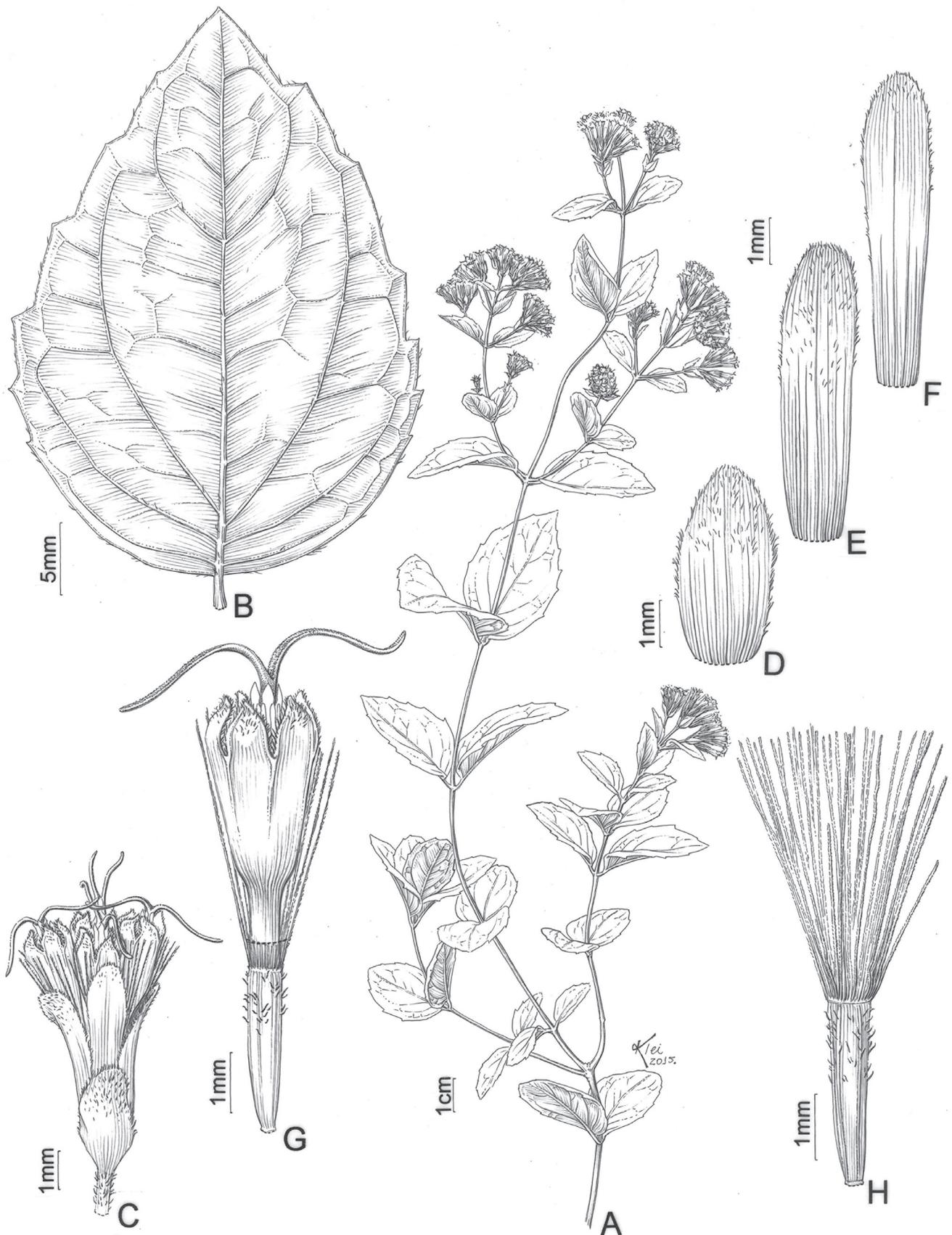
slightly unequal, 3.1-3.5 mm long, longer than cypselae, cream colored.

**Etymology:** The species epithet honors the late botanist Dr João Semir (1937-2018), professor of the Botany Department of UNICAMP, Campinas, São Paulo, Brazil. Dr Semir was a synantherologist who greatly contributed to the systematic knowledge of Asteraceae in Brazil, especially in Vernoniaceae, but also in Bignoniaceae, Malvaceae, and Orchidaceae. Dr Semir mentored several Brazilian botanists and is recognized as a pioneer of floristic studies of the *campos rupestres*.

**Preliminary Conservation Status:** Critically Endangered: CR B2ab(i, ii, iii). *Mikania semirii* was found exclusively on summits (at elevations above 1400 m a.s.l.) of two of the highest peaks located in the eastern Minas Gerais quartzitic formations, Pico do Padre Ângelo (part of Serra do Padre Ângelo) and Pico da Aliança, *ca.* 12 km distant from each other. At both sites, the number of individuals observed was less than 20, but exploration of the habitat is hindered by the rugged relief. Similar habitats and elevations may be further found at Pico do Pinhão and the virtually inaccessible Pico do Sossego (both part of Serra do Padre Ângelo). All these areas are susceptible to invasion by alien grasses, most remarkably “capim-gordura”, *Melinis minutiflora* (Gonella *et*



**Figure 1.** Geographic distribution of *Mikania semirii* C.T.Oliveira & Antar (white circles) and *Mikania funkiae* C.T.Oliveira & Antar (white star) in eastern Minas Gerais, with land use projected over a satellite image and highlighting the limits of the only protected area in the region (Sete Salões State Park). In the reference maps to the right, the green shadowing represents the Legal Atlantic Forest area. State acronyms, BA: Bahia, ES: Espírito Santo, MG: Minas Gerais.



**Figure 2.** *Mikania semirii* C.T.Oliveira & Antar **A.** Leafy flowering branch. **B.** Leaf abaxial surface **C.** Capitulum **D.** Subinvolucral bract. **E.** Outer involucral bract. **F.** Inner involucral bract. **G.** Floret, with the pappus partially removed for a clearer view. **H.** Cypsela with pappus. Illustration by Klei Souza, based on C.T. Oliveira et al. 1000 (SPF).

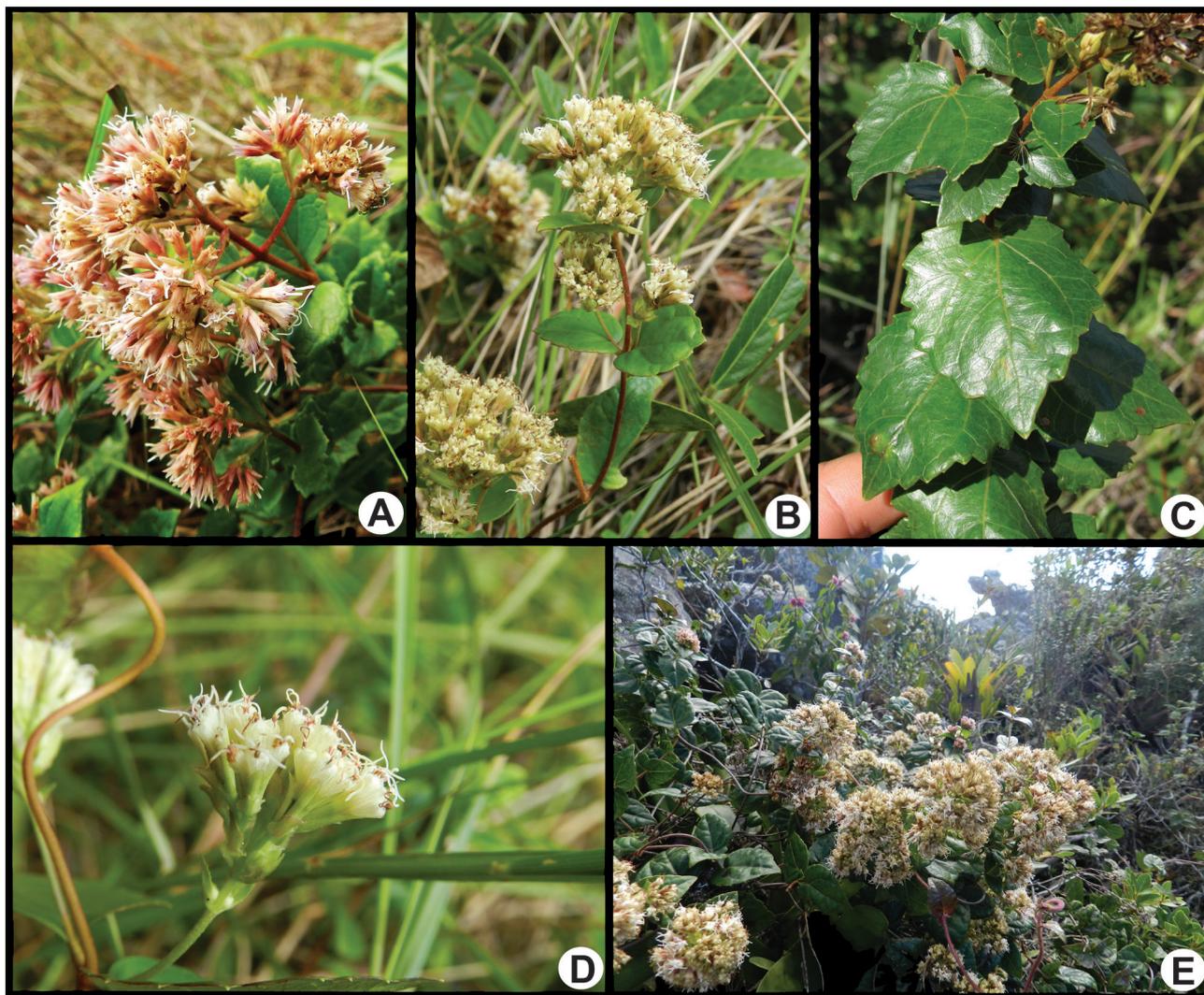
al. 2015), which can be further aggravated by the lack of management and control. Invasion by alien species can be also intensified by wildfires, which are a common practice for pasture renovation in the surrounding areas that had their original vegetation extensively modified (Fig. 1). None of the occurrence areas are included in protected areas, therefore leaving the species habitat susceptible to human disturbance (including predatory collection of plants, garbage dumping, trampling, fire, etc.). Similar to other endemic species of Serra do Padre Ângelo, the population of *M. semirii* was affected by an anthropogenic fire of large proportions in late 2020 (Andrino & Gonella 2021; Antar *et al.* 2021b; Kollmann & Gonella 2021). Additionally, mountaintop-restricted endemics are severely threatened by climatic change, as they cannot migrate to higher elevations to remain in their climatic envelopes. Based on the restricted range (AOO of 8 km<sup>2</sup>) and the listed threats, *M. semirii* should be listed

as Critically Endangered based on IUCN criteria B2ab(i, ii, iii) (IUCN 2012).

**Distribution and Habitat:** *Mikania semirii* is probably endemic to Serra do Padre Ângelo and Pico da Aliança in the municipalities of Conselheiro Pena and Alvarenga, respectively, in the State of Minas Gerais (Fig. 1). It is found in the highest areas of these peaks, near the summits, growing in *campos rupestres* vegetation, in sandy soils with organic matter among rock outcrops, from 1430 to 1500 m a.s.l.

**Phenology:** *Mikania semirii* was found fertile in the dry season, in June, July, and August.

**Additional Specimens Examined (Paratypes):** BRAZIL. Minas Gerais: Alvarenga, Pico da Aliança, cume do pico, 19° 23' 44" S, 41° 40' 40" W, 1430 m alt., 4/VIII/2014, C.T. Oliveira *et al.* 1011 (SPF); Conselheiro Pena, Pico do Padre Ângelo, no topo do pico, 19°19'14.2"S, 41°34'43.7"W, 1530 m alt., 8/VII/2014, P.M. Gonella *et al.* 681 (SPF); *ibid.*,



**Figure 3.** *Mikania semirii* C.T.Oliveira & Antar **A.** Inflorescence detailing the pinkish involucre bracts. **B.** Inflorescence. **C.** Leaves. **D.** Part of inflorescence, detailing whitish involucre bracts. **E.** Habit and habitat. **A-B.** Photos by Caetano T. Oliveira. **C-E.** Photos by P.M. Gonella.

Serra do Padre Ângelo, Pico do Padre Ângelo, platô do topo do pico, 19° 19' 05.04" S, 41° 3' 42.26" W, 1480 m alt., 11/VI/2020, P.M. Gonella et al. 1423 (SPF); ibid., 21/VIII/2020, P.M. Gonella 1566 (SPF).

**Affinities and morphological notes:** *Mikania semirii* presents a unique combination of the following features: lianescent habit; ovate leaf blade, with cordate or rounded base, adaxially glabrous and abaxially glabrescent, with serrulate, revolute to slightly revolute margins. The subinvolucral bracts are elliptic and located directly beneath the capitulum, the peduncles are sessile to 1 mm long and the involucral bracts pinkish or whitish.

The new species is morphologically similar to *M. phaeocladus* which also occurs in the State of Minas Gerais, but their distributions do not overlap.

***Mikania funkiae*** C.T.Oliveira & Antar, *sp.nov.* (Figs. 1, 4, 5)

Type: BRAZIL. Minas Gerais. Alvarenga. Pico da Aliança. Cume do pico. 19° 23' 44" S, 41° 40' 40" W, 1430 m, 4/VIII/2014, C.T. Oliveira et al. 1008 (holotype SPF, isotypes to be distributed to BHCB, RB)

*Mikania funkiae* is morphologically similar to *Mikania glauca*, as both share a similar shrubby habit, and glabrous leaves with slightly revolute margins. However, they differ in that *M. funkiae* possesses coriaceous leaves without wax (vs. leaves chartaceous, mostly waxy), petiole 0.3-0.6 cm long (vs. petiole absent to 1 mm long), leaf margins with 3-4 pairs of obtuse teeth above the mid portion of the blade (vs. blade entire or sinuate) and leaf shape obovate or wide elliptic (vs. wide elliptic or suborbiculate).

Shrub erect, ca. 60 cm tall, perennial; stems glabrous, angulose, canaliculate, becoming ± cylindrical and striate when older. Leaves opposite, petiole 0.3-0.6 cm long, glabrous, blade 3.3-5.7 × 2.4-5.0 cm, coriaceous, orbiculate, obovate or wide elliptic, apex obtuse, base attenuate or cuneate, margins eciliate, revolute, entire to mid portion of blade, 3-4 toothed distally, teeth obtuse, venation actinodromous, primary and secondary veins ± prominent, adaxial surface glabrous to glabrescent with few simple eglandular trichomes, shiny, abaxial surface glabrous and punctate with small glands sunken in blade. Capitulescence a terminal raceme, sessile or shortly pedunculate, peduncle up to 2 mm long, villous with curved trichomes; subinvolucral bracts 1, 1.8-2.6 × 0.6-0.9 mm, narrow elliptic or narrow oblong, apex rounded, ciliate, just beneath capitulum or slightly lower on peduncle. Capitula discoid, 4.8-5.6 mm tall; involucre greenish, cylindrical, 2.1-2.5 mm diam.; involucral bracts 4, 3.0-3.8 × 1.2-1.5 mm, 2 inner bracts slightly larger than 2 outer, persistent, oblong or narrow obovate, stiffly chartaceous, apex obtuse, ciliate, venation parallel, inconspicuous. Florets 4, unisexual, fertile; corolla 3.1-3.5 mm long, white, tube 1.3-1.7 mm long, always longer than limb, limb 0.9-1.2 mm long, lobes 5, 0.8-1.0 × 0.5-0.6 mm, deltate, apex acute or shortly acuminate,

divergent relative to tube, reflexed; anthers 0.7-0.8 mm long, straw-colored, apical anther appendages ovate, apex acute, base rounded; style 3.3-4.5 mm long, style branches 1.5-1.7 mm long, papillose. Cypselae 1.7-2.1 × 0.4-0.6 mm, carbonized, punctate with scattered glands, mostly near apex and base, 5-ribbed, white, setulate, with twin hairs; carpodium present, present, annuliform, pale, glabrous; pappus bristles ca. 40, uniseriate, barbellate, 3.1-3.5 mm long, longer than cypselae, whitish.

**Etymology:** The species epithet honors the late botanist and synantherologist Dr Vicki Ann Funk (1947-2019), who was a Senior Researcher and Curator at the Smithsonian National Museum of Natural History, Washington D.C., United States of America. Dr Funk greatly contributed to the knowledge of Asteraceae as well as to the understanding of phylogenetic relationships and biogeography of the family.

**Preliminary Conservation Status:** Critically Endangered: CR B2ab(i, ii, iii). *Mikania funkiae* is currently known only from the type collection at the summit of Pico da Aliança (Fig. 1), where less than 20 individuals have been observed, which suggests it is a rare and microendemic species. The taxon is not protected by any conservation area, and is vulnerable to the same threats listed above for *M. semirii*, therefore being assessed as Critically Endangered based on criteria B2ab(i, ii, iii) of IUCN (IUCN 2012).

**Distribution and Habitat:** *Mikania funkiae* is probably endemic to the summit of Pico da Aliança, in the municipality of Alvarenga, State of Minas Gerais. It is found growing in *campos rupestres* in dry sandy soils among rocks, at around 1400 m a.s.l. (Fig. 1).

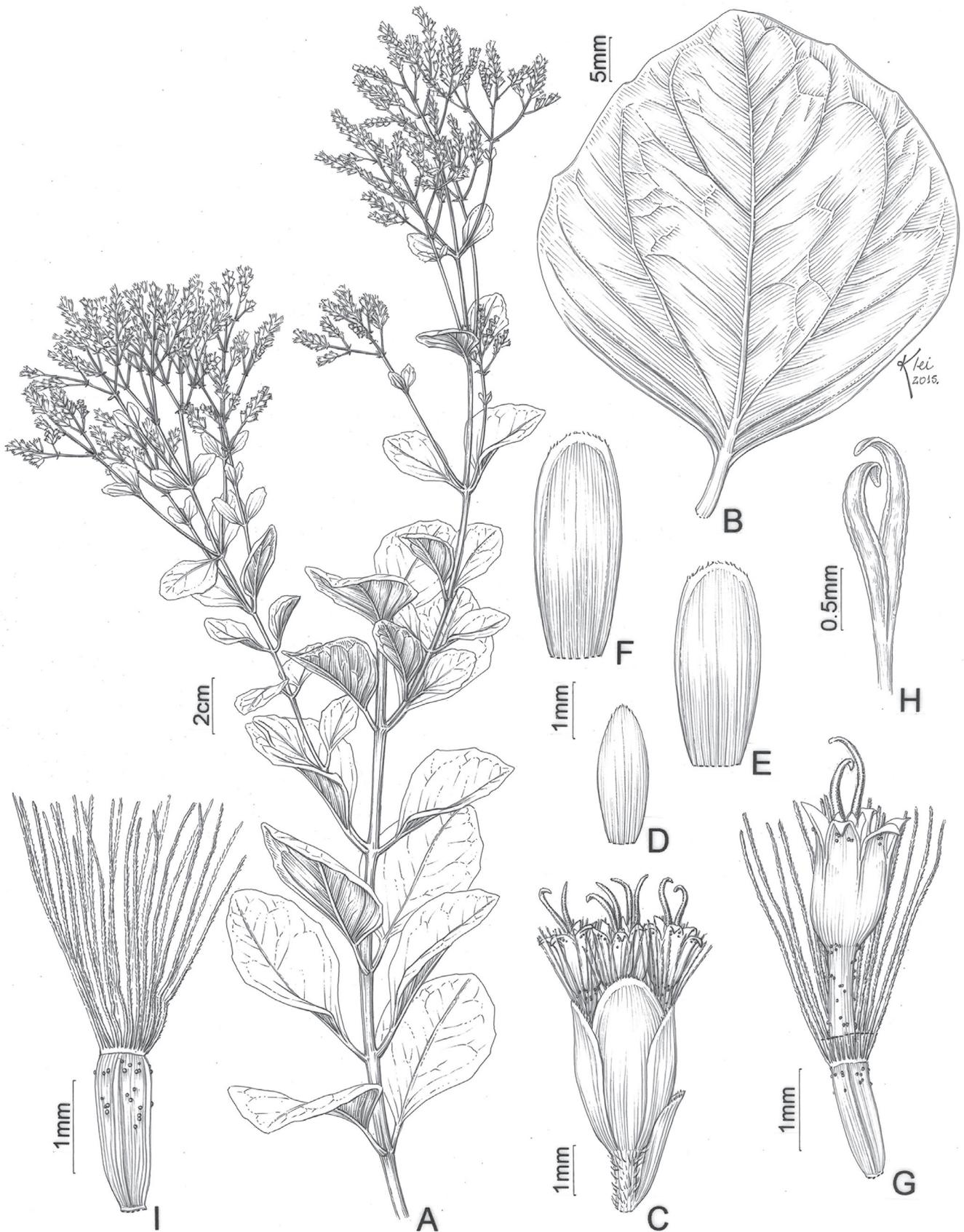
**Phenology:** *Mikania funkiae* was found fertile in August.

**Affinities and morphological notes:** *Mikania funkiae* has the following unique combination of characters: shrubby habit, opposite, petiolate leaves that are coriaceous, orbiculate, obovate or wide elliptic, with slightly revolute margins, and sessile or shortly pedunculate inflorescence, with peduncles up to 2 mm long. The new species is morphologically similar to *Mikania glauca*, which also occurs in Minas Gerais State but not recorded in the same region. Both species differ by the features indicated in the diagnosis. *Mikania funkiae* is also similar to *M. obtusata* based on the shrubby habit, opposite, glabrous leaves with attenuate base and slightly revolute margins, and similar petiole length. However, the new species differs from *M. obtusata* by the presence of 3-4 pairs of obtuse teeth above the mid portion of the blade (vs. margins entire, repand), coriaceous leaf texture (vs. chartaceous) and obovate or broad-elliptic blade (vs. elliptic).

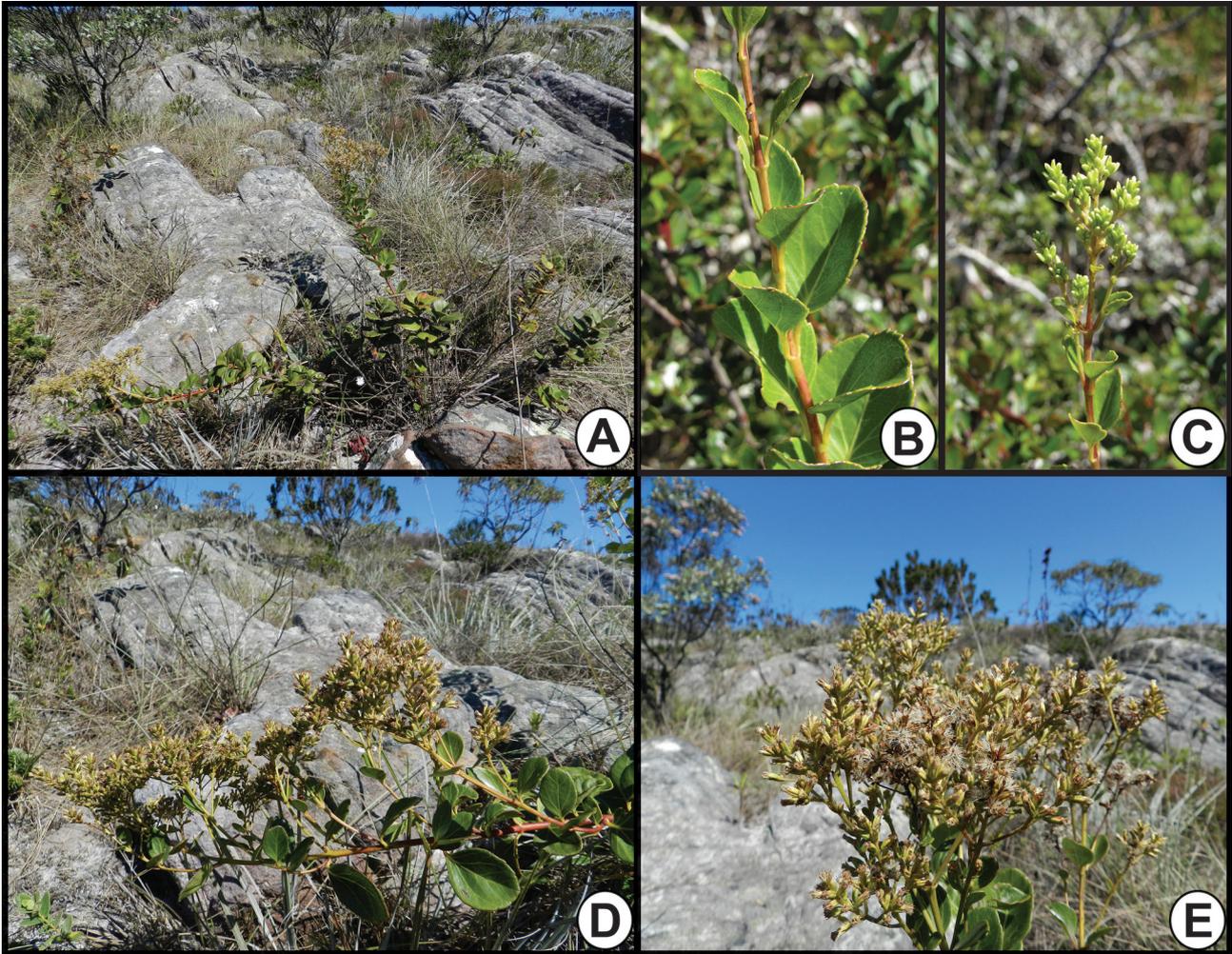
### Final remarks

Species of *Mikania* are usually widely distributed and without a very specific niche. A few species are microendemics and/or exclusive of restricted habitats, such as some *Cerrado* and *campo rupestre* taxa (e.g. *M. nelsonii*, Hind 1993;





**Figure 4.** *Mikania funkiae* C.T.Oliveira & Antar **A.** Leafy flowering branch. **B.** Leaf abaxial surface. **C.** Capitulum. **D.** Subinvolucral bract. **E.** Outer involucral bract. **F.** Inner involucral bract. **G.** Floret, with the pappus partially removed for a clearer view. **H.** Style arms. **I.** Cypsela with pappus. Illustration by Klei Souza, based on C.T. Oliveira et al. 1008 (SPF).



**Figure 5.** *Mikania funkiae* C.T.Oliveira & Antar **A.** Habit and habitat. **B.** Leaves. **C.** Young Inflorescence (capitulescence). **D.** Branch bearing leaves and inflorescence. **E.** Branch bearing inflorescence. **A, D** and **E.** Photos by Caetano T. Oliveira. **B-C.** Photos by P.M. Gonella.

*M. fasciculata*, Oliveira *et al.* 2016; *M. cipoensis*, Ritter *et al.* 2020). The distribution pattern documented herein for *M. semirii* and *M. funkiae*, restricted to the summits of two mountaintops within the Atlantic Forest domain, has not been previously reported for the genus. Further collection efforts are needed to confirm the restricted distribution of these two new taxa, as well as ongoing phylogenetic studies that may shed light on their evolution and origin.

The present results highlight a well-documented gap in botanical collections in Brazil and South America as a whole (Mori *et al.* 2011; BFG 2015; Morim & Lughadha 2015; Oliveira *et al.* 2017, 2019). Even though the Atlantic Forest is one of the most intensively collected Brazilian phytogeographic domains (Oliveira *et al.* 2019), the few expeditions carried out so far in the underexplored areas of Serra do Padre Ângelo and Pico da Aliança have revealed 24 new taxa in different angiosperm families, including the two new species proposed herein. This study highlights the need for more botanical expeditions and sampling effort in these mountains, as well as the importance of active conservation plans for these localities.

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