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Research article

Hemipogon trilobatus sp. nov. (Apocynaceae: Asclepiadoideae), a new microendemic from Chapada dos Veadeiros, Central Brazil

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Abstract. *Hemipogon* s. str. (Apocynaceae: Asclepiadoideae) currently consists of three species sharing an erect herbaceous habit, narrow leaves and corona-less flowers with urceolate, internally bearded corolla, that are mainly distributed in savannahs of the Cerrado biodiversity hotspot, South America. Here, we describe and illustrate a new species of *Hemipogon*, *H. trilobatus* Bitencourt & Rapini sp. nov., from an open savannah in Chapada dos Veadeiros, Central Brazil. *Hemipogon trilobatus* sp. nov. differs from the other species of the genus mainly by the presence of a reduced staminal corona with 3-lobed lobes, but also by opposite leaves and triangular anthers. Distribution and habitat data, as well as a key and a comparative table to distinguish the four species currently accepted in *Hemipogon* s. str., are provided. Based on criteria B2ab(i,ii,iii,iv) of the International Union for Conservation of Nature (IUCN), the species is provisionally assessed as Critically Endangered.

Keywords. Cerrado, Metastelmatinae, Neotropics, savannah, taxonomy.

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Introduction

Hemipogon Decne. (Apocynaceae Juss.: Asclepiadoideae Burnett) belongs to the neotropical subtribe Metastelmatinae Endl. ex Meisn. and originally comprised erect perennial herbs with narrow leaves and urceolate, internally bearded, corona-less flowers (Fournier 1885). The genus was enlarged with the inclusion of twining plants with corona-less flowers classified in the American *Astephanus* R.Br. and erect herbs with corona-bearing flowers segregated from *Metastelma* R.Br. (Rapini *et al.* 2001; Rapini 2002). Phylogenetic studies (Ribeiro *et al.* 2012, 2014; Silva *et al.* 2012), however, showed that these two groups form a lineage predominantly distributed through the campos rupestres (rocky

grasslands on quartzite outcrops) of the Espinhaço Range and are not closely related to *Hemipogon acerosus* Decne., the type of the genus. The phylogenetic inference indicates that the corona was lost several times within Metastelmatinae and thus *Hemipogon* should be treated under its narrow concept, comprising only three species, *H. acerosus*, *H. setaceus* Decne. and *H. irwinii* Fontella & Paixão, or four, if *H. acerosus* var. *platyphyllus* Hoehne would be recognised at the species level (Bitencourt 2019). Using this narrow circumscription, *Hemipogon* is predominantly distributed in savannahs, and less often in campos rupestres of the Cerrado domain, in Central Brazil, reaching Bolivia, Peru and Paraguay.

Cerrado is a biodiversity hotspot (Myers *et al.* 2000) and the world's most diverse savannah, with around 6910 species of flowering plants, approximately 3815 of which are endemic (Silva & Bates 2002; Flora do Brasil 2020). Despite its great importance, about half of the area originally occupied by Cerrado has been lost due to the implantation of pasture and commercial crops, mainly soybean and corn, and only 10% of its original area is protected in conservation units (Beuchle *et al.* 2015). Chapada dos Veadeiros in the Brazilian Cerrado houses savannahs in lowlands and patches of campos rupestres over mountaintops up to 1683 m a.s.l. (topographic map, https://www.arcgis.com/), and is considered a conservation priority area due to the high level of unique evolutionary diversity (Carvalho *et al.* 2015; Fenker *et al.* 2020).

Describing the biodiversity is an essential step to understand evolutionary and biogeographic patterns, and establish conservation strategies (Brach & Boufford 2011; Ulloa *et al.* 2017). This task is especially relevant in areas under high pressure, such as the Cerrado hotspot. Herbaria are important source of new species (Prance 2001; Joppa *et al.* 2010; Bebber *et al.* 2010) and most undescribed species are discovered a long time after a first specimen was collected (Bebber *et al.* 2010). Here, we describe a new species from Chapada dos Veadeiros first collected 28 years ago. It fits the narrow concept of *Hemipogon* and is here provisionally assessed as Critically Endangered.

Material and methods

As part of a large study which aims to propose a new circumscription for the genus *Hemipogon*, specimens from different species of South American savannahs were examined in herbaria and collected *in situ*. Morphological measurements for this study were taken from specimens in the herbaria BHCB, CEN, HBR, HRB, HUEFS, IBGE, LPB, MBM, MO, NY, R, RB, UB, UFG, UFMT and USZ (acronyms according to the Index Herbariorum, Thiers continuously updated: http://sweetgum.nybg.org/science/ih/). Morphological terms follow Beentje (2016) and Endress *et al.* (2018). A provisional species conservation status was inferred based on IUCN (2019), according to the categories, criteria and conditions outlined in the Red List Guidelines. We used the GeoCAT tool (Bachman *et al.* 2011) to calculate the area of occupancy (AOO) using a 2×2 km^2 cell resolution.

Results

Class Magnoliopsida Brongn.
Order Gentianales Bercht. & J.Presl
Family Apocynaceae Juss.
Subfamily Asclepiadoideae Burnett
Genus *Hemipogon* Decne.

Hemipogon trilobatus Bitencourt & Rapini sp. nov.
urn:lsid:ipni.org:names:77213240-1
Figs 1–2

Diagnosis

Flowers with reduced, apically 3-lobed corona lobes. Similar to *H. acerosus* due to the acicular leaves, sessile cymes and urceolate corolla, internally bearded along the lobe basal half, but can be distinguished by the opposite leaves (vs verticillate in *H. acerosus*) and presence of a corona (vs absence in *H. acerosus*).

Etymology

The epithet '*trilobatus*' refers to the apically 3-lobed corona lobes.

Type material

BRAZIL • Goiás, Alto Paraíso de Goiás, Chapada dos Veadeiros, 9 km de Alto Paraíso para Vila São Jorge, Cachoeira São Bento; 9 Sep. 1994; *M. Aparecida da Silva, T.S. Filgueiras, R.C. Mendonça, M.L.F. Resende, F.C.A. Oliveira and E. Cardoso 2320*; holotype: IBGE[33546]!; isotype: RB[496900]!.

Paratype
BRAZIL • Goiás, Alto Paraíso de Goiás, Chapada dos Veadeiros; 14 Aug. 1992; *H.D. Ferreira 2579*; UFG[14114]!.

Description

Herbs to subshrub erect, 20–30 cm tall; stems 2 or 3, diverging at base, cylindrical, glabrescent; latex white. *Leaves* opposite, obliquely erect, sessile, acicular to narrowly elliptic, 0.7–1 × 0.1–0.13 mm, apex acute, base cuneate, margins entire, coriaceous, glabrescent. *Cymes* alternate, 2- or 4-flowered, subaxillary; bracts lanceolate, ca 1.5 × 0.6 mm, glabrous, sessile. *Flowers* with pedicel 1–1.5 mm long; sepals ovate, 1.5–1.6 × 0.5–0.7 mm, apex acute, glabrescent, axillary colleters not seen; corolla urceolate, probably cream or white, abaxially glabrescent, adaxially bearded from base to centre of lobes, tube 0.5–0.7 × 0.8–1.1 mm, lobes triangular, 1–1.2 × 0.8–1 mm, apex acute and recurved; corona staminal, lobes short, at base of anthers, oblate, 0.3–0.45 × 0.7–0.76 mm, apex 3-lobed; anthers 0.45–0.5 × 0.6–0.7 mm, triangular, wings triangular, 0.3–0.4 × 0.15–0.2 mm, connective appendage oblong, 0.3–0.4 mm long, over gynostegium; corpusculum ellipsoid, 0.17–0.25 × 0.08–0.1 mm; caudicles horizontal, ca 0.05 mm long, subapically attached to pollinia; pollinia ellipsoid, 0.16–0.2 × 0.06–0.08 mm; style-head apically mammillate, included within corolla tube. *Follicles* not seen.

Distribution, habitat and phenology

Hemipogon trilobatus sp. nov. is known from a small population nearby the São Bento waterfall, in Chapada dos Veadeiros, Goiás, Brazil (Fig. 2). It grows in open savannah and wet grasslands locally known as "várzea" and was collected with flowers in August and September. The species has not been found since a fire burned the type locality (M.A. da Silva, pers. com., 2015).

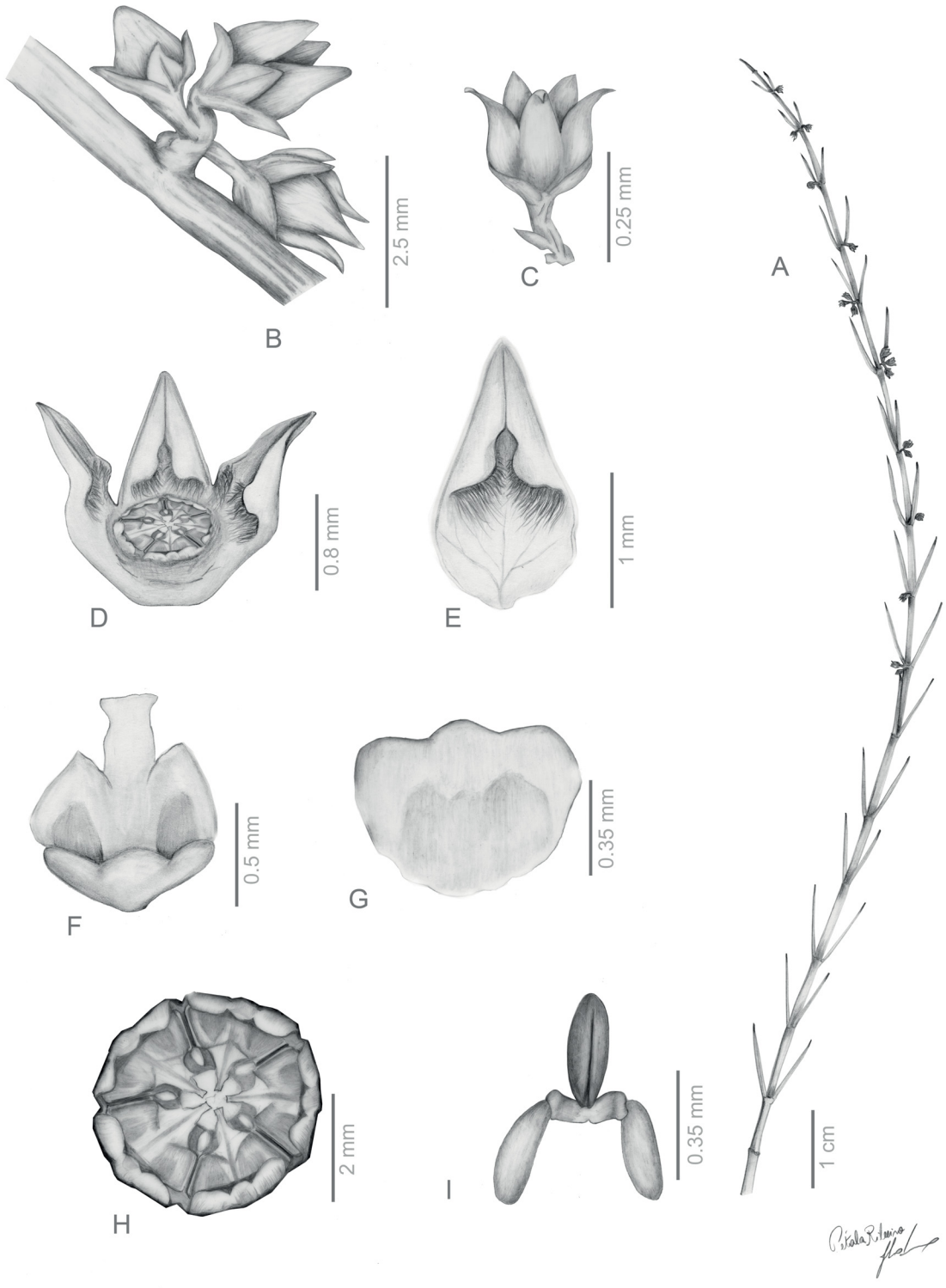

Fig. 1. *Hemipogon trilobatus* Bitencourt & Rapini sp. nov. **A**. Habitus. **B**. Cyme with two flowers and a bud. **C**. Flower. **D**. Flower with calyx and two corolla lobes removed to show the gynostegium. **E**. Corolla lobe, adaxial view. **F**. Anther with a staminal corona lobe basally attached. **G**. Corona lobe showing the 3-lobed apex, adaxial view. **H**. Gynostegium, viewed from above. **I**. Pollinarium. Drawn by Pétala Gomes Ribeiro from the holotype (IBGE[33546]).

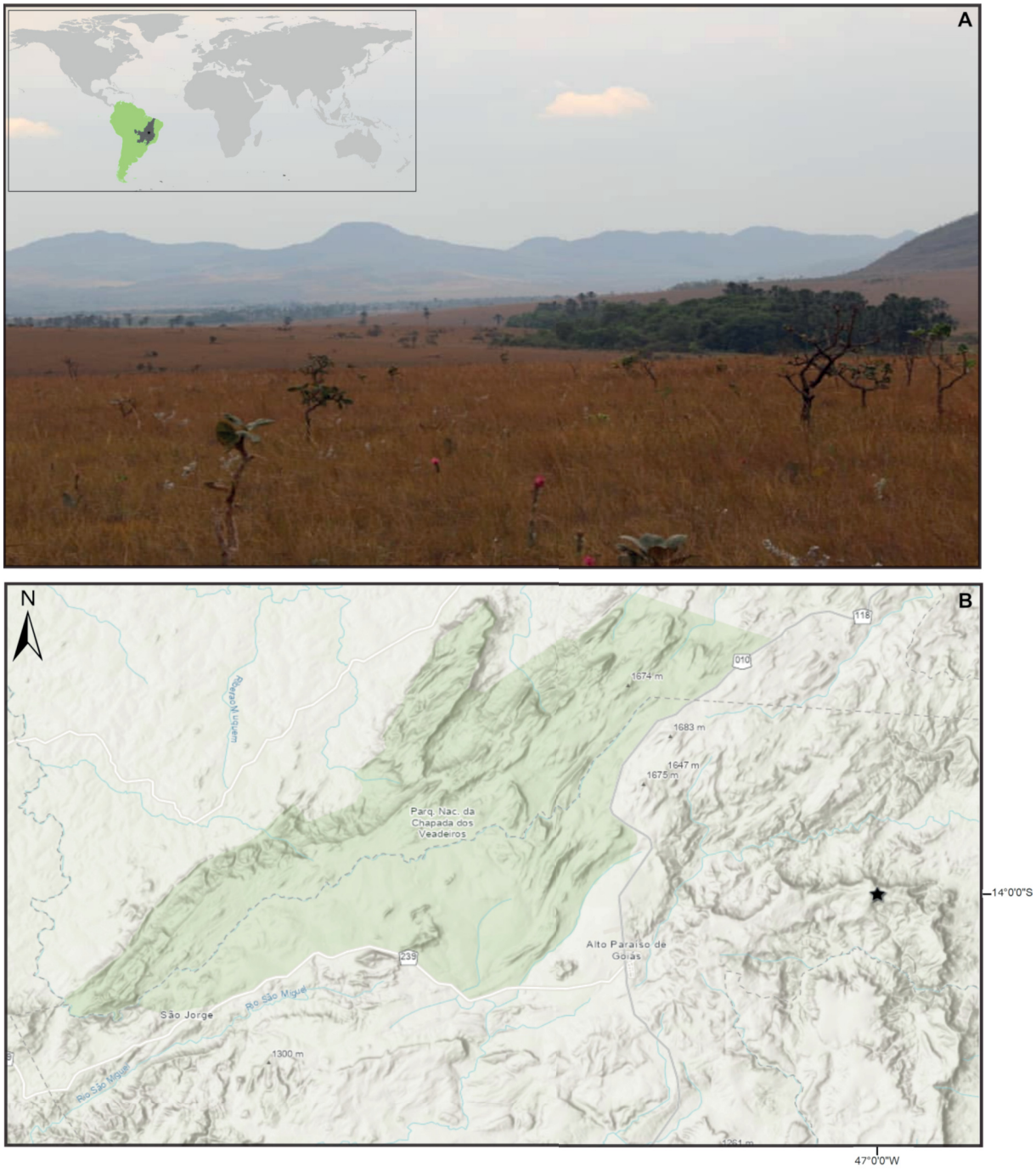

Fig. 2. Habitat and distribution of *Hemipogon trilobatus* Bitencourt & Rapini sp. nov. **A**. Open savannah in Chapada dos Veadeiros, state of Goiás, Brazil. Photo by CB. **B**. Map showing the geographic distribution of *H. trilobatus* sp. nov. in the Cerrado domain (shaded area at reference map in A) and its occurrence (black star) nearby the Chapada dos Veadeiros National Park. Images and distribution maps were built and exported using ArcGIS online (https://www.arcgis.com). © Esri and its licensors, all rights reserved.

Provisional conservation status

Hemipogon trilobatus sp. nov. is known from only two collections, both near the São Bento waterfall, in Chapada dos Veadeiros. Specimen labels provide no information about population density. However, the species is known to occur in a tourist location, surrounded by farms and cattle raising, has an area of occupancy (AOO) estimated at 8 km^2, probably under continuing decline in geographic range and habitat quality. During fieldwork in the type locality, we did not find any specimen of *H. trilobatus* sp. nov. and the new species has not been recollected since 1994. Based on criteria B2ab(i,ii,iii,iv) of the International Union for Conservation of Nature (IUCN 2019) Red List assessment, we provisionally classify the species as Critically Endangered (CR).

Taxonomic note

Hemipogon trilobatus sp. nov. has narrow leaves, urceolate corolla with bearded lobes and was found in a savannah of Central Brazil. Together, these features support its classification in *Hemipogon* s. str. It most closely resembles *H. acerosus* based on the acicular leaves and sessile cymes, but differs from all other taxa in the genus by the opposite leaves and flowers with reduced corona lobes, as presented in the key below and Table 1.

Key to species of the genus *Hemipogon* s. str.

1. Leaves opposite; flowers with short, 3-lobed staminal corona lobes ..... ***H. trilobatus*** Bitencourt & Rapini sp. nov.
– Leaves verticillate or spirally arranged, flowers without corona 2

2. Leaf blade filiform, spirally arranged 3
– Leaf blade acicular or ovate to lanceolate, verticillate 4

3. Corolla lobes 8.5–10 mm long, twisted in the bud, adaxially barbate on the basal half, sericeous on the apical half ..... ***H. irwinii*** Fontella & Paixão
– Corolla lobes 3.8–7 mm long, straight in the bud, adaxially barbate on the basal third, puberulous towards the apex ..... ***H. setaceus*** Decne.

4. Leaves sessile, the blade acicular, ≤ 1.5 mm wide ..... ***H. acerosus* var. *acerosus*** Decne.
– Leaves petiolate, the blade ovate to lanceolate, ca 3 mm wide ..... ***H. acerosus* var. *platyphyllus*** Hoehne

Discussion

Asclepiadoideae is a cosmopolitan subfamily with approximately 180 genera and 3200 species (Endress *et al.* 2018); around one third of this diversity is represented in the Americas (Good 1952; Rapini 2012). The proportion of narrowly distributed species and genera in the subfamily is high (Good 1952), and many species are known only from the type locality (Endress *et al.* 2018). Brazil harbours 35 native genera of Asclepiadoideae, only five of them including more than 15 species. Narrowly distributed species of Asclepiadoideae are common in the country (Rapini *et al.* 2001, 2002, 2009; Rapini 2010) and several Brazilian microendemics have been described in the last years (e.g., Bitencourt *et al.* 2020). This contributed to the increase of the number of Asclepiadoideae species in Brazil from 376 (Rapini *et al.* 2005) to 400 (Flora do Brazil 2020) in the last 15 years.

Some of the Asclepiadoideae microendemics are poorly known due to the limited number of collections. *Hemipogon abietoides* E.Fourn., described in *Flora Brasiliensis* (Fournier 1885) from a specimen collected by Riedel during the legendary expedition headed by Langsdorff through the Espinhaço Range of Minas Gerais, for instance, was recollected only 175 years after its original collection (Rapini

Table 1. Diagnostic characters to distinguish the species of *Hemipogon* s. str.

Characters	***H. trilobatus* sp. nov.**	***H. acerosus***	***H. irwinii***	***H. setaceus***
Leaves	opposite and acicular	verticillate and acicular	spirally arranged and filiform	spirally arranged and filiform
Corolla	probably cream or white	cream	white	cream
Corona	present	absent	absent	absent
Anther	triangular	subtriangular	subsagittate	subtringular
Corpusculum	ellipsoid	ellipsoid	oblong	ellipsoid

et al. 2010). Molecular phylogenetic analyses (Ribeiro *et al.* 2012, 2014; Silva *et al.* 2012), however, showed that this species together with *H. hemipogonoides* (Malme) Rapini and *H. hatschbachii* (Fontella & Marquete) Rapini, both erect herbs with narrow leaves and endemic to the campos rupestres (rocky grasslands on quartzite outcrops) of Serra do Cipó in the Espinhaço Range, belong to a lineage distant to *Hemipogon* s. str. and sister to the clade of twining plants predominantly distributed in the Espinhaço Range and assigned to the recently described *Morilloa* Fontella, Goes & S.Cáceres (= the former American *Astephanus*; Fontella-Pereira *et al.* 2014).

Unpublished plastome phylogenetic analyses confirmed that convergences in Metastelmatinae are more common than previously supposed. They showed that two other species from the Espinhaço Range, also morphologically similar to *Hemipogon* s. lat. but endemic to cangas (rocky grasslands on iron outcrops) of the Iron Quadrangle form a clade separate from both *Hemipogon* s. str. and *Morilloa* (Bitencourt 2019). The two species were recently described in the non-monophyletic *Ditassa* R.Br., as *D. cangae* Bitencourt & Rapini and *D. ferricola* Bitencourt & Rapini (Bitencourt *et al.* 2020). The erect habit, narrow leaves and urceolate corolla of *Hemipogon trilobatus* sp. nov. may also represent another example of morphological convergence. In preliminary phylogenetic analyses of ITS rDNA sequence data, *H. acerosus* and *H. trilobatus* sp. nov. appeared in a polytomy, but not closely related to *Morilloa* (unpublished results). The geographical distribution of *H. trilobatus* sp. nov., restricted to an open savannah in Central Brazil rather than cangas or campos rupestres of Espinhaço Range, can be regarded as additional evidence for its placement in *Hemipogon* until further phylogenetic studies may provide new insights towards a new generic circumscription in Metastelmatinae and a more confident placement for *H. trilobatus* sp. nov.

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Authors' contributions

AR recognised the new species. CB examined the types and paratypes, described the new species and wrote a first draft of the manuscript. CB and AR revised the manuscript with additional contributions from APBS and CS. All authors revised the final version of the manuscript.

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