



# *Heterocypsela brachylepis* (Compositae: Vernoniaeae: Dipterocypselinae), a new species from the Brazilian dry forest

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**Summary.** Limestone or calcareous outcrops are geological formations that support tropical forests regarded as relict communities with many endemic species. However, these environments are constantly threatened by mining of calcareous rock. The genus *Heterocypsela* H. Rob. (Compositae, Vernoniaeae: Dipterocypselinae) has been long-known from only one species which is endemic to Brazilian limestone outcrops in the State of Minas Gerais. During field work on limestone outcrops of northern Minas Gerais, a second species of *Heterocypsela* was discovered. This species is described in the genus *Heterocypsela* since it has relatively long-pedunculate heads, dimorphic cypselae with only cubic crystals, glandular apical anther appendages and echinolophate type “C” pollen. Further investigation in herbarium specimen databases (Specieslink and Herbario Virtual Re flora) revealed other specimens of a new species, *Heterocypsela brachylepis* J.N. Nakaj. & D. Marques, expanding its geographic distribution to southwestern Bahia and southeastern Tocantins States in Brazil, in the same habitat. *Heterocypsela brachylepis* is described and illustrated. Despite its wide geographic distribution, this species should be considered Critically Endangered (CR), criterion D according to the IUCN guidelines, due to its restricted occurrence and few individuals.

**Key Words.** Asteraceae, calcareous rock, karst outcrops, endemic species, mining, taxonomy.

## Introduction

Karst or limestone outcrops are biologically important because they have a wealth of endemic species (Cowling *et al.* 1994; Xu 1995; Willis *et al.* 1996a, b; Bardot-Vaucoulon 1997; Médail & Verlaque 1997; Vermeulen & Whitten 1999; Tuyet 2001; Zhu *et al.* 2003; Clements *et al.* 2006; Hart 2007; Espírito Santo *et al.* 2018). These outcrops present very specific environmental conditions such as alkaline, shallow and rich soils, with large amounts of calcium, magnesium and potassium (Arruda *et al.* 2015), high temperatures and solar incidence and low availability of water (Espírito Santo *et al.* 2018). Due to these characteristics, the dry forest that grows on these outcrops is highly specialised and tolerant to these extreme conditions, however, it is also very susceptible to environmental disturbances (Médail & Verlaque 1997).

Since calcareous outcrops are composed mainly of calcium carbonate (Radam Brasil 1982), it is possible to extract limestone, an important raw material used in the cement industry (Clements *et al.* 2006). This mining, in conjunction with other human impacts, threatens the unique plant diversity of these outcrops (Vermeulen & Whitten 1999; Clements *et al.* 2006; Day 2010a, b; Coelho *et al.* 2012; Melo *et al.* 2013). The tropical dry forests are the most threatened terrestrial ecosystem on the planet (Janzen 1988).

In South America, less than 2% of the territory has calcareous outcrops, and most of these areas are present in Central Brazil (Auler & Farrant 1996; Auler 2004). During a botanical survey on a limestone outcrop of northern Minas Gerais in Brazil, a new species of *Heterocypsela* H. Rob. (Vernoniaeae: Compositae: Dipterocypselae) was found.

*Heterocypsela* is a monospecific genus, represented by *H. andersonii* H. Rob. (Robinson 1979), which is endemic to calcareous outcrops from northern Minas Gerais State, Brazil (Robinson 1979; BFG 2015). It can be recognised by its dimorphic cypselae, relatively long-pedunculate heads, glandular anther appendages, quadrate raphids on the cypselae wall and echinolophate type ‘C’ pollen (Robinson 1979, 1999). Since the presence of dimorphic cypselae is unique in the tribe Vernoniaeae, Keeley & Robinson (2009) recognised the new subtribe Dipterocypselinae, composed of *Heterocypsela* (Brazil), *Dipterocypsela* S.F. Blake (Colombia) and *Manyonia* H. Rob. (Tanzania). A fourth Brazilian genus, *Allocephalus* Bringel, J.N. Nakaj. & H. Rob., has been added to this subtribe (Bringel *et al.* 2011). All four genera were originally described as monotypic and occur on limestone outcrops in South America and Africa, revealing the importance of this type of environment, which needs to be

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preserved for a better understanding of its biological diversity.

## Materials and Methods

The description of the new species is based on observations of one natural population in northern Minas Gerais State, Brazil, and herbarium specimens. The morphological terminology follows Radford (1986) and Robinson (1979).

For analysis of microcharacters and pollen, one capitulum was softened in boiling water including a drop of detergent. After that, floret samples were mounted in Hoyer's solution (Anderson 1954; King & Robinson 1970) and examined with a Zeiss Axioplan microscope.

The assessment of the conservation status was based on the IUCN Red List Categories and Criteria Version 13 (IUCN 2017).

## Taxonomic Treatment

***Heterocypselia brachylepis* J.N.Nakaj. & D.Marques sp. nov.** Type: Brazil, Minas Gerais, Montes Claros, Fazenda Pequi-Porteirinha, 16°45'43"S, 43°54'42"W, 30 April 2018 (fl.), R. S. Fonseca 1212 (holotype MCCA 01854!; isotype HUFU!, K!, RB!).

*Erect annual herb*, c. 0.3 – 1.6 m tall, roots fasciculate. *Stem* undivided or branched, c. 0.1 – 0.3 cm diam., terete, fistulose, striate, white-greenish, densely glandular-punctate, adpressed setose, trichomes T-shaped, distal internodes 1.8 – 8.2 cm long. *Leaves* simple, alternate, membranaceous, concolorous, distal leaves sessile, basal leaves petiolate, petiole c. 0.5 – 1.5 cm long, blade 6.7 – 21.4 × 2.1 – 9 cm, ovate, elliptic, oblanceolate to obovate, margins serrulate, each tooth with a hydathode, apex acute to acuminate, also with a hydathode, base short to long-attenuate, symmetric or asymmetric, adaxial surface sparsely sericeous, with trichomes T-shaped and glandular punctations, abaxial surface densely sericeous, with trichomes T-shaped and glandular punctations, whitish, venation eucamptodromous, secondary veins 10 – 12 per side, ascendant, prominent above, sericeous. *Capitulescence* terminal, c. 5 – 19 cm long, monochasial or compound dichasial cyme, branches 4 – 6, densely adpressed-tomentose, heads 5 – 21. *Head* discoid, homogamous, long-pedunculate, peduncles 4 – 11 mm long; involucre campanulate, sometimes urceolate, 4.5 – 7 × 4 – 5 mm; phyllaries 34 – 51 per capitulum, 4 – 6 – (– 8)-seriate, imbricate, appressed, striate, outer 2 – 3 × 0.5 – 0.8 mm, ovate, apex acute-apiculate, margins hyaline, fimbriate, sparsely appressed-tomentose, inner 4 – 5 × 1 – 2 mm, elliptic-lanceolate to lanceolate, apex apiculate, sparsely tomentose, glandular-punctate, margins hyaline, fimbriate,

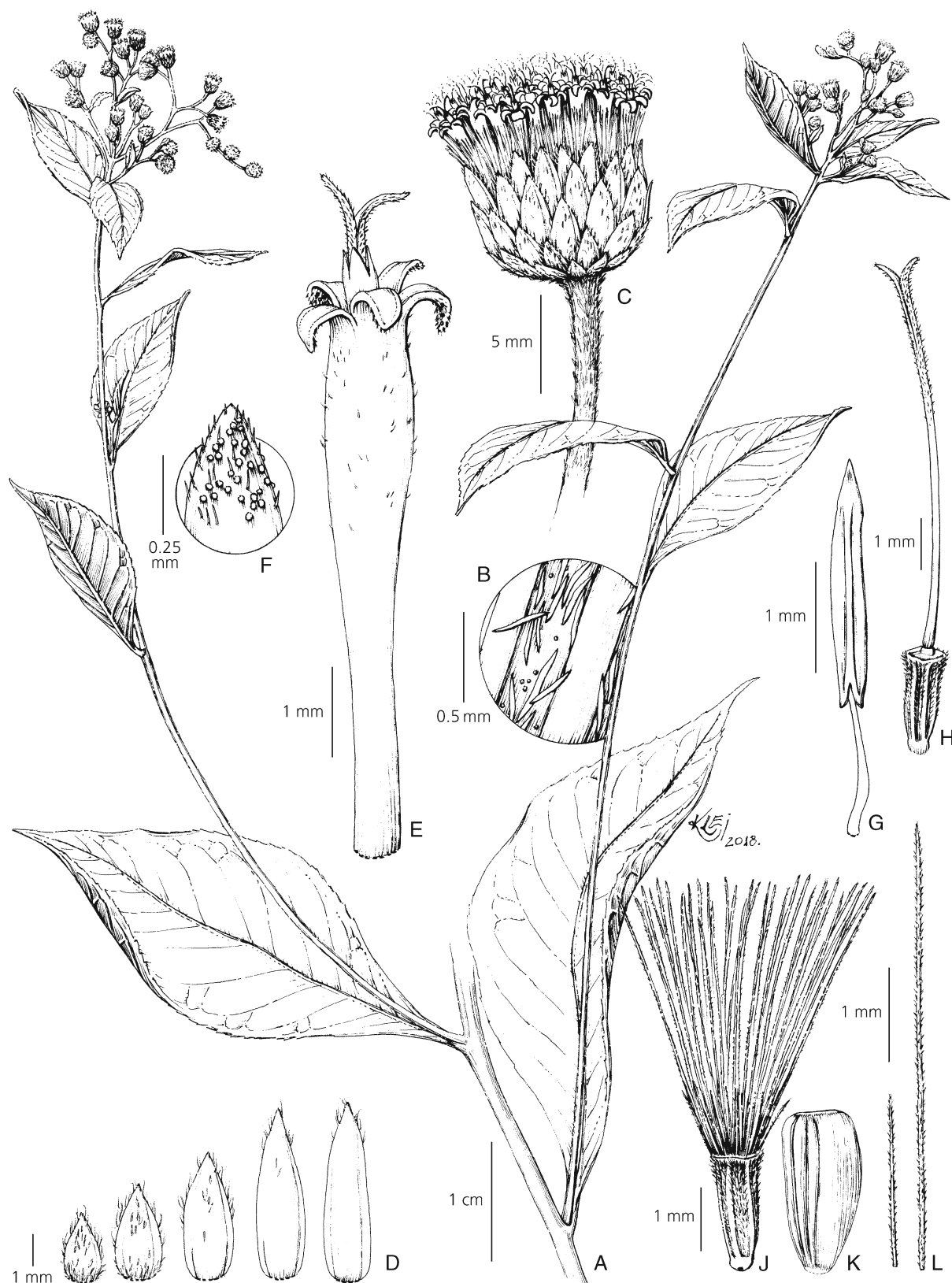
deep red-vinaceous, glabrescent; receptacle flat or convex in mature capitula, epaleaceous, glabrous. *Florets* 30 – 56, perfect, corollas infundibulariform, lilac, tube 2 – 6 mm long, cylindrical, glabrous, throat ampliate, glandular, 1.6 – 3 mm long, sparsely strigillose, lobes 0.8 – 1.5 mm long, lanceolate, apex recurved, abaxially strigillose and punctate-glandular; filaments cylindrical to base, glabrous, anthers c. 2 mm long, apical anther appendages lanceolate, acute, glandulous, basal anther appendages sagittate, with glandular trichomes; styles 4 – 6 mm long, with sweeping hairs below bifurcation point of style arms, basal node slightly enlarged, cells with druses. *Cypselae* dimorphic, exalate, with idioblasts, cubic crystals present in wall, outer cypselae compressed, triquetrous, c. 2.0 mm long, glabrous, externally without ribs, internally 5-ribbed; carpopodium asymmetrical, inconspicuous; inner cypselae 1.8 – 2.0 mm long, prismatic, 8 – 10-ribbed, densely long-setose, glandular-punctate; carpopodium symmetric, annular; outer cypselae epappose; inner cypselae with a biseriate pappus, setae cream-coloured or pinkish, outer series of short bristles, 3 – 4 mm long, inner series of filiform bristles, deciduous, 9 – 10 mm long. Pollen grains echinolophate, tricolporate (type C). Figs 1 – 3.

**RECOGNITION.** The new species differs from *Heterocypselia andersonii* by its ovate outer phyllaries with apiculate apices (vs linear-filiform with acuminate and caudate apices), 30 – 56 florets per capitulum (vs 60 – 70) and corolla tubes glabrous (vs pilose) and corolla lobes with punctuated glands (vs only hirtellous or scabridulous).

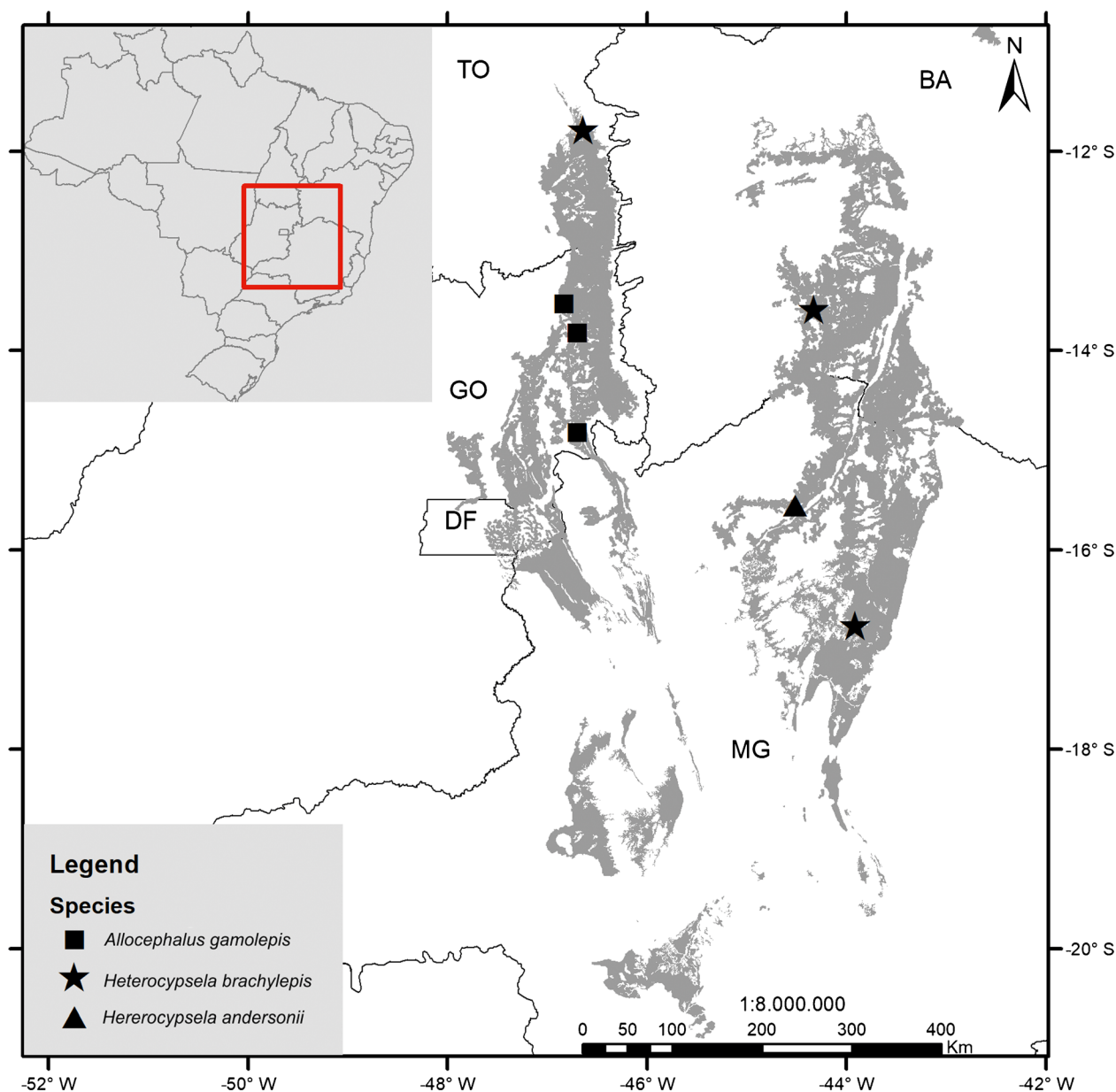
**DISTRIBUTION.** BRAZIL. Minas Gerais: Montes Claros; Tocantins: Novo Jardim; Bahia: Coribe (Map 1).

**SPECIMENS EXAMINED.** BRAZIL. Minas Gerais: Montes Claros, Fazenda Pequi-Porteirinha, 16°45'43"S, 43°54'42"W, 832 m, 30 April 2018 (fl.), R. S. Fonseca 1212 (holotype MCCA!, isotypes HUFU!, K! RB!); loc. cit., 4 Sept. 2017 (fl.), E. Micelli et al. s.n. (HUFU! MCCA 1797!); loc. cit., 9 Sept. 2017 (fl.), E. Micelli et al. s.n. (MCCA 1798!); loc. cit., 16 May. 2018 (fl.); loc. cit., 16 May 2018 (fl.), D. T. Iglesias s.n. (HUEFS! MCCA 2411!); loc. cit., 27 July 2018 (fl. & fr.), H. I. R. Silva & R. S. Fonseca s.n. (MCCA 78! NY!); Tocantins: Novo Jardim, 11°47'09.13"S, 46°38'13.02"W, 653 m, 22 March 2016 (fl.), P. H. A. Melo 4994 & F. F. Pezzini (HRCB, HUFU!); loc. cit., 11°47'02.78"S, 46°38'13.31"W, 632 m, 12 March 2017 (fl.), P. H. A. Melo 6808 & J. A. Lombardi (HRCB, HUFU!); Bahia: Coribe, 24.4 km S de São Felix do Coribe, 10 April 2007 (fl.), L. P. Queiroz 12704 (HUEFS!).

**HABITAT.** *Heterocypselia brachylepis* is found in limestone outcrops of the Bambuí group in the municipalities of Montes Claros, Minas Gerais State; Novo Jardim, Tocantins State; and Coribe, Bahia, State. The Bambuí



**Fig. 1.** *Heterocypsela brachylepis*. A flowering branch; B branch indumentum; C capitulum; D phyllaries (outer (left) to inner (right)); E floret (pappus and ovary removed); F abaxial surface of apex of corolla lobe; G anther; H inner cypsel with style; J inner cypsel with pappus; K outer cypsel; L pappus setae: outer (left), inner (right). DRAWN BY KLEI SOUSA.



**Map. 1.** Distribution map of *Allocephalus* and *Heterocypsela* (subtribe Dipterocypselinae); each genus is endemic to limestone outcrops of the Bambuí group.

group is covered mostly by seasonally dry forests (Arruda *et al.* 2015). The Montes Claros site is a deciduous seasonal forest, at an average elevation of 840 m. The two populations of Montes Claros have about 4 – 30 plants. All plants are therophytes, with seedlings emerging and developing in the rainy season, and dying in the dry season. The root system, which lacks xylopodia (Fig. 2F), grows in the cracks of the calcareous rocks with accumulated soil.

**CONSERVATION STATUS.** *Heterocypsela brachylepis* is considered Critically Endangered CR, criterion D1, according to IUCN (2017). The new species is endemic to calcareous outcrops of the ‘Bambuí’ group. It forms

small populations (4 – 30 plants) growing on calcareous rocks in direct sunlight within dry forest in areas where the canopy is broken. Of the three recorded sites, only two have recognised populations of this species, since Novo Jardim, Tocantins State, is under a process of accelerated mining. The environment around these dry forests has rich soil of great agricultural interest, from which most of the forests have already been removed. The remaining areas, which have outcrops of these rocks, are threatened by mining for cement production, amongst other activities (Espírito Santo *et al.* 2014). These factors promoted alarming rates of loss of plant cover for this forest.



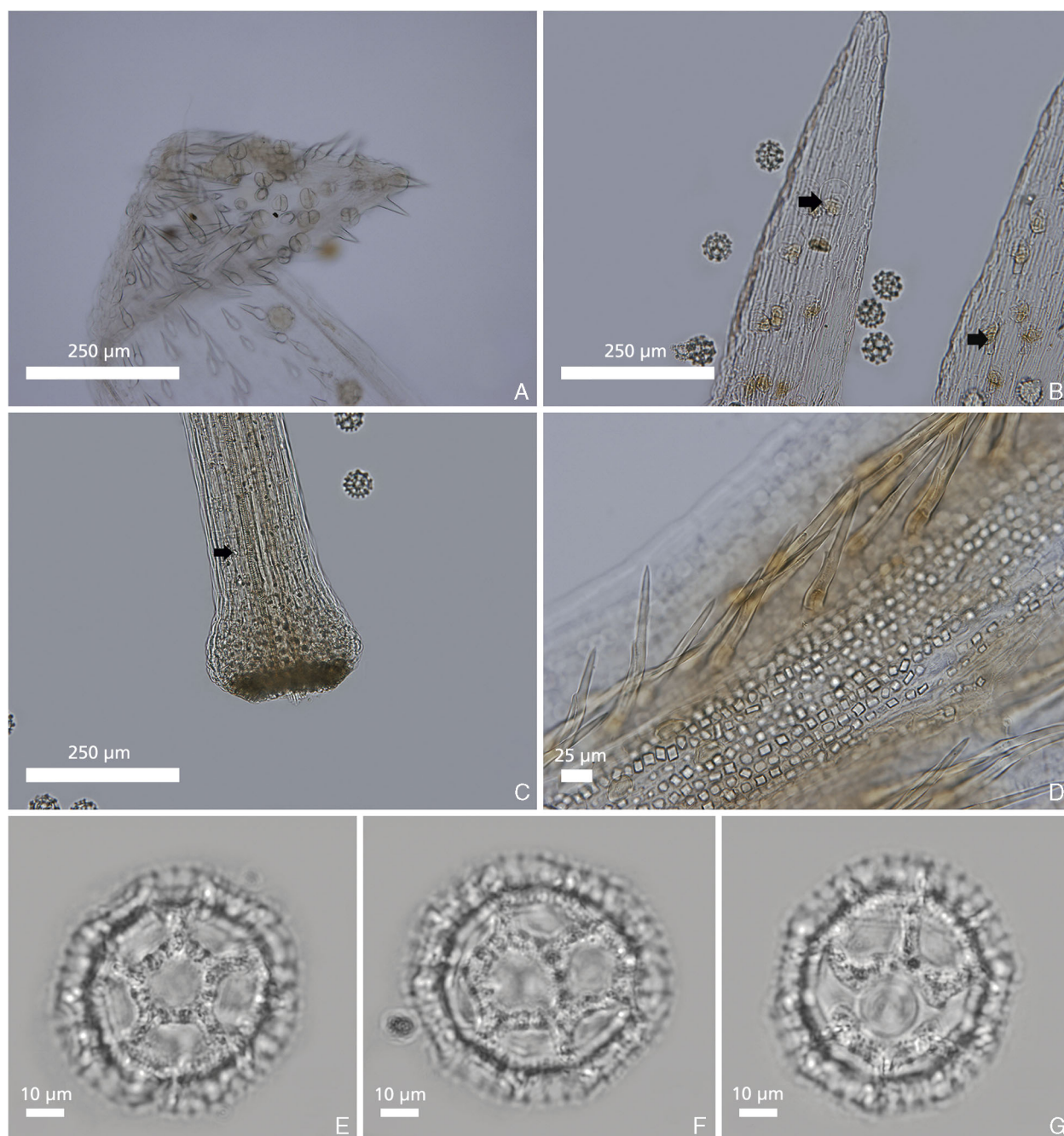


**Fig. 2.** *Heterocypselia brachylepis*. **A** habitat; **B** guttation on leaf (black arrow); **C** – **D** branch with capitulescence; **E** capitulescence with mature cypselae; **F** roots without xylopodium. PHOTOS: D. T. IGLESÍAS.

In the north of Minas Gerais State, between 2000 and 2015, the annual vegetation change rate was - 1.2% (deforestation less natural regeneration) (Dupin *et al.*

2018). However, when analysing only loss of areas with original vegetation, typical habitat of *H. brachylepis*, it is verified that 53% of this vegetation was suppressed,





**Fig. 3.** Microcharacters and pollen of *Heterocypselia brachylepis*. **A** corolla lobe with glandular and eglandular trichomes; **B** apical anther appendages with glandular trichomes (black arrows); **C** stylar basal node with crystals (black arrow); **D** cypsel wall with cubic crystals; **E** pollen, polar view, high focus; **F** equatorial view, mesocolpium, high focus; **G** equatorial view, colpus, high focus.

resulting in a reduction of 3.57% per year (Dupin *et al.* 2018). Similar results were recorded by Bianchi & Haig (2013) for dry forests in central Brazil, which showed a decrease of 66.3% between 1977 and 2008, and annual rate of forest cover change of 3.5%. For these authors, the maintenance of the pattern of deforestation will

promote the disappearance of dry forest in the basin studied in 25 years (Bianchi & Haig 2013). In addition to the significant loss of vegetation, there is a reduced area of protection for this vegetal formation, which in Brazil covers only 3.9% of the extent of dry forests (Espírito Santo *et al.* 2008). These facts demonstrate

**Table 1.** Morphological characters separating *Heterocypsela* species.

Characters	<i>H. andersonii</i>	<i>H. brachylepis</i>
Stem colour	yellowish-brown	white-greenish
Leaf size (cm)	7 – 14 × 5.7	6.7 – 21.4 × 2.1 – 9
Capitulescence type	monochasial cyme	monochasial or dichasial cyme
Capitulescence length (cm)	14	5 – 19
Capitulum height (mm)	15	7 – 10
Capitulum width (mm)	12 – 15	5 – 6
Receptacle type	plane	plane to convex
Outer phyllaries	linear to filiform	ovate
Apex of phyllaries	acuminate-caudate, recurved	apiculate, erect
Number of florets	60 – 70	30 – 56
Corolla length (mm)	9	5.5 – 7
Corolla tube (mm)	3.5 – 4.5	2 – 6.2
Corolla lobes (mm)	3	0.8 – 1.5
Corolla tube	pilose	glabrous
Corolla lobe	hirtellous or scabridulous	strigillose, punctate-glandular
Filament base	enlarged	cylindrical
Apical anther appendice	ovate	lanceolate
Idioblasts	absent	present
Outer cypselae	alate	angled

the threat to dry forests and the urgency of recognising biota for effective conservation actions.

**PHENOLOGY.** *Heterocypsela brachylepis* was collected with florets from March to April, and with fruits in July.

**ETYMOLOGY.** The epithet *brachylepis* refers to the shape of the outer phyllaries which are ovate and very distinct from the other species of the genus.

**NOTES.** The new species was described in the genus *Heterocypsela* since it has relatively long-pedunculate heads, dimorphic cypselae (distinctly outer flattened/ glabrous and inner prismatic/pilose) with only cubic crystals, glandular apical anther appendages and echinolphate type ‘C’ pollen. The new species differs from *H. andersonii* by all the morphological characters presented in Table 1. It should be noted that Robinson (1979) suggested that the capitula of *H. andersonii* are heterogamous, but this author made no distinction between the outer florets and inner. However, we did not find morphological differences between the florets of the capitula of *H. brachylepis*, and therefore we consider its capitula as homogamous.

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