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Espeletia restricta (Millerieae, Asteraceae), a new species from the páramos of northern Colombia

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Abstract

An intensive exploration of the páramos ecosystem on northwestern Colombia allowed the discovery of a new species of *Espeletia* (Millerieae: Asteraceae), *E. restricta*. *Espeletia* is an endemic taxon to the páramos of Colombia, Venezuela and Ecuador, generally found above 3000 m of elevation. *Espeletia restricta* has a very narrow distribution limited to the northern Central Cordillera of Los Andes. The new species is similar to *Espeletia occidentalis*, species occurring in the Central and Western Cordillera, from which it differs in the size of its synflorescences relative to the rosette length (less than 1.5 times longer than the rosette vs. 2–3 times longer than the rosette) and indument colour (yellowish vs. greenish-white). The new species was assessed Critically Endangered (CR) due to the small size of its population and the restricted nature of its occurrence, which makes this taxon of great conservation concern.

Keywords: Antioquia, Central Cordillera, Compositae, Espeletiinae, frailejón, Sonsón

Introduction

Espeletia Mutis ex Humboldt & Bonpland (1808: 10) is one of the most emblematic genera occurring in the páramo ecosystem, and belongs to the tribe Millerieae, subtribe Espeletiinae of the Asteraceae. *Espeletia* is distributed in the Andes of Colombia, Ecuador and Venezuela, and occurs at elevations between 2600 and 4600 m (Rauscher 2002). Diazgranados (2012) estimated the genus to be composed of about 71 species and more than 15 hybrids, although in a posthumous publication, Cuatrecasas *et al.* (2013) recognized only 49 species.

Some authors like Cabrera & Ramirez (2014) estimated the rate of endemic species of vascular plants for this ecosystem at 60%, which is favored by the level of isolation and environmental peculiarities. Páramos are found in the three Colombian cordilleras, the Sierra Nevada de Santa Marta and the Nudo de los Pastos on the border with Ecuador (Sarmiento *et al*. 2013). In the Central Cordillera of Colombia, only five species of *Espeletia* are found, this contrasts with 39 species reported by Cuatrecasas *et al.* (2013) for the Eastern Cordillera, which is attributed by Cuatrecasas (1986) to the environmental homogeneity of the Central Cordillera during the Holocene: *E. hartwegiana* Schultz Bipontius ex Cuatrecasas (1933: 17) has a very wide distribution in the Central Cordillera of Colombia, from the border with Ecuador to the Nevado del Ruiz in the north-central part of the cordillera; *E. schultesiana* Cuatrecasas (1942: 26) and *E. pycnophylla* Cuatrecasas (1942: 24) are found in the southern part, in the departments of Nariño and Putumayo, while *E. idroboi* Cuatrecasas (1977:12) occurs in The Papas páramo, in the departments of Cauca and Huila, and *E. occidentalis* Smith (1935: 520) represents the northern species for this cordillera, in the department of Antioquia (Cuatrecasas *et al.* 2013).

The Andes in Colombia reach the altitude of 5775 m and are divided into three Cordilleras named Western, Central and Eastern. The Western and Central Cordilleras reach north-western South America including the department of Antioquia, where they disappear. Antioquia, located in northwestern Colombia, has six páramo complexes in the Central and Western Cordilleras of the Colombian Andes (Sarmiento *et al.* 2013, Alzate & Murillo 2016) totalling 46.000 ha, of which the páramo of Sonson has an extension close to 3,400 ha.

According to Alzate *et al.* (2016), the páramo of Sonsón is located in the southeastern part of the Department of Antioquia, isolated by the tropical rainforest ecosystem, reaching an elevation of 3.340 m and developing very steep

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peaks with páramo vegetation. The dominant flora in this páramo is mainly represented by herbs, shrubs and small trees of the family Asteraceae, Bromeliaceae, Ericaceae and Melastomataceae (Alzate *et al.* 2016). These authors reported for the páramo of Sonson the presence of 61 families of angiosperm plants, 140 genera and 229 species.

In this paper we describe a new species of *Espeletia*, endemic to the northern Central Cordillera of Colombian Andes, discuss its taxonomic affinities and present a key to the sympatric species.

Material and methods

The morphological study was based on specimens of *Espeletia* collected in the department of Antioquia and specimens available in COL, HUA, MO, NY and US (herbarium acronyms follow Thiers 2019) and images available at JSTOR (2018). General morphological characterization and description were made using the terminology from Cuatrecasas *et al.* (2013).

For descriptions of capitula, ray and disc florets, phyllaries and achenes, fresh mature capitula were first fixated in a formal-acetic-alcohol solution and then preserved in an ethanol-glycerol solution. For leaf architecture descriptions, dry leaves were cleared in a sodium hydroxide solution, and then stained with safranin dye, based on the protocol proposed by Vasco *et al.* (2014). Descriptions were made following the terminology established by Ellis *et al.* (2009). Indument descriptions were made following the terminology proposed by Beentje (2010). Threat level of the species was assessed using the Geospatial Conservation Assessment Tool (GeoCAT) (Bachman *et al.* 2011).

A key to *Espeletia* species from the northern Central and Western Andes of Colombia is provided in this work.

Taxonomy

Espeletia restricta Alzate & Giraldo, *sp. nov*. (Figs 1, 2).

Type:—COLOMBIA. Antioquia: Municipio Sonsón, Vereda La Paloma, páramo de Sonsón, Cerro de Las Palomas, 3370 m a.s.l., 5°43'34" N, 75°14'58" W, 7 January 2016 (fl), *F. Alzate 5220* (holotype: HUA! [2 sheets]; isotypes: MO!, COL!).

Espeletia restricta is a herb with a stem up to 1.2 m tall, yellowish indument (grayish in *E. occidentalis*), laminae 24–40 × 6–12 cm; synflorescences 23–50 cm long, 0.8–1.2(–1.5) times longer than the rosettes, bracts very variable in number and phyllotaxy; ray florets 31–42, disc florets 110–153.

Caulirosulous herbs with a stem usually not exceeding 0.6 m tall but on occasions up to 1.2 m, not ramified, erect, densely covered by marcescent leaves; stem diameter at rosette base 5–12 cm. Rosette 0.30–0.42 m tall and 0.32–0.53 m in diameter, appearance yellowish. *Leaves* 29–43 cm long, alternate, simple, sessile. Laminae 24–40 cm × 6–12 cm, elliptic to oblong, symmetrical, gradually narrowing toward base, base truncate and obtuse, width at lamina base (0.7–)1.4(–3) cm, apex acute, apex shape usually straight but sometimes slightly acuminate, margins entire and slightly revolute. Blades coriaceous, flexible in all stages of development, adaxially rugulate, venular reticulum conspicuous, depressed; abaxially the midvein prominent, longitudinally striated, secondary nerves 6–15 mm apart, noticeably prominent, excurrently attached to the costa, regularly spaced in the center of the laminae and frequently becoming closer toward base and apex, deviation angle slightly uniform or increasing upwards, varying between 17°–44°, brochidodromous, occasionally weakly anastomosed with each other near the margin, intersecondary veins strongly developed when present, usually one per intercostal area, longer than the half of subjacent-secondary longitude, course proximally and distally parallel to main secondaries, tertiary nerves irregularly reticulated, forming a raised, tiny network with quaternary and quinary nerves, both of which are regularly polygonal reticulated; epimedial tertiaries reticulated and exterior tertiaries course variable, often ending at the margin. Areolation well developed, areoles of relatively consistent size and shape, minutely pilose on the inside. Marginal ultimate venation looped. Freely ending veinlets not visible. *Sheaths* 2.7–5.9 cm × 2.0–4.1 cm, multinerved, ovate, apex obtuse, adaxially glabrous, green-brown, abaxially the indument dense. *Synflorescences* thyrsoid, usually 3–4(–7) coetaneous, 23–50 cm long, 0.8–1.2(–1.5) times longer than the rosettes. Synflorescence's main axe 5–13 mm in diameter above base, erect, basally rigid, distally flexible; proximal part 0.39–0.87 of total length, with a very variable number (0–8) and phyllotaxy of bracts, those being sometimes 1–3 pairs decussate, other times being 1 opposite basal pair followed by 1–6 alternate bracts or 2 basal decussate pairs followed by 1–4 alternate bracts, even in some cases all the bracts alternate and occasionally

without bracts. Bracts, when present, 15–23.3 cm × 2.1–4.5 cm, oblong attenuate towards the base, with somewhat connate sheaths, apex acute, the lowermost ones at 0–8 cm above the base of the synflorescence, the following ones gradually decreasing upwards. Distal part of the synflorescence with 4–14 capitula, the most distal branch usually with 3 but sometimes with 1–2 capitula. Indument on axes and branches yellowish, dense, lanate, longer and less entangled in main axes, bracts with indument similar to leaves. *Capitula* 20–27 mm in diameter, radiate, usually erect, involucre subglobose, each capitulum with 143–186 flowers; ligular circle 25–33 mm in diameter and disc 15–20 mm in diameter. Phyllaries becoming smaller inwards and giving the appearance of being distributed in 2–3 whorls, but actually spirally arranged; the external sterile ones usually 4–5, coriaceous, a basal opposite pair of them differentiated for being longer, triangular and with a markedly acuminate apex, meanwhile the remaining ones have acute or slightly rounded apex; the internal fertile ones 3–10, chartaceous, discontinuous, apex acute to rounded. Receptacles convex, glabrous, paleate. *Ray florets* 31–42; corollas true ray, yellow; tubes 1.2–2.0 mm long, densely pilose; limbs 7.2–9.9 × 2.5–3.6 mm, oblong to elliptic, apically 2–3-lobed, 7–10-veined. Style 4.5–5.9 mm long, stigmatic branches 2.5–4.6 mm long. *Achenes* 3.7–4.2 mm × 1.6–2.8 mm, obconic, triangular in transversal section, usually 3(–6)-ribbed, dark brown when mature. Pappus absent. *Disc florets* 110–153; corollas tubular yellow, throats 5–5.3 mm long, mostly glabrous, lobes 5, triangular, tubes 2.1–2.7 mm long. *Anthers* 2.8–3.9 mm long, apical appendage about 1/8 of anther lengths, rounded. Style 8–9 mm long, stigmatic branches 0.4–0.5 mm long, broadening distally, papillose; rudimentary ovary present. *Pappus* absent. *Paleae* 7.0–8.7 × 2.5–3.3 mm, elliptic, scarious, rigid, basally enclosing florets, usually 7-veined with veins occasionally ramifying dicotomically at medial-distal section, apex acute.

Indument description:—*Leaves* with indument thickly and densely lanate throughout, adaxially yellowish, forming a uniform cover, with the long trichomes straight to undulated, appressed and not so entangled. The costa abaxially sericeous, yellowish, the rest of the lamina with whitish and entangled trichomes. *Sheaths* abaxially with a dense indument, trichomes long, barbate, undulated, ascending, whitish. *Ray florets* densely pilose, trichomes glandular, multicellular, ascending or patent. *Disc florets* with few external minute trichomes in the tube portion. *Paleae* pubescent apically, on edges and abaxially, mostly over veins, glabrous adaxially.

Etymology:—The name refers to the extreme level of endemism in the distribution of this taxon.

Morphological affinities:—*Espeletia restricta* is similar to *Espeletia occidentalis* subsp. *antioquiensis* (Cuatrecasas 1942: 24) Cuatrecasas (2013: 216) because both have a short stem, no more than 1.5 m, similar number of capitula per synflorescence (4–14) and distributed in the north of the Central Cordillera. *Espeletia restricta* differs by the size of its synflorescences relative to the rosette length (less than 1.5 times longer than the rosette vs. 2–3 times longer than the rosette), indument colour (yellowish vs. greenish-white) and synflorescences total length (< 50 cm vs. > 60 cm).

Taxonomic affinities:—Cuatrecasas *et al.* (2013) proposed a taxonomical affinity for the *Espeletia* species occurring in the Western Cordillera of Colombia. These authors suggested that *E. frontinoensis* Cuatrecasas (1977: 15) is sister to *E. praefrontina* Cuatrecasas (1980: 10), both species endemic of the Western Cordillera. The last two species form a clade that also would include *E. hartwegiana* and *E. pycnophylla*, species with a wider distribution. As a basal group to this clade, Cuatrecasas *et al.* (2013) proposed *E. occidentalis* subsp. *antioquensis*. In the same work, the authors suggested that *E. occidentalis* subsp. *antioquensis* is related to *E. grandiflora* Humboldt & Bonpland (1808: 11) which occurs at the Eastern Cordillera. *Espeletia restricta* is distributed at the same Cordillera as *E. occidentalis* and both have the morphological traits that suggest their taxonomic affinity.

Distribution, habitat and ecology:—The new species have been collected only in two areas of the páramo of Sonsón, Department of Antioquia in the northern Andes Cordillera. Although the total area of the páramo is 8707 ha, *E. restricta* only grows in an area of approximately 2 ha, at elevations between 3300 and 3363 m a.s.l. The habitat of *E. rectricta* has a vegetation characterized by a very dense and diverse páramo flora, dominated by representatives of Asteraceae, Bromeliaceae and Poaceae families. The dominant vegetation corresponds to shrublands with abundant small plants of the genera *Cortaderia, Guzmania, Paepalanthus* and *Disterigma*.

The Sonsón páramo complex is located in the Central Cordillera of Colombia, southern department of Antioquia and northern department of Caldas (Alzate *et al*. 2016). The mountain topography of this region allows to have scarce páramo zones, most of the time isolated from one another (Alzate *et al.* 2016).
Espeletia restricta populations are found in the southern part of the Central Cordillera of Department of Antioquia, while other species of *Espeletia* growing in the nearest area of this Cordillera are separated by a depression formed due to Porce river canyon.

Conservation status:—This new species has a very restricted distribution and the populations have a low number of individuals, which makes it very susceptible to any environmental change, such as those generated by climate

change and anthropic activities. Considering these conditions, it is evident that *E. restricta* is under a very high risk of extinction, since the possible area of occupation of the species would be reduced in a scenario of global warming. Using the occurrence data and based on the assessment carried out on GeoCat, the species was found Critically Endangered (CR) for both IUCN metrics, the extent of occurrence (EOO) and the area of occupancy (AOO).

Additional specimens examined:—COLOMBIA. Antioquia: Municipio Sonsón, Vereda La Paloma, páramo de Sonsón, Cerro de Las Palomas, 3370 m.a.s.l, 5°43'34" N, 75°14'58" W, 7 October 2011 (fr), *F. Alzate, O. Díaz, S. Varela, P. Pérez & S. Murillo 4234* (HUA); Municipio Sonsón, Vereda San Francisco, páramo de Sonsón, Cerro de Las Palomas, alrededores de la escuela para subir a la cima del cerro, 3250 m.a.s.l, 5°43'32" N, 75°15'00" W, 16 June 2012 (fl), *O. Díaz, S. Varela, P. Pérez & M. Hincapié 861* (HUA); Municipio Sonsón, Vereda La Paloma, páramo de Sonsón, Cerro de Las Palomas, 3370 m.a.s.l, 5°43'34" N, 75°14'58" W, 16 October 2009 (fr), *F. Alzate, A. Álvarez, J.P. Naranjo, J. Marín, N. Montaño, S. López, A. Diez, S. Monsalve, W. Berti, S. Villa & E. Ospina 3337* (HUA).

Key to the species of *Espeletia* occurring in the northern region of Central and Western Cordilleras of Colombia, corresponding to the department of Antioquia

1. Synflorescences > 60 cm long, 2–3 times longer than the rosettes ..... *E. occidentalis*
- Synflorescences < 50 cm long, up to 1.5 times longer than the rosettes 2
2. Lamina width > 6 cm, subtending bracts normally surpassing peduncles, anthers more than 2.8 mm long; Central Cordillera ..... *E. restricta*
- Lamina width < 5.6 cm, subtending bracts normally shorter than peduncles, anthers less than 2.5 mm long; Western Cordillera 3
3. Proximal part of synflorescences with 1–2 pairs of bracts ..... *E. praefrontina*
- Proximal part of synflorescences aphyllous ..... *E. frontinoensis*

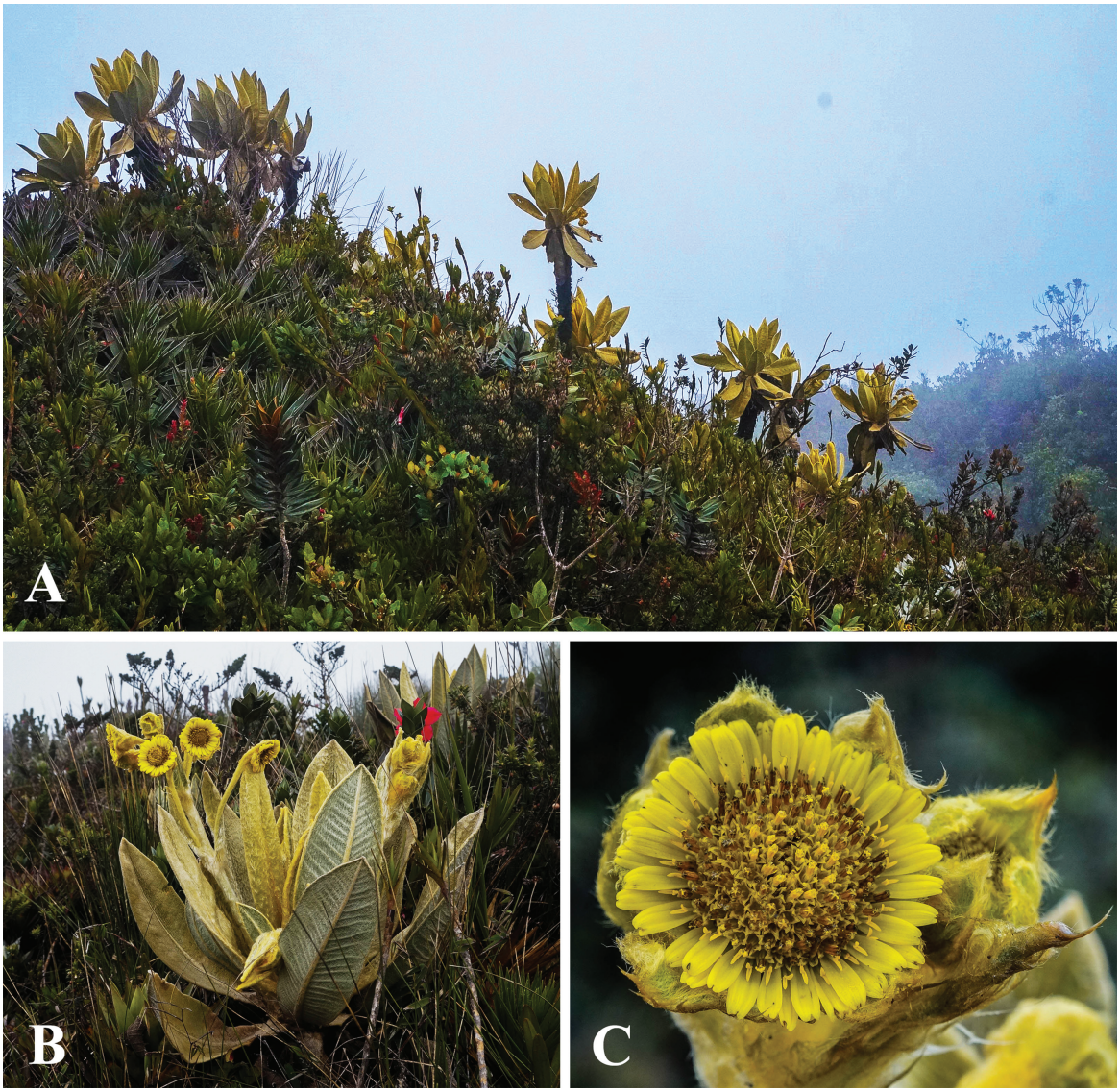

FIGURE 1. *Espeletia restricta.* A. Habitat. B. Habit. C. Capitulum, frontal view. Photos by S. Giraldo.

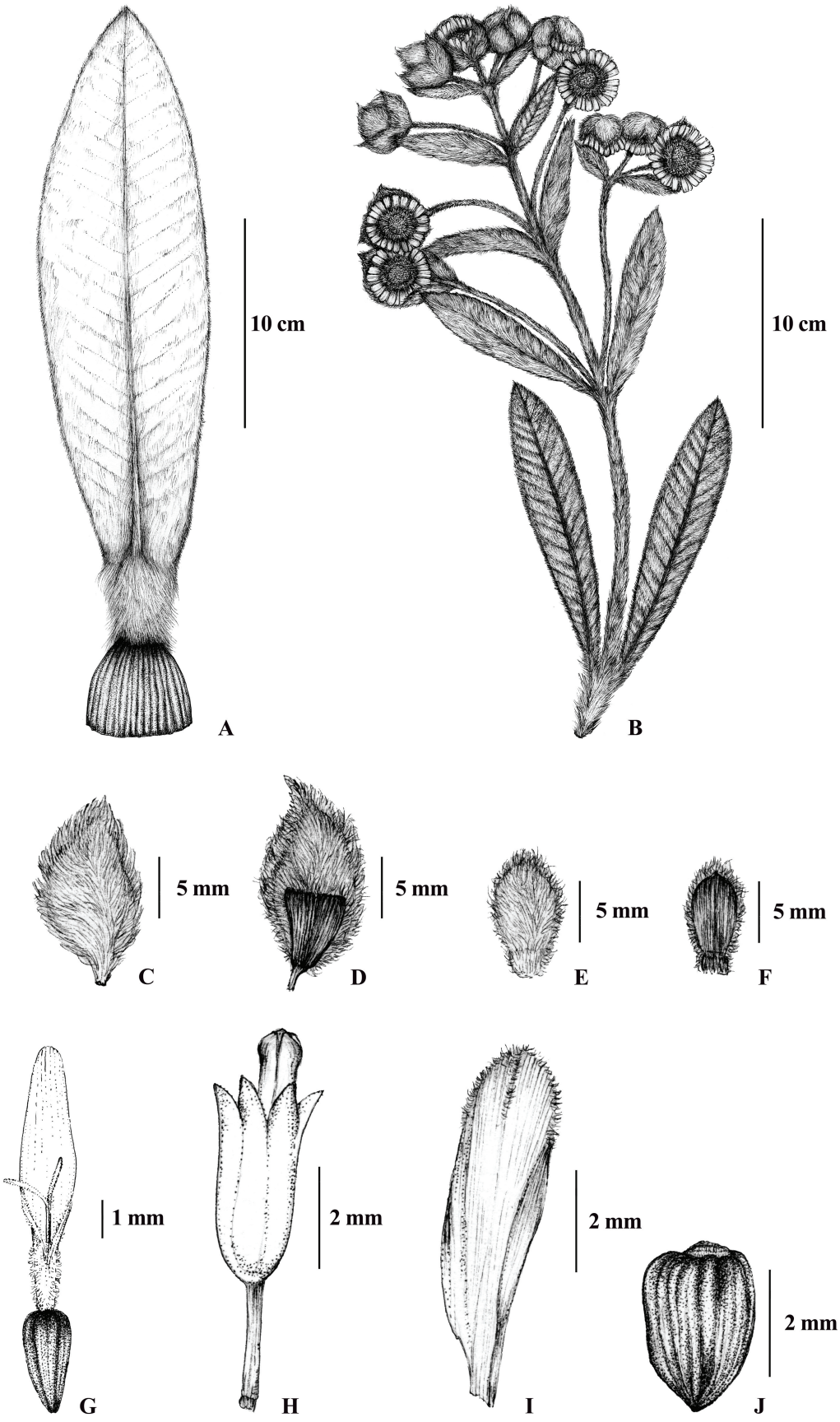

FIGURE 2. *Espeletia restricta*. A. Adaxial view of leaf. B. Synflorescence. C. Outer phyllary (abaxial view). D. Outer phyllary (adaxial view). E. Inner phyllary (abaxial view). F. Inner phyllary (adaxial view). G. Ray floret with immature achene. H. Disc floret. I. Palea (adaxial view). J. Achene (dorsal view). Illustrations made by Adriana Sanín (HUA).

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