



## *Erigeron morelensis* (Asteraceae): a rediscovery after more than 120 years of a microendemic and threatened species in central Mexico

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### Abstract

The rediscovery of *Erigeron morelensis*, not collected since 1898, is reported. Between 2021 and 2022, *E. morelensis* was recorded at two sites in the northwestern canyons of Cuernavaca, Morelos, Mexico, which are subjected to degradation pressure. The morphological description is updated and complemented, and a key for *E. sect. Erigeridium* is included. Data about the known distribution, ecology and habitat of the species are provided. Based on the IUCN criteria, it is recommended that the species be listed as Critically Endangered (CR).

**Keywords:** canyons, Conyzinae, critically endangered, Morelos, taxonomy

### Introduction

*Erigeron* Linnaeus (1753: 863) is a genus included in the subtribe Conyzinae Horan., tribe Astereae Cass., subfamily Asteroideae Lindl. in Asteraceae Bercht. & J. Presl (Nesom 2008, 2020). *Erigeron* includes ca. 390 species, mostly in temperate regions from North to South America, West Indies, Galapagos, and Eurasia (Nesom & Robinson 2007). Nesom (2008) proposed an infrageneric classification for the New World species of *Erigeron* recognizing 35 sections.

*Erigeron morelensis* Greenman (1905: 256–257), together with *E. hintoniorum* G.L. Nesom (1989a: 489), *E. palmeri* A. Gray (1880: 32), *E. vernus* (L.) Torrey & A. Gray (1841: 176–177), and *E. wellsii* G.L. Nesom (1981: 136–140) were included in *E. sect. Fruticosus* G. Don also known as the “*E. palmeri* group” (sensu Nesom 1989b). Currently, these five species make up *E. sect. Erigeridium* Torrey & A. Gray and have not yet been included in molecular studies (Nesom 2008). This group is distributed from eastern USA to Mexico. *Erigeron sect. Erigeridium* comprises perennial, rhizomatous, or stoloniferous plants that are glabrous to sparsely strigose or hispid. The caudex is simple or branched with obovate to spatulate leaves. The leaves are often thick with entire or shallowly toothed margins. Leaf bases are not clasping. The heads, or capitula, are erect in bud, the ray florets white to pink, not coiling or reflexing. Disc florets are tubular–funnelform. Cypselae are 1.2–1.6 mm, 4-nerved, with a pappus of 16–30 bristles (Nesom 2008).

In Mexico, 87 species of *Erigeron* are recorded, of which 65 are endemic, and 16 are microendemic (Villaseñor 2016, 2018). *Erigeron* is the fourth largest genus of Asteraceae in Mexico, after *Ageratina* Spach (167 species), *Verbesina* L. (164 species) and *Stevia* Cav. (116 species) (Villaseñor 2018).

*Erigeron morelensis* is known from a single collection made in Cuernavaca, Morelos, Mexico by Pringle (C.G. Pringle 7668), on 15 May 1898. However, this species was not described until 1905 by J.M. Greenman based it on a specimen deposited at GH, and duplicates placed at ENCB, MEXU, TEX, US, and VT. It was recently collected

again (2021–2022) after more than 120 years, while conducting a comprehensive exploration to update the status and distribution of endemic species of Morelos. The observation and collection of this taxon was a highlight because it has not been recorded for such a long period of time.

This rediscovery allowed us to update the morphological description and to assess the conservation status of *E. morelensis*. Additionally, a key to the species included in *E. sect. Erigeridium* is provided.

## Material and methods

Fieldwork specifically targeting *Erigeron morelensis* was carried out along several canyons located in the northwestern part of the municipality of Cuernavaca, in the state of Morelos, Mexico, from May 2021 to April 2022. The first population was discovered in the Tepeite Valley during July 2021. An immature plant was collected and grown until it flowered in a home garden with similar environmental conditions. A second population was located in April 2022 at the Chalchihuapan Canyon. The two populations are 2.3 km apart in a straight line. Several specimens were collected, and photographs were taken in the field and in cultivation. Voucher specimens were deposited in HUMO. Morphological characters were measured from living and dried specimens, with the aid of dissecting microscopes, and described using the terminology in Nesom (1981, 1989a, b).

## Taxonomic treatment

*Erigeron morelensis* Greenman (1905: 256–257) (Figs. 1, 2)

**Type:**—MEXICO. Morelos: wet cliffs, mountain cañon near Cuernavaca, 6500 ft, 15 May 1898, C.G. Pringle 7668 (holotype: GH!, isotypes: ENCB!, GH!, MEXU!, US!, TEX!, VT!).

**Herb**, perennial, stoloniferous, stem scapiform, slender, more or less flexuous, 15.0–32.5 cm high, bearing 3–5 linear acute bracts between leafy base and solitary terminal head, striate or ribbed, green or slight to dark purplish, sparsely pubescent. **Leaves** basal, crowning the oblique rhizome, petiolate, lanceolate to somewhat obovate-lanceolate including the petiole 3–10(17.3) cm long, 0.5–3.0 cm wide, apex acuminate, acute, margin bearing 3–4 teeth or mucros on each side, gradually narrowed at the base into the slender petiole, dark green and pubescent adaxially with scattered trichomes, paler and glabrous abaxially; petioles channeled, green to reddish-purple 4.5–7.5 cm long, usually as long as or sometimes exceeding the blade. **Capitulum** 6–8.8 mm high, including the rays 1.5–3.4 cm in diameter; involucre campanulate, about as high as the disc florets. **Receptacle** convex, ca. 4.5 mm in diam, glabrous. **Phyllaries** 2–3 seriate, imbricate, subequal, lanceolate, acute, pubescent with scattered trichomes, green with purple apices. **Radiate florets** 60–90 in 2 series; corollas 7–8 mm long, tube 2.1 mm long, ligules 2 veined, 0.7 mm wide, white, drying white to tinged with reddish-purple, apex 2–3 dentate. **Disc florets** 160–170; corollas tubular, bright yellow, 2.94 mm long, with erect to divaricate, deltate lobes, tube 2.6 mm long, style branches 0.8–1 mm long. **Cypselas** narrowly oblong, compressed, 1.5 mm long, with 2 thin orange ribs, glabrous to sparsely strigose. **Pappus** bristles 20, in single series, 2 mm long for both ray and disc florets (Fig. 2).

**Phenology:**—Flowering and fruiting from February to May.

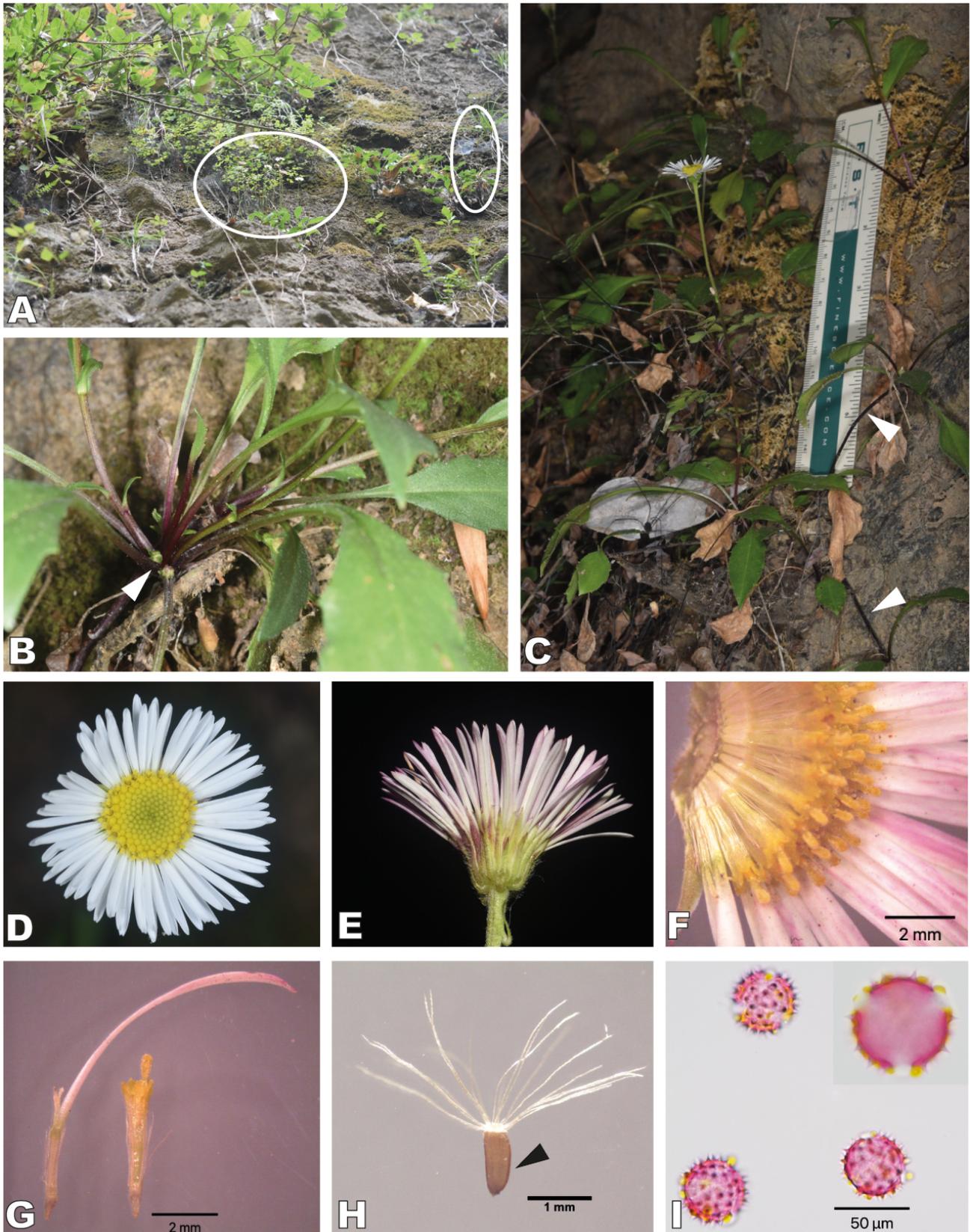
**Distribution:**—Endemic of northern Morelos, Mexico, only known from two localities in the northwestern canyons of Cuernavaca, Morelos, Mexico (Fig. 3).

**Ecology and habitat:**—*Erigeron morelensis* grows in the northwestern area of the municipality of Cuernavaca, on wet cliffs in canyons, at elevations from 1980 (historic record) to 2260 m (Fig. 3). Both newly discovered localities occur in disturbed *Quercus* forests with cloud forest elements. *Erigeron* plants were growing with *Adiantum* sp., *Thelypteris* sp., *Pteridium* sp., *Erigeron karvinskianus* DC., *Smilax mollis* Humb. & Bonpl. ex Willd., *Oxalis* sp., *Styrax argenteus* var. *ramirezii* (Greenm.) Gonsoulin, and *Carpinus caroliniana* Walter. Capitula of *Erigeron* in the wild and cultivation were eaten by caterpillars.

**Conservation status:**—*Erigeron morelensis* was only known from specimens collected at the type locality (canyons of Cuernavaca, Morelos) in 1898. It had not been collected for more than 120 years, until the first population (present study) was observed in 2021 with approximately 25 individuals. A second population found in April 2022 comprises 250–300 individuals. It is proposed that *E. morelensis* should be classified as Critically Endangered (CR) using the IUCN B2ab(iii) criteria (IUCN 2022).



FIGURE 1. *Erigeron morelensis* Greenm. (Holotype: C.G. Pringle 7668, GH!).



**FIGURE 2.** *Erigeron morelensis*. A. Habitat with *Erigeron* plants indicated by white circles; B. Basal leaves with reddish to purple petioles, white arrows show immature capitula; C. Habit highlighting basal leaves and a monocephalous stem, white arrows show aboveground stolons; D. Capitula with ligules; E. Phyllaries green and purple with pink ray florets; F. Receptacle with disc and ray florets; G. Individual ray and disc florets; H. Cypsel with orange ribs (black arrow) and bristles; I. Echnate pollen grains. Photos by Rosa Cerros-Tlatilpa and Mónica I. Miguel-Vázquez.

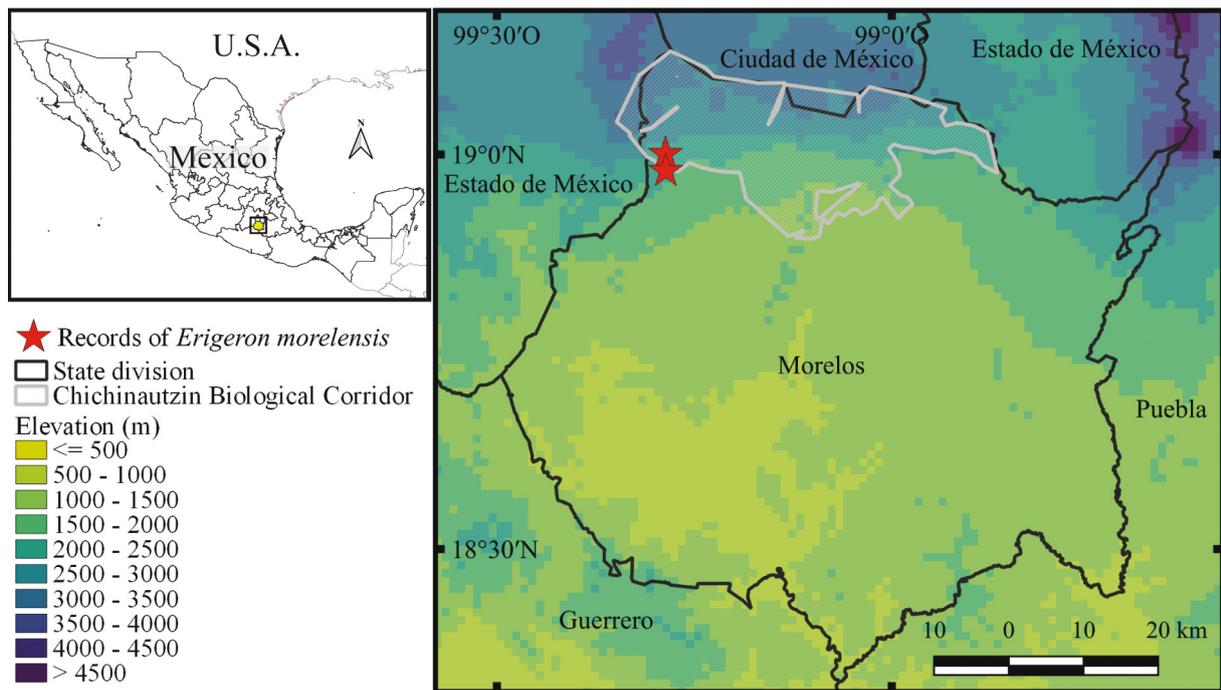


FIGURE 3. Known geographic distribution of *Erigeron morelensis* Greenm.

**Specimens examined:**—MEXICO. Morelos: Cuernavaca, wet cliffs, mountain cañon near Cuernavaca, 6500 ft, 15 May 1898, *C.G. Pringle* 7668 (ENCB!, GH!, MEXU!, TEX!, US!, VT!); Cuernavaca, Tepeite Valley, on wet cliff, 2260 m, 19°0'N, 99°17'W, collected immature 28 July 2021, pressed 1 April 2022 (fl), *M.I. Miguel V.* 972B (HUMO); Chalchihuapan Canyon, steep, wet south-facing slope, 2070 m, 18°58'N, 99°17'W, 11 April 2022 (fl, fr), *R. Cerros T.* 3178 (HUMO).

**Key to *Erigeron* species from *E. sect. Erigeridium* (based on Nesom 2008)**

1. Stems branched, corymbiform, (1–)4–20(–25) capitula; plants distributed in SE US.....*E. vernus*
- Stems not branched, monocephalous; plants distributed in Mexico .....2
2. Involucre densely white-villous; phyllaries with glandular trichomes..... *E. hintoniorum*
- Involucre sparsely white-villous; phyllaries sparsely pubescent without glandular trichomes .....3
3. Stolons present; phyllaries lanceolate, apex acute to acuminate; ray florets 60–90 ..... *E. morelensis*
- Stolons absent; phyllaries linear-lanceolate to elliptic-lanceolate, apex acuminate; ray florets 70–135 .....4
4. Leaves spatulate-oblong, obtuse; phyllaries linear-lanceolate; ray florets 80–90.....*E. palmeri*
- Leaves narrowly to broadly oblanceolate to spatulate; phyllaries lanceolate to elliptic-lanceolate; ray florets 70–135 .....*E. wellsii*

**Discussion**

*Erigeron morelensis* is a perennial herb known only from two canyons in Cuernavaca, Morelos. Extensive surveys over successive seasons (2021–2022) resulted in the location and documentation of two small populations. The type locality given by Pringle is “Wet cliffs, mountain cañon near Cuernavaca” and the only elevation information available (6500 ft~1980 m) had been for the historical site until these discoveries. The lack of geo-coordinate information makes the identification of the precise type locality difficult. Currently, the population of Cuernavaca is increasing and expanding into areas that have similar altitudes to that of the type specimen. We are confident that this plant presently does not exist anymore at the lower elevation ( $\leq 1980$  m).

Cyrus G. Pringle spent twenty-five years collecting in Mexico including at his favorite collecting areas “barrancas”, where at least 20% of his collection numbers were new species (Burns 1936, Nicholson 2001) and some of them, such as *E. morelensis*, have not been collected again. In order to gain more clues about the type locality of *E. morelensis*, Pringle’s collection notebook (Pringle 1898) was reviewed. The notebook indicated that two other taxa were collected the same day and presumably at the same canyon, *Smilax pringlei* Greenm. (6848) and *Styrax argenteus* var. *ramirezii* (Greenm.) Gonsoulin (6843). Curiously, Pringle followed a strange and confusing consecutive collecting number

system, and the collection number of *Erigeron morelensis* does not follow in sequence (7668) with either of the two numbers mentioned above.

Cuernavaca municipality is situated in the central south biogeographic province of Trans-Mexican Volcanic Belt (TMVB). The canyons (barrancas) of Cuernavaca consist of volcanic rocks of different composition from 38 mya (García-Barrios *et al.* 2008). The steep slopes are formed by permanent or intermittent runoff water and the cliffs there may or may not have vegetation. Paradoxically, the locality in the Tepeite Valley is included in the Chichinautzin Biological Corridor Natural Protected Area, but it has been severely damaged and disturbed due to anthropogenic activities such as ecotourism, fires and clearing roads for other activities. The second locality is secluded but is outside the protected area boundaries and is under strong pressure due to the increasing population size and development of greenhouses for ornamental purposes. Water redirection has dramatically changed along the “barrancas” reducing the flow downstream during the dry season. The water diversion for both human and greenhouse use is changing the landscape and the ecosystem dynamics.

*Erigeron morelensis* is one of the three Asteraceae microendemic species distributed in Morelos (Villaseñor 2016, 2018), which also occur in municipalities included in the Chichinautzin Biological Corridor. Type specimens (in flower) were collected on May 15, 1898, while our living collections flowered from February through April 2022. The shift in blooming period may be due to variable weather patterns; March to May 1898 ranks as one of the coolest 3-month periods on record (NOAA 2022), or this could be reflective of more long-term climatic changes. Some of the plants observed were flowering in the field, however, most of them were juvenile, or immature (Fig. 2A, B). The cypsela in *E. morelensis* have two orange ribs (Fig. 2H) also previously observed in other members of *E. sect. Erigeridium* (Torrey & Gray 1841, Nesom 1981, Nesom 1989a). In addition, the echinate pollen grains of *E. morelensis* average 37.2 µm in diameter with a range of 28.4–41.2 µm (Fig. 2I) which differs from the smaller grains (25 µm) of *E. wellsii* (Nesom 1981). As part of this study, leaf material dried in silica gel will be used for molecular phylogenetic analysis of the species together with the rest of the related taxa, since it has not yet been included in any study of this type (Nesom 2008).

The conservation of both *Erigeron* populations is urgent. Fieldwork carried out has shown that the species (and its plant community) is facing habitat fragmentation, frequent fires, land conversion for development, pollution, invasive species, and natural resource overexploitation, all conditions that have already been reported in other areas of Morelos (Guerrero 2020). Despite environmental pressures, *E. morelensis* has persisted, but was overlooked and not collected in part due to the lack of a precise locality or habitat information. The evidence provided in this study supports the listing of the taxon in conservation standards, such as the NOM-O59-SEMARNAT-2020 (SERMARNAT 2010), or at the IUCN Red List of Threatened Species (IUCN 2022), taking into account that until now it was an almost unknown species, which is at imminent threat.

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