Phytotaxa 653 (2): 115–133
https://www.mapress.com/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.653.2.2

Two new species of *Echeveria* (Crassulaceae, Saxifragales) from the Sierra de Manantlán, Jalisco, Mexico

J. ANTONIO VÁZQUEZ-GARCÍA[1,4], RAMÓN CUEVAS GUZMÁN[2,5*], C. SANTIAGO ROSALES-MARTÍNEZ[3,6], JOSÉ GUADALUPE MORALES ARIAS[2,7] & JESÚS PADILLA-LEPE[1,8]

[1]*Herbario IBUG, Instituto de Botánica, Departamento de Botánica y Zoología, Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, km 15.5 Guadalajara-Nogales, Las Agujas, Nextipac, Zapopan, C.P. 45110, Jalisco, México*

[2]*Laboratorio de Botánica, Departamento de Ecología y Recursos Naturales, Centro Universitario de la Costa Sur, Universidad de Guadalajara, Independencia Nacional 151, Autlán de Navarro, Jalisco, 48900, México*

[3]*Instituto Tecnológico y de Estudios Superiores de Occidente, C.P. 45604, Tlaquepaque, Jalisco, México*

[4] *talaumaofeliae@gmail.com; https://orcid.org/0000-0002-8393-5906*

[5] *rcuevas@cucsur.udg.mx; https://orcid.org/0000-0002-4980-8989*

[6] *santiagorosales412@gmail.com; https://orcid.org/0000-0003-1791-5058*

[7] *jose.morales@academicos.udg.mx; https://orcid.org/0000-0001-6895-8870*

[8] *ludtita@yahoo.com; https://orcid.org/0000-0002-7165-8040*

**Corresponding author: rcuevas@cucsur.udg.mx*

Abstract

Two new species are described and illustrated. *Echeveria cuevasii* shares with *E. flammigera* typical characteristics of *Echeveria* of the *Nudae* series, for instance, a subshruby habit, medium-sized rosettes and short sub spicate inflorescences. However, it differs from the latter by having fewer shorter branches, longer leaves, more flowers per inflorescence, longer bracts; shorter stamens and petals with bright yellow margins. *Echeveria vazquezii* is similar to *E. marianae* and *E. novogaliciana* by having large and glabrous rosettes, short caudex, and paniculate inflorescence with several cincinni, typical features of *Echeveria* series *Gibbiflorae,* in addition to the presence of appendages on the inner side of the petals. However, it differs from both species by the deciduous bracts, fewer cincinni per inflorescence, and whitish to pale yellow nectaries. A classification of the risk status of the two species proposed as new is provided.

Key words: Allopatric speciation, biogeographic region, endemism, western Mexico, *Quetzalcoatlia*

Resumen

Se describen e ilustran dos especies nuevas. *Echeveria cuevasii* comparte con *E. flammigera* características típicas de *Echeveria* serie *Nudae*, por ejemplo, un hábito subarbustivo, rosetas de tamaño mediano e inflorescencias subespigadas cortas. Sin embargo, se diferencia de esta última por tener menos ramas más cortas y gruesas, hojas más largas, más flores por inflorescencia, brácteas más largas; corolas y estambres más cortas. *Echeveria vazquezii* es similar a *E. marianae* and *E. novogaliciana* en tener rosetas grandes y glabras, tallos cortos e inflorescencia paniculada con varios cincinos, en general, rasgos típicos de *Echeveria* serie *Gibbiflorae*, además de la presencia de un par de apéndices en la parte basal e interna de cada pétalo. Sin embargo, se diferencia de ambas especies por las brácteas caducas, menos cincinos por inflorescencia y nectarios blanquecinos a pálido amarillo. Se proporciona la clasificación del estado de riesgo de las dos especies propuestas como nuevas.

Palabras clave: Endemismo, especiación alopátrica, occidente de México, región biogeográfica, *Quetzalcoatlia*

Introduction

Echeveria de Candolle (1828: 401), with over 175 species accepted (POWO 2023), is a diverse genus of the Crassulaceae family, confined to the American continent with the highest diversity and endemism occurring in Mexico (Meyrán-García 2019; Meyrán-García & López-Chavez 2003). This genus displays a remarkable pattern of allopatric speciation

Accepted by Nicodemo Giuseppe Passalacqua: 29 May 2024; published: 18 Jun. 2024

and a complex diversification history, partly due to the high homoplasy of morphological characters and the high polyploidy (Gontcharova & Gontcharov 2007; Uhl 1992).

Molecular studies have shown that the genus is not monophyletic (Acevedo-Rosas *et al*. 2004, 2018; Carrillo-Reyes *et al*. 2008, 2009; Mort *et al*. 2001; Nikulin *et al*. 2016; van Ham & 't Hart 1998). A recent phylogenetic analysis (de la Cruz-López *et al*. 2019) performed by maximum likelihood and Bayesian inference on a combined standard barcoding loci matrix (*rbcL, matK and ITS2*) suggests that *Echeveria* is paraphyletic, with four main clades recovered within the "Echeveria group".

Such evidence prompted the recent segregation of three new genera based on well-supported subclades and/or morphological distinctiveness including *Chazaroa* A.Vázquez, Padilla-Lepe & Rosales in Vázquez-García *et al*. (2023b: 38), *Jeronimoa* A.Vázquez, Islas & Rosales in Vázquez-García *et al*. (2023a: 51) and *Quetzalcoatlia* A. Vázquez, Rosales & Padilla-Lepe in Vázquez-García *et al*. (2023b: 38). However, further studies using the phylogenomic approach are needed to shed light on understanding the relationship among several low supported subclades.

Although most of the *Echeveria* series have been recovered as non-monophyletic, the current infrageneric morphological classification by Kimnach (2003), involving seventeen *Echeveria* series, remains a useful tool for species identification.

The Sierra de Manantlán, Jalisco-Colima, currently harbours 13 species of Crassulaceae: *Chazaroa* (1 sp.), *Graptopetalum* Rose (1911: 296) (1 sp.), *Quetzalcoatlia* (1 sp.), *Sedum* Linnaeus (1753: 430) (6 spp.) and *Echeveria* (4 spp.). The latter genus is represented by *E. cerrograndensis* A.Vázquez & G. Nieves in Nieves-Hernández *et al*. (2014: 248) and *E. rulfiana* Jimeno-Sevilla, Santana-Michel & P. Carrillo in Jimeno-Sevilla *et al*. (2015: 72) from the highlands of the calcareous Cerro Grande massif in the eastern Sierra de Manantlán, and two other from the volcanic highlands of the central Sierra de Manantlán, here proposed as new species.

Methods

Fieldwork included several expeditions to the highlands of the Sierra de Manantlán in January 2014 & 2024, October 2015 & 2016 and November 2017 & 2022 to document the habitat and obtain plant material and photographs. The species were described based on specimens available in the IBUG and ZEA herbaria of the University of Guadalajara. Relevant literature and taxonomic keys for the *Echeveria* series and species were consulted (Meyrán-García & López-Chávez 2003; Walther 1972). Photographs of type specimens of morphologically close species to the proposed new taxa (here described) were examined in the Tropicos (2024) (www.tropicos.org) and JSTOR (2024) (http://plants.jstor.org) databases. Most measurements were made on fresh material. Information on related species was obtained from type images and the Naturalista platform (2023, observation 5476012, by José Daniel Graf Pérez).

The population of *Echeveria* sp., from Cerro El Muñeco, Sierra de Manantlán, were contrasted against two morphologically close species belonging to the series *Nudae* Walter (1958: 46), one of the most diverse series of the genus: 1) *E. flammigera* Rosales in Rosales-Martínez & Hernández-Campos (2023: 105), and 2) *E. multicaulis* Rose (1905: 294) (Table 1).

While the population of *Echeveria* sp. from Cerro El Almeal, Sierra de Manantlán, was contrasted against three morphologically close species of belonging to ser. *Gibbiflorae* (Baker 1869: 2[analytical t.]) Berger (1930: 474), another of the most diverse *Echeveria* series: 1) *E. dactylifera* Walther (1972: 179), 2) *E. marianae* J. García & Costea (2014: 36) and 3) *E. novogaliciana* J.Reyes, Brachet & O.González in Reyes-Santiago *et al*. (2011: 89) (Table 1).

A comprehensive analysis of available herbarium specimens, living specimens and images of all taxa of *Echeveria* ser. *Gibbiflorae* and ser. *Nudae* allowed the recognition of two new species from the Sierra de Manantlán Biosphere Reserve, Jalisco, Mexico.

Results

The population from Cerro El Muñeco, Sierra de Manantlán, with a rupicolous red-flowered subshruby habit, small rosettes, minutely papillose leaf epidermis and short and lax subspicate to racemose inflorescence belongs to the *Echeveria* ser. *Nudae*. It is confined to the dryer crest of the Sierra de Manantlán above 2700 m in elevation. In terms of quantitative and qualitative characters, it differs substantially from other morphologically close species such as *E. flammigera* and *E. multicaulis* and is here described as a new species (Table 1).

TABLE 1. Differences among *Echeveria cuevasii*, *E. flammigera* and *E. multicaulis.*

	E. cuevasii	*E. flammigera*	*E. multicaulis*
Habit	Subshrub, with few decumbent or ascending branches	Subshrub, with numerous decumbent or ascending branches	Subshrubby, with numerous spreading branches
Plant surface	Glabrous, leaves minutely papillose	Glabrous, leaves minutely papillose	Glabrous leaves not papillose
Stem length (cm)	23.0 or more	up to 40.0	up to 120.0
Stem diameter (mm)	11.0–13.0	3.0–5.0	10.0–12.0
Leaf size (cm)	5.1–2.2	1.0–1.5 × 0.5–1.0	3.0–4.0 × 1.5–3.0
Leaf colour	Grass green with blood red to purplish red margins close to the apex, the basal ones almost all in red	Green but nearly always with intense red colourations	Shining green with red tips and edges
Inflorescence length (cm)	14.0–23.9	Up to 20.0	Up to 25.0
Number of flowers per inflorescence	8–14	2–5 (–7)	5–15
Bracts (cm)	2.5–2.6 × 1.0–1.1	1.0–1.5	2.5
Peduncle Length (cm)	7.0–15.8 × 0.4–0.6	15.0 × 0.3	20–25 × 0.3–0.4
Pedicel length (mm)	5.0	4.0–8.0	6.0–10.0
Sepal length (mm)	6.0–8.0	6.0–9.0	4.0–8.0
Corolla length (mm)	13.0	12.0–18.0	8.0–10.0
Nectary width (mm)	1.7	1.0–1.5	1.0
Colour nectary	Yellows	Whitish to yellowish	Yellowish
Geographic distribution	Jalisco: Sierra de Manantlán	Durango: San Dimas	Guerrero: Omiltemi

The population from El Almeal, Sierra de Manantlán, a cliff-dwelling orangish-flowered tall herb with large rosettes, evident stems, cuneate leaves, long paniculate inflorescence, numerous cincinni and petal appendages belongs to the *Echeveria* ser. *Gibbiflorae*, is another of the most diverse *Echeveria* series. It is confined to some of the more mesic slopes of the Sierra de Manantlán at ca. 2000–2100 m in elevation. It differs significantly from other morphologically close species such as *E. dactylifera*, *E. marianae* and *E. novogaliciana* and is here described as a new species (Table 2).

TABLE 2. Differences among *Echeveria vazquezii*, *E. dactylifera. E. marianae* and *E. novogaliciana.*

	E. vazquezii	***E. dactylifera***	***E. marianae***	***E. novogaliciana***
Stem	Evident	Evident	Not obvious	Not obvious
Stem length (cm) Stem diameter (cm)	6.0 3.0	10.0–20.0 3.5	4.0–6.0 3.0–4.5	4.0 2.0
Rosette diameter (cm)	25.0–32.0	30.0–60.0	30–40	44.0–60.0
Leaf shape	Lanceolate to oblanceolate	Elliptical-oblong	Obovate-oblanceolate	Lanceolate, ensiform
Colour	Yellowish-green to purplish-green or scarlet	Reddish green to brown	Ligh green to yellow-green	Purplish-pink, fleshy to olive green
Length (cm)	12.0–17.0	25.0 or more	5.0–24.0	22.0–27.0
Width (cm)	4.0–6.0	9.0	3.0–7.5	3.0–5.0
Margin	Sometimes with pronounced undulations	Entire	Entire to lobate in the upper distal part	Denticulate
Flowering stems	1–2	1	1–2	1–2
Length (cm) Diameter (cm)	80.0–85.0 1.1–2.0	40.0–100.0 3.0	80.0–90.0 0.6–1.3	66.0–80.0 1.0–1.8
Flower stem leaves	It has no leaves	Narrowly oblong-elliptical	Oblong to ovate-lanceolate	Oblanceolate

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TABLE 2. (Continued)

	E. vazquezii	*E. dactylifera*	*E. marianae*	*E. novogaliciana*
Length (cm)	Unknown	Up to 7.0	2.0–6.2	6.5–10.0
Width (cm)	Unknown	3.0	0.5–1.5	1.5–2.0
Cincinni per inflorescence	3–5	14–16	6–8	10–14
Pedicel length (mm)	5.0–14.0	25.0–30.0	5.0–9.0	5.0–7.0
Sepals				
Position	Reflexed or widely spreading to obliquely ascending	Ascending	Spreading to slightly recurved	Spreading to slightly ascending
Shape	Linear-triangular, rounded at the apex	Deltoid to oblong-ovate	Triangular-lanceolate	Triangular lanceolate
Length (mm)	7.0–15.0	20.0	9.0–15.0	6.0–8.0
Width (mm)	3.0–5.0	5.4–5.8	3.0–6.0	5.0–7.0
Petals				
Shape	Lanceolate	Lanceolate and keeled	Oblong-lanceolate, carinate	Lanceolate
Length (mm)	15.0–20.0	16.0–17.0	15.0–20.0	18.0–24.0
Colour	Orangish-pink to reddish-yellow	Yellow-pink outside Yellow inside	Whitish-yellow at the base, orange in the rest with the tips reddish	Faintly pink, Pruinose outside and yellow inside
Appendages	2-lanceolate to conical, ascendant and divergent	2-finger-like, recurved	2-lanceolate, oblanceolate to conical, ascendant or convergent	Bent downwards
Gynoecia				
Size (mm)	14.0–15.0 × 6.0–7.0	26.0 × 8.6	10.0–13.0 × 4.0	10.0–11.0 × 8.0
Shape	Pyriform	Narrowly prismatic	-	Narrowly prismatic
Colour	White with purple style	White with purple style	White-yellowish with dark brown-reddish styles	Beige white w/purple styles
Stamens (mm)				
Epipetalous	12.0–13.0	20.0–25.0	7.0–9.0	10.0–13.0
Antesepalous	10.0–11.0	22.0–24.0	10.0–12.0	13.0–16.0
Anthers	Beige to brownish	Reddish	Pink-reddish to yellow	Reddish
Nectaries				
Shape	Reniform	Narrowly mooned	Reniform	Reniform
Colour	Whitish to pale yellow	Yellowish	Pink with reddish-margins	Red to yellowish with reddish edges
Width (mm)	2.0	4.0	1.0	2.4
Geographical distribution	Jaliscan-Manantlán District, Western Sierra de Manantlán subprovince, Sierra Madre del Sur Province	Sierra Madre Occidental province, Durango, Jalisco	Transmexican Volcanic Belt province, SE of Jalisco	Transmexican Volcanic Belt province, Aguascalientes, Jalisco

Discussion

Substantial morphological, ecological and biogeographical evidence support the distinctiveness of *Echeveria cuevasii* (ser. *Nudae*) and *E. vazquezii* (ser. *Gibbiflorae*) as new species (Table 1, 2). The two species *E. cuevasii* and *E. vazquezii* are allopatric and occur at different elevational niches within the Sierra de Manantlán Biosphere Reserve in Jalisco, Mexico.

Echeveria cuevasii is placed in *E.* ser. *Nudae* based on its morphological features. Although this series is not a monophyletic group according to phylogenetic evidence (de la Cruz-Lopez *et al.* 2019), it remains a valuable tool for species identification. Morphological evidence indicates that *E. flammigera* and *E. multicaulis* are likely closest relatives. It distinguished itself from *E. flammigera* by its few branches, robust stems with compressed hexagonal sections around leaf scars, flowers with small pedicels and petals with bright yellow margins. In comparison with *E. multicaulis*, *E. cuevasii* stands out with its minutely papillose epidermis, smaller inflorescences, longer corollas and wider nectaries.

The morphologically close species of the *Echeveria* ser. *Nudae* inhabit different biogeographical regions: *E. flammigera* is confined to the central Sierra Madre Occidental province; *E. multicaulis* occurs throughout the Sierra Madre del Sur province; and *E. cuevasii* is endemic to the Jaliscan-Manantlán District within the Western Sierra Madre del Sur subprovince (Morrone 2017; Morrone *et al*. 2017).

The morphologically close species of *Echeveria* ser. *Gibbiflorae* inhabit different biogeographic regions: *E. dactylifera,* inhabit the Sierra Madre Occidental province; *E. marianae* and *E. novogaliciana* are confined to the Trans-Mexican Volcanic Belt province; while *E. vazquezii* is endemic to the Sierra Madre del Sur province, in the Jaliscan-Manantlán District within the Western Sierra Madre del Sur subprovince (Morrone 2017; Morrone *et al*. 2017).

Following IUCN criteria (IUCN 2012), given their narrow distribution the two species are endangered of extinction. Further exploration in the Sierra de Manantlán and Western Mexico is needed to locate additional populations of these endangered species and to propagate them for ex-situ conservation.

Populations of *Echeveria* sp. from Picachos del Pozanco (between Capillas and El Muñeco), Cuautitlán, were excluded, since we indicate that they could represent an undescribed species that deserves a study of population variability.

Phylogenomic studies of *Echeveria*, including these species, are particularly needed to understand their relationships better and to help develop novel evolutionary and biogeographical hypotheses.

Taxonomic treatment

Echeveria cuevasii A. Vázquez & Padilla-Lepe *sp. nov.* Figs. 1–4.

Type:—MEXICO. Jalisco: Municipio de Cuautitlán de García Barragán, El Muñeco, Sierra de Manantlán, 24 November, 2022, *J. A. Vázquez-García, R. Cuevas-Guzmán, J. G. Morales Arias & J. Padilla Lepe 10315* (holotype: ZEA, isotype: IBUG).

Diagnosis:—*Echeveria cuevasii* is similar to *E. flammigera* in having a subshruby habit with ascending branches, stem length and inflorescence length. However, it differs from the latter in having fewer shorter and thinner branches; longer and wider leaves (5.1 × 2.2 vs. 1.0–1.5 × 0.5–1.0 cm); more flowers per inflorescence (8–14 vs. 2–7); longer bracts (2.5–2.6 vs. 1.0 cm); shorter stamens, the epipetalous (5.3–5.8 vs. 6–7 mm), the antesepalous (6.9–8.1 vs. 8–9 mm); and petals with bright yellow margins vs. petals with light orange to reddish margins. From *E. multicaulis* it differs by the leaves minutely papillose, shorter caudex, shorter inflorescences, and wider nectaries.

Plants perennial, caulescent, shrubby, with few ascending or decumbent branches, glabrous. Stems 23 cm long or more, 11.0–13.0 mm in diameter, greyish green, obscure green between the leaves, with conspicuous hexagonal-shaped sections around the leaf scars. Rosettes terminal, 7.0–9.0 cm in diameter, lax. Leaves 19–35 per rosette, 5.1 cm long, 2.2 cm wide, 6 mm thick near the apex, oblanceolate, apex rounded, mucronate, somehow incurved, lower face convex, keeled in the middle, upper face almost flat but slightly convex in the middle, minutely papillose, grass green with blood red to purplish red margins close to the apex, the basal ones almost all in red. Inflorescence lateral, sub-spicate to racemose, generally 1 per rosette, 14.0–23.9 cm long, with 8–14 flowers; peduncle 7.0–15.8 cm long, 0.4–0.6 cm wide in the base, dark green in the proximal part, reddish green in the fertile portion; peduncle bracts 8–12, alternate, extended, persistent, 2.5–2.6 cm long, 1.0–1.1 cm wide, 3.5–5.0 mm thick next to the apex, similar to leaves in shape and colour; bracteoles 2 in the pedicels, lanceolate, 4.0–5.0 mm long, 1.0–1.3 wide, reddish. Flowers pentamerous, 8–14 per inflorescence; pedicels cylindric, to 5 mm long, 3.0 mm wide, reddish green, papillose; sepals 5, subequal, deltoid-oblanceolate, acuminate, 6.0–8.0 mm long, 2.5–3.5 mm wide, extended but slightly recurved in the distal part, both surfaces convex, reddish; corolla campanulate-tubular, 13.0 mm long, 8.0 mm in diameter in the base, pentagonal; petals 13.0 mm long, 5.0 mm in its widest part in the second third of the distal part, oblong, acute, ventrally concave, dorsally keeled, red to bright orange with bright yellow in the margins next to the apex in the outer face, yellow in the inner face; stamens 10, whitish yellow, 5 epipetalous, 5.3–5.8 mm long, 5 antesepalous, 6.9–8.1 mm long; nectaries reniform 1.7 mm wide, yellow. Gynoecium reddish, carpels 5, 5.9 mm long, 5.2 mm wide, style red, 3.4 mm, stigmas blackish; Fruits polyfollicular with dorsal dehiscence, ascendant, brown. Seeds inconspicuous.

FIGURE 1. *Echeveria cuevasii* in situ, in the highland crest of the Sierra de Manantlán central at Cerro El Muñeco, Cuautitlán de García Barragán, Jalisco. Photograph by A. Vázquez.

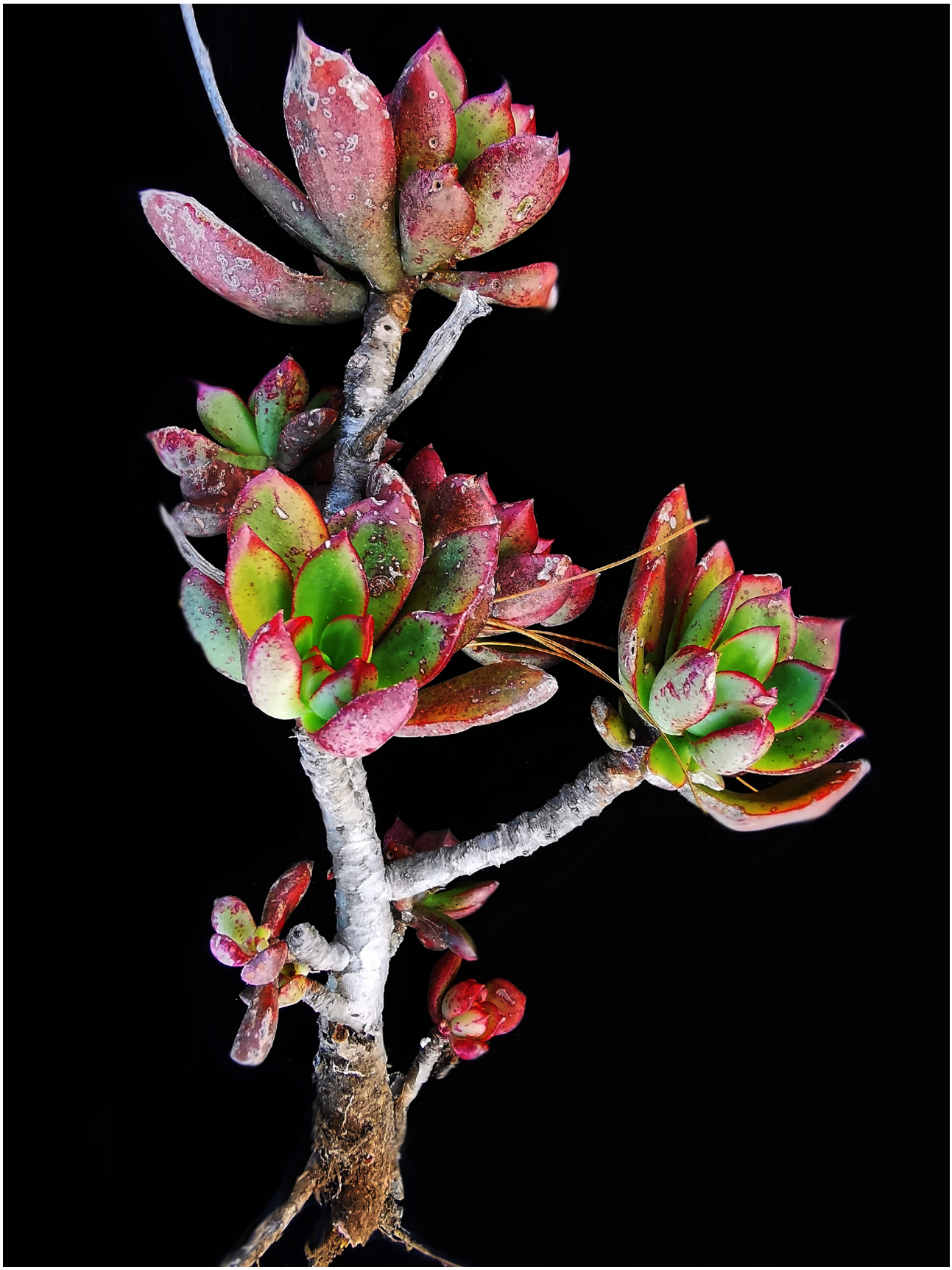

FIGURE 2. *Echeveria cuevasii*. Subshruby habit, the stem branching near the base. Photograph by A. Vázquez.

FIGURE 3. *Echeveria cuevasii*.Compact rosettes (left) and subspicate inflorescence. Photographs by A. Vázquez.

FIGURE 4. *Echeveria cuevasii*. Top left: Flower with pedicel and sepals. Top right: Dissected flower to show nectaries and gynoecium. Bottom row: Petals showing the yellowish inner side with stamens attached and the bright red outer side. Photographs by A. Vázquez.

FIGURE 5. (A) Ramón Cuevas-Guzmán and J. Antonio Vázquez-García at the entrance of the Scientific Station Las Joyas, Autlán, Jalisco. (B & D) R. Cuevas at El Muñeco in habitat of *Echeveria cuevasii*; (C & E). A. Vázquez takes a picture of *Echeveria cuevasii* (C) at El Muñeco and *E. sp. nov*. ined. (E) at Picachos del Pozanco; F. Expedition team (botanists and park rangers: From left to right: Germán Guzmán-Sánchez, Ramón Cuevas-Guzmán, J. Cresencio de Los Santos-Flores, J. Antonio Vázquez-García, Oscar Elías-Trinidad, Manuel Anguiano-Preciado, Israel Elías-Trinidad y Jesús Padilla-Lepe) of the Sierra de Manantlán Biosphere Reserve. Fotografías: A–D & F by J.G. Morales-Arias, 2022; and E by J.G. Morales-Padilla, 2014.

Distribution and ecology:—The species is only known from the type locality on El Muñeco hill, at the confluence of the municipalities of Cuautitlán de García Barragán, Tolimán, and Tuxcacuesco in the upper and central part of the Sierra de Manantlán, at elevations between 2750–2800 m. It is found in cliff pine forest with *Agave manantlanicola* Cuevas & Santana Mich. in Cuevas *et al.* (2012: 330), *A. inaequidens* K. Koch (1860: 28), *Arbutus xalapensis* Kunth (1818[1819]: 279), *Castilleja albobarbata* in Iltis *et al.* (2003: 1343), *Heuchera longipetala* Moc. ex Ser. in de Candolle (1830: 52), *Muhlenbergia dumosa* Scribn. ex Vasey (1892: 71), *Pinus devoniana* Lindley (1839: 62), *P. durangensis* Martínez (1942: 23), *Quercus crassifolia* Bonpl. in Humboldt & Bonpland (1809[1810–1811: 49), *Q. laurina* Bonpl. in Humboldt & Bonpland (1809: 32), *Salvia meera* Ramamoorthy ex J.G. González & Santana Mich. in González-Gallegos *et al*. (2012: 593) and *Stevia lucida* Lagasca (1816: 28), among others.

Phenology:—The plants start developing inflorescences in summer, usually around July. They are in full bloom during late fall and early winter, from late November to mid-January. Fruits and seeds complete their ripening process between mid-January and mid-March.

Eponymy:—We are honoured to name this species after Dr. Ramón Cuevas-Guzmán (Tequesquitlán, Cuautitlán de García Barragán, Jalisco) (Fig. 5), a dear friend and outstanding botanist who first determined that this species was new to science. He has been actively collecting in the area since 1985 and published the books *Flora de Manantlán: plantas vasculares de la Reserva de la Biósfera Sierra de Manantlán, Jalisco-Colima, México* (Vázquez-García *et al.* 1995), *Flora y Vegetación de la Estación Científica Las Joyas* (Cuevas & Jardel 2004) and *Árboles de la Estación Científica Las Joyas y áreas adyacentes, Sierra de Manantlán, México* (Cuevas *et al.* 2021). Moreover, he has described a dozen new species from the Sierra de Manantlán, including *Agave manantlanicola* Cuevas & Santana Mich., *Beilschmiedia manantlanensis* Cuevas & Cochrane (1999: 18), *Bursera macvaughiana* Cuevas & Rzed. (Cuevas & Rzedowski 1999: 78), *Echeveria vazquezii* (here described), *Cestrum mortonianum* var. *jardelii* Cuevas & Mont.-Castro (2011: 38), *Licaria ramiroi* Cuevas in Cuevas *et al*. (2023: 72); *Populus guzmanantlensis* A.Vázquez & Cuevas (1989: 39), *Salvia rogersiana* Ramamoorthy ex J.G.González & Cuevas in González *et al.* (2012: 598), *Sedum dormiens* Cuevas, Pérez-Calix & P. Carrillo (2022: 80), *Sideroxylon brucebenzii* Cuevas & A.Vázquez (2021: 92(e923535), 2–5), "*Quetzalcoatlia santanamichelii*" *sp. nov.* ined., *Sloanea cuautitlanensis* Cuevas & J.L. Mend., in Cuevas *et al.* (2018: 227) and *Trophis noraminervae* Cuevas & Carvajal (1999: 2).

Conservation status:—According to the categories and criteria of the IUCN Red List (IUCN 2012), *Echeveria cuevasii* is assigned a preliminary status of "endangered" EN (B2a). Its known and estimated geographical distribution is less than 500 km^2 in area, and it has been recorded from only one locality.

Additional specimens examined:—MEXICO. Jalisco: Municipio de Cuautitlán de García Barragán, cerro El Muñeco, Sierra de Manantlán, 17 October 2015 (fl), *R. Cuevas-Guzmán & O. Balcazar-Medina 11950* (ZEA).

Echeveria vazquezii Cuevas, Rosales & Padilla-Lepe *sp. nov*. Figs. 6–9.

Type:—MEXICO. Jalisco: Municipio de Cuautitlán de García Barragán. El Almeal, Sierra de Manantlán, 25 November 2022 (fl), *J. A. Vázquez-García, R. Cuevas-Guzmán, J. G. Morales Arias & J. Padilla Lepe 10320* (holotype: IBUG, isotype: ZEA).

Diagnosis:—*Echeveria vazquezii* is similar morphologically to *E. marianae* and *E. novogaliciana* by its short caudex, inflorescence dimension, length of pedicels, dimensions of sepals, and presence of corolla appendages at the base of epipetalous stamens, but differs from both species by the bracts deciduous, fewer cincinni per inflorescence (3–5 vs. up 5), nectaries whitish to pale yellow vs. pink to red, and appendages of epipetalous stamens divergent. *E. vazquezii* differs from *E. dactylifera* by shorter caudex (6 vs. 10–20 cm); smaller leaves (12.0–17 × 4.0–6.0 vs. up 25 × 9.0 cm); bracts deciduous vs. persistent; shorter pedicels (5.0–14.0 vs. 25.0–30.0 cm); shorter sepals and other traits proportioned in table 2.

Description:—Plants perennial, glabrous, succulent, rupicolous, solitary, up to 1.1 m tall with inflorescence. Stems simple, mostly subterraneous, up to 6.0 cm long, up to 3.0 cm in diameter, straight to somewhat curved, bronze to tan greyish, brownish-yellow distally. Rosettes terminal, 20.0–32.0 cm in diameter, lax, lying upon the ground. Leaves spirally arranged, 20–23 per rosette, 12.0–17.0 cm long, 4.0–6.0 cm at the widest point, lanceolate to oblanceolate, pseudo-petiolate, acute to the apex, with a small mucron, horizontally spreading to ascending, yellowish-green to purplish-green or scarlet, epidermis smooth, keeled on the abaxial surface, flattish to somewhat channelled on the adaxial surface. Margins entire, sometimes with pronounced undulations, whitish, hyaline. Panicles lateral, 1–2 per rosette, 80.0–95.0 cm long, erect. Peduncles 0.7–0.8 cm thick at the base, erect, bracteate, pale yellowish-orange to pinkish. Cincinni 3–5 per inflorescence, 5.0–20.0 cm long, nearly straight to curved, ascending, orangish to salmon-pink. Flowers 6–8 per cincinnus. Pedicels 5.0–14.0 mm long, 25.0–30.0 mm in diameter, nearly straight to curved. Calyx 32.0–36.0 mm in diameter, discoid, star-shaped. Sepals unequal, 7.0–15.0 mm long, 3.0–5.0 mm at the widest

point, linear-triangular, rounded at the apex, reflexed or widely spreading to obliquely ascending, yellowish-orange to wine red, sometimes pruinose, both surface convex. Corolla 15.0–20.0 mm long, 10.0–11.0 mm wide, tubular, pentagonal. Petals 5.0–6.0 mm at the widest point, fused at the base, lanceolate, dorsally keeled, orangish-pink to reddish-yellow, with two appendages linear to conical on the inner face, divergent at apexes, 2.0–2.5 mm long, 0.70–0.90 mm wide. Nectary scales 2.0 mm wide, reniform, whitish to pale yellow. Stamens 10, 5 episepalous, 5 epipetalous. Filaments 10.0–11.0 mm long in alternipetalous stamens, 12.0–13.0 mm long in epipetalous stamens, erect, whitish to pale yellow. Anthers 2.0 mm long, beige to brownish. Gynoecia 14.0–15.0 cm long, 6.0–7.0 cm at the widest point near the base, pyriform. Carpels 5, free. Ovaries whitish-green to pale yellowish. Styles dark red to purplish-red, sometimes greenish proximally. Stigmas translucent yellow. Fruits follicles, brownish. Seeds inconspicuous, reddish-brown.

FIGURE 6. *Echeveria vazquezii*. José Guadalupe Morales-Arias at El Almeal, the type locality, showing the habit of large rosettes with tall paniculate inflorescence. Photograph by A. Vázquez.

FIGURE 7. *Echeveria vazquezii*. Rosette with fading adult leaves, El Almeal Cuautitlán, Jalisco. Photograph by R. Cuevas-Guzmán.

Distribution and ecology:—The species is only confirmed from the type locality at the Cuautitlán de García Barragán, municipality in the Sierra de Manantlán. Judging from an image of a large rosette from Las Joyas Scientific Station, Municipio Autlán, available at http://Naturalista.mx/Photos/5476012 by José D. Graf-Pérez it could correspond to this species.

FIGURE 8. *Echeveria vazquezii*. Leaves and paniculate inflorescence, lacking bracts. Photographs by A. Vázquez.

It grows in south-facing cloudy cliffs at 2100 m, coexisting with *Agave attenuata* Salm-Dyck in Salm-Reifferscheidt-Dyck (1834: 303), *A. vazquezgarciae* Cházaro & J.A. Lomelí in Cházaro-Basañez *et al*. (2006: 459), *Geranium hernandesii* DC. in de Candolle (1824: 640), *Lepechinia nelsonii* (Fernald) Epling (1940: 511), *Muhlenbergia dumosa, Phacelia platycarpa* (Cav.) Spreng. in Sprenger (1825[1824]: 584]), *Plantago australis* Lam. in Lamarck & Poiret (1791[1792]: 339), *Salvia cinnabarina* M. Martens & Galeotti (1844: 63), *S. elegans* Vahl (1804: 361), *Sporobolus indicus* (L.) R. Br. in Brown (1810: 170) & *Trifolium amabile* Kunth in Humboldt *et al.* (1823[1824]: 503), among others.

Phenology:—The plants start developing their inflorescences in summer, usually around July. They are in full bloom during late fall and early winter, from late November to mid-January. Fruits and seeds complete their ripening process between mid-January and mid-March.

Eponymy:—We are honoured to name this species after Dr. José Antonio Vázquez-García (Guadalajara, Jalisco) (Fig. 5), a dear friend and outstanding botanist who first determined that this species was a new one to science. He has been actively collecting in the area since 1979 and published *Flora de Manantlán: plantas vasculares de la Reserva de la Biósfera Sierra de Manantlán, Jalisco-Colima, México* (Vázquez-García *et al*. 1995) and about vegetation gradients in the Cerro Grande Massiff, Sierra de Manantlán (Vázquez-García & Givnish 1998, 2000). Dr. Antonio Vázquez-García is currently one of the best specialists in America in the *Magnolia* genus and in Mexico in the *Agave* genus and the Crassulacea family, of this last he has described numerous new taxa including three new genera: *Chazaroa*, *Jeronimoa* and *Quetzalcoatlia*; and a dozen new species: *Chazaroa* (1 sp.), *Echeveria* (4 spp.), including one of the species here published and *Quetzalcoatlia* (7 spp.) (Vázquez-García *et al*. 2013, 2014, 2023a, 2023b; Nieves-

Hernández *et al*. 2014; Jimeno-Sevilla *et al*. 2019). Moreover, he has described at least three new species of trees for the Sierra de Manantlán, including the emblematic *Magnolia iltisiana* Vázquez-García (1994: 7).

Conservation status:—According to the categories and criteria of the IUCN Red List (IUCN 2012), *Echeveria vazquezii* is assigned a preliminary status of "endangered" EN (B2a). Its known and estimated geographical distribution is less than 500 km^2 in area, and it has been recorded from only three localities.

Additional specimens examined:—MEXICO. Jalisco: Municipio de Cuautitlán de García Barragán, El Almeal, Sierra de Manantlán, 25 October 2016 (fl), *R. Cuevas-Guzmán, E.V. Sánchez-Rodríguez & J.G. Morales-Arias 12122a* (ZEA); 30 November 2017 (fl), *R. Cuevas-Guzmán, L. Guzmán-Hernández, J.G. Morales-Arias & E.V. Sánchez-Rodríguez 14067* (ZEA); 9 January 2024 (fr), *J.G. Morale-Arias, R. Cuevas G. & E.V. Sánchez-Rodríguez 880* (ZEA).

FIGURE 9. *Echeveria vazquezii*. Left: Flowers in natural stage. Right: flowers with petals forced backwards to show inner parts and colours: nectaries, stamens and gynoecia. Photographs by A. Vázquez.

Acknowledgements

We are grateful to the park rangers of the Reserva de la Biosfera Sierra de Manantlán, for their logistic support and guidance. To Julia Etter, Martin Kristen, Miguel Cházaro R.I.P., and Juan Gabriel Morales & Rodolfo Chávez for field companionship in expeditions to the Sierra de Manantlán. To Daniel Hernández Campo for the review and suggestions that improved the writing. To the Universidad de Guadalajara-CUCBA and CUCSUR, CONACyT-SNI, and PROMEP-SEP in Mexico, for financial support and research facilities

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