



# *Triolena anisophylla* (Melastomataceae), a new and threatened species endemic to Panama

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**Summary.** A new species of *Triolena*, endemic to Colón Province, Panama, is described and illustrated. The specimens of this taxon were previously identified as *Triolena lanceolata*, but closer inspection has shown them to be morphologically and geographically distinct. *Triolena anisophylla* K.Samra & Michelang. grows on rocks and tree trunks along rivers in Colón Province. This species is distinguishable by its strongly anisophyllous leaves and unique trichomes on the adaxial surface of the leaves. A complete description, distribution map, preliminary conservation assessment, taxonomic notes, and regional key are provided.

**Key Words.** Mesoamerica, Mining, New species, Taxonomy, Threatened, Trioleneae.

## Introduction

*Triolena* Naudin (1851: 328) is a genus of approximately 28 species distributed from southern Mexico through the Andes of Bolivia and into western Amazonia (Bacci *et al.* 2022). *Triolena* includes taxa once placed in *Diolena* Naudin (1851: 329) and *Diplarpea* Triana in Benth. & Hook.f. (Bentham & Hooker 1867: 732, 756). *Triolena* was recently recovered as sister to *Monolena* Triana in Bentham & Hooker (1867: 732, 756) and together the two genera make up the tribe Trioleneae Bacci, Michelang. & R.Goldenb. (Bacci *et al.* 2019). *Triolena* are commonly found in moist areas and along rivers, from lowland to montane forests. In addition to growing terrestrially, many species have been found to be lithophytic and epiphytic on trunks and low branches. *Triolena* are distinguished by their suffrutescent habit, helicoid cymes, 5-merous flowers, 2 – 3 ventral stamen appendages, and dehiscent, triquetrous, ‘splash cup’ capsules that are water-dependent for dispersal (Bacci *et al.* 2022).

Mesoamerica fosters a rich diversity of Melastomataceae, with 29 native and 1 introduced genera known to the region, of which 20 occur in Panama (Almeda 2009, following current generic circumscriptions in Ulloa Ulloa *et al.* 2022). Seven species of *Monolena* are known to Panama, and with the inclusion of *Triolena anisophylla*, five species of *Triolena*. Although *Monolena* has been relatively well-studied in Central America (Warner 2002), *Triolena* lacks a comprehensive regional revision. Two new species were recently described from Peru (Michelangeli & Goldenberg 2018) and additional undocumented diversity of *Triolena*, throughout its distribution, is strongly suspected.

## Materials and Methods

The description was based on herbarium specimens from CAS and MO (herbarium acronyms follow Thiers 2023, continuously updated). Vegetative and floral measurements were taken from dried and rehydrated material, respectively. Images and measurements were captured with a Zeiss Stemi 305 Stereoscope and AxioCam ERc 5s (Rev. 2). Leaves for scanning electron microscopy (SEM) studies were extracted from herbarium specimens, mounted on aluminium stubs, and coated with gold-palladium in a Denton DSK00V-0016 sputter coater at 15 kv for 4 min. SEM was performed on a Hitachi SU3500-VP and images captured with the SE detector with accelerating voltages ranging from 5 – 10 kV. We use calyx terminology for Melastomataceae proposed by Basso-Alves *et al.* (2017) and by Penneys & Judd (2005). All other terminology follows Beentje (2015). Specimens seen by the authors are marked below with “!”.

Coordinates from herbarium specimens were plotted in R (R Core Team 2022) using the package mapview (Appelhans *et al.* 2023) and base maps from OpenStreetMap (2022). Area of Occupancy (AOO) and Extent of Occurrence (EOO) were calculated in GeoCat (Bachman *et al.* 2011) based on a 2 km<sup>2</sup> grid. The conservation assessment is based on calculated range size (Criterion B), according to IUCN guidelines and criteria (IUCN 2012; IUCN 2022). Locations of specimens were taken from herbarium labels and the MO Tropicos database (<http://www.tropicos.org>). Elevations for coordinates were extracted with the R package elevatr (Hollister *et al.* 2021).

## Taxonomic Treatment

***Triolena anisophylla*** K.Samra & Michelang. **sp. nov.**

Type: Panama, Colón Province, Distr. Donoso, afueras del área de la concesión de Minera Panamá, al sur del Helipad PC7, 34 m, 8°56'17"N, 80°45'46"W, 25 Aug. 2012, fl., fr., O. Ortiz, J. Carrión, & E. Sánchez 837 (holotype MO! [accession 6750825]; isotype PMA).

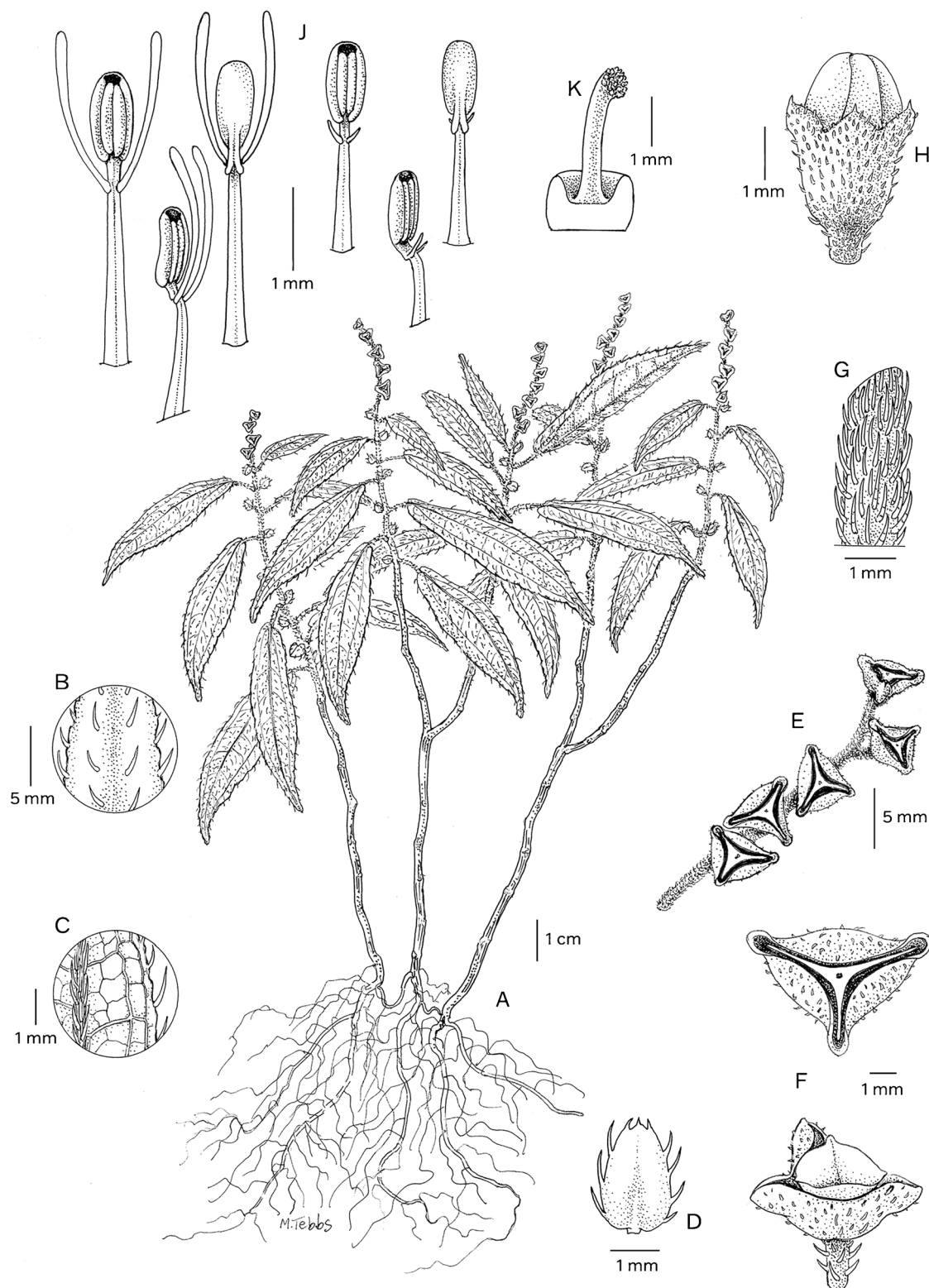
<http://www.ipni.org//urn:lsid:ipni.org:names:77342079-1>

*Rhizomatous herbs* 10 – 35 cm tall. *Stems* terete, younger shoots moderately to densely covered with 0.2 – 0.5 mm long, unbranched, simple trichomes, these mostly appressed and slightly incurved but a few erect, sometimes with slightly longer and denser tufts of trichomes surrounding the petiole base, those 0.4 – 0.6 mm long. *Leaves* opposite, strongly anisophyllous. *Larger leaf* in each pair with petioles 2 – 4 mm long, densely covered in 0.2 – 0.8 mm long, unbranched, simple trichomes, these mostly appressed; blade 30 – 68 × 4 – 14 mm, linear-lanceolate; base oblique; margins sinuate-crenulate and ciliolate, the cilia slender, 0.2 – 1 mm long, incurved, decreasing in length towards leaf apex; apex narrow-obtuse to sometimes retuse. Acrodromous nerves 3, suprabasal. Midvein slightly depressed, abaxially densely covered in the same simple trichomes as the petiole, these trichomes mostly appressed, decreasing in length and density towards leaf apex. Secondary veins joining the midvein 1 – 3 mm above leaf base, often asymmetrically offset 1 – 2 mm apart from each other. Tertiary venation barely visible adaxially. Leaf blade abaxial surface sparsely covered with simple, stiff, appressed, elongated trichomes 0.8 – 1.2 mm long that only occur along tertiary venation, many appearing in pairs adjacent to and on either side of the midvein. Leaf blade adaxial surface with simple, stiff, appressed, elongated trichomes 0.8 – 1.2 mm long, typically equally spaced between midvein and secondary acrodromous veins, often appearing in two rows, appressed towards leaf apex and incurved towards midvein. *Smaller leaf* in each pair often caducous in older shoots, when present appearing sessile or with petiole 0.1 – 0.3 mm long; petiole and abaxial surface of midvein sometimes with sparse simple trichomes 0.1 – 0.3 mm long; blade 1.5 – 6 × 1 – 3 mm, lanceolate; adaxial surface glabrous; base oblique and often twisted or slightly folded so that it appears cordate, often on the same side of the stem as and at an acute angle to the larger leaf in pressed specimens; margins sinuate-crenulate and ciliolate; cilia slender, 0.2 – 0.8 mm long, incurved and decreasing in length toward leaf apex; apex obtuse but sometimes appearing retuse with a pair of terminal cilia. Secondary acrodromous venation faintly visible abaxially; only the midvein distinguishable adaxially. *Inflorescence* apical, a uniparous cyme 1 – 2.5 cm long, 1 – 5-flowered; axis covered with the same slender appressed trichomes

as the stems, but slightly shorter, 0.2 – 0.4 mm long, denser tufts of trichomes surrounding the base of some pedicels; pedicels c. 1 – 1.5 mm long and densely covered in short simple trichomes 0.1 – 0.2 mm long; bracteoles lacking or perhaps early caducous. *Flowers* 5-merous. *Calyx* tube 0.3 – 0.4 mm long, glabrous on both sides; sepals internal laminae 0.2 – 0.3 mm long, widely triangular, apices obtuse, margins entire; sepals external projections triangular, 0.6 – 0.8 mm long including setula, apices acute and topped with setula 0.1 – 0.2 mm long. *Hypanthium* 1.7 – 2.2 × 1.9 – 2.1 mm, campanulate, externally covered in the same short trichomes as the pedicels, inside glabrous, torus glabrous. *Petals* 2.8 – 3 × 2.2 – 2.6 mm, elliptic, apices rounded-truncate, margin repand, glabrous on both sides, white to pink. *Stamens* dimorphic, yellow. Larger stamens antesealous with filaments c. 2.1 mm long, glabrous and narrowing towards the anther; anthers c. 1 mm long, oblong, with an apical-ventral pore; connective barely prolonged below the thecae, dorsally projected into one or two very short knobs 0.05 mm long, ventrally projected into two long slender appendages 1.5 – 1.9 mm long, erect and bending backwards, the apex spatulate and rounded, glabrous. Smaller stamens antepetalous with filaments c. 1.4 mm long, glabrous; anthers c. 0.8 mm long, with an apical-ventral pore; connective barely prolonged below the thecae, dorsally projected into one or two short knobs 0.05 mm long, ventrally projected into two short appendages, 0.25 mm long, slender and erect, apices rounded, glabrous. *Ovary* 3-locular,  $\frac{1}{2}$  – completely inferior, collar around the base of the style 0.3 mm tall. *Style* 2.6 mm long, straight but slightly curved at the apex, glabrous. *Stigma* capitate, rounded and papillose. *Fruits* capsular, triquetrous, splash cups, 2.5 – 4 × 4 – 7 mm. *Seeds* not seen.

**RECOGNITION.** *Triolena anisophylla* is distinct from all other *Triolena* in its combination of strongly anisophyllous leaves (the smaller < half the length of the larger), presence of two evenly spaced rows of trichomes on the adaxial surface of the larger leaf, and the lack of glandular hairs on its stem and hypanthium (Fig. 1).

Specimens of *Triolena anisophylla* were previously identified as *T. lanceolata* Almeda & Alvear in Bernal *et al.* (2015: 4) (= *Diolena lanceolata* Gleason (1925: 374)), which is known only from Colombia. *Triolena anisophylla* differs from *T. lanceolata* (Gleason) Almeda & Alvear (Bernal *et al.* 2015: 4) in its strongly anisophyllous leaves (Fig. 2), where the smaller is < half the length of the larger (vs weakly anisophyllous in *T. lanceolata*) and by the presence of two rows of equally spaced trichomes on the adaxial surface of the larger leaves (Fig. 3) (vs inconspicuous, sparse, irregularly spaced trichomes). These same characters distinguish *T. anisophylla* from *T. campii* (Wurdack) Wurdack (1975: 493), an Ecuadorian species which also exhibits weak anisophylly and



**Fig. 1.** *Triolena anisophylla*. **A** plant habit; **B** detail of adaxial surface of larger leaf; **C** detail of abaxial surface of larger leaf; **D** smaller anisophyllous leaf; **E** infructescence; **F** detail of splash cup fruit from above; **G** stem pubescence; **H** flower bud; **J** stamens, from left to right, antesepalous – ventral view, antesepalous – lateral view, antesepalous – dorsal view, antepetalous – ventral view, antepetalous – lateral view, antepetalous – dorsal view; **K** style and stigma. **A** – **G** Hammel et al. 26291 (CAS); **H** – **J** Ortiz et al. 837 (MO). DRAWN BY MARGARET TEBBS.

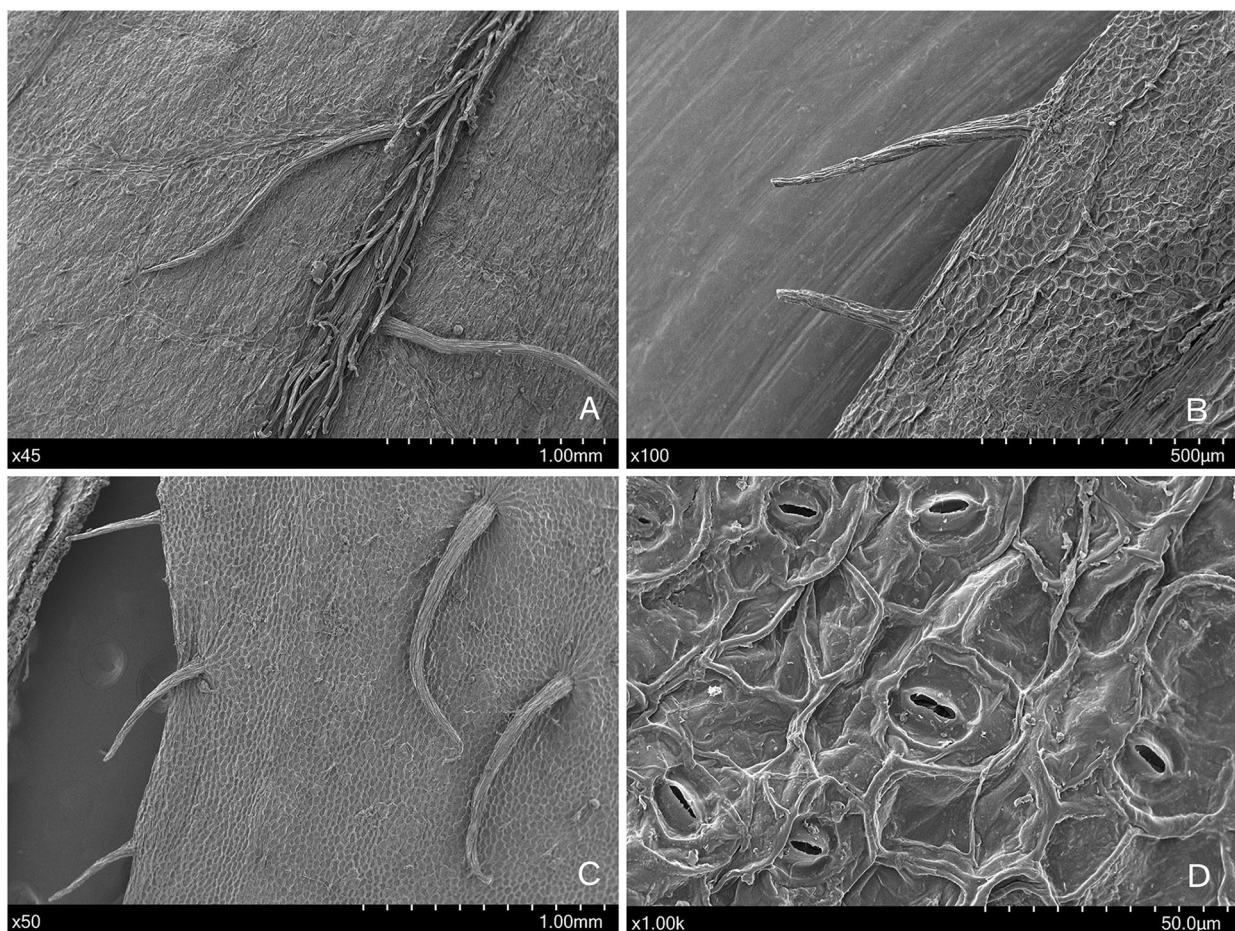


**Fig. 2.** Distinguishing characters of *Triolena anisophylla*. **A** anisophyllous leaf pairs at acute angles (Aranda *et al.* 4206, CAS); **B** rows of equally spaced trichomes on adaxial surface of larger leaf (Aranda 4276, CAS); **C** cyme of mature fruits (Hammel *et al.* 26291, MO). PHOTOS: K. E. SAMRA.

sparse, inconspicuous trichomes on the adaxial surface of the leaves. *T. anisophylla* differs from the Colombian *T. agrimonioides* (Triana) Almeda & Alvear (Bernal *et al.* 2015: 4) primarily by its sinuate-crenulate leaf margins (vs dentate in *T. agrimonioides*).

**DISTRIBUTION.** *Triolena anisophylla* is known only from the Caribbean slopes of Panama, in the western portion of Donoso District in Colón Province. Map 1.

**ADDITIONAL SPECIMENS EXAMINED. PANAMA.** Colón, Distr. Donoso: Coclé del Norte, área del helipad CR10,



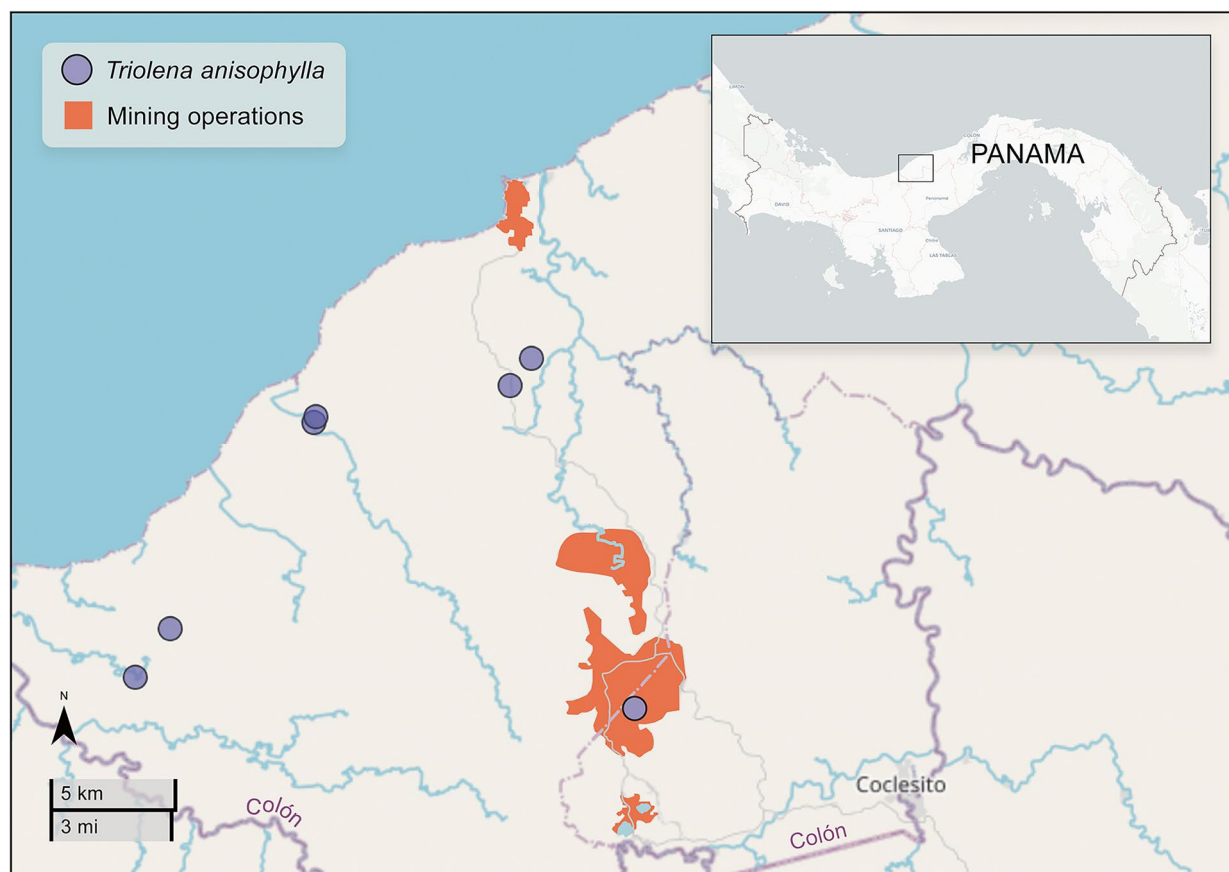
**Fig. 3.** SEM details of larger *Triolena anisophylla* leaves. **A** abaxial midvein (scale bar = 1 mm); **B** abaxial margin (scale bar = 500 µm); **C** adaxial margin (scale bar = 1 mm); **D** adaxial surface (scale bar = 50 µm). **A – D** Aranda *et al.* 4206 (MO). PHOTOS: F. A. MICHELANGELI.

tomando hacia el norte, 08°56'55"N, 80°41'37"W, 17 July 2012 (fr.), *J. Aranda et al.* 4206, collected with: F. Hernández, A. Morris & O. Rodríguez (CAS! [accession 1129405], MO! [accession 6750823], PMA); Coclé del Norte, área del helipad BL02, tomando hacia el norte, a orilla de quebrada, 08°51'51"N, 80°48'51"W, 20 July 2012 (fl., fr.), *J. Aranda et al.* 4276, collected with: A. Morris, E. Cedeño & O. Rodríguez (CAS! [accession 1129406], MO! [accession 6750828], PMA); Coclé del Norte, Helipad Primera corriente 07, rumbo sur, próximo a Nueva Lucha, orillas del camino, 08°56'10"N, 080°45'48"W, 24 Aug. 2012 (fl., fr.), *A. Zapata et al.* 3013, collected with: B. Castro, O. Ortiz & E. Sánchez (MO! [accession 6750827], PMA); Coclé del Norte, cerca de el Río Escribano, área del helipad BL03, 40 m, 08°50'50"N, 080°49'34"W, 24 Aug. 2012 (fl.), *L. Martínez et al.* 969, collected with: H. Espinosa, J. Carrión & E. Sánchez (MO! [accession 6750826], PMA); Coclé del Norte, area del helipad [helipad] C18, zona de estudio fuera de la zona de concesion de Minera Panama, UTM WGS84: 17 P 0534436 990286 [08°57'31"N, 080°41'11"W], 10 March 2010 (fr.), *C. Guerra* 1241 (MO! [accession 6359512], PMA); MPSA Concession, Botija Camp, along Quebrada

Botija, 08°50'10"N, 080°39'00"W, 22 May 2012 (fl., fr.), *B. E. Hammel et al.* 26291, collected with: J. De Gracia, R. Flores, J. Martínez, M. Merello & H. Quiel (CAS! [accession 1154071], MO! [accession 6450917]).

**HABITAT & ECOLOGY.** *Triolena anisophylla* occurs on rocks and tree trunks, usually along the edges of streams or near rivers at 25 – 150 m elevation in moist forests.

**CONSERVATION STATUS.** *Triolena anisophylla* is known from only seven specimens and has an EOO of 163 km<sup>2</sup> and an AOO of 24 km<sup>2</sup>. With proximity considered, it appears there are four subpopulations of the species. Although all of the populations fall within the boundaries of the Donoso Protected Area (UNEP-WCMC & IUCN 2023), Donoso is designated as 'multiple use', and First Quantum Minerals Ltd. has several active copper mining operations within the area (Gray *et al.* 2019). Two of the cited collections mention proximity to the mining area (Hammel *et al.* 26291, Ortiz *et al.* 837), and one specimen (Guerra 1241) was collected within the mining concession (Map 1). Furthermore, in their most recent technical report, First Quantum Minerals Ltd. proposed a significant expansion to the



**Map 1.** Distribution of *Triolena anisophylla* and local mining operations.

mining area (Gray *et al.* 2019). Because of its EOO and AOO, restricted habitat in lowland riparian forest, small number of known locations, and the active threat of mining in those locations, we recommend that *Triolena anisophylla* be provisionally considered Endangered [EN B1ab(i,ii)+2ab(i,ii)].

**PHENOLOGY.** *Triolena anisophylla* has been found in flower May – Aug. and in fruit March – Aug.

**ETYMOLOGY.** *Triolena anisophylla* is named for its strongly anisophyllous leaves.

**NOTES.** The most comprehensive key that exists for *Triolena* is that of *Flora Mesoamericana* (Almeda 2009), in which *T. anisophylla* keys out closest to *T. pileoides* subsp. *panamensis* Wurdack (1976: 9) and *T. spicata* (Triana) L.O.Williams (1963: 586). *Triolena anisophylla* differs from *T. pileoides* subsp. *panamensis* in its larger

leaves > 3 cm long and linear-lanceolate (vs < 2 cm long and oblong-elliptic in *T. pileoides* subsp. *panamensis*), its appressed trichomes on the stems (vs pilose), and by its lack of glandular trichomes (vs two types of glandular trichomes abundantly present). *Triolena anisophylla* is easily distinguished from *T. spicata* by its slender, linear-lanceolate leaves (vs obovate to pandurate in *T. spicata*) and by the presence of two rows of equally spaced trichomes on the adaxial surface of the leaves (vs glabrous or sparse and irregularly spaced trichomes).

Of the other Panamanian species, *Triolena anisophylla* differs from *T. dressleri* Wurdack (1975: 493) and *T. hirsuta* (Benth.) Triana (1867: 211) in its strongly anisophyllous and linear-lanceolate, larger leaves (vs weakly anisophyllous and elliptic-ovate or ovate in *T. dressleri* and *T. hirsuta*).

### Key to the species of *Triolena* in Panama

1. Opposing leaves weakly anisophyllous, the smaller  $\geq$  half the length of the larger ..... 2
1. Opposing leaves strongly anisophyllous, the smaller < half the length of the larger ..... 3
2. Leaves adaxially pustulate, abaxially foveolate ..... **T. dressleri**
2. Leaves adaxially and abaxially smooth (not pustulate or foveolate) ..... **T. hirsuta**
3. Larger leaves  $\leq$  2 cm long ..... **T. pileoides** subsp. **panamensis**
3. Larger leaves  $\geq$  3 cm long ..... 4
4. Larger leaves  $\leq$  1.4 cm wide, linear-lanceolate, apices acute-obtuse to retuse, adaxial surface with equally spaced trichomes often in two rows ..... **T. anisophylla**
4. Larger leaves  $\geq$  1.8 cm wide, obovate to slightly pandurate, apices long-acuminate, adaxial surface glabrous or with sparse, irregularly spaced trichomes ..... **T. spicata**

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### Declarations

**Conflict of Interest** The authors declare that they have no conflict of interest.

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