Plant Ecology and Evolution 155 (3): 417–424, 2022
https://doi.org/10.5091/plecevo.86519

RESEARCH ARTICLE

A striking new species of *Rhipidocladum* (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) with single, terminal-spikelet synflorescences, endemic to Jalisco, Mexico

Eduardo Ruiz-Sanchez[1,2], Christopher D. Tyrrell[3,4], Pablo Carrillo-Reyes[1,2], A.T. Nuño-Rubio[5]

1 Departamento de Botánica y Zoología, Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Zapopan, Jalisco, Mexico
2 Laboratorio Nacional de Identificación y Caracterización Vegetal (LaniVeg), Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Zapopan, Jalisco, Mexico
3 Botany Department, Milwaukee Public Museum, Milwaukee, Wisconsin, USA
4 Department of Biological Sciences, Marquette University, Milwaukee, Wisconsin, USA
5 Puerto Vallarta Botanical Gardens, Puerto Vallarta, Jalisco Mexico

Corresponding author: Eduardo Ruiz-Sanchez (ruizsanchez.eduardo@gmail.com)

Academic editor: Brecht Verstraete ♦ **Received** 13 May 2022 ♦ **Accepted** 20 June 2022 ♦ **Published** 30 November 2022

Abstract

Background and aims – *Rhipidocladum*, a woody bamboo genus distributed from Mexico to Argentina, has raceme like synflorescences of multiple spikelets. Six of the 21 known species occur in Mexico. In this study, we present a full description, distribution map, illustrations, and photographs of an unusual new *Rhipidocladum* species endemic to Jalisco, Mexico. Additionally, we provide an updated key to the species of *Rhipidocladum* in Mexico.
Material and methods – This study was based on fieldwork, literature, and herbarium specimens review. Specimens collected were analysed and photographed during fieldwork. The conservation assessment is based on spatial analyses, following the IUCN guidelines and criteria.
Results – This is the first species in the genus *Rhipidocladum* that has synflorescences with only a single, terminal spikelet. *Rhipidocladum singuliflorum* occurs only in three localities in the municipality of Puerto Vallarta, Jalisco, Mexico. This species inhabits the canyon slopes of rivers in subdeciduous and tropical dry forests, at 6–150 m a.s.l. According to our IUCN assessment, this new species should be considered Critically Endangered.

Keywords

Arthrostylidiinae, *Rhipidocladum* sect. *Racemiflorum*, spicate synflorescence, tropical subdeciduous forest, woody bamboos

INTRODUCTION

Rhipidocladum McClure is one of eight genera of woody bamboo found in Mexico, and one of the four Mexican bamboo genera in subtribe Arthrostylidiinae (Ruiz-Sanchez et al. 2015). The genus has 21 described species, six of which are present in the country and three of which are endemic (Ruiz-Sanchez et al. 2019, 2021a, 2021b). Taxonomically, *Rhipidocladum* is classified into two sections: *Rhipidocladum* sect. *Rhipidocladum* and *R.* sect. *Racemiflorum* (Clark and Londoño 1991). *Rhipidocladum* sect. *Rhipidocladum* is characterized by robust culms with an apically arching or pendulous habit, basally fused fimbriae on the foliage sheath summit, a zig-zagged synflorescence axis, and obtuse, unawned lemmas. Meanwhile, *R.* sect. *Racemiflorum* is characterized by plants with viny culms with a scandent or climbing habit, racemiform synflorescences with a straight (non-

Plant Ecology and Evolution is published by Meise Botanic Garden and Royal Botanical Society of Belgium.

zig-zag) axes, and acute, usually awned lemmas (Clark and Londoño 1991). Only three species: *Rhipidocladum arenicola* C.D.Tyrrell & L.G.Clark, *R. cordatum* C.D.Tyrrell & L.G.Clark, and *R. harmonicum* (Parodi) McClure comprise the sect. *Rhipidocladum* (Clark and Londoño 1991; Tyrrell and Clark 2013). The rest of the species belong to the sect. *Racemiflorum*.

Rhipidocladum species inhabit tropical forests from sea level to 2800 m a.s.l. with species in sect. *Rhipidocladum* generally found at higher elevations. The geographical distribution of *Rhipidocladum* spans from Mexico and Trinidad in the north to Argentina and central Brazil in the south (Tyrrell and Clark 2013; Ruiz-Sanchez et al. 2019, 2021a, 2021b). The six species in Mexico are all classified within the *R.* sect. *Racemiflorum* and include: *Rhipidocladum barbinode* Ruiz-Sanchez, C.D.Tyrrell & Vigosa (endemic), *R. bartlettii* McClure, *R. martinezii* Davidse & Pohl (endemic), *R. pittieri* (Hack.) McClure, *R. racemiflorum* (Steud.) McClure, and *R. zoqueorum* Ruiz-Sanchez, C.D.Tyrrell & Sosa (endemic) (Ruiz-Sanchez et al. 2019, 2021b).

Two species are known from the state of Jalisco: *R. barbinode* and *R. racemiflorum.* The first inhabits tropical dry forest and subdeciduous tropical forest glens, mainly in the southwestern part of the state at elevations of 500–1000 m a.s.l. The second inhabits tropical subdeciduous forest at the western edge of the state at elevations of 100–1000 m a.s.l. (Ruiz-Sanchez et al. 2021b) (Fig. 1). Until now, none of these species are found in sympatry. *Rhipidocladum barbinode* has spicate synflorescences, bearing 3–7 spikelets spaced 5–7 mm apart, glumes are awnless, and mucronate lemmas. Meanwhile, *R. racemiflorum* has racemose inflorescences with 10–13 spikelets, glumes have awns, and the lemmas are aristate.

During our fieldwork carried out in Puerto Vallarta, Jalisco along the Palo María, El Nogalito, and El Pitillal rivers, we found a population of flowering bamboos that can be clearly assigned to *Rhipidocladum*, but cannot be assigned to any known Mexican or American *Rhipidocladum* species. This new species has synflorescences with only a single, terminal spikelet (compared to all other *Rhipidocladum* species which have two to many spikelets). Further, these spikelets were strikingly wide for a *Rhipidocladum* with large, inflated lemmas. A few individual branchlets had spikelets bearing numerous (> 20) florets. In this study, we present a full description of this unusual new *Rhipidocladum* species and provide a distribution map, illustrations, photographs, and a new key to the species of *Rhipidocladum* in Mexico.

MATERIAL AND METHODS

Fieldwork was carried out in November and December 2021, and from January to March 2022. We collected flowering specimens growing along the Palo María, El Nogalito, and El Pitillal rivers in Puerto Vallarta, Jalisco, Mexico (Fig. 1). Specimens from the following herbaria were examined: IBUG, MEXU, and ZEA (acronyms according to Thiers continuously updated). Collection procedures followed Soderstrom and Young (1983), thus complete specimens with branch complements, culm leaves, culm nodes, and internodes were preserved. The new specimens were deposited at IBUG. Macromorphological characters were measured using a centimetre ruler and micromorphological measurements were made using a millimetre-calibrated optical micrometre in a dissecting microscope. Measurement procedures follow Ruiz-Sanchez et al. (2019, 2021b). Morphological terminology follows McClure (1973) and Tyrrell and Clark (2013). The distribution map was made using QGIS v.2.16.3 (QGIS Development Team 2016). We followed Rzedowski (2006) to classify vegetation types. For biogeographic regionalization, we followed Santiago-Alvarado et al. (2016) and Morrone et al. (2017).

The conservation status was assessed based on the IUCN Red List categories and criteria (IUCN Standards and Petitions Committee 2022). The extent of occurrence (EOO) and area of occupancy (AOO), using 2 × 2 km grid cells (4 km^2), were estimated using the Geospatial Conservation Assessment Tool (GeoCAT; Bachman et al. 2011).

TAXONOMIC TREATMENT

Rhipidocladum singuliflorum Ruiz-Sanchez & C.D.Tyrrell, **sp**. **nov**.
urn:lsid:ipni.org:names:77308912-1
Figs 2, 3, 4

Type. MEXICO – **Jalisco** • Puerto Vallarta, Río Palo María; 20°33'8.76"N, 105°15'34"W; 6 m; 10 Dec. 2021; fl.; *E. Ruiz-Sanchez, A.T. Nuño, A. Zabalgoitia, L.A. Monroy & L. Campos 722;* holotype: IBUG; isotypes: MEXU, ZEA.
Diagnosis. *Rhipidocladum singuliflorum* differs from *R. barbinode* and *R. racemiflorum* by having a single terminal spikelet. Meanwhile, *R. barbinode* has a spicate synflorescence with 3–7 spikelets and *R. racemiflorum* has a raceme synflorescence with 10–13 spikelets. *R. singuliflorum* has efimbriate or poorly developed fimbriae on the foliage leaves, meanwhile, *R. barbinode* and *R. racemiflorum* bear fimbriae at the apex of the sheath of the foliage leaves.
Description. Culm height 3–10 m. Internodes smooth, uniform in colour, 9–33 cm long, 3–9 mm in diameter, hollow (pithy when young); walls 2–3 mm thick. Culm leaves 17–19 cm long; sheaths (6.5–)7.6–9(–9.9) cm long, abaxially glabrous, adaxially glabrous and shiny; blades erect, 9–10 cm long, abaxially sparsely pubescent at the base, adaxially glabrous, margins entire; fimbriae not seen. Branch complements at mid-culm nodes with (30–)41–87(–120) branchlets; branchlets (8–)13–30(–50) cm long, glabrous or pubescent. Foliage leaves 3–4 observed on flowering branchlets; sheaths 9–22 mm long, abaxially pubescent (occasionally glabrous); mostly efimbriate,

when fimbriate 0.2–0.8 mm long, white to stramineous; pseudopetioles 1.0–1.6 mm long, abaxially and adaxially pubescent; blades lanceolate to narrowly ovate with an attenuate apex, 32–75 mm long, 5–7 mm wide, abaxially and adaxially glabrous, without sparse patches of white cilia near the base on the abaxial side. Synflorescences 2.0–3.4 cm long, 0.9–10 mm wide, composed of a single spike, sometimes develop two spikelets, one of them with only two florets; rachis pubescent. Spikelets 2.0–3.4 cm long, comprising 2–4 glumes and (2–)4–5(–20) fertile florets, rachilla joints 3.5–4 mm long, glabrous. Glumes pubescent margins ciliate, awnless, lower glume, 3.2–5.8 mm long, 6-, 9-, 10-nerved, lanceolate; upper glume, 4.8–7.0 mm long, 11-, 13-nerved, lanceolate. Lemmas 8.8–12.0 mm long, 9-, 13-nerved, ovate and inflated, pubescent, apex rounded-obtuse and muticous. Palea 10.0–13.6 mm long, keels and sulcus pubescent, apex rounded-obtuse and muticous. Lodicules 3, abaxially glabrous, hyaline, margin ciliate apex fimbriate, the anterior pair 2.6–3.2 mm long, the posterior one 2.0–2.4 mm long. Anthers 3. Ovary 1.0–1.5 mm long, stigmas 2, plumose. Caryopsis 3.3–3.5 mm long, ellipsoid, pubescent with trichomes near base and apex, indented on hilum side, yellowish-golden.

Distribution. This species is only known from three localities in the municipality of Puerto Vallarta, Jalisco, Mexico in the Jalisciense-Tuito district of the Sierra Madre del Sur (Santiago-Alvarado et al. 2016) (Fig. 1).

Habitat and ecology. This species inhabits the slopes of humid canyons of creeks and rivers at 6–150 m a.s.l. The vegetation corresponds to subdeciduous and tropical dry forests with associated species, such as *Astronium graveolens* Jacq., *Bursera* spp., *Casearia arguta* Kunth, *Cecropia obtusifolia* Bertol., *Cnidoscolus tepiquensis* (Cost. & Gall.) Lundell, *Croton schiedeanus* Schltdl., *Cupania dentata* Moc. & Sesse, *Dendropanax arboreus* (L.) Decne. & Planch., *Euphorbia* spp., *Ficus* spp., *Guettarda elliptica* Sw., *Inga laurina* (Sw.) Willd., *Lonchocarpus* spp., *Luehea candida* Mart., *Lysiloma divaricatum* (Jacq.) Benth., *Ouratea madrensis* L.Riley, *Pseudobombax ellipticum* (Kunth) Dugand, and *Zygia conzattii* (Standl.) Britton & Rose, among others (Fig. 3A).

Etymology. Latin singulus, solitary, and florum, flowered, alluding to usual occurrence of single, terminal spikelet in synflorescence (Figs 2A, 3D–F). The use of -florum instead of -spiculum is preferred here [cf., R. racemiflorum]

Preliminary IUCN conservation assessment. Critically endangered: CR B1ab(iii). *Rhipidocladum singuliflorum* is known from three localities that are separated by no more than 14 km. Using GeoCAT, the Extent of Occurrence (EOO) was calculated to be 10.6 km^2, and the Area of Occupancy to be 12 km^2, based on 2 × 2 km cells. The three localities are canyons that are not suitable for agriculture

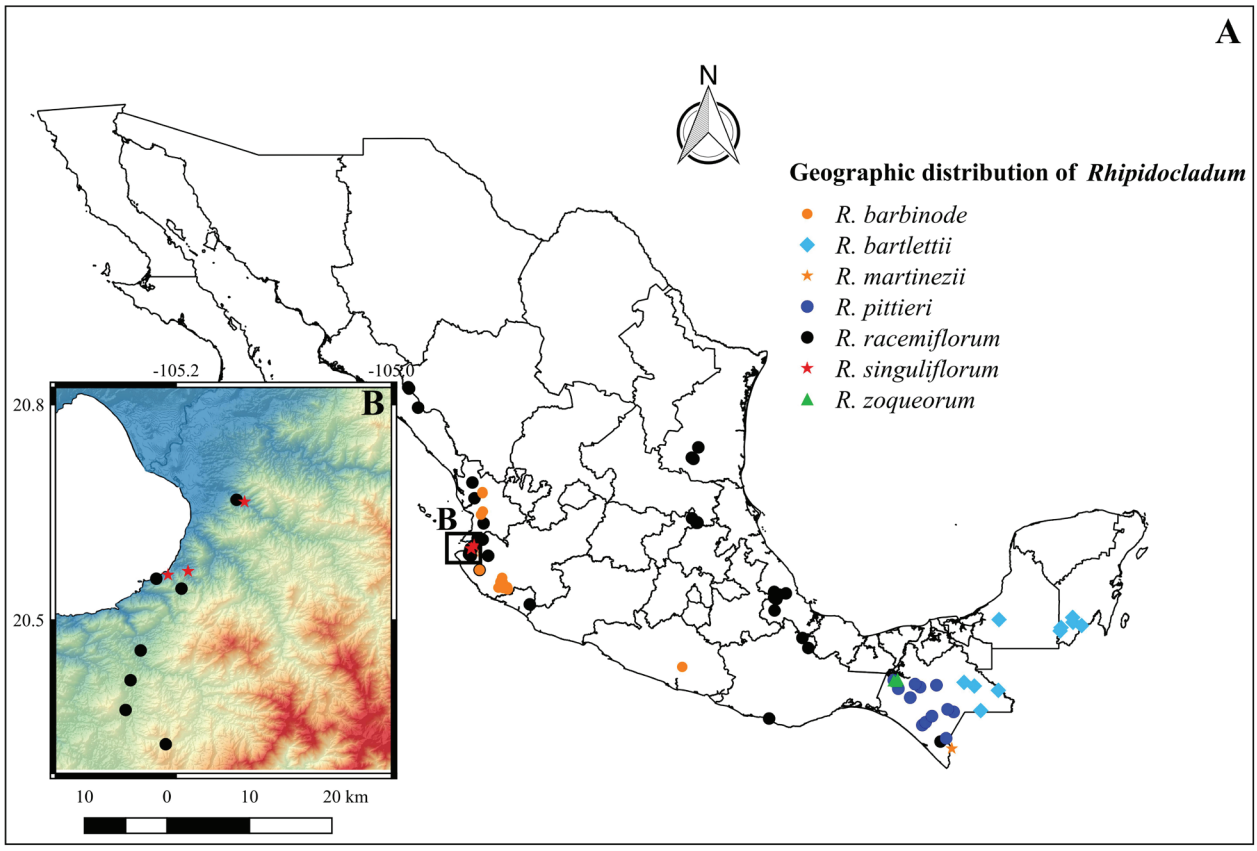

Figure 1. A. Geographical distribution of the species of *Rhipidocladum* in Mexico based on georeferenced localities of herbarium specimens (Ruiz-Sanchez et al. 2019, 2020, 2021b). **B**. Close up to the geographical distribution of *R. singuliflorum* (red stars) and *R. racemiflorum* (black circles) in western Jalisco.

or grazing, and are often used for recreation with one of them (El Nogalito) currently under management by an ecotourism centre. The localities, however, are adjacent to the Carretera Pacífico (Carretera Federal 200), the major west coast highway, and potentially in the path of the planned series of "vía corta" highway expansions. A preliminary category of Critically endangered: CR B1ab(iii) is proposed following the IUCN (IUCN Standards and Petitions Committee 2022) criteria.

Additional specimens examined. MEXICO – **Jalisco** • Puerto Vallarta, 4 km al SE de Playa Grande, subiendo por el Río Pitillal (2.4 km en línea recta); 20°38'14"N, 105°10'14"W; 120 m; 18 Feb. 2022; fl.; *P. Carrillo-Reyes & S. Quijas-Fonseca 10093*; IBUG • Arroyo El Nogalito, 0.8 km en línea recta al SE del Ecoparque El Nogalito; 20°33'24"N, 105°14'10"W; 130 m; 20 Mar. 2022; *P. Carrillo-Reyes & A.T. Nuño-Rubio 10106*; IBUG • Río Palo María; 20°33'8.76"N, 105°15'34"W; 6 m; 16 Nov. 2021; fl.; *A.T. Nuño & L. Campos s.n.*; IBUG.

Key to the species of *Rhipidocladum* in Mexico

1. Plants with spikelets (reproductive stage) **2**
– Plants without spikelets (vegetative stage) **8**
2. Synflorescence racemose or spicate with several, narrow, evenly-spaced spikelets **3**
– Synflorescence bearing a single, 0.9–10 mm wide spikelet, or a single spikelet-pair appearing to arise from the same terminal point ..... ***R. singuliflorum***
3. Spikelets with 3 glumes (the first sometimes small and acicular) **4**
– Spikelets with 2 glumes (more or less similarly shaped) **6**
4. Mid-culm nodes with more than 100 subequal branchlets; foliage leaves linear-lanceolate (ratio of length to width 16–23) ..... ***R. martinezii***
– Mid-culm nodes with fewer than 50 subequal branchlets; foliage leaves lanceolate (ratio of length to width 10–14) **5**
5. Glumes puberulent to scabrous; foliage leaves adaxially scabrid, abaxially glabrous; sheath margins ciliolate; pseudopetioles scabrous ..... ***R. bartlettii***
– Glumes glabrous; leaves adaxially glabrous, abaxially with a patch of hairs near the base; sheath margins entire; pseudopetioles glabrous ..... ***R. pittieri***
6. Glumes scabrous; lemmas 6.5–10 mm long; synflorescences with spikelets on both sides, spaced 5–20 mm apart **7**
– Glumes glabrous to puberulent; lemmas 5–7 mm long; synflorescences with spikelets secund, spaced 3–5 mm apart ..... ***R. racemiflorum***
7. Synflorescences 2.5–9 cm long, with 3–7 spikelets spaced 5–7 mm apart; glumes awnless ..... ***R. barbinode***
– Synflorescences 13–22.5 cm long, with 13–21 spikelets spaced 5–20 mm apart; glumes awned ..... ***R. zoqueorum***
8. Foliage leaf blades narrowly lanceolate to linear, 4–8 cm long, ratio of length to width 16–23 ..... ***R. martinezii***
– Foliage leaf blades lanceolate to narrowly ovate, 2.5–13 cm long, ratio of length to width 4–16 ..... **9**
9. Foliage leaf blades abaxially retrorsely scabrous, fimbriae absent on the sheath summit ..... ***R. zoqueorum***
– Foliage leaf blades abaxially glabrous, fimbriae present or absent on the sheath summit **10**
10. Foliage leaf blades sheaths with a copious band of hairs near the base ..... ***R. barbinode***
– Foliage leaf blades sheaths glabrous or sparsely pubescent but not with a copious band of hairs near the base **11**
11. Foliage leaf blades shorter than 5.5 cm and narrower than 5 mm wide; pseudopetioles less than 2 mm long; foliage leaf sheaths less than or equal to 2 cm long **12**
– Foliage leaf blades longer than or equal to 5.5 cm and wider than 5.5 mm; pseudopetioles more than 2 mm long; foliage leaf sheaths more than 2 cm long **13**
12. Culms appearing solid or, if hollow, the wall thickness at mid-culm half or more the diameter of the lumen ..... ***R. singuliflorum***
– Culms hollow with thin walls, the wall thickness at mid-culm (usually much) less than half the diameter of the lumen ..... ***R. racemiflorum***
13. Foliage leaves adaxially scabrid, abaxially glabrous; sheath margins ciliolate; pseudopetioles scabrous ..... ***R. bartlettii***
– Foliage leaves adaxially glabrous, abaxially with a patch of hairs near the base; sheath margins entire; pseudopetioles glabrous ..... ***R. pittieri***

DISCUSSION

Rhipidocladum singuliflorum is the most singular species of the genus. It is the first known to have synflorescences bearing one terminal spikelet. All other species in the genus have at least two (and usually more than three) spikelets per synflorescence axis. We observed some synflorescences in *R. singuliflorum* with two spikelets, but the second spikelet appeared to arise from a gemmiparous bract at the base of the first, suggesting this species is capable of producing pseudospikelets. It is possible that the single spikelets in *R. singuliflorum* evolved through reduction of synflorescence paraclades/co-florescences into the single spikelets observed. If true, this species may provide some insight into the evolution and origin of pseudospikelets within the bamboos.

Pseudospikelets have been evolved twice in Arthrostylidiinae: in the genera *Alvimia* C.E.Calderón

ex Soderstr. & Londoño and *Elytrostachys* McClure (Tyrrell et al. 2012). *Elytrostachys* is nested in the same clade as *Arthrostylidium* Rupr., *Didymogonyx* (L.G.Clark & Londoño) C.D.Tyrrell, L.G.Clark & Londoño and *Rhipidocladum*, these last three genera have spikelets. Then *R. singuliflorum* could be a key species to understand spikelet-pseudospikelet evolution.

Rhipidocladum singuliflorum is nearly indistinguishable from *R. racemiflorum* in vegetative morphology, but strikingly different in the reproductive phase. In floral morphology, *R. singuliflorum* shares the inflated lemma characteristic of *R. barbinode*, but the latter species has spicate synflorescences with two or more spikelets, spaced 5–7 mm apart (Ruiz-Sanchez et al. 2021b). It is possible that *R. singuliflorum* and *R. barbinode* could be sister species, however, a molecular phylogenetic study would be needed to test this hypothesis.

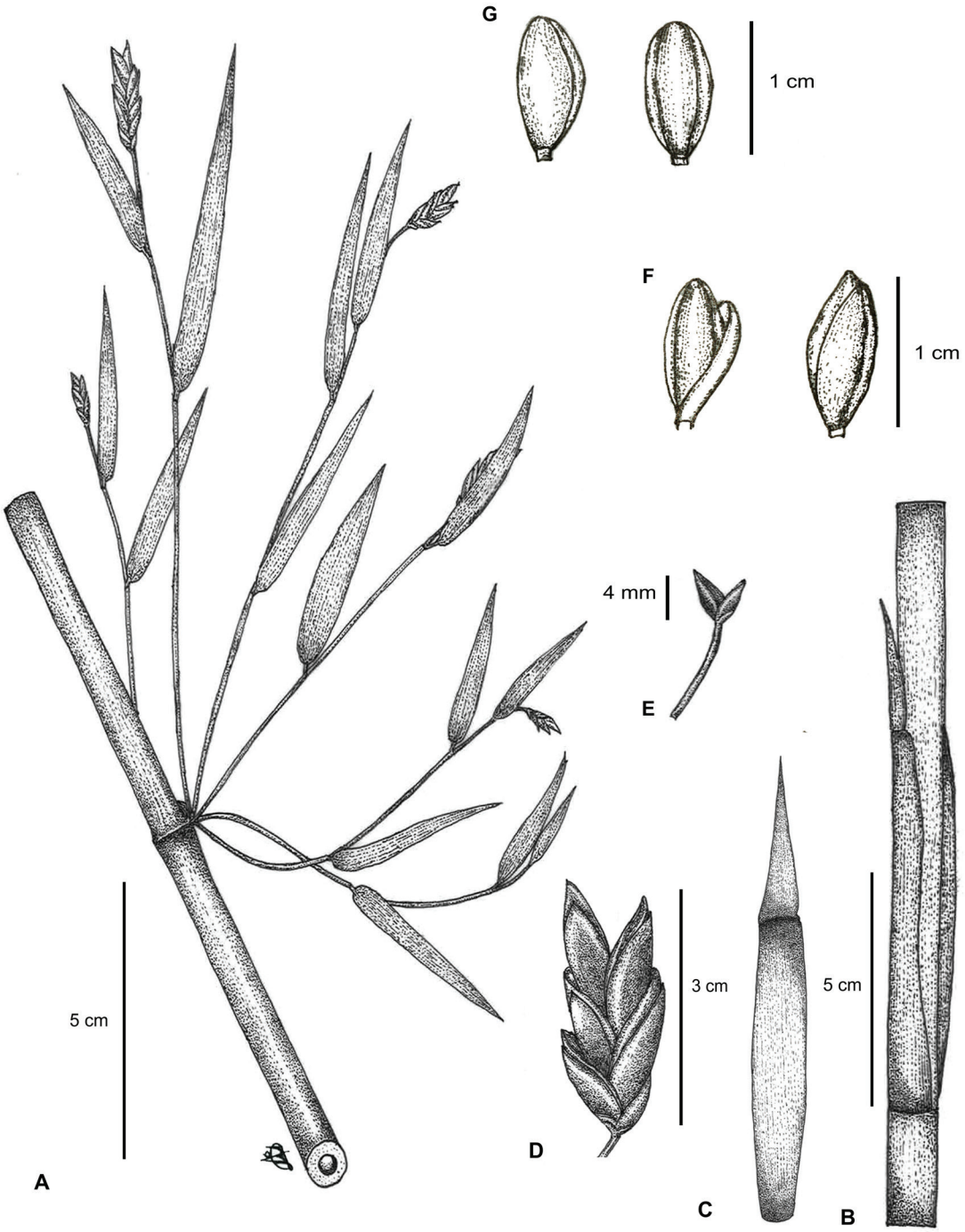

Figure 2. *Rhipidocladum singuliflorum*. **A**. Culm segment showing foliage leaves complement and synflorescences. **B**. Culm segment, showing culm leaf sheath and blade. **C**. Culm leaf sheath and blade abaxial view. **D**. Spikelet bearing 2 glumes and 5 florets. **E**. Glumes. **F**. Floret, lateral (right) and dorsal (left) views. **G**. Palea, frontal (right) and lateral (left) views. Drawing by Juvenal Aargón Parada based on *E. Ruiz-Sanchez, A. Nuño, A. Zabalgoitia L.A. Monroy y L. Campos 722* (IBUG).

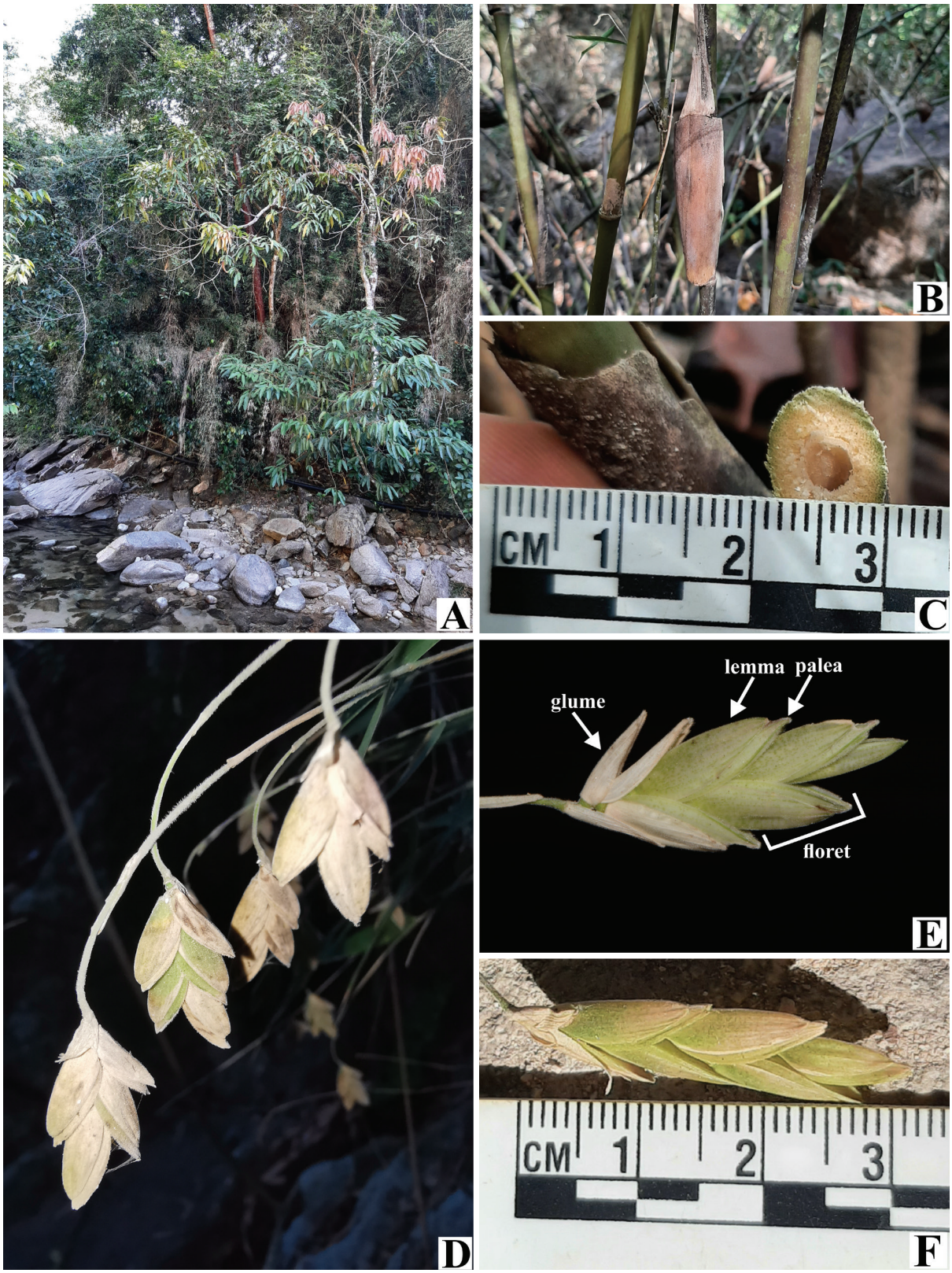

Figure 3. *Rhipidocladum singuliflorum*. **A**. Panoramic view of the subdeciduous tropical forest glen habitat at the Palo María river, culms showing scandent habit. **B**. Basal clump showing culms habit and culm leaves. **C**. Cross section and size cut of culm, showing hollow culm with thick wall. **D**. Synflorescence branches bearing one terminal spikelet. **E**. Close up of the spikelet showing glumes, lemma, palea and florets. **F**. Spikelet. Photos by Eduardo Ruiz-Sanchez (A, B, C, E) and Pablo Carrillo-Reyes (D, F).

This new species has likely been overlooked due to the long flowering cycles characteristic of many woody bamboos (Zheng et al. 2020). It is presumed that all *Rhipidocladum* species have gregarious and cyclical flowering events (Tyrrell and Clark 2013). According to our field observation, *R. singuliflorum* also exhibits a gregarious flowering pattern (Franklin 2004). In the three localities, plants were flowering simultaneously, however, we do not know the flowering cycle length as this is the first time it has been recorded in flower. *Rhipidocladum racemiflorum* is also present in the same region and in some places, such as Río Palo María and Río El Pitillal, and it is sympatric with *R. singuliflorum* (Fig. 1B). We did not see evidence of hybridization between the two species despite having collected *R. racemiflorum* in flower at Río Palo María in 2019. The individuals of *R. racemiflorum* were no longer flowering during our field investigations that uncovered *R. singuliflorum* in flower.

The Jalisciense-Tuito district together with the Jalisciense-Manantlán district are classified into the subprovince of Sierra Madre del Sur Occidental (Santiago-Alvarado et al. 2016). According to Aragón-Parada et al. (2021), this subprovince has 193 endemic vascular plants. The Sierra Madre del Sur is the richest woody bamboo floristic province in Mexico. Several other species of woody bamboos are known to inhabit the Jalisciense-Tuito district of the Sierra Madre del Sur (Santiago-Alvarado et al. 2016; Morrone et al. 2017), including: *Chusquea circinata* Soderstr. & C.E.Calderón, *C. cortesii* L.G.Clark & Ruiz-Sanchez, *C. contrerasii* Ruiz-Sanchez & L.G.Clark, *C. guzmanii* Ruiz-Sanchez & L.G.Clark, *C. liebmannii* E.Fourn., *Guadua paniculata* Munro, *Otatea acuminata* (Munro) C.E.Calderón & Soderstr., *O. reynosoana* Ruiz-Sanchez & L.G.Clark, and *Rhipidocladum barbinode* (Ruiz-Sanchez et al. 2020, 2021b, 2021c). Like *R. singuliflorum*, *C. contrerasii* is also endemic to this district (Ruiz-Sanchez et al. 2021c).

With the description of *R. singuliflorum*, the total number of species of *Rhipidocladum* increases to 22, with seven occurring in Mexico (Ruiz-Sanchez et al. 2021b). The number of native Mexican woody bamboo species also increases to 59, 42 (71%) of them endemic (Ruiz-Sanchez et al. 2022), and the number of woody bamboo species in the Sierra Madre del Sur province increases to 23 (Ruiz-Sanchez et al. 2020, 2021b, 2021c, 2022). The limited geographic distribution of *R. singuliflorum* and putative single population, coupled with whit its gregarious, semelparous, multiyear phenology, and the potential for roadway expansion in the area, led us to assign a preliminary IUCN category of Critically Endangered to this species. Given the prospective threats, we recommend a formal assessment to be performed to establish whether any additional subpopulations can be found and to monitor trends in their size, extent and, potentially, gene flow.

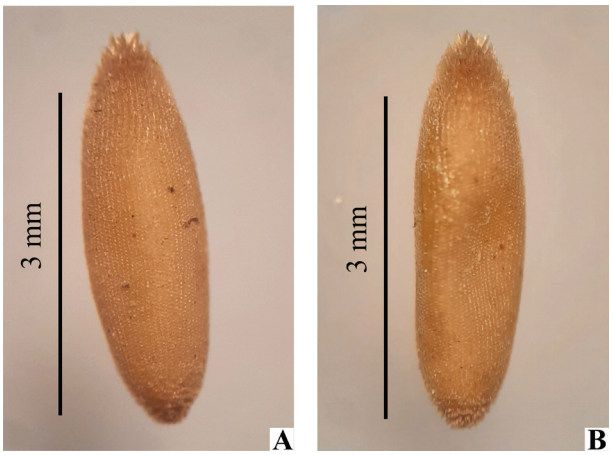

Figure 4. *Rhipidocladum singuliflorum*. **A**. Caryopsis dorsal view. **B**. Caryopsis ventral view showing indent near the hilum.

ACKNOWLEDGEMENTS

We thank Leonardo Campos, Luis Alberto Monroy, Sandra Quijas-Fonseca, and Alejandro Zabalgoitia for their assistance during the fieldwork. Juvenal Aragón Parada is thanked for the illustration. Curators and staff of the following herbaria provided access to their collections: IBUG, MEXU, WIS, and ZEA. We thank Ximena Londoño, the anonymous reviewer, and the associate editor for helpful comments.

REFERENCES

Aragón-Parada J, Rodríguez A, Munguía-Lino G, De-Nova JA, Salinas-Rodríguez MM, Carrillo-Reyes P (2021) Las plantas vasculares endémicas de la Sierra Madre del Sur, México. Botanical Sciences 99(3): 643–660. https://doi.org/10.17129/botsci.2682

Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. Zookeys 150: 117–126. https://doi.org/10.3897/zookeys.150.2109

Clark LG, Londoño X (1991) A new species and new sections of *Rhipidocladum* (Poaceae: Bambusoideae). American Journal of Botany 78(9): 1260–1279. https://doi.org/10.2307/2444930

Franklin DC (2004) Synchrony and asynchrony: observations and hypotheses for the flowering wave in a long lived semelparous bamboo. Journal of Biogeography 31(5): 773–786. https://doi.org/10.1111/j.1365-2699.2003.01057.x

IUCN Standards and Petitions Committee (2022) Guidelines for using the IUCN Red List categories and criteria. Version 15. Prepared by the Standards and Petitions Committee. http://www.iucnredlist.org/documents/RedListGuidelines.pdf [accessed 17.04.2022]

McClure FA (1973) Genera of bamboos native to the New World (Gramineae: Bambusoideae). Smithsonian Contributions to Botany 9: 1–148. https://doi.org/10.5479/si.0081024X.9

Morrone JJ, Escalante T, Rodríguez-Tapia G (2017) Mexican biogeographic provinces: map and shapefiles. Zootaxa 4277: 277–279. https://doi.org/10.11646/zootaxa.4277.2.8

QGIS Development Team (2016) QGIS Geographic Information System. Version 2.16.3. Open Source Geospatial Foundation. http://www.qgis.org [accessed 17.04.2022]

Ruiz-Sanchez E, Clark LG, Londoño X, Mejía-Saulés MT, Cortés Rodríguez G (2015) Morphological keys to the genera and species of bamboos (Poaceae: Bambusoideae) of Mexico. Phytotaxa 236(1): 1–24. https://doi.org/10.11646/phytotaxa.236.1.1

Ruiz-Sanchez E, Tyrrell CD, Ortiz-Rodriguez AE, Sosa V, Gomez-Dominguez H (2019) A new species of *Rhipidocladum* (Poaceae: Bambusoideae: Arthrostylidiinae) from Mexico. Phytotaxa 420(4): 255–263. https://doi.org/10.11646/phytotaxa.420.4.1

Ruiz-Sanchez E, Munguía-Lino G, Vargas-Amado G, Rodríguez A (2020) Diversity, endemism and conservation status of native Mexican woody bamboos (Poaceae: Bambusoideae: Bambuseae). Botanical Journal of the Linnean Society 192(1): 281–295. https://doi.org/10.1093/botlinnean/boz062

Ruiz-Sanchez E, Tyrrell CD, Londoño X, Oliveria RP, Clark LG (2021a) Diversity, distribution, and classification of Neotropical woody bamboos (Poaceae: Bambusoideae) in the 21st Century. Botanical Sciences 99(2): 198–228. https://doi.org/10.17129/botsci.2722

Ruiz-Sanchez E, Tyrrell CD, Vigosa-Mercado JL (2021b) An overlooked new endemic species of *Rhipidocladum* (Poaceae: Bambusoideae: Arthrostylidiinae) from Mexico. Systematic Botany 46(2): 333–338. https://doi.org/10.1600/036364421X16231782047569

Ruiz-Sanchez E, Romero-Guzman R, Flores-Argüelles A, Ortiz-Brunel JP, Clark LG (2021c) *Chusquea contrerasii* and *C. guzmanii* (Poaceae, Bambusoideae, Bambuseae, Chusqueinae), two new endemic species from Jalisco, Mexico. Phytotaxa 497(3): 285–297. https://doi.org/10.11646/phytotaxa.497.3.7

Ruiz-Sanchez E, Mejia-Saulés MT, Clark LG (2022) A new species of *Chusquea* sect. *Serpentes* (Poaceae: Bambusoideae: Bambuseae: Chusqueinae) endemic to Oaxaca, Mexico. Phytotaxa 542(2): 199–206. https://doi.org/10.11646/phytotaxa.542.2.7

Rzedowski J (2006) Vegetación de México. 1ra. Edición digital. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México, 1–504.

Santiago-Alvarado M, Montaño-Arias G, Espinosa D (2016) Áreas de endemismo de la Sierra Madre del Sur. In: Luna-Vega I, Espinosa D, Contreras-Medina R (Eds) Biodiversidad de la Sierra Madre del Sur: una Síntesis preliminar. Universidad Nacional Autónoma de México, México, 431–448.

Soderstrom TR, Young SM (1983) A guide to collecting bamboos. Annals of the Missouri Botanical Garden 70(1): 128-136. https://doi.org/10.2307/2399010

Thiers B (continuously updated) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/ih/ [accessed 20.06.2022]

Tyrrell CD, Clark LG (2013) Three new species of *Rhipidocladum* (Poaceae: Bambusoideae: Arthrostylidiinae) from South America. Phytotaxa 98(2): 55–64. https://doi.org/10.11646/phytotaxa.98.2.3

Tyrrell CD, Santos-Gonçalves AP, Londoño X, Clark LG (2012) Molecular phylogeny of the arthrostylidioid bamboos (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) and new genus *Didymogonyx*. Molecular Phylogenetics and Evolution 65(1): 136–148. https://doi.org/10.1016/j.ympev.2012.05.033

Zheng X, Lin S, Fu H, Wan Y, Ding Y (2020) The bamboo flowering cycle sheds light on flowering diversity. Frontiers in Plant Science 11: 381. https://doi.org/10.3389/fpls.2020.00381