

Return *Verdesmum menglaense* to the genus *Hylodesmum* (Fabaceae) based on morphological and molecular evidence

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Abstract

Verdesmum menglaense (C. Chen & X. J. Cui) H. Ohashi & K. Ohashi is a rare species in the tribe Desmodieae (Fabaceae) from Southwest China. The morphological observation shows that the species has minute capitate stigma and ebracteolate calyces, which are entirely different from the funnel-shaped stigma and bracteolate calyces of the genus *Verdesmum* H. Ohashi & K. Ohashi, but are consistent with those of the genus *Hylodesmum* H. Ohashi & R. R. Mill. The generic placement of *V. menglaense* within *Hylodesmum* was further supported by molecular evidence. Therefore, this species should be returned to *Hylodesmum* as *H. menglaense* (C. Chen & X. J. Cui) H. Ohashi & R. R. Mill. A full description including floral characters, a colour plate and a distribution map are first provided here for this species. After excluding the solo representative in China, *Verdesmum* should be removed from the record in *Flora of China*.

Keywords

China, Leguminosae, taxonomy, systematic position, *trnL-F*, phylogeny

Introduction

Verdesmum H. Ohashi & K. Ohashi is a newly established genus in the tribe Desmodieae (Fabaceae) (Ohashi and Ohashi 2012a; Lewis et al. 2013; Azani et al. 2017), based on only one species *V. hentyi* (Verdc.) H. Ohashi & K. Ohashi which is a shrub distributed in Papua New Guinea and Malaysia and was first described in the genus *Desmodium* Desv. as *D. hentyi* Verdc. (Verdcourt 1977; Ohashi 2004). This genus was considered to be most similar to *Hylodesmum* H. Ohashi & R. R. Mill, but differs in having funnel-shaped terminal stigma, bracteolate calyces, linear pods, very narrow obovate-elliptic articles and stipes longer than fruiting pedicels (Ohashi and Ohashi 2012a). Amongst these characters, the shape of the stigma was considered to be the most important trait of *Verdesmum* and to be unique amongst the whole tribe Desmodieae (Ohashi and Ohashi 2012a, 2013).

Verdesmum menglaense (C. Chen & X. J. Cui) H. Ohashi & K. Ohashi, the second species recognised in *Verdesmum* (Ohashi and Ohashi 2013), was originally published in the genus *Podocarpium* (Benth.) Y. C. Yang & P. H. Huang as *P. menglaense* C. Chen & X. J. Cui, based on two fruiting gatherings from Yunnan, Southwest China (Cui et al. 1987). The species had been suggested for transfer to the genus *Desmodium* Desv. by Ohashi (1995), but was not accepted by other taxonomists. Later, Ohashi and Mill (2000) found that *Podocarpium* was an illegitimate generic name and thus proposed to replace it by *Hylodesmum* H. Ohashi & R. R. Mill. Correspondingly, *P. menglaense* was proposed as *Hylodesmum menglaense* (C. Chen & X. J. Cui) H. Ohashi & R. R. Mill (Ohashi and Mill 2000; Gao 2006; Zhu et al. 2007; Huang and Ohashi 2010). The species was further transferred to the genus *Verdesmum* as *V. menglaense* (C. Chen & X. J. Cui) H. Ohashi & K. Ohashi for the similarity in the linear pods and very narrow obovate-elliptic articles (Ohashi and Ohashi 2013). This treatment was followed by subsequent research (Zhu 2015a, Zhu 2015b; Liu et al. 2015; Ohashi et al. 2018b).

However, *Verdesmum menglaense* is a rare species endemic to Yunnan, Southwest China. After being published, it was not re-discovered in the field and its flowers have not been described in any literature (e.g. Ohashi 1995; Gao 2006; Huang and Ohashi 2010). Ohashi and Ohashi (2013) considered that it is difficult to determine the correct generic position of this species with the absence of flowers. Fortunately, in a collecting trip to Yunnan Province in 2010, we found several living individuals without flowers or fruits of this species at a streamside in the forest. Subsequently, these plants successfully produced flowers and fruits under cultivated conditions in South China Botanical Garden. Our morphological observation showed this species has terminal minute capitate stigma and ebracteolate calyces (Fig. 1). In these important floral characters, *Verdesmum menglaense* is thus distinct from *Verdesmum*, but is consistent with *Hylodesmum*. Furthermore, the placement of this species within *Hylodesmum* was also strongly supported by molecular evidence from the *trnL-F* sequences (Fig. 2). Therefore, this species should be returned to *Hylodesmum* as *H. menglaense*. Currently, *Verdesmum* just includes a single species (*V. hentyi*) and its distribution in China should be excluded.

Material and methods

Morphological studies

The morphological characters were examined based on the living plants and specimens kept in the HITBC, IBSC and KUN herbaria. Acronyms for the herbaria follow the Index Herbariorum (Thiers 2018). The distribution map was made by the software ArcGIS 10.2.

Molecular analyses

In order to clarify the generic position of the species *Verdesmum menglaense* within the *Desmodium* group of the tribe Desmodieae, a phylogeny was reconstructed based on analyses of the noncoding plastid marker *trnL-F*, which was often used in phylogenetic studies of this tribe in single or combined analyses with other DNA sequences (e.g. Stefanovic et al. 2009; Nemoto et al. 2010; Xu et al. 2012; Ohashi et al. 2018b). DNA sequences were downloaded mostly from Genbank (www.ncbi.nlm.nih.gov/Genbank) and 14 taxa were newly sequenced in the present study. In total, 53 species were sampled in phylogenetic analyses, including 23 of the 28 genera in the *Desmodium* group (Ohashi et al. 2018a) and 11 of the 12 species in the genus *Hylodesmum* (if *Verdesmum menglaense* is not considered). Information about relevant samples and Genbank accessions are listed in Appendix 1. The phylogenetic trees were reconstructed using two approaches: Maximum Likelihood (ML) and Bayesian Inference (BI). Detailed information about the experiment operations (DNA extraction and PCR amplification), sequences of primer used, model selection of the sequence matrix constructed and methods in tree reconstruction can be accessed in Li et al. (2009) and Yao et al. (2016).

Results and discussion

Results from phylogenetic analyses revealed that three groups (clade A: *Lespedeza* group, clade B: *Phyllodendron* group and clade C: *Desmodium* group) were well supported in the tribe Desmodieae, just as reported in most recent research (Jabbour et al. 2018; Zhang et al. 2018; Ohashi et al. 2018a; Ohashi et al. 2018b). Although the type species of the genus *Verdesmum* was not sampled and thereby its phylogenetic position could not be resolved, the species *V. menglaense* was deeply embedded within the genus *Hylodesmum* in both of the ML (BS=98%) and BI (PP=1.00) analyses (Fig. 2). Thus, the taxonomic status of *V. menglaense* within the genus *Hylodesmum* was strongly supported by this molecular evidence, despite the absence of a good specific relationship.

Currently, *Hylodesmum* comprises 13 species (including *H. menglaense*) and 4 subspecies (Ohashi and Mill 2000; Huang and Ohashi 2010), after excluding *H. dolabriforme* (Benth.) H. Ohashi & R. R. Mill (as a member of *Monarthrocarpus*, Ohashi and Ohashi

2012b) and *H. laxum* subsp. *falfolium* (H. Ohashi) H. Ohashi & R. R. Mill (as a synonym of *H. laxum* subsp. *laxum*, Song et al. 2013). The genus is disjunctly distributed in eastern North America (3 species) and eastern Asia (10 species), one of which extends from Asia to Africa (Ohashi and Mill 2000; Woods 2008). China has the highest species richness in the genus and includes 10 species and 4 subspecies (Huang and Ohashi 2010; Song et al. 2013). Morphologically, *H. menglaense* is most similar to *H. leptopus* (A. Gray ex Benth.) H. Ohashi & R. R. Mill, as pointed out by Cui et al. (1987) and Ohashi (1995), because both species have calyx lobes much shorter than tube, lateral veins of leaflets not reaching margin and abxial surfaces of leaflets scattered with white spots. Especially, the white spots appear on the abxial blades only for the two species in the whole genus. However, *H. menglaense* has very narrow obovate-elliptic articles and pods with central isthmi between the articles, which are unique amongst the genus (Ohashi and Ohashi 2012a). When without fruits, we found that *H. menglaense* can be distinguished from *H. leptopus* by slightly larger and thicker terminal leaflets.

Taxonomic treatment

***Hylodesmum menglaense* (C. Chen & X. J. Cui) H. Ohashi & R.R. Mill, Edinburgh J. Bot. 57(2): 180. 2000**

Figure 1

Podocarpium menglaense C. Chen & X. J. Cui, Acta Bot. Yunnan. 9(3): 305. fig. 1. 1987. \equiv *Desmodium menglaense* (C. Chen & X. J. Cui) H. Ohashi, J. Jap. Bot. 70(3): 142. 1995. \equiv *Verdesmum menglaense* (C. Chen & X. J. Cui) H. Ohashi & K. Ohashi, J. Jap. Bot. 88(3): 161. 2013, **syn. nov.**

Type. China. Yunnan Province, Mengla County, Menglun Town, 21°58'N, 101°15'E, 620 m a.s.l., 6 Aug 1974, *Guo-Da Tao* 009050 (holotype, HITBC!, [No. 020113]; isotype, HITBC!, [No. 020112]).

Description. Perennial herbs or subshrubs, 30–100 cm high. Stem erect, simple, usually woody at base. Stipules striate, lanceolate, 3.5 mm \times 1 mm in size, green to brown, uncinat-hairy. Stipels subulate, ca. 1.4 mm long. Leaves 3-foliolate, scattered along stem; petiole 8–12 cm including rachis 1–2.5 cm long, uncinat-hairy; leaflet blades thickly papery to subleathery; adaxial surfaces dark green, shiny, glabrous; abaxial surfaces pale green, scattered with white spots, very sparsely uncinat-hairy under the microscope; terminal leaflet ovate, 12–19 cm \times 7–10 cm in size, entire along margin, rounded or broadly cuneate at base, acuminate or caudate at apex, 2-stipellate at base of pulvinule; lateral veins about 5 pairs, not reaching margin; lateral leaflets slightly smaller, narrowly ovate to lanceolate, base oblique, 7–12 cm \times 3–5 cm in size, sessile but pulvinule distinct, 1-stipellate at base of pulvinule; pulvinule ca. 5 mm long. Inflorescences terminal or axillary, sometimes borne at leafless nodes or near the base of

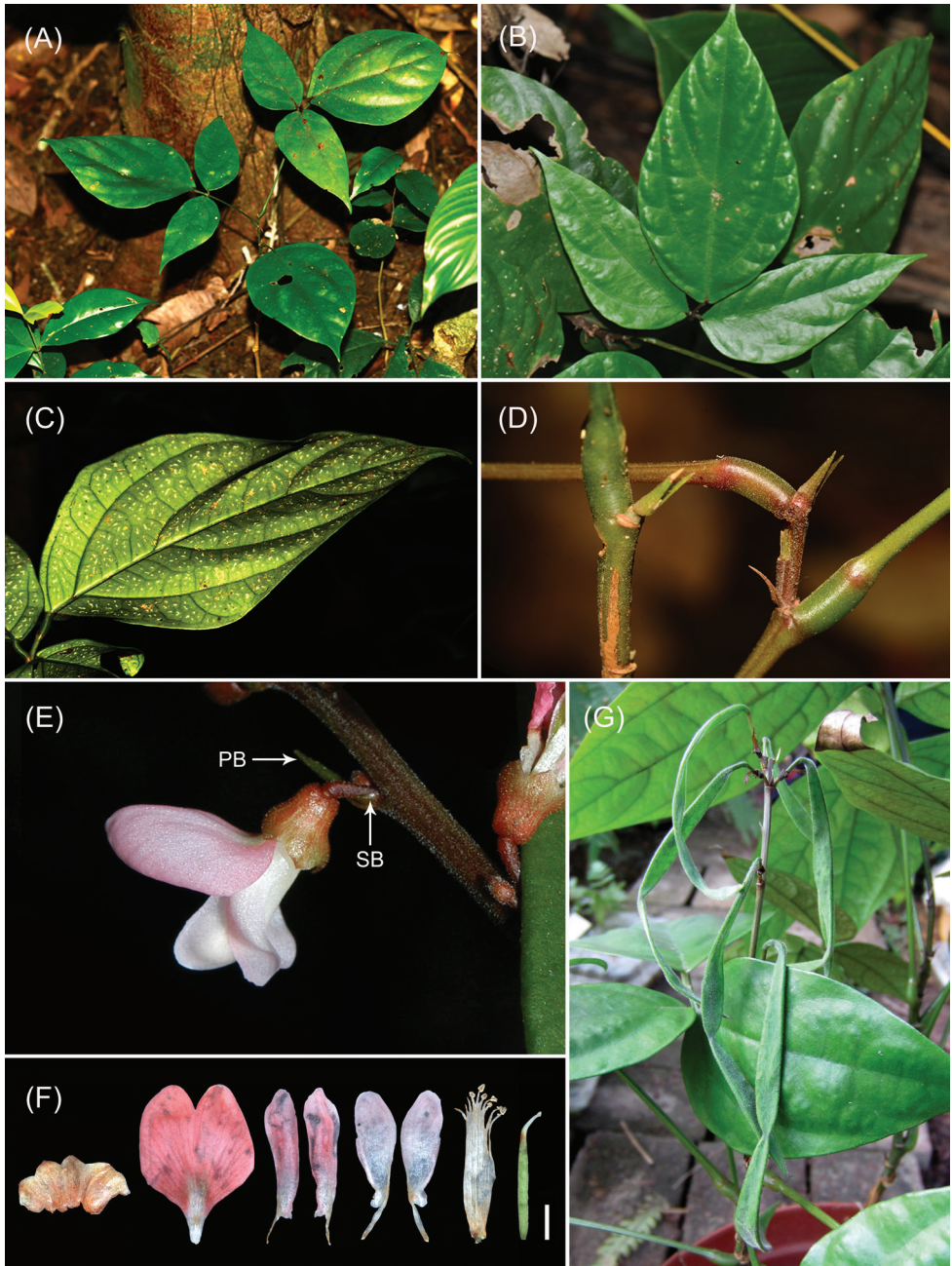


Figure 1. *Hylodesmum menglaense* (\equiv *Verdesmum menglaense*). **A** habitat **B** adaxial leaf surface **C** abaxial leaf surface, showing scattered white spots **D** stipules **E** a node of inflorescences, showing a primary bract (PB) and a secondary bract (SB), but without bracteoles at base of calyx, **(F)** a flower with the different parts separated, especially showing the terminal minute capitate stigma of the ovary, **(G)** linear pods with very narrow obovate-elliptic articles, bar = 2 mm.

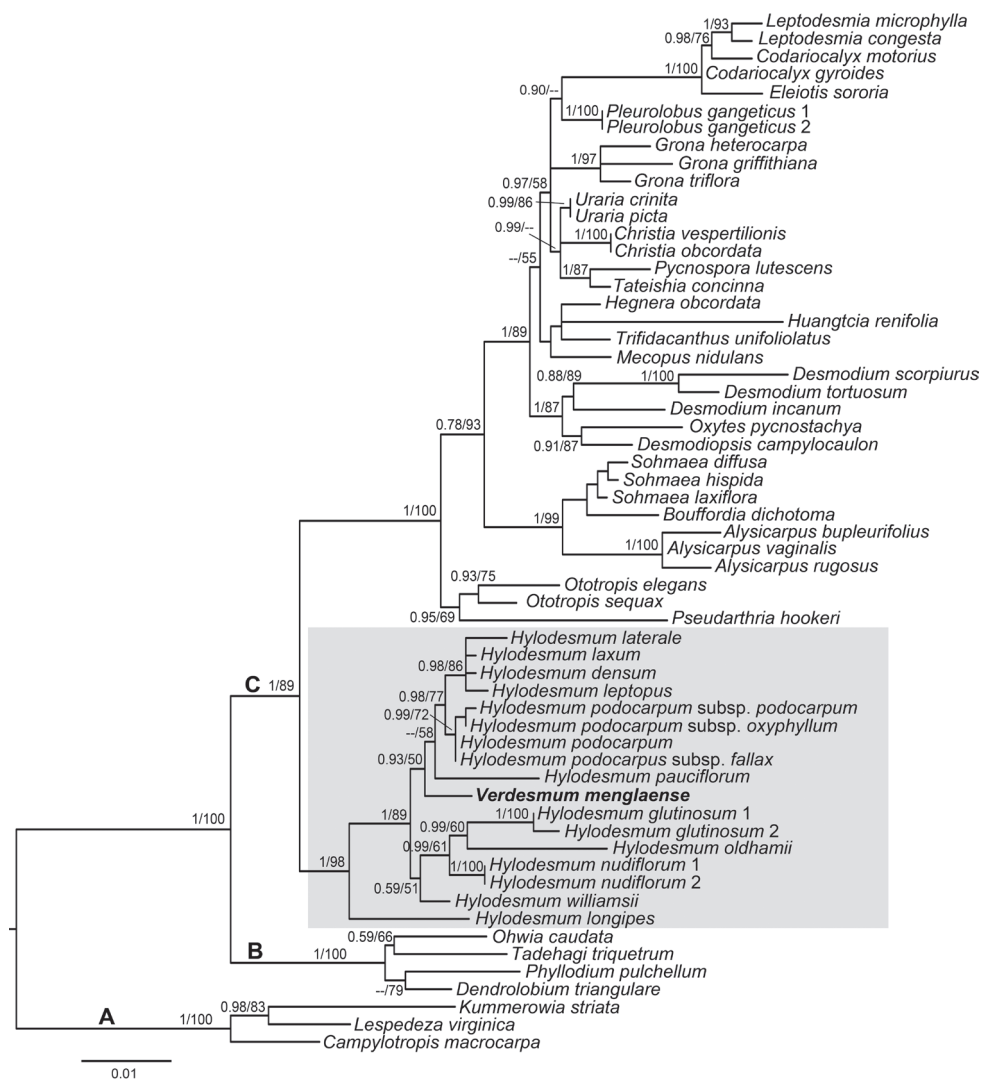


Figure 2. Phylogenetic relationships amongst 53 species from 30 genera of the tribe Desmodieae based on the *trnL-F* sequence data using Maximum Likelihood analysis. Numbers at the nodes are posterior probabilities and bootstrap percentages (PP, BP) from Bayesian and Maximum Likelihood analysis, respectively. A dash (–) indicates PP < 0.5 or BP < 50%. The grey cover shows the representative of *Hylodesmum* within which *Verdesmum menglaense* (indicated by bold font) was deeply embedded.

old stem, pseudoracemose, up to 15–50 cm long, laxly flowered, 2-flowered per node, with minute hooked hairs. Primary bracts subtending the secondary bracts, narrowly triangular, acute at the apex, 4.3 mm × 1.6 mm in size, with uncinat hairs. Secondary bracts triangular, 1 mm × 0.7 mm in size, with uncinat hairs. Bracteole absent at base of calyx. Pedicles 2.5–3 mm long, with minute uncinat hairs. Calyx 4-lobed; tube 2.5–2.6 mm long; lobes much shorter than the tube, upper lobe minutely 2-toothed

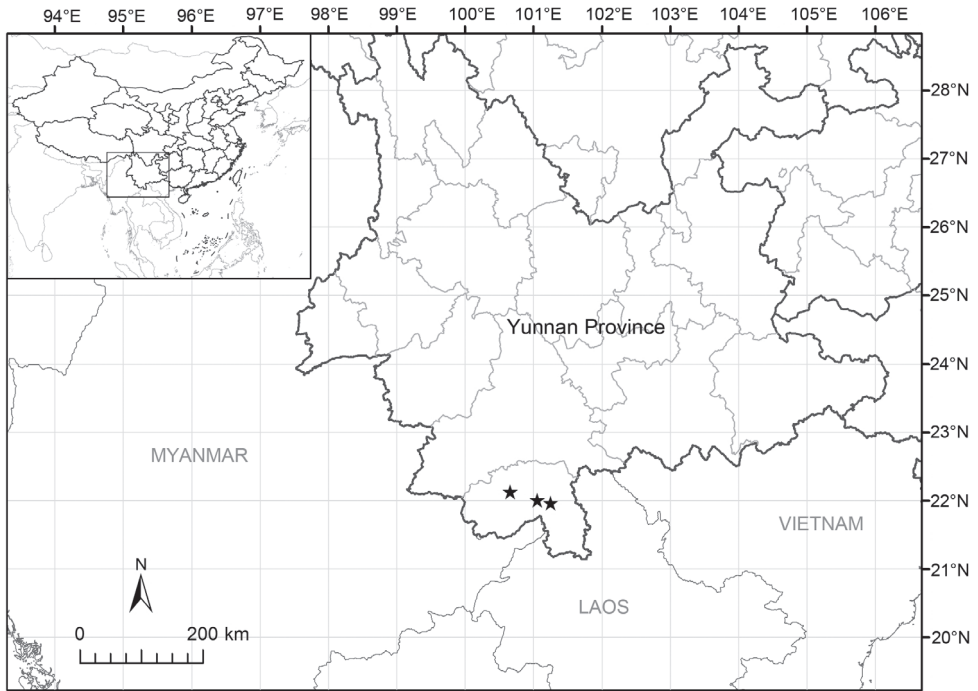


Figure 3. Distribution map of *Hylodesmum menglaense* (stars).

at the apex, lateral and lower lobes shallowly triangular with minute hooked hairs, 1.3–1.5 mm \times 0.4–0.6 mm in size; floral disc absent. Corolla pale reddish-pink, glabrous; standard blade orbiculate or suborbiculate, 7.3 mm \times 6.5 mm in size, reflexed, emarginate at the apex, suddenly cuneate to the base, with ca. 1.8 mm long claw; wings narrowly elliptic, 7.3 mm \times 1.8 mm in size, slightly twisted, obtuse at the apex, slightly auriculate at the base, with ca. 1.8 mm long claw; keel-petals connate, 6.6 mm \times 2.3 mm in size, obtuse at the apex, auriculate at the base, with ca. 2.3 mm long claw. Stamens 10, monadelphous, filaments connate into a tube, ca. 9 mm long. Ovary linear, minute uncinat-hairy, about 7.5 mm long including style 1.5 mm long, usually 2–5-ovuled, with a very short stipe; style curved upwards, with a terminal minute capitate stigma. Pods 2–5-jointed, linear, densely minute hooked hairy, with central isthmi between articles; fruiting pedicels 5–7 mm long, fruiting stipes 9–15 mm long; articles very narrow obovate-elliptic, 3.2–5.4 cm \times 3.5–6 mm in size, covered with prominent reticulate veins when mature. Seeds 1 in each locule, very narrow obovate-elliptic, 2.5–3.5 cm \times 3 mm in size, without rim-arillate around the hilum.

Distribution. Three locations of Yunnan Province, Southwest China, were found for this species (Fig. 3). It usually occurs in moist conditions under the evergreen forests, with an elevation range from 600 m to 1000 m.

Phenology. Under natural conditions in the field, the species was recorded in fruit from August to November. Under cultivated conditions in Guangzhou City, plants were observed in flower in October and in fruit from November to December.

Conservation status. Before our investigation, only five type specimens of two fruiting gatherings have been found in a single locality for this species. We explored the type locality of this species and found two additional localities, but individual numbers of each of the three populations were discovered to be less than 30. Therefore this species might be considered as ‘Critically Endangered’ (CR) under the IUCN (2001) categories criteria C2a(i).

Notes. *Hylodesmum menglaense* was described as having terminal and/or axillary inflorescences in some references (Cui et al. 1987; Gao 2006; Huang and Ohashi 2010). Through examining type specimens, however, Ohashi and Ohashi (2013) pointed out that inflorescences of this species arise from leafless nodes or from the base of old stem, but seem not to be terminal. Our observations show this species does produce terminal inflorescences as well.

Specimens examined. CHINA. Yunnan Province: Mengla County, Menglun Town, 15 Nov 1984, 620 m a.s.l., *Xian-Ju Cui & Guo-Da Tao* 84111501 (KUN); Jinghong City, Jiluo Town, 995 m a.s.l., 11 Sept 2010, *Zhu-Qiu Song* 2010091101 (IBSC); Jinghong City, Gasa Town, 24 Dec 2017, 729 m a.s.l., *Zhu-Qiu Song* 2017017 (IBSC).

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Appendix I

Scientific names, GenBank accession numbers and voucher information for *trnL-F* used in the molecular analyses

*: indicates the taxon was newly sequenced in the present study

Alysicarpus bupleurifolius, LC378320, T. C. Huang & M. J. Wu 14826 (TUS); *Alysicarpus rugosus*, LC378324, L. S. Man 087879 (TUS); *Alysicarpus vaginalis*, LC378321, K. Yonekura et al. 98078 (TUS); *Bouffordia dichotoma*, LC378333, L. S. Man 087882 (TUS); *Campylotropis macrocarpa*, JN402864, B. Xu & L. B. Zhang 97; *Christia obcordata*, LC378328, K. Yonekura 12047 (TUS); *Christia vespertilionis*, LC378326, K. Ohashi 2981 (TUS); *Codariocalyx gyroides*, LC378325, K. Yoda et al. 9614111 (TUS); *Codariocalyx motorius*, LC378327, J. M. Hu & K. H. Wang 849 (TUS); *Dendrolobium triangulare*, MK652468, Z. Q. Song 2010120402 (IBSC)*; *Desmodiopsis campylocaulon*, LC378355, R. Pullen 9274 (TUS); *Desmodium incanum*, LC378339, Yonekura 9667 (TUS); *Desmodium scorpiurus*, LC378348, T. C. Huang & W. T. Huang 14490 (TUS); *Desmodium tortuosum*, LC378349, H. Ohashi et al. 9580602-1 (TUS); *Eleiotis sororia*, LC378354, J. Murata et al. 24817 (TUS); *Grona griffithiana*, LC378318, K. Iwatsuki et al. 1634 (TUS); *Grona heterophylla*, LC378338, Huan-Yu Chen 1544 (TUS); *Grona triflora*, LC378351, K. Yonekura & K. Yasuda 11200 (TUS); *Hegnera obcordata*, LC378356, Poilane 22850 (TUS); *Huangticia renifolia*, LC378346, N. Sasamoto 902081 (TUS); *Hylodesmum densum*, MK652461, Z. Q. Song 90 (IBSC)*; *Hylodesmum glutinosum* 1, KM098856; *Hylodesmum glutinosum* 2, EU717294, Ellsworth 60 (IND); *Hylodesmum laterale*, MK652460, Z. Q. Song 72 (IBSC)*; *Hylodesmum laxum*, MK652462, Z. Q. Song 37 (IBSC)*; *Hylodesmum leptopus*, MK652463, Z. Q. Song 21 (IBSC)*; *Hylodesmum longipes*, MK652467, Z. Q. Song 142 (IBSC)*; *Hylodesmum nudiflorum* 1, EU717296, Stefanovic SS-03-22 (TRTE); *Hylodesmum nudiflorum* 2, KM098857; *Hylodesmum oldhamii*, MK652465, Z. Q. Song 2010092801 (IBSC)*; *Hylodesmum pauciflorum*, EU717297, Stefanovic SS-03-27, (TRTE); *Hylodesmum podocarpum*, LC378358, H. Ohashi 68914 (TUS); *Hylodesmum podocarpum* subsp. *fallax*, MK652459, Z. Q. Song 2010092802 (IBSC)*; *Hylodesmum podocarpum* subsp. *oxyphyllum*, MK652458, Z. Q. Song 2010102001 (IBSC)*; *Hylodesmum podocarpum* subsp. *podocarpum*, MK652457, Z. Q. Song 2010082803 (IBSC)*; *Hylodesmum williamsii*, MK652466, Z. Q. Song 2010082001 (IBSC)*; *Kummerowia striata*, JN402866, N. C. Henderson 04-01; *Leptodesmia congesta*, LC378360, E. Barnes 5 (A); *Leptodesmia microphylla*, LC378343, Bai-Zhong Xiao 4362 (TUS); *Lespedeza virginica*, JN402855, L. B. Zhang 4816; *Mecopus nidulans*, LC378361, Y. Tateishi et al. 1025001 (TUS); *Ohwia caudata*, LC378362, Murata and Mori 88083 (TUS); *Ototropis elegans*, LC378363, H. Ohashi 721015 (TUS); *Ototropis sequax*, MK652456, Z. Q. Song 112 (IBSC)*; *Oxytes pycnostachya*, LC378345, H. S. McKee 45980 (TUS); *Phyllodium pulchellum*, MK652469, Z. Q.

Song 2010111701 (IBSC)*; *Pleurolobus gangeticus* 1, LC378336, N. Sasamoto 80201 (TUS); *Pleurolobus gangeticus* 2, LC378314, K. F. Chung 1148 (TUS); *Pseudarthria hookeri*, LC378365, K. Ohashi s.n. (TUS); *Pycnospora lutescens*, LC378364, T. Y. Liu 1202 (TUS); *Sohmaea diffusa*, LC378334, T. C. Huang et al. 14456 (TUS); *Sohmaea hispida*, LC378357, L. S. Man 091650 (TUS); *Sohmaea laxiflora*, LC378341, N. Sasamoto 809254 (TUS); *Tadehagi triquetrum*, KF621117, X. Y. Zhu 2009052-1 (PE); *Tateishia concinna*, LC378317, M. Suzuki et al. 9160908 (TUS); *Trifidacanthus unifoliolatus*, LC378367, Y. Tateishi et al. 1020113 (TUS); *Uraria crinita*, LC378368, N. Sasamoto 809254 (TUS); *Uraria picta*, LC378370, M. Suzuki et al. 9191248 (TUS); *Verdesmum menglaense*, MK652464, Z. Q. Song 2010091101 (IBSC)*.

A new species of dragon's blood *Croton* (Euphorbiaceae) from Serra dos Órgãos (Rio de Janeiro, Brazil)

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Abstract

Croton rizzinii Farias & Riina, **sp. nov.** is a new species from Serra dos Órgãos National Park in the Atlantic Rain Forest domain (Rio de Janeiro state, Brazil). It is known from the municipalities of Guapimirim, Teresópolis and Petrópolis, where it grows in montane ombrophilous dense forest, between 500 and 1500 m elevation. This arborescent species belongs to *Croton* section *Cyclostigma* Griseb., a Neotropical lineage distributed in forest habitats from Mexico to northern Argentina. It is mainly characterised by its lacinate-glandular stipules, bracts with two inconspicuous glands (colleters) at the base and campanulate pistillate flowers with sepals covering the ovary. We describe and illustrate the new species, and compare it with close relatives occurring in the Atlantic Rain Forest. We also provide a distribution map, habitat information and suggestions for the assessment of its conservation status.

Resumo

Croton rizzinii Farias & Riina, **sp. nov.**, é uma nova espécie do Parque Nacional da Serra dos Órgãos, no domínio da Mata Atlântica (Rio de Janeiro, Brasil). É conhecida nos municípios de Guapimirim, Teresópolis e Petrópolis, onde cresce em floresta ombrófila densa montana, entre 500 e 1500 m de elevação. Esta espécie arborescente pertence a *Croton* seção *Cyclostigma* Griseb., uma linhagem de espécies neotropicais distribuídas em habitats florestais desde o México ao norte da Argentina. Caracteriza-se, principalmente, pelas estípulas laciniado-glandulares, brácteas com duas glândulas inconspícuas (coléteres) na base e flores pistiladas campanuladas com sépalas cobrindo o ovário. Descrevemos e ilustramos a nova espécie e a comparamos com espécies relacionadas ocorrentes na Mata Atlântica. Incluímos um mapa de distribuição, informações de habitat e recomendações para a avaliação do estado de conservação da espécie.

Keywords

Atlantic Rain Forest, *Croton* sect. *Cyclostigma*, Neotropics, taxonomy

Introduction

The Atlantic Rain Forest (ARF) is the richest Brazilian domain for flowering plants (BFG 2018) and one of the world hotspots of biodiversity (Myers et al. 2000). Not surprisingly, the megadiverse genus *Croton* L., with around 1200 spp. (Berry et al. 2005), is well represented in this region. Of the 305 species of *Croton* known for Brazil, 96 occur in the ARF (Flora do Brasil in prep), of which 21 species are trees (Santos et al. 2017). Amongst these arborescent lineages, *C.* sect. *Cyclostigma* is the most diverse in the ARF, having nine species (Santos et al. 2017).

While working on *Croton* for the Flora do Brasil project, we came across several specimens from Serra dos Órgãos that we could not place to species, all of which were collected within the limits of the eponymous national park (PARNASO). These specimens were from small trees and detailed examination of their morphology showed a clear affinity to species in section *Cyclostigma*.

Croton section *Cyclostigma*, which includes species commonly known as dragon's blood, comprises 46 species distributed from Mexico to northern Argentina (Feio et al. 2018a). The new species, described here, increases the total number in the section to 47 and to ten species in the ARF. This section is characterised by fast-growing trees, generally occurring in secondary vegetation, roadsides, river banks and landslide areas of wet forests (Riina et al. 2009), but there are a few species also occurring in dry forests (Riina et al. 2007, Feio et al. 2018a). The common name, dragon's blood, comes from the presence of abundant and often reddish latex, which is used by indigenous and rural populations for wound-healing, preventing infections and other ailments (Ubillas et al. 1994, Jones 2003, Smith 2006).

The Serra dos Órgãos mountain range is part of the Serra do Mar mountain system in Rio de Janeiro state. The PARNASO was created in 1939 and it covers the municipalities of Guapimirim, Magé, Petrópolis and Teresópolis (Cronemberger and Castro 2007). Most of the park's vegetation consists of dense ombrophilous forests, but there are also sparse areas with open vegetation or "campos de altitude" (Velooso et al. 1991). The great elevational gradient (ca. 100 to 2285 m) in a relatively small area has been suggested as the main factor in the formation of this unique and highly diverse environment (Cronemberger and Castro 2007).

Our study contributes to the botanical knowledge of the ARF region by describing a new tree species, *Croton rizzinii*. We provide a complete morphological description, detailed illustrations and a distribution map. We also compare the new taxon with the morphologically most similar species in section *Cyclostigma* occurring in the ARF area.

Materials and methods

We carried out fieldwork between 2015 and 2017 in different areas of the PARNASO, focusing on *Croton* species. Species were randomly sampled at each locality and the in-

dividuals were revisited during the following two years after the initial collections. The description of the new species was based on the analysis of dry plant material deposited in herbaria, including recently collected specimens, as well as field observations. The comparison with related species was undertaken using specimens from the herbaria R and RB, as well as photographs of specimens, including types, from herbaria F, G, K, NY, P, US and W (acronyms follow Index Herbariorum, available at <https://sweetgum.nybg.org/science/ih/>). We also used protologues of *Croton* species known from the ARF and recent floristic studies, particularly that of Santos et al. (2017). Morphological terms follow Hickey and King (2000) and Radford et al. (1974) for leaf morphology, Webster et al. (1996) and Feio et al. (2018b) for trichomes and Vitarelli et al. (2015) and Feio et al. (2016) for secretory structures. The classification of habitat (vegetation type) follows Veloso et al. (1991). The distribution map was produced using the software QGIS version 2.14 (QGIS Development Team 2019), based on geographic coordinates obtained during the collection expeditions and from herbarium specimens. Our suggestion for conservation status was based on field observations, IUCN Red List Categories and Criteria (IUCN 2017) and geospatial conservation assessment (GeoCAT) (Bachman et al. 2011). The extension of occurrence (EOO) was calculated using the GeoCAT online tool (<http://geocat.kew.org>).

Results

Taxonomic treatment

***Croton rizzinii* Farias & Riina, sp. nov.**

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Figures 1, 2

Diagnosis. *Croton rizzinii* is similar to *Croton celtidifolius* Baill., but differs from the latter by the yellowish latex (vs. ochraceous to reddish latex), branches with appressed to stipitate stellate-porrect, stipitate-fasciculate and appressed-multiradiate trichomes (vs. appressed to stipitate stellate, stellate-porrect, appressed dendritic and dendritic-porrect trichomes), stipules (10–)12–14 mm long, laciniate-glandular (vs. 2–6 mm long, entire, eglandular), bracts with two inconspicuous glands (colleters) at the base (vs. eglandular bracts), staminate flowers with 64–76 stamens (vs. 50–60), campanulate pistillate flowers, sepals ca. 6–9.5 mm long, valvate to slightly imbricate (vs. rotate, ca. 2.5–5 mm long, valvate).

Type. BRAZIL. Rio de Janeiro: Teresópolis, Parque Nacional da Serra dos Órgãos, BR-495, rodovia Teresópolis-Itaipava, em borda de mata de encosta, 22°24'40.8"S, 43°02'08.5"W, alt. 1414 m, 28 Jan 2017, fl, S.Q. Farias & J.L. Silva 205 (holotype: R!; isotype: RB!).

Description. *Trees* ca. 5–10 m tall, monoecious; young branches with a dense to sparse indumentum of appressed to stipitate stellate-porrect, stipitate-fasciculate and appressed-multiradiate trichomes, cinereous, yellowish, or pale ferrugineous; latex yellowish. *Leaves* alternate, simple; lamina 7–22 × 2.4–12.2 cm, discolorous, membrana-



Figure 1. *Croton rizzinii*. **A** Adult individual in hillside forest **B** young flowering branch **C** mature flowering branch **D** detail of a mature flowering branch **E** detail of lacinate-glandular stipules **F** young branch showing yellowish latex **G** detail of leaf showing acropetiole glands **H–K** stages of development of pistillate flowers **H** top view of a young pistillate flower **I** young pistillate flower showing a maculate gland on the distal portion of the sepal **J** young pistillate flower **K** mature pistillate flower **L** fruit **M** inflorescence showing pistillate and staminate flowers **N** inflorescence showing fruits. (Photos by S.Q. Farias).

ceous, ovate to cordate, apex acute, long-acuminate to caudate-acuminate, base rounded, obtuse to cordate, adaxial surface sparsely pubescent with indumentum of appressed to short-stipitate fasciculate trichomes, more concentrated along the veins, abaxial surface densely pubescent with indumentum of stipitate stellate-porrect to stipitate-multiradiate trichomes; venation brochidodromous, trinerved at the base to palminerved; margin inconspicuously dentate, with ovoid to cylindrical glands (colleters) at the tip of each tooth; petioles 1.9–13 cm long, with dense indumentum of appressed to stipitate stellate-porrect, stipitate-fasciculate and appressed-multiradiate trichomes; nectary glands 2, acropetiole, patelliform, shortly stipitate to stipitate, on the abaxial side; stipules (10–)12–14 mm long, linear-lanceolate, cream to yellowish-green, margin lacinate-glandular, sometimes with a glandular tip, abaxial surface with sparse indumentum of appressed stellate-porrect to multiradiate trichomes. **Inflorescences** terminal, erect, 6–29 cm long, axis with dense indumentum of appressed to stipitate stellate-porrect trichomes; proximal cymules bisexual, spaced along the axis; cymule bracts variable in size and shape, 4–9 × 1.6–2 mm, narrowly oblong, linear-lanceolate or lanceolate, abaxial surface with appressed stellate-porrect trichomes, with 2 sessile, minute, basal glands (colleters), margin entire to irregularly dissected with stipitate-fasciculate trichomes. **Staminate flowers** rotate, 7–11 mm long; pedicel 2.5–6 mm long, with indumentum of appressed stellate-porrect trichomes; sepals 5, valvate, connate at the base, entire, equal, 3.5–4 × 2–2.5 mm, ovate, apex acute, adaxial surface with simple trichomes at the base and along the margin; abaxial surface with appressed stellate-porrect trichomes; petals 5, 2.2–3.5 × 0.9–1.2 mm, distinct, oblanceolate, apex acute, adaxial surface with simple trichomes at the base, abaxial surface with simple trichomes along the margin; stamens 64–76, filaments 2.5–4.5 mm long, with simple trichomes, disc 5-segmented, receptacle villose with dense simple trichomes. **Pistillate flowers** campanulate, 6.5–10.1 mm long, sessile to subsessile; sepals 5, 6–9.5 × 4–5 mm, valvate to slightly imbricate, connate at the base, entire, unequal, ovate to broadly ovate, apex acute to abruptly acute with glandular tip (colleter), adaxial surface with indumentum of short-stipitate stellate trichomes at the distal portion, abaxial surface with indumentum of appressed stellate-porrect and appressed-multiradiate trichomes; maculate glands sometimes present on some of the sepals; petals each reduced to a filament with an apical gland (colleter); ovary ca. 3.4 mm in diam., densely covered with pale ferruginous rosulate trichomes; styles 3, 4-fid to multifid (12–18 terminal tips), connate at the base, with appressed stellate-porrect trichomes; disc 5-segmented. **Capsules** 7.5–10 × 4.8–5.4 mm, subglobose, densely covered with pale ferruginous rosulate trichomes; sepals and columella persistent; columella 6 mm long. **Seeds** 4.1–5.4 × 3–3.3 mm, oblongoid, brown, ribbed; caruncle 1 × 2.5 mm, cream, transversely oblong.

Specimens examined. BRAZIL – Rio de Janeiro • A. Souza et al. 1576 (R); Teresópolis [Guapimirim], Serra dos Órgãos, rodovia Rio-Teresópolis, próximo ao rio Soberbo; 22°29'23.56"S, 43°00'27.71"W; alt. 505 m; 28 Nov. 1986; fl • A. Souza et al. 1575 (R); Petrópolis, Parque Nacional da Serra dos Órgãos, BR-495, rodovia Teresópolis-Itaipava; 28 Nov. 1986; fl • S.Q. Farias & J.L. Silva 239 (R); ibid, km 9; 22°24'38.5"S, 43°02'24.2"W; alt. 1416 m; 28 Apr. 2018; fl • R. Barnes s.n. (R)

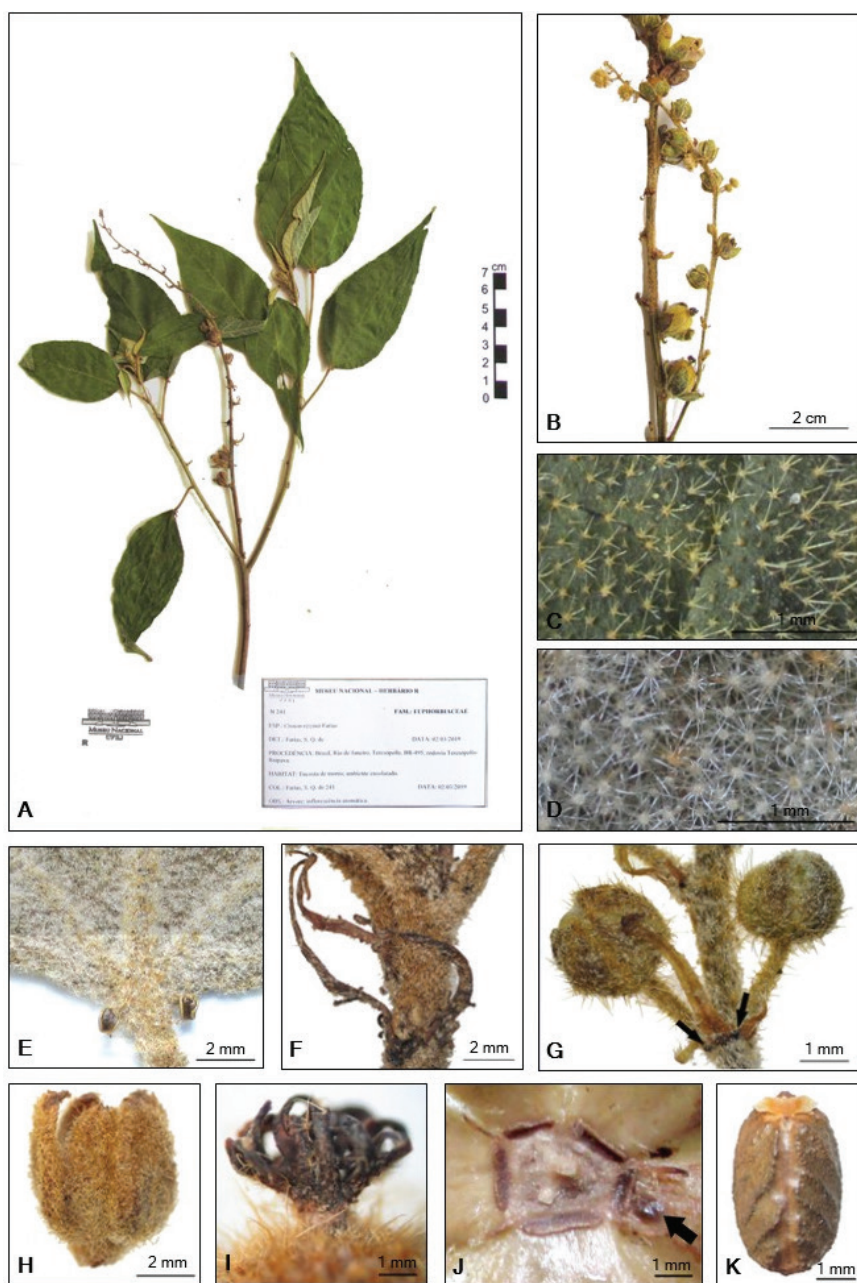


Figure 2. Images from herbarium specimens of *Croton rizzinii*. **A** Flowering branch **B** inflorescence **C** indumentum on the adaxial surface of the lamina **D** indumentum on the abaxial surface of the lamina **E** detail of leaf showing the two acropetiolar glands **F** stipules **G** detail of a bract of a cymule with glands (colleters) at the base **H** mature pistillate flower **I** detail of the styles connate at the base **J** pistillate flower with ovary removed, showing disc and a gland at the base of one of the sepals **K** seed (ventral surface). (**A, B** S.Q. Farias 241 **C, D, G** S.Q. Farias & J.L. Silva 239 **E, F, K** S.Q. Farias & J.L. Silva 234; **H, I, J** S.Q. Farias & J.L. Silva 205, holotype).

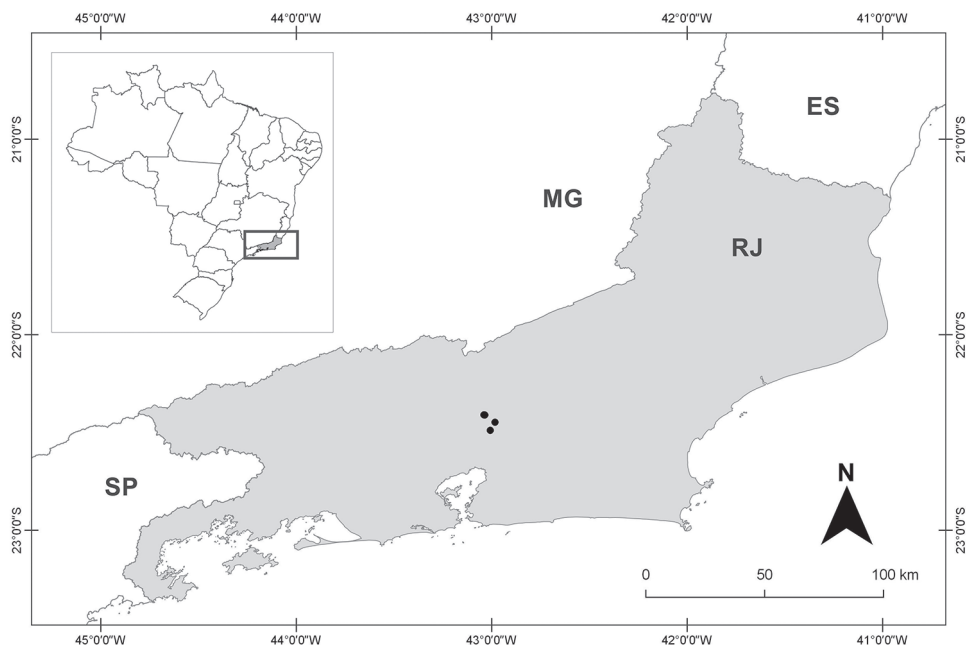


Figure 3. Map of Rio de Janeiro State showing the distribution of *Croton rizzinii* (black circles). The inset map of Brazil on the left provides the context with the state of Rio de Janeiro highlighted in grey. ES = Espírito Santo, MG = Minas Gerais, RJ = Rio de Janeiro, SP = São Paulo.

186364, FUEL34028, INPA 212592, IPA 61764, MBM 275097, RB 377649, SP 361735); Teresópolis; 30 Jun. 1995; fl • R. Barnes s.n. (R 185344); Serra dos Órgãos, próximo ao abrigo 3; 22°26'54.32"S, 42°59'0.21"W; alt. 1000 m; 25 Jan. 1995; fl • S.Q. Farias & J.L. Silva 200 (R); BR-495, rodovia Teresópolis-Itaipava; 22°24'40.8"S, 43°02'08.5"W; alt. 1414 m; 15 Jan. 2017; fl, fr • S.Q. Farias & J.L. Silva 234 (R, RB); ibid; 2 Apr. 2018; fl, fr • S.Q. Farias 241 (R, RB); ibid; 2 Mar. 2019; fl, fr.

Distribution and habitat. *Croton rizzinii* is only known from the Serra dos Órgãos National Park, with records in the municipalities of Guapimirim, Petrópolis and Teresópolis (Rio de Janeiro) (Figure 3). It grows in montane ombrophilous dense forest, between 500 and 1500 m elevation and in disturbed areas like forest edges and roadsides.

Phenology. The new species has been collected in flower in January, March, April, June, November and December. The flowering peak is in December and January, with fruits between January and April.

Etymology. The specific epithet is given in homage to Carlos Toledo Rizzini, a Brazilian botanist, for his dedication to the study of the flora of the Serra dos Órgãos mountain range.

Conservation status. *Croton rizzinii* is known from a few collections in three municipalities of the PARNASO. It has an estimated Extent of Occurrence (EOO) of 19,653 km². Although the species occurs within a conservation unit, it suffers considerably from anthropic pressure caused by tourism, urbanisation, agriculture and

grazing. Based on our data, *Croton rizzinii* could be assessed either as Critically Endangered (CR B1b[iii]) or Data Deficient (DD). The latter category is based on the lack of sufficient information regarding the distribution and size of populations.

Discussion. *Croton rizzinii* can be recognised in the field by its yellowish latex, lacinate-glandular stipules that are cream to green-yellowish in colour, bracts with two inconspicuous glands (colleters) at the base, campanulate pistillate flowers with sepals covering the entire ovary and the presence of maculate glands on the adaxial surface. We are assigning the species to *Croton* sect. *Cyclostigma* (Van Ee et al. 2011) due to its arborescent habit, yellowish latex, stellate trichomes, triplinerved to palmate venation, acropetiole glands, basal bisexual cymules, pistillate flowers with vestigial petals and staminate flowers with numerous stamens. However, further testing using molecular characters would be desirable to confirm its phylogenetic position. The finding of a new species in this section in a relatively well explored area is surprising and shows that botanical exploration continues to be relevant in highly diverse Neotropical areas and especially in biodiversity hotspots (Myers et al. 2000, Joppa et al. 2011) regardless of their current level of floristic inventory and the taxonomic knowledge of the focal group (Riina et al. 2018).

Croton rizzinii can be distinguished from other Brazilian *Cyclostigma* species by its lacinate-glandular stipules, bracts with glands (colleters) at the base, sepals of the pistillate flowers with glands (colleters) at the apex and, sometimes, macular glands on the adaxial surface. Another character distinguishing it from its most similar species in the ARF is the size of seeds, which are the smallest in size amongst them (Table 1). Amongst the ARF *Cyclostigma* species, *Croton rizzinii* appears to be most similar to *C. celtidifolius* (Santos et al. 2017; Caruzo and Cordeiro 2007). Both species occur sympatrically and syntopically and can be confused by their similar ovate to cordate and pubescent leaves, trinerved at the base to palminerved venation, short-stipitate to stipitate petiole glands on the abaxial side of the petiole and subglobose fruits. However, they can be readily distinguished by several characters, mainly by those related to latex colour, type of trichomes on branches, number of acropetiole glands, stipules, bracteoles, stamen number and pistillate flowers (see Table 1 and identification key). Due to their resemblance, specimens of *C. rizzinii* have often been misidentified as *C. celtidifolius* in herbaria.

Croton rizzinii is also similar to *C. vulnerarius* Baill. and *C. alchorneicarpus* Croizat, mostly regarding the young pistillate flowers. *Croton vulnerarius* and *C. rizzinii* occur sympatrically within PARNASO, but so far, they have not been found in the same locality. These species share an arborescent habit, pubescent leaves, conspicuous stipules, sessile to subsessile campanulate pistillate flowers, valvate to slightly imbricate sepals and styles connate at the base. Nevertheless, they can be distinguished by several characters (see Table 1 and identification key). In relation to *C. alchorneicarpus*, both species present ovate to cordate leaves, trinerved at the base to palminerved venation, conspicuous stipules, sessile to subsessile pistillate flowers with styles connate at the base, rotate staminate flowers and subglobose fruits. However, they too can be separated by several vegetative and reproductive characters (see Table 1 and identification key).

Table 1. Main characters distinguishing *Croton rizzinii* from its morphologically closest species in the Atlantic Rain Forest (ARF).

Characters	<i>C. rizzinii</i>	<i>C. alchorneicarpus</i>	<i>C. celtidifolius</i>	<i>C. lagoensis</i>	<i>C. vulnerarius</i>
Maximum height (m)	10	15	15	4	10
Trichomes on branches	Appressed to stipitate stellate-porrect, stipitate-fasciculate and appressed-multiradiate	Appressed stellate, stellate-porrect, dendritic and dendritic-porrect	Appressed to stipitate stellate, stellate-porrect, appressed dendritic and dendritic-porrect	Appressed to stipitate stellate-lepidote	Appressed-stellate, stipitate-dendritic and appressed-rosulate
Petiole glands	2, short-stipitate to stipitate	2(–4), stipitate	2(–4), stipitate, rarely short-stipitate	2, sessile	2(–4), stipitate
Stipule shape	Linear-lanceolate, never foliaceous	Linear to lanceolate, sometimes foliaceous	Linear to lanceolate, rarely foliaceous	Linear-lanceolate to lanceolate, never foliaceous	Lanceolate to filiform, never foliaceous
Stipule margin	Laciniate-glandular	Entire	Entire	Entire	Entire
Stipule length (mm)	(10–)12–14	6–12	2–6	6–8	(9–)13–16
Inflorescence length (cm)	6–29	6–13	(11–)22–32	10–15	7–12
Bracts of the cymes	Entire to irregularly dissected, 2 glands at the base	Entire, eglandular	Entire, eglandular	Entire, eglandular	Entire, eglandular
Staminate flower shape	Rotate	Rotate	Rotate	Rotate	Subcampanulate
Stamen number	64–76	ca. 60	50–60	40–50	ca. 100
Pistillate flower shape	Campanulate	Subcampanulate	Rotate	Campanulate	Campanulate
Pistillate sepal shape	Ovate to broadly ovate	Broadly ovate	Ovate to lanceolate	Broadly ovate	Ovate-lanceolate
Pistillate sepal length (mm)	6–9.5	5–9.4	2.5–5	3–6	5.5–7.5
Vestigial pistillate petals	Filiform	Filiform	Filiform	Filiform	Linear-lanceolate
Seed size (mm)	4.1–5.4 × 3–3.3	7.5 × 4	5.7–7 × 3.7–4	7 × 4	5.9 × 3.4
Habitat	Montane wet forest	Montane wet forest, riparian forest	Montane wet forest, dry forest riparian forest	Dry forest, campos rupestres	Montane wet forest, dry forest
Elevation (m)	500–1500	800–2320	350–1400	800–1800	780–1600
Distribution	ARF (RJ)	ARF (MG, SP, RJ)	ARF (ES, MG, PR, RJ, SC, SP, RS)	Between ARF and Cerrado (MG)	ARF (MG, SP, RJ, PR)

Several collections (Cordeiro 3056, 3057, Riina and Caruzo 1526, 1529) from ARF areas of São Paulo and Rio de Janeiro states show characteristics intermediate between *Croton alchorneicarpus* and *C. rizzinii*. The overall aspect of the plant and the floral morphology are more similar to *C. alchorneicarpus*, but the stipules are more similar to those of *C. rizzinii* (laciniate-glandular). Further studies and additional sampling of *Croton* trees from the ARF are needed to determine the identity of these specimens.

Croton lagoensis Müll. Arg. is also similar to *C. rizzinii*, but it occurs in deciduous forest and in transitional areas between the Cerrado and the ARF in the state of Minas Gerais (Santos et al. 2017). Both species have ovate to cordate and pubescent leaves, two acropetiole glands and campanulate pistillate flowers with sepals covering the en-

tire ovary. However, *C. rizzinii* differs from *C. lagoensis* mainly by its arborescent habit and other features listed in Table 1 and in the identification key.

The description of *C. rizzinii* adds to the number of species with laciniate stipules in *Croton* and in section *Cyclostigma* in particular. Laciniate stipules are found in seven species in *Cyclostigma* (*C. charaguensis* Standl., *C. churutensis* Riina & Cornejo, *C. medusae* Müll. Arg., *C. perspicuosus* Croizat, *C. purdiei* Müll. Arg., *C. rizzinii* and *C. speciosus* Müll. Arg.), but they can be present in other sections of *Croton* (sect. *Adenophylli* Griseb., sect. *Barhamia* (Klotzsch) Baill., sect. *Medea* (Klotzsch) Pax, amongst others) (Van Ee et al. 2011). However, given the inconsistencies found in *Croton* taxonomic treatments regarding the terms used to describe stipules, we suggest further studies to standardise this terminology across the genus.

Identification key for *Croton rizzinii* and morphologically similar species in the ARF

- 1 Habit shrubby; acropetiole glands sessile ***C. lagoensis***
- Habit arborescent; acropetiole glands short-stipitate to stipitate **2**
- 2 Latex yellowish; stipules laciniate-glandular; bracts with tiny glands (colleters) at the base; pistillate flowers campanulate, sepals with a tiny gland (colleter) at the apex ***C. rizzinii***
- Latex translucent, ochraceous to reddish; stipules entire; bracts eglandular; pistillate flowers rotate, subcampanulate to campanulate, apex of sepals eglandular **3**
- 3 Lamina pubescent on adaxial surface **4**
- Lamina glabrous to glabrescent on adaxial surface ***C. alchorneicarpus***
- 4 Stipules linear to lanceolate, 2–6 mm long; stamens 50–60; pistillate flowers rotate, pedicellate, rarely sessile; vestigial pistillate petals filiform ***C. celtidifolius***
- Stipules lanceolate to filiform, (9–)13–16 mm long; stamens ca. 100; pistillate flowers campanulate, sessile to subsessile; vestigial pistillate petals linear-lanceolate ***C. vulnerarius***

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Twelve new and exciting Annonaceae from the Neotropics

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Abstract

As a result of concerted efforts of the community of Annonaceae taxonomists, increasingly detailed knowledge of the diversity of the Neotropical genera has been documented. With the exception of just two large genera, *Annona* and *Xylopia*, all Neotropical Annonaceae have been revised within the last 25 years. Subsequent to these publications, many new specimens have been collected and sent to us in Leiden for identification. These included a number that, despite the advanced state of taxonomic knowledge, proved to represent rarely collected, undescribed species. Here we describe 12 new species of *Annona*, *Guatteria*, *Klarobelia*, *Tetrameranthus*, and *Xylopia*. These species serve to illustrate the still underestimated diversity of the Neotropical flora, even in well studied plant groups like Annonaceae.

Keywords

Annonaceae, *Annona*, *Guatteria*, *Klarobelia*, *Tetrameranthus*, *Xylopia*, neotropics, new species, taxonomy

Introduction

The Neotropics are rich in plant diversity but how rich they are is still a matter of serious debate. For instance, estimating how many tree species exist in the Amazon basin is a non-trivial exercise (e.g. ter Steege et al. 2016, Cardoso et al. 2017, ter Steege et al. 2019). Yet,

a proper estimate of this diversity is essential in order to answer questions on the ecology, evolution and origins of the Neotropical flora and fauna and the processes that are responsible for creating and maintaining its hyperdiverse communities (Cardoso et al. 2017).

Annonaceae is a family of ca. 2450 species of trees and lianas that is well represented in the Neotropical tree flora with ca. 950 species (Rainer and Chatrou 2006, Maas et al. 2011). Understanding the species delineations in this family therefore contributes noticeably to the aim of understanding Neotropical tree diversity. Ongoing revisional work on Neotropical Annonaceae has already led to the revision of almost all genera during the last 25 years (for an overview see Erkens et al. 2017). Still, in this article new species in several genera of Annonaceae are described, and some notes are added on congeneric species of which the circumscription is affected by the newly described species.

The genus *Annona* L. is distributed in tropical America and tropical Africa. It is the second-largest genus of Annonaceae in the Neotropics with a total number of ca. 160 species, four of which inhabit Africa. Nowadays, it is taken in its original concept including two genera which were treated for a long time as segregates. This concerns *Raimondia* Saff. and *Rollinia* A.St.-Hil.: see the comments under the new species *Annona caput-medusae* and *A. oleifolia*.

The new species of *Klarobelia* Chatrou is an addition to the revision of Chatrou (1998). The Neotropical distribution of this genus is similar to that of *Mosannona* and *Crematosperma* (Pirie et al. 2018). As in *Mosannona*, species of *Klarobelia* have small, non-overlapping distributions. Species have been discovered before (e.g. *K. megalocarpa*, Chatrou 1998) when new areas, in between known distribution areas, were first disclosed by plant collectors. The new species described has become known through collecting efforts, especially in the Peruvian province of Oxapampa.

Guatteria Ruiz & Pav. is the largest Neotropical genus of Annonaceae with more than 175 species. It is distributed from Mexico to south-eastern Brazil and was recently revised by Maas et al. (2015). Both because of very recently received specimens and a reinterpretation of some species complexes, several new species of *Guatteria* have to be described in the present paper.

The very small and poorly collected genus *Tetrameranthus* R.E.Fr., quite aberrant from all other genera of Annonaceae because of its spirally arranged (instead of distichous) leaves, was treated twice by Westra (Westra 1985; Westra and Maas 2012). *Tetrameranthus* is a small genus with 8 species, occurring in the Amazon Region, neighbouring French Guiana and the Colombian state of Chocó. Recently we received very rich flowering and fruiting material, accompanied by nice field photographs of an undescribed species from Amazonian Peru which is herewith described.

The genus *Xylopia* L., the only genus of Annonaceae occurring in three continents, has recently been revised for Africa (Johnson and Murray 2018), but treatments for the Asian and American species are needed. The last revision of the Neotropical species of *Xylopia* dates back to Fries (Fries 1930, various supplements). A recent estimation by David Johnson of the total number of species of *Xylopia* in the tropics is 160, whereas ca. 50 species inhabit the Neotropics (DM Johnson pers. comm.). In the present paper a new Colombian species with very distinctive leaf features is described.

Materials and methods

All IUCN Redlist assessments were done on data from herbarium collections and following the IUCN guidelines (IUCN 2012, 2017). Only criterion B could be used for the assessments since data on species' populations (Criteria A, C and D) and extinction probability (Criterion E) were lacking. The area of occupancy (AOO) was calculated by overlaying the occurrence data points with a 2×2 km grid and adding the area of all occupied cells. The extent of occurrence (EOO) was determined by calculating the area of the minimum convex polygon that was drawn around the outer occurrence points. Both AOO and EOO were calculated in R using the ConR package (Dauby et al. 2017). For several species only one to a few data points were available and these were considered Data Deficient. Although assessments can still be carried out for species with such low numbers of collections (Rivers et al 2011) it was unclear whether a lack of data caused the apparent rarity of these species or if they were actually rare, since no other data was available to the authors. It is important to note that a species with such small amounts of data can be endangered and thus a reassessment is needed when more data becomes available.

For those species that were not considered Data Deficient (i.e. had more than 3 collections) data on forest cover loss (Hansen et al. 2013) was investigated to infer if habitat loss was a threat for those species. This was the case if the species occurred in regions where forest cover loss had been observed in the past years. For this assessment, it was assumed that forest cover loss was regulated differently outside and across different protected areas, and thus every occurrence point within a particular protected area was considered as one location. For occurrence points that were not situated in a protected area, a 10 × 10 km grid was used to estimate separate locations.

It must be noted that no extensive survey on the occurrence of these species was undertaken; the AOO and number of locations are therefore a conservative estimate.

Taxonomy

Annona caput-medusae Westra & H.Rainer, sp. nov.

urn:lsid:ipni.org:names:77199050-1

Figs 1, 2

Diagnosis. *Annona caput-medusae* resembles cauliflorous specimens of *A. quinduensis* Kunth (formerly *Raimondia quinduensis*), but differs by the shorter pedicels (7–11 vs. 10–30 mm long) and smaller seeds (ca. 6 vs. 10–14 mm long).

Type. COLOMBIA, Antioquia: Mun. Anorí, electric power plant, road to Aljibes, 7°19'61"N, 75°02'407"W, 350 m, 26 Mar 1996 (fl), *Fonnegra et al.* 5935 (holotype: HUA! [HUA104142]; isotype: MO! [MO1958355]).

Description. Tree 5–7 m tall, cauliflorous; young twigs rather densely covered with appressed brown hairs < 0.5 mm long, soon glabrous. *Leaves:* petioles 16–18 by 2 mm;



Figure 1. *Annona caput-medusae* Westra & H.Rainer. Flowering specimen (Fonnegra et al. 5935, holotype HUA).



Figure 2. *Annona caput-medusae* Westra & H.Rainer. Fruiting specimen (Correa et al. 2307, HUA).

lamina narrowly elliptic, 28–30 by 9–12 cm (leaf index 2.5–3.1), membranous, greenish grey above *in sicco*, somewhat lighter so below, glabrous above except for the large veins sparsely covered with erect, brown hairs, sparsely covered with appressed hairs to glabrous below, base obtuse, extreme base very shortly attenuate, apex acuminate (acumen 10–15 mm long), primary vein impressed to flat above, secondary veins ca. 15, not loop-forming or loop-forming close to the apex (shortest distance between loops and margin ca. 2 mm), tertiary veins mostly percurrent, domatia present in axils of part of the secondary veins; plants androdioecious, probably: only bisexual flowers seen. *Inflorescence* borne on the stem on older branches, much-branched thyrsoids bearing many flowers in succession; pedicels 7–11 by 1–2 mm, gradually widening from base to flower, densely covered with appressed, brown hairs to 0.2 mm long; bracts triangular-ovate or broadly triangular-ovate, outer side densely covered with hairs 0.1–0.2 mm long, more or less persistent, upper bract 0.3–0.4 mm from base of pedicel; flower buds narrowly conical; sepals free or connate at the base, broadly ovate to triangular-ovate, ca. 1 mm long, appressed, later spreading to reflexed, apex acuminate, outer side densely covered with brown hairs; outer petals connate at the base, narrowly triangular, ca. 20 by 5 mm, outer side densely covered with brown hairs, inner petals ca. 0.4 the length of the outer ones, torus ca. 3 mm long, the lower third beset with stamens, the apical two-thirds beset with carpels; stamens ca. 150, ca. 1.5 mm long, anther oblong, ca. 1 mm long, no apical prolongation of connective; carpels 150–200. *Fruit* ellipsoid, ca. 6.5 by 3.5 cm, densely covered with brown hairs ca. 0.2 mm long in young stage, becoming glabrous, areoles not or weakly protruding, not apiculate. *Seeds* ca. 6 by 5 mm, brown.

Distribution. Colombia (Antioquia, Caldas) (Fig. 3).

Habitat and ecology. On industrial ground, in secondary forest. At elevations of 350–450 m. Flowering: March; fruiting: June.

Notes. A domatium here is a small thin membrane in the axil spanning the distance between primary vein and secondary vein. It conforms to the *Annona muricata* type (Van den Bos et al. 1989).

Annona caput-medusae clearly falls within a distinct group formerly known as the segregate genus *Raimondia* (Safford 1913; Westra 1995), but (re-)united later with *Annona* (Rainer 2007). When using Westra's key *A. caput-medusae* comes closest to *A. quinduensis* Kunth which generally is not cauliflorous. Whereas *A. quinduensis* normally is found at higher elevations up to 2500 m, *A. caput-medusae*, as known from the scanty material collected thus far, occurs at elevations below 500 m. The flowers we examined appear to be bisexual. However, given the obvious similarity with other former *Raimondia* species, which are all androdioecious, staminate flowers might be expected in *A. caput-medusae* as well.

Etymology. Caput (L) = head. Medusa, an ancient Greek goddess whose head was covered with snakes. Referring to the shape of the inflorescence.

Preliminary IUCN conservation status. DD. This species is only known from two localities. Although the collections are not made near each other, more data are needed to determine the AOO and EOO. Also, the current population size and population trend of this species are unknown. Habitat loss because of forest cover loss is a

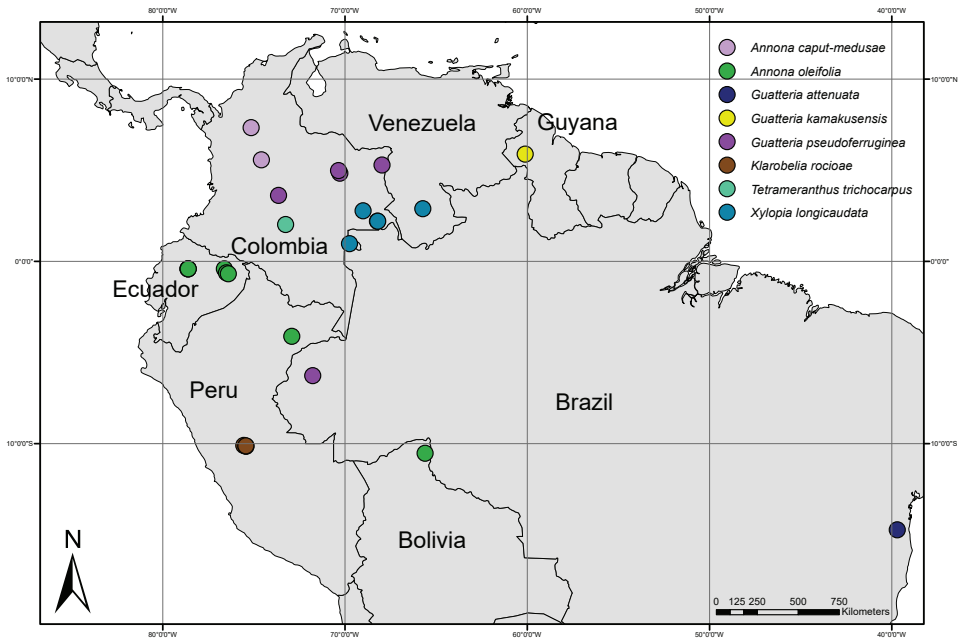


Figure 3. Distribution map of *Annona caput-medusae*, *A. oleifolia*, *Guatteria attenuata*, *G. kamakusensis*, *G. pseudoferruginea*, *Klarobelia rocioae*, and *Xylopia longicaudata*.

possible threat for this species of *Annona* given its occurrence in fragmented forest areas. However, since proper data on the distribution of this taxon is lacking, we assessed it as Data Deficient.

Other specimen examined. COLOMBIA. Caldas: Norcasia, Vereda Moscovita, quebrada Santa Bárbara, 5°34'N, 74°35'W, 450 m, 15 Jun 2001 (fr), *Correa et al.* 2307 (HUA).

***Annona oleifolia* Westra & H.Rainer, sp. nov.**

urn:lsid:ipni.org:names:77199051-1

Figs 4, 5

Diagnosis. When using the key of the Flora Neotropica Monograph of *Rollinia* (Maas, Westra et al. 1992) *Annona oleifolia* keys out to the SE Brazilian *Annona neosericea* H.Rainer by an indument of appressed hairs on the lower side of the lamina, non-gibbous sepals, and narrow wings, but it is very distinct from that species by the very low number of carpels (≤ 25 vs. ≥ 100 , respectively), very narrow leaves (leaf index ≥ 5 vs. 2.5–3) and the slightly recurved instead of horizontal to erect wings in *Annona neosericea*.

Type. ECUADOR, Napo: La Joya de los Sachas, Parroquia Pompeya, Campamento de Maxus, Carretera Maxus km 1–4, 00°25'S, 78°36'W, 235 m, 10–18 Aug 1993 (fr), *Grijalva et al.* 637 (holotype: QCNE! [QCNE75007]; isotype: U! [U1567540]).

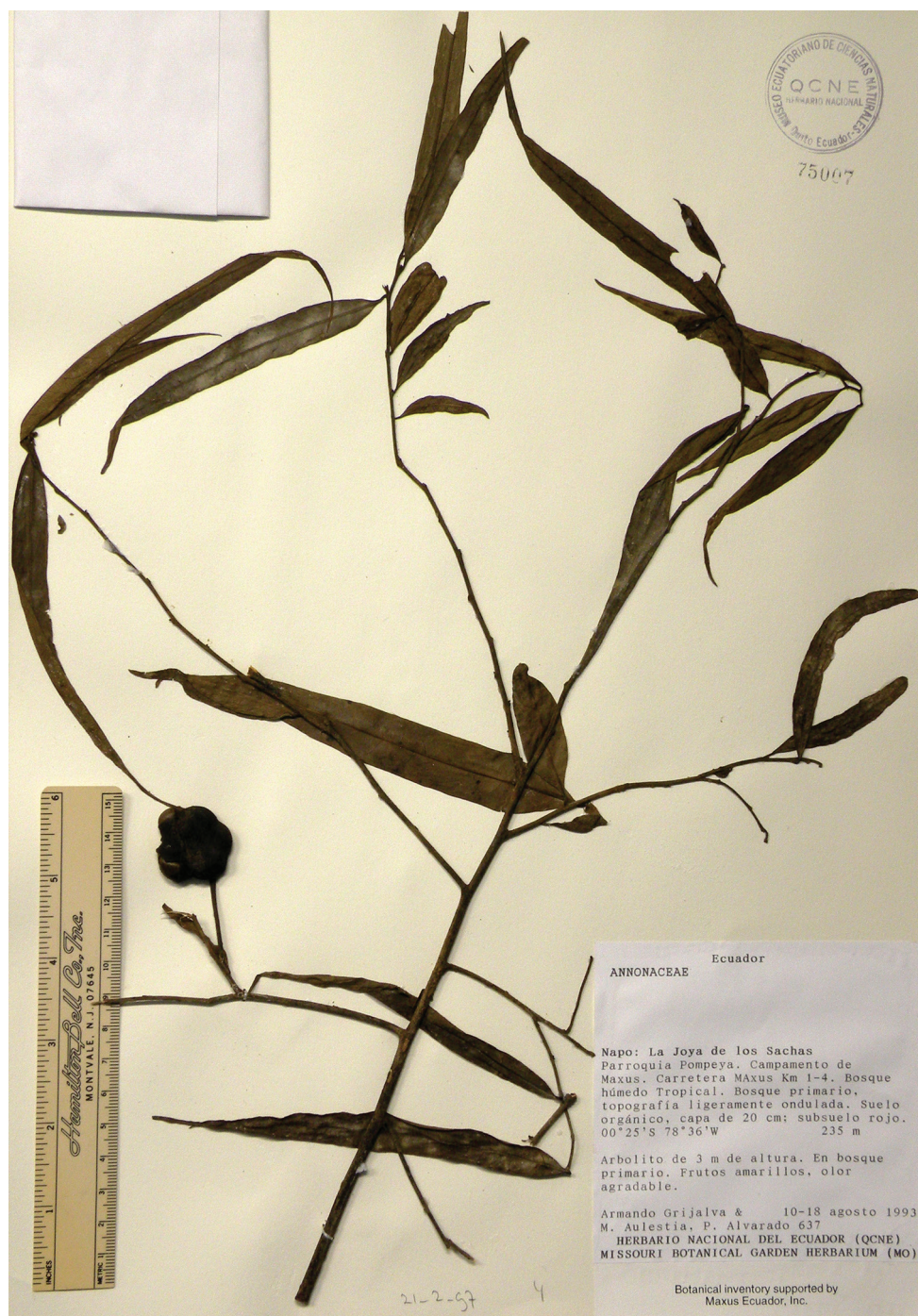


Figure 4. *Annona oleifolia* Westra & H.Rainer. Fruiting specimen (Grijalva et al. 637, holotype QCNE).

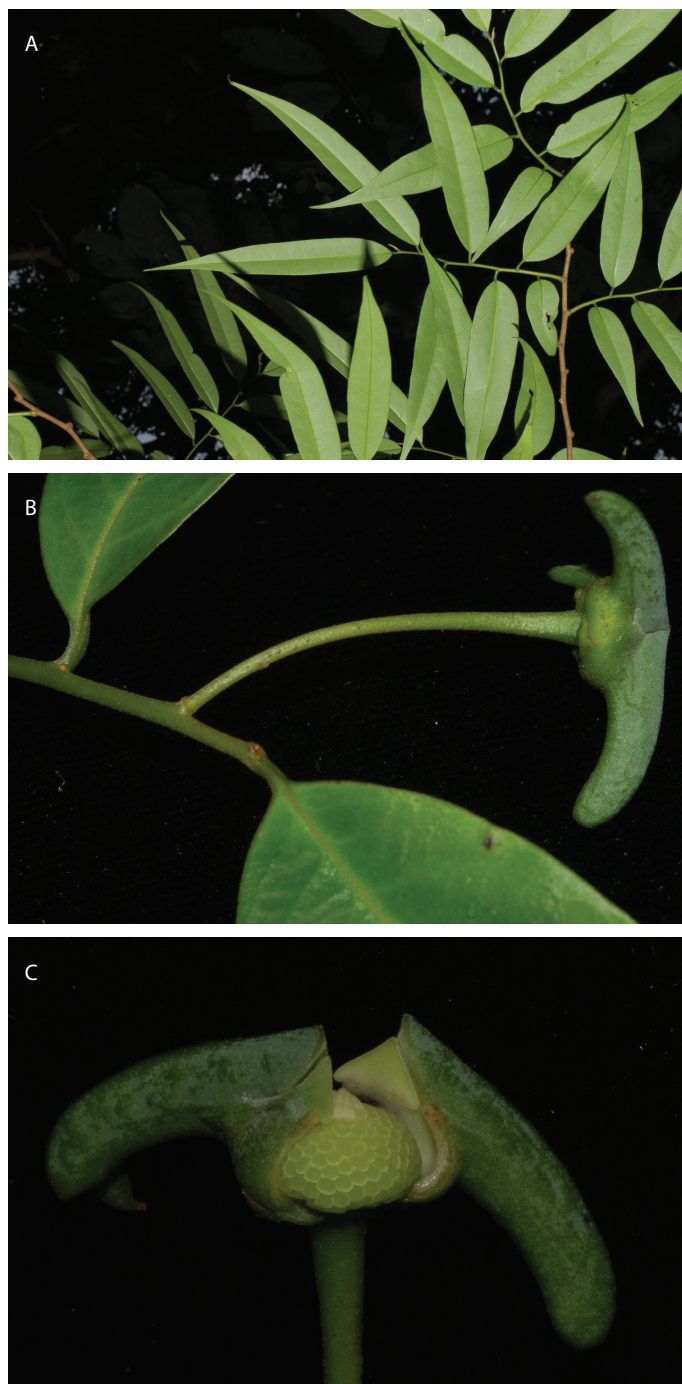


Figure 5. *Annona oleifolia* Westra & H.Rainer. **A** Leaves **B** flowering branch **C** flower with part of the corolla removed to show the interior. Photographs by H. Rainer.

Description. *Small tree* 2–3 m tall, to 3.5 cm diam.; young twigs rather densely to sparsely covered with appressed, brownish hairs < 0.5 mm long, soon glabrous. *Leaves:* petioles 4–8 by 5 mm, sparsely covered with appressed hairs similar to hairs on twigs to glabrous; lamina narrowly elliptic to narrowly elliptic-oblong, 10–17 by 1–2 cm (leaf index 5–8.5), membranous, greenish brown above, somewhat lighter so below, glabrous above except for primary vein densely to sparsely covered with more or less curved hairs, sparsely covered with appressed hairs to mostly glabrous and the primary vein rather densely so to glabrous below, base acute to attenuate, apex long-acute to long-acuminate (acumen 10–30 mm long or not distinct), primary vein impressed above, secondary veins distinct to rather indistinct, 15–17 on either side, often loop-forming, shortest distance between loops and margin 1–2 mm, tertiary venation reticulate, domatia absent. *Flowers* solitary, among leaves, supra-axillary; pedicels ca. 30 by 1 mm, to 50 by 2 mm in fruit, sparsely covered with appressed hairs, soon glabrous; bracts minute, all basal; sepals free, broadly ovate, to ca. 2 mm long, appressed; corolla tube ca. 5 mm high, ca. 7 mm in diam., wings slightly recurved, ca. 10 by 3 mm, ≥ 2 mm thick, free part of inner petals sagittate-triangular, ca. 2 mm long and wide. *Fruit* green to yellow, globose or irregularly so, ca. 2.5 cm diam., glabrous, carpels 20–25, areoles cushion-shaped, slightly protruding. *Seeds* 6–7 by 6 mm, brown.

Distribution. Ecuador (Napo), Peru (Loreto), Bolivia (Beni) (Fig. 3).

Habitat and ecology. In forest. At elevations of 100–300 m; flowering: May, June; fruiting: August and September.

Notes. The flower had to be described from photographs. *Annona oleifolia* falls within the former concept of *Rollinia* because of the characteristic shape of the corolla, with the outer petals wing-like, and the whole flower suggesting a miniature propellor (see Maas et al. 1992).

Using the key to the species in the monograph of *Rollinia* (Maas et al. 1992), *Annona oleifolia* ends near *Rollinia sericea* = *Annona neosericea*, but it is immediately distinct from that species by the very low number of carpels (≤ 25 vs. ≥ 100 , respectively).

Etymology. ‘Oleifolia’ = with leaves resembling those of *Olea europaea* L., the Olive Tree.

Preliminary IUCN conservation status. EN B2ab(iii). The EOO (126.356 km²) was too large to classify as threatened, but AOO (24 km²) would classify as Endangered. It was determined that this species occurs in 5 locations. Although the species occurs within national parks in Ecuador, it is also found in heavily fragmented forest regions. Since the current population size and population trend of this species are unknown, we have classified it as Endangered.

Other specimens examined. **ECUADOR. Napo:** La Joya de los Sachas, Cantón Pompeya, 00°25'S, 78°37'W, 14 Sep 1992, *Gudiño & Grefa* 1775 (MO, QCNE). **PERU. Loreto:** Prov. Maynas, Distr. Sargento Lores, Constancia Norte, 04°07'S, 72°55'W, 11 Apr 1997, *Vásquez et al.* 22963 (MO). **BOLIVIA. Beni:** Prov. Vaca Díez, Cachuela Esperanza, along Río Beni, 10°32'S, 65°36'W, 9 Nov 2001, *Chatrou et al.* 417 (U).

***Guatteria aliciae* Maas & Erkens, sp. nov.**

urn:lsid:ipni.org:names:77199052-1

Figs 6–8

Diagnosis. *Guatteria aliciae* is similar to *Guatteria tenera* R.E.Fr. in terms of its very small and narrow leaves that are not verruculose, straight young twigs, and secondary veins that are impressed to raised on the upper side of the lamina, but it is distinct from that species by long-pedicellate flowers (20–45 vs. 10–20 mm long) and longer petioles (5–10 vs. 2–5 mm long) and almost smooth (to slightly pitted) seeds.

Type. PANAMA, Veraguas: Parque Nacional Santa Fé, La Sabaneta, E0501556 N0959877, 1000 m, 16 Jul 2009, *Ibañez et al.* 5799 (holotype: MO! [MO6619251]; isotype: L!).

Description. *Tree* 4–6 m tall; young twigs sparsely covered with appressed hairs, soon glabrous. *Leaves:* petioles 5–10 by 2 mm; lamina narrowly elliptic to narrowly oblong-elliptic, 8–12 by 3–4 cm (leaf index 2.6–3.6), chartaceous, not verruculose, dull, greyish above, brown below, glabrous above, sparsely to densely (large veins) covered with appressed hairs below, base acute to obtuse, or attenuate, apex acuminate (acumen 5–15 mm long), primary vein impressed above, secondary veins distinct, 10–12 on either side of primary vein, slightly raised above, smallest distance between loops and margin ca. 2 mm, tertiary veins indistinct, flat above, reticulate. *Flowers* solitary or rarely in 2-flowered inflorescences in axils of leaves or on leafless branchlets; flowering and fruiting pedicels 20–45 by 1 mm, sparsely to rather densely covered with appressed hairs, articulated at 0.2–0.3 from the base; bracts (4–)6–7, soon falling, the basal ones (one seen) broadly ovate, ca. 1 mm long, the 2 upper ones not seen; flower buds depressed ovoid; sepals free, broadly ovate-triangular, 5–6 by 5–6 mm, appressed, outer side rather densely covered with appressed hairs; petals green to yellowish green *in vivo*, oblong-elliptic, 10–15 by 4–6 mm, outer side densely covered with appressed hairs; stamens ca. 2 mm long, connective shield densely papillate. *Monocarps* ca. 20, green *in vivo*, black *in sicco*, ellipsoid, 9–10 by 4 mm, glabrous, apex apiculate (apiculum <0.5 mm long), wall ca. 0.2 mm thick, stipes red *in vivo*, 10–15 by 1 mm. *Seed* ellipsoid, ca. 10 by 4 mm, brown, surface smooth to slightly pitted, raphe raised.

Distribution. Panama (Veraguas) (Fig. 9).

Habitat and ecology. In low forest of 6–8 m tall, with the palm species *Colpothrinax aphanopetala* R.Evans. At an elevation of ca. 1000 m. Flowering and fruiting: July.

Notes. *Guatteria aliciae* is named in honour of its collector Alicia Ibañez, who assisted us in all kinds of ways in 2006, during our visit to Panama. This species is only known from one locality in the Panamanian province of Veraguas.

Preliminary IUCN conservation status. DD. This species is only known from one locality with three collections. Therefore AOO and EOO could not be calculated. Given that the species occurs in Santa Fé National Park we assume that currently there are no major threats. However, since the current population size and population trend of this species are unknown, it was assessed as Data Deficient.



Figure 6. *Guatteria aliciae* Maas & Erkens. Flowering branch (Ibáñez et al. 5799, holotype MO).



Figure 7. *Guatteria aliciae* Maas & Erkens. Fruiting branch, detail (Ibañez et al. 5813, MO).



Figure 8. *Guatteria aliciae* Maas & Erkens. **A, B** Flowering branch **C** flower seen from above **D** young fruit **E** flower seen from aside **F** flower seen from above (**A–D** Ibañez et al. 5799 **E** Ibañez et al. 5770 **F** Ibañez et al. 5813).

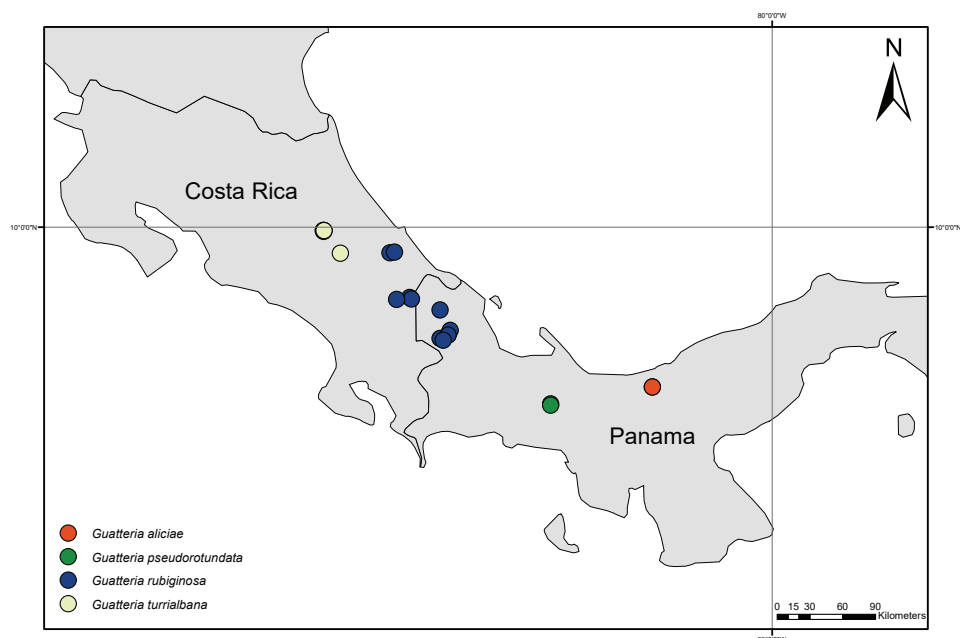


Figure 9. Distribution map of *Guatteria aliciae*, *G. pseudorotundata*, *G. rubiginosa*, and *G. turrialbana*.

Other specimens examined. PANAMA. Veraguas: Parque Nacional Santa Fé, La Sabaneta, E0501556 N0959877, 1000 m, 16 Jul 2009, *Ibañez et al.* 5770 (MO), 5813 (MO, 2 sheets).

***Guatteria attenuata* Maas & Westra, sp. nov.**

urn:lsid:ipni.org:names:77199053-1

Fig. 10

Diagnosis. Resembling the Amazonian species *G. modesta* Diels by the long-attenuate leaf base, but differing by a shorter petiole (2–5 vs. 5–10 mm long), and distinct secondary and tertiary veins which are strongly raised above vs. inconspicuous and flat to slightly raised above.

Type. BRAZIL, Bahia: Almadina, Serra do Sete-Paus, Rodovia de Almadina para Ibitupã, entrada à esquerda ca. 5 km Fazenda Cruzeiro do Sul, ca. 8 km da entrada do ramal, 14°44'06"S, 39°41'46"W, 300 m, 3 Mar 2005, *Fiaschi et al.* 2735 (holotype: NY! [NY01196019]; isotypes: RB! [RB427393], U! [U0248902]).

Description. *Tree* ca. 35 m tall, to ca. 58 cm diam.; young twigs densely covered with half-appressed hairs. *Leaves:* petioles 2–5 by 0.5–1 mm; lamina narrowly elliptic, 6–12 by 2–3 cm (leaf index 3.5–4), chartaceous to coriaceous, discoloured, greyish green above *in sicco*, brown below *in sicco*, sparsely covered with appressed hairs above, mainly along primary vein, rather densely covered with appressed hairs below, base



Figure 10. *Guatteria attenuata* Maas & Westra. Flowering branch (Fiaschi et al. 2735, isotype U).

long-attenuate, basal margins revolute, apex very shortly and bluntly acuminate (acumen 1–3 mm long), primary vein impressed above, secondary veins 13–18 on either side of primary vein, strongly raised above, smallest distance between secondary veins and margin 2–3 mm, tertiary veins strongly raised on both sides, strongly reticulate. *Inflorescence* axillary, 1–2-flowered; pedicels 8–20 by 1–2 mm, densely covered with half-appressed, white hairs, articulated at 0.3–0.4 from the base; bracts 5–7, depressed ovate, 1–2 mm long, outer side densely covered with half-appressed, white hairs; flower buds not seen; sepals free, deltate, 4–5 by 4–5 mm, reflexed, inner and outer side densely covered with appressed and erect, curly, greyish hairs; petals greenish, maturing yellowish cream *in vivo*, narrowly elliptic to obovate, 10–16 by 6–8 mm, inner and outer side densely covered with appressed and erect, curly, greyish hairs; stamens 1–1.5 mm long, connective shield discoid, glabrous. *Monocarps* and *seeds* not seen.

Distribution. Brazil (Bahia) (Fig. 3).

Habitat and ecology. In non-inundated, Atlantic rain forest. At an elevation of ca. 300 m. Flowering: March; fruiting: not recorded.

Notes. *Guatteria attenuata*, only known from the type collection and a second sterile collection from the same tree, is according to the label a tree of 35 m high, a size rarely seen in the genus. Also the long-attenuate leaf base is a rare feature in the *Guatteria*, although in *G. modesta* from the Amazon region, the base is attenuate.

Preliminary IUCN conservation status. DD. This species is only known from one locality and the current population size and population trend of this species are unknown. *Guatteria attenuata* was collected in an area that shows habitat loss due to forest cover loss and this is therefore a possible threat for this species. Nonetheless, this species was assessed as Data Deficient given the overall lack of data of this species.

Other specimen examined. BRAZIL. Bahia: Almadina, Serra do Sete-Paus, 6 km de Almadina, na estrada para Ibitupã, então 7 km N para a comunidade de Sete-Paus, na nascente do rio Almadina, 14°44'S, 39°42'W, 19 Jul 2005, *Lobão et al.* 735 (RB).

Field observations. According to the label of the type collection, the flowers emit a strong scent (“odor forte”).

Guatteria kamakusensis Maas & Westra, sp. nov.

urn:lsid:ipni.org:names:77199054-1

Fig. 11

Diagnosis. *Guatteria kamakusensis* resembles *G. schomburgkiana* Mart. by solitary, short-pedicellate flowers in axils of leaves but differs by the connective shield of the stamens which are papillate vs. densely hairy in *G. schomburgkiana*.

Type. GUYANA, Cuyuni-Mazaruni Region, 2nd and 3rd escarpments of Kamakusa Mt., 5°52'55.2"N, 60°6'34.5"W, 1330 m, 8 Jun 2012, *K.J. Wurdack et al.* 5874 (holotype: U!; isotypes US!).

Description. Tree to 10 m tall; young twigs densely to rather densely covered with appressed, whitish hairs to ca. 0.5 mm long, soon glabrous. *Leaves:* petioles 10–15 by

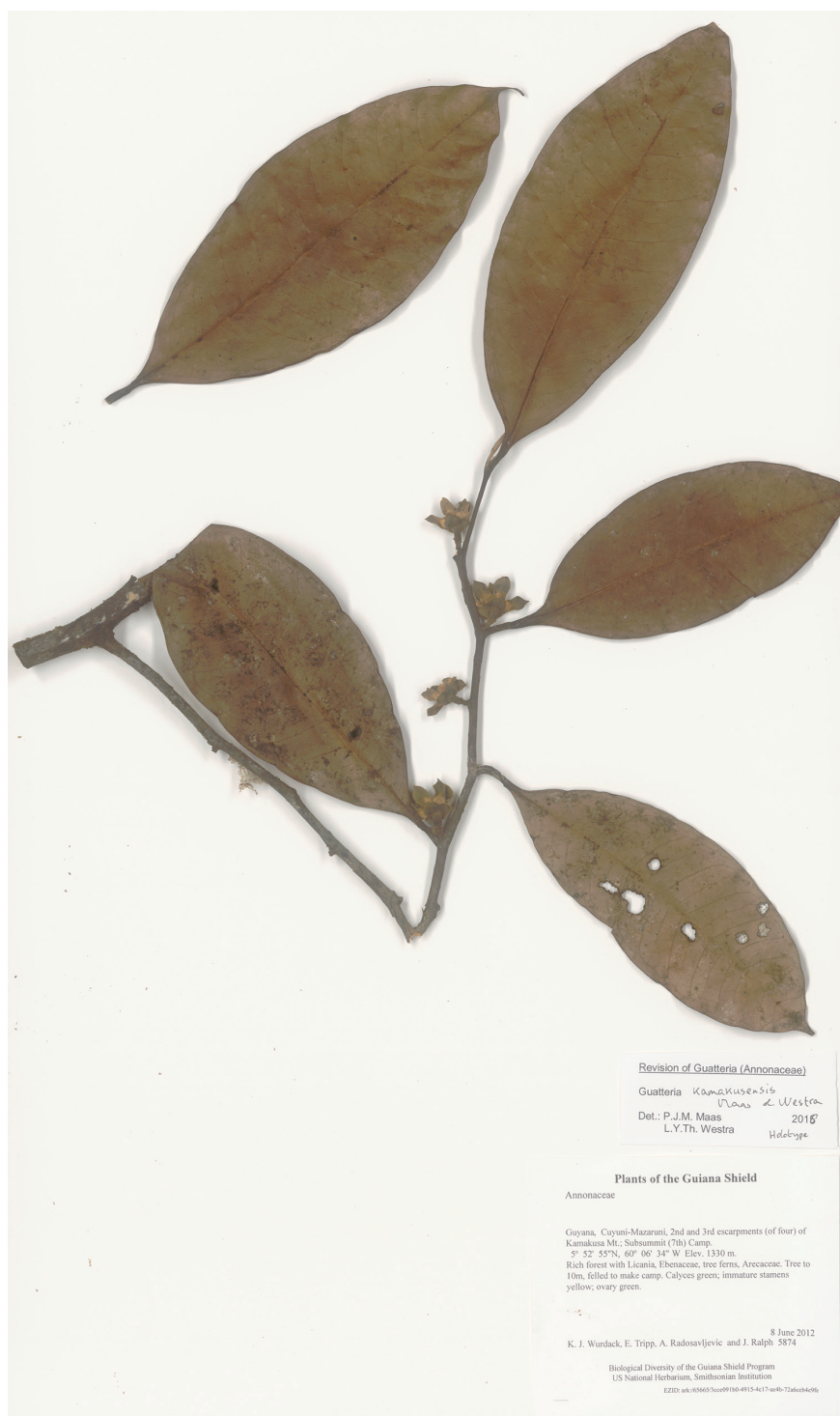


Figure 11. *Guatteria kamakusensis* Maas & Westra. Flowering branch (Wurdack et al. 5874, holotype U).

1.5–2.5 mm; lamina elliptic, 12–17 by 4.5–7 cm (leaf index 2.5–2.7), thinly coriaceous, smooth, slightly shiny above and below *in sicco*, greyish brown above *in sicco*, pale brown below *in sicco*, sparsely covered with appressed hairs to glabrous above, rather densely (primary vein) to sparsely covered with appressed, whitish hairs below, base acute, extreme base shortly attenuate, apex acuminate (acumen 10–15 mm long), primary vein impressed above, secondary veins distinct, 10–12 on either side of primary vein, slightly raised above, loop-forming in part, shortest distance between loops and margin 2–3 mm, tertiary veins mostly reticulate, slightly raised above. *Flowers* solitary in axils of leaves; pedicels 5–7 by 1.5–2.5 mm, densely covered with appressed hairs, articulated at 0.5–0.6 from the base; bracts 4–5, soon falling, basal ones 1–1.5 mm long, the two uppermost elliptic, ca. 5 mm long; flower buds very broadly ovoid, apiculate; sepals basally connate to free, broadly triangular-ovate, 3–5 by 5–6 mm, outer side densely covered with appressed hairs; petals [as “calyces”] green *in vivo*, elliptic, ca. 10 by 5 mm, outer side densely covered with appressed hairs; stamens 80–100, yellow *in vivo*, ca. 1.5 mm long, connective shield densely covered with papillae and with few minute erect hairs; carpels 30–40, stigmas green *in vivo*. *Monocarps* and *seeds* not seen.

Distribution. Guyana, only known from the type collection (Fig. 3).

Habitat and ecology. In rich rain forest with *Licania*, Ebenaceae, tree ferns, and palms. At an elevation of ca. 1330 m. Flowering: June; fruiting: unknown.

Notes. *Guatteria kamakusensis* was found at a fairly high elevation as compared to most of the *Guatteria* species in the Guianas, in a poorly collected area. It is similar to *G. schomburgkiana* Mart. in leaf shape and the short-pedicellate flowers, but the connective shield is papillate with few intermixed hairs, vs. a densely hairy connective shield in *G. schomburgkiana*. Its place remains unclear though, especially because the fruits are still lacking, and requires further research.

Preliminary IUCN conservation status. DD. This species is only known from one locality in a poorly collected area and the current population size and population trend of this species are unknown. There seem to be no immediate threats to this species in terms of habitat loss. However, since no AOO and EOO could be determined or any other assessment criterium could be used, this species was assessed as Data Deficient.

***Guatteria pseudoferruginea* Maas & Westra, sp. nov.**

urn:lsid:ipni.org:names:77199055-1

Figs 12, 13

Guatteria sp. 2 Maas & Westra, *Blumea* (2015) 188.

Diagnosis. *Guatteria pseudoferruginea* superficially resembles the SE Brazilian *G. ferruginea* A.St.-Hil. by having young twigs densely covered with erect, brown hairs, non-verruculose leaves, and ellipsoid seeds, but it is different from that species by being not cauliflorous, and having smaller leaves (14–20 vs. 17–40 cm long), petals hairy on both sides, shorter pedicels (7–15 vs. 15–70 mm long) and seeds that are smooth vs. pitted.



Figure 12. *Guatteria pseudoferruginea* Maas & Westra. Flowering branch (Cabrera R. 1991, COL).

Type. COLOMBIA, Vichada: Gaviotas, afluente del Caño Urimica, 1 Jan 1973, Cabrera R. 2522 (holotype: COL! [COL411248]; 2 isotypes: COL! [COL265832 and COL411249]).

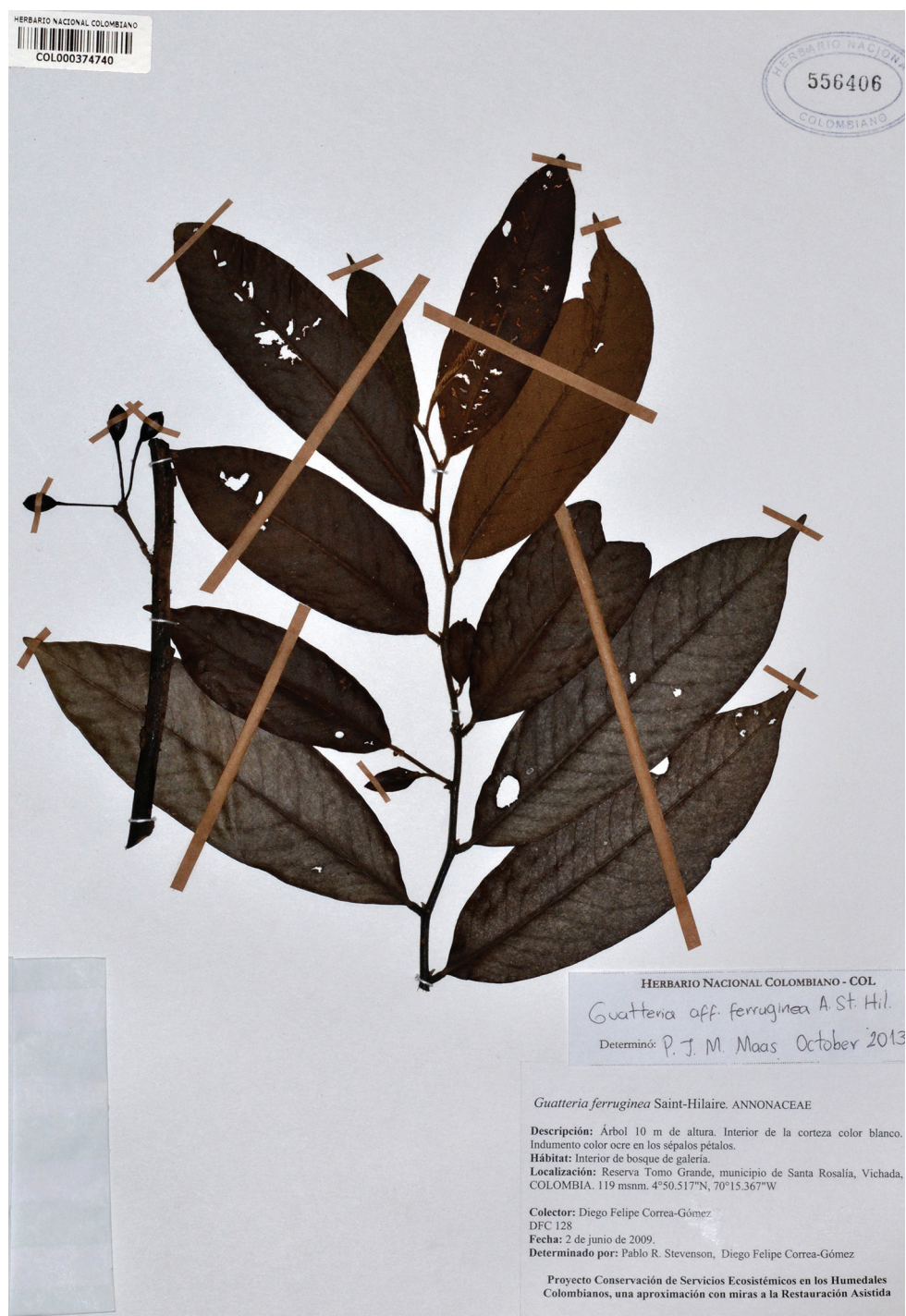


Figure 13. *Guatteria pseudoferruginea* Maas & Westra. Fruiting branch (Correa-Gómez 128, COL).

Description. *Tree or shrub* 5–12 m tall, 5–15 cm diam.; young twigs densely covered with erect, brown hairs, soon glabrous. *Leaves:* petioles 4–10 by 1–2 mm; lamina narrowly elliptic, 14–20 by 4–6.5 cm (leaf index 2.8–3.5), chartaceous, not verruculose, dull, greyish above, brown below, densely covered with appressed hairs to glabrous above, sparsely covered with appressed hairs to glabrous below, base acute to slightly attenuate, apex acuminate (acumen 5–15 mm long), primary vein impressed above, secondary veins distinct, 15–17 on either side of primary vein, slightly impressed above, smallest distance between loops and margin ca. 2 mm, tertiary veins flat above, reticulate. *Inflorescence* axillary, 1–2-flowered; pedicels 7–15 by 1 mm, to 15–20 by 1–2 mm in fruit, densely covered with appressed and erect, brown hairs, articulated at ca. 0.3 from the base; bracts not seen; flower buds subglobose; sepals free, broadly ovate-triangular, 7–8 by 6 mm, reflexed, outer and inner side densely covered with appressed and erect, brown hairs, inner base glabrous; petals green *in vivo*, ovate-elliptic, 7–12 by 5–11 mm, both sides densely covered with appressed and erect, brown hairs, except for the inner glabrous base; stamens ca. 1.5 mm long, connective shield papillate. *Monocarps* 10–50, colour *in vivo* not recorded, black *in sicco*, ellipsoid to narrowly ellipsoid, 10–20 by 5 mm, glabrous, apex apiculate (apiculum < 0.5 mm long), wall ca. 0.2 mm thick, stipes 15–20 by 5 mm. *Seed* ellipsoid, dark, shiny brown, ca. 8 by 5 mm, smooth.

Distribution. Colombia (Arauca, Meta, Vichada) (Fig. 3).

Habitat and ecology. In non-inundated forest or gallery forest. At elevations of 100–1000 m. Flowering: January to April; fruiting: March, June.

Notes. Specimens of *Guatteria pseudoferruginea* have previously been identified as *G. ferruginea* A.St.-Hil. from E and SE Brazil, which differs from *G. pseudoferruginea* in being cauliflorous. Both species are characterised by a dense indument of brownish, erect hairs on the twigs. However the new species differs from *G. ferruginea* by characters as given in the diagnosis, notably by petals covered with brown hairs on both sides (vs. on the outer side only in *G. ferruginea*), and by the absence of cauliflory. The description of *G. pseudoferruginea*, formerly named *Guatteria* sp. 2 in the monograph of *Guatteria* (Maas et al. 2015), could be completed by the first author during a recent visit to Colombia and the COL Herbarium in Bogotá.

Preliminary IUCN conservation status. EN B2ab(iii). EOO (378,742 km²) was too large to classify as threatened, but AOO (20 km²) would classify as Endangered. It was determined that this species has 5 locations almost all in heavily deforested areas outside national parks. Furthermore, because no information is available on the current population size and population trend of this species, we have classified it as Endangered.

Other specimens examined. **COLOMBIA.** **Arauca:** Mun. Tame, Vereda Caribabare, 6°16'36.5"S, 71°46'01.4"W, 290 m, 30 Mar 2015, *Trujillo-C. & Gantiva* 3298 (COL). **Meta:** San Martín, Vereda La Castañeda, Finca Santa Rosa, 3°36'51"N, 73°38'33"W, 363 m, 27 Feb 2005, *Aldana & Stevenson* 10 (ANDES), 22 (ANDES, COL); forested slopes of Río Negro, ca. 20 km W of Villavicencio, along road between main highway and finca of Helmuth Schmidt, 1050 m, 23 Feb 1972, *Barclay et al.* 3198 (US). **Vichada:** Caño Urimica, 3 Jan 1972, *Cabrera R.* 1991 (COL); Mun. Puerto Carreño, Mata de monte grande, 5°17'00"N, 67°57'50"W, 4 Aug 1995, *Córdoba et al.*

1369 (COL); Mun. Santa Rosalia, Reserva Tomo Grande, 4°50.400'N, 70°16.388'W, 124 m, 27 Apr 2009, *Correa-Gómez* 87 (COL); Mun. Santa Rosalia, Reserva Tomo Grande, 4°50'517"N, 70°15'367"W, 119 m, 2 Jun 2009, *Correa-Gómez* 128 (COL).

***Guatteria pseudorotundata* Maas & Erkens, sp. nov.**

urn:lsid:ipni.org:names:77199056-1

Figs 14–16

Diagnosis. *Guatteria pseudorotundata* resembles the Panamanian *G. rotundata* Maas & Setten by its coriaceous leaves, the number of distinct secondary veins below (8–12 vs. 7–12) and the broadly ovate-triangular sepals, but it differs by the young twigs that are glabrous vs. sparsely covered with appressed hairs, slightly smaller leaves (5–9 vs. 5–14 cm long) with a mostly acute leaf apex vs. obtuse or rounded apex, the lack of any verruculae in the lamina, and longer pedicels (15–20 vs. 4–15 mm long).

Type. PANAMA, Comarca Ngabe-Buglé: Nole Duima, Alto Ratón, E409440, N944626, 1590 m, 28 Nov 2011, *Pineda & Castillo* 15 (holotype: MO! [MO6613500]).

Description. *Tree* 6–10 m tall; young twigs glabrous. *Leaves:* petioles 2–4 by 1 mm; lamina narrowly elliptic, 5–9 by 2–3 cm (leaf index 2.5–3), chartaceous *in sicco*, coriaceous *in vivo*, not verruculose, shiny above *in vivo*, brown above, paler brown below, glabrous on both sides, base attenuate, apex obtuse or more or less acute with an obtuse extreme apex, primary vein slightly raised above, secondary veins distinct, 8–12 on either side of primary vein, raised above (but even more so below), smallest distance between loops and margin 1–2 mm, tertiary veins raised above, reticulate. *Flowers* solitary in axils of leaves; pedicels 15–20 by 0.5–1 mm to 1.5 mm diam. in fruit, rather densely to sparsely covered with appressed hairs, articulated at 0.1–0.2 from the base; bracts 5–7, soon falling, one of the lower bracts sometimes leafy, ca. 15 by 5 mm; flower buds ovoid, slightly pointed; sepals free, broadly ovate-triangular, ca. 4 by 3 mm, appressed, outer side rather densely covered with appressed, greyish white hairs, particularly towards the apex; petals greenish yellow *in vivo*, ovate-elliptic, 6–7 by 5 mm, outer and inner, side densely covered with appressed and curly, greyish white hairs, base of inner petals glabrous; stamens 1–2 mm long, connective shield papillate. *Monocarps* 10–25, green *in vivo*, black *in sicco*, narrowly ellipsoid, 13–16{–18} by 4{–6} mm, glabrous, apex apiculate (apiculum <0.1 mm long), wall 0.1–0.2 mm thick, stipes 1–4 by 1–2 mm. *Seed* narrowly ellipsoid, 13–16 by 4–5 mm, brown, rugulose.

Distribution. Panama (Comarca Ngabe-Buglé) (Fig. 9).

Habitat and ecology. In secondary forest. At elevations of 1590–1700 m. Flowering and fruiting: November and December.

Vernacular names. Panama: Soron drune.

Notes. When working on the revision of *Guatteria* (Maas et al. 2015) we received photographs of flowering and fruiting specimens of a plant from Panama which seemed to match well *Guatteria rotundata* Maas & Setten, and we identified them as such and



Figure 14. *Guatteria pseudorotundata* Maas & Erkens. Fruiting branch and flower (Maas et al. (2015): 148, Plate 7a [as *Guatteria rotundata*]).

included the appropriate illustration as Pl. 7a in our work. *G. rotundata*, it should be pointed out, is unique among Central American species of *Guatteria* on account of its leaves having a rounded apex. Recently we received the corresponding herbarium material and it became clear that the photographed plant did not represent *G. rotundata* at all, but an undescribed species instead. *G. pseudorotundata* differs from *G. rotundata* by characters as given in the diagnosis, but notably the lack of verruculae in the lamina. Although more or less hidden from view in the photograph just mentioned, the leaf apex in *G. pseudorotundata* tends to be acute rather than obtuse or rounded (excl. the extreme tip) as in *G. rotundata*.

Preliminary IUCN conservation status. DD. This species is only known from three nearby collections and therefore no AOO and EOO was calculated (that would constitute one location) in a region that is partially deforested. More continuous forest is, however, available nearby but it is unclear whether this species occurs there. Habitat loss because of forest cover loss is therefore a possible threat for *Guatteria pseudorotundata*. Unfortunately, no other assessment criterium could be used for this species since no information is available on the current population size and population trend of this species. Hence, this species was assessed as Data Deficient.

Other specimens examined. PANAMA. Comarca Ngabe-Buglé: Kankintú, E409436, N943433, 1700 m, Dec 2011, *Carrión et al.* 517 (MO), ibidem, *Flores et al.* 1725 (STRI).



Figure 15. *Guatteria pseudorotundata* Maas & Erkens. Flowering branch (Pineda et al. 15, holotype MO).

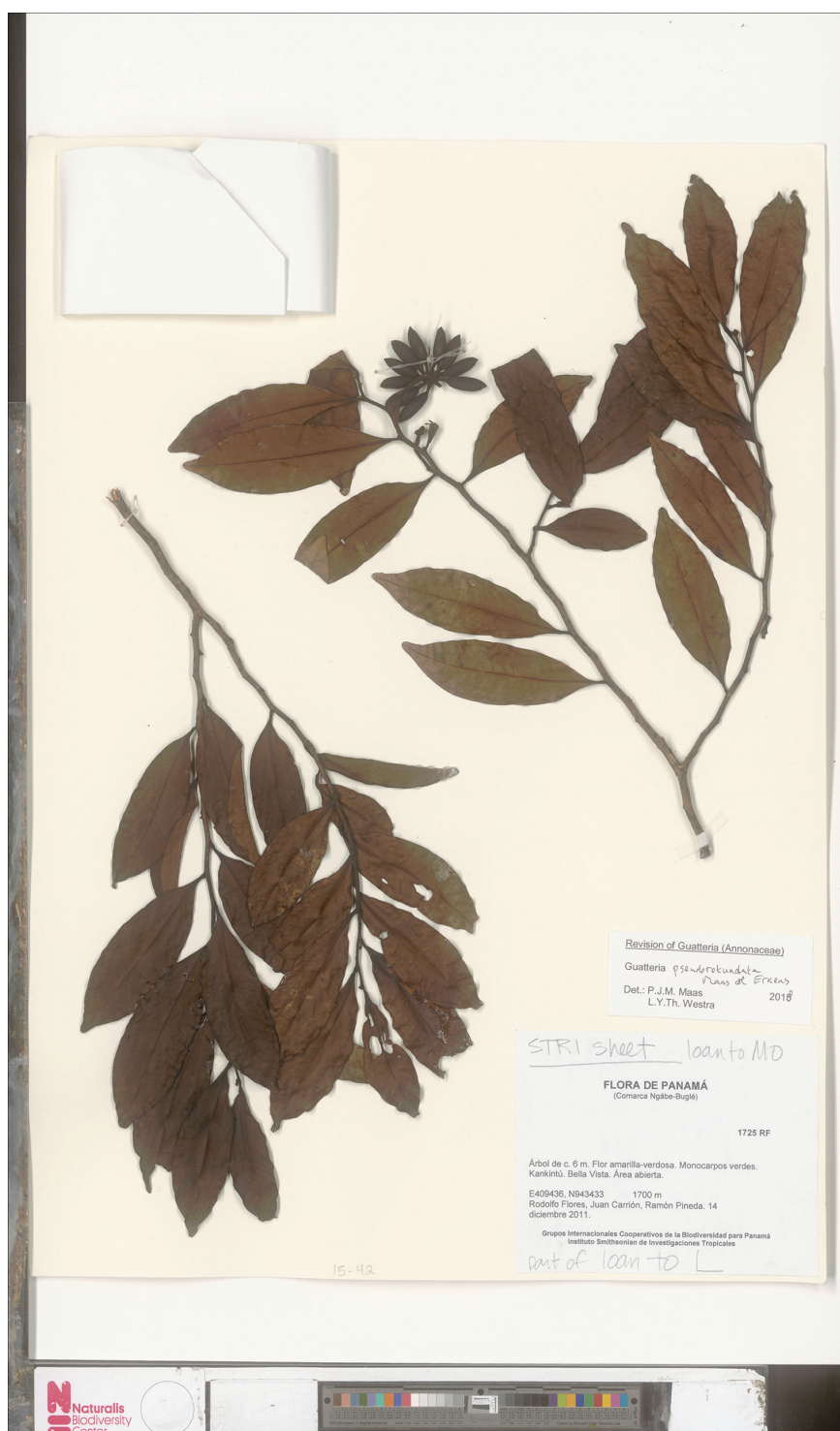


Figure 16. *Guatteria pseudorotundata* Maas & Erken. Fruiting branch (Flores et al. 1725, STR1).

***Guatteria rotundata* Maas & Setten, Proc. Kon. Ned. Akad. Wetensch. C 91(3): 255. f. 11. 1988.**

Notes. In the recent revision of *Guatteria* (Maas et al. 2015) the measurements of fruits and seeds were erroneously included under *G. rotundata*. The fruiting material appeared to belong to the now described *G. pseudorotundata* and the fruits and monocarps of *G. rotundata* are still unknown.

***Guatteria rubiginosa* N.Zamora & Maas, sp. nov.**

urn:lsid:ipni.org:names:77199057-1

Fig. 17

Diagnosis. *Guatteria rubiginosa* is strikingly similar to *Guatteria talamancana* N.Zamora & Maas in terms of the presence of long-persistent, erect, brownish red to brownish hairs of 2–3 mm long on its young twigs and lower side of the lamina, but differs by the smaller petals (11–17 by 7–8 mm vs. 15–25 by 10–15 mm), smaller sepals (7–11 by 7–10 mm vs. 15–20 by 10–15 mm), and smaller monocarps (7–13 by 4–7 mm vs. 20–30 by 18–20 mm).

Type. PANAMA, Bocas del Toro: Changuinola, Parque Internacional La Amistad (PILA), Rancho Santín, 9°06'41.9"N, 82°40'03.7"W, 1340 m, 31 Jul 2008, *Monro et al.* 6108 (holotype: CR!; isotypes: BM, MO! [MO2494703]).

Description. *Tree* 7–20 m tall; young twigs somewhat zigzagging, densely covered with long-persistent, erect, brownish red to brown hairs to 3 mm long. *Leaves:* petioles 0–3 mm long, densely covered with erect, brownish hairs; lamina narrowly ovate to narrowly oblong-elliptic, (5-)7–21 by (2.5-)3–5.5 cm (leaf index 3.2–3.6), chartaceous, densely verruculose on both sides, dull or dark glossy green above, brown to greenish brown below, densely covered with erect, brown to reddish brown hairs on both sides, but becoming almost glabrous above, except for the primary vein, base acute to obtuse, often oblique, apex acute to acuminate (acumen 10–15 mm long), primary vein flat above, secondary veins distinct, flat to slightly raised above, 10–20 on either side of primary vein, smallest distance between loops and margin 2–3 mm, tertiary veins inconspicuous, flat above. *Flowers* solitary in axils of leaves; pedicels 5–15 by 1–2 mm, to 20 by 3 mm in fruit, articulated at ca. 0.5 from the base, densely covered with erect, brown or reddish brown hairs; bracts soon falling, not seen; flower buds depressed ovoid; sepals free, broadly ovate-triangular, 7–11 by 7–10 mm, apex acuminate, outer side densely covered with appressed, brown hairs, inner side glabrous, conspicuously verruculose; petals pale yellow or cream *in vivo*, ovate to oblong-ovate, 11–17 by 7–10 mm, outer side densely covered with appressed hairs; stamens 1–2 mm long, connective shield glabrous. *Monocarps* 25–30, green *in vivo*, black *in sicco*, ellipsoid to narrowly ellipsoid, sometimes laterally compressed, 7–13 by 4–7 mm, glabrous, apex apiculate (apiculum <0.5 mm long), wall 0.2–0.3 mm thick, stipes 1–8 by 2–3 mm. *Seed* ellipsoid, 9–11 by 5–6 mm, dark, dark brown to reddish brown, rugose to rugulose, raphe impressed.

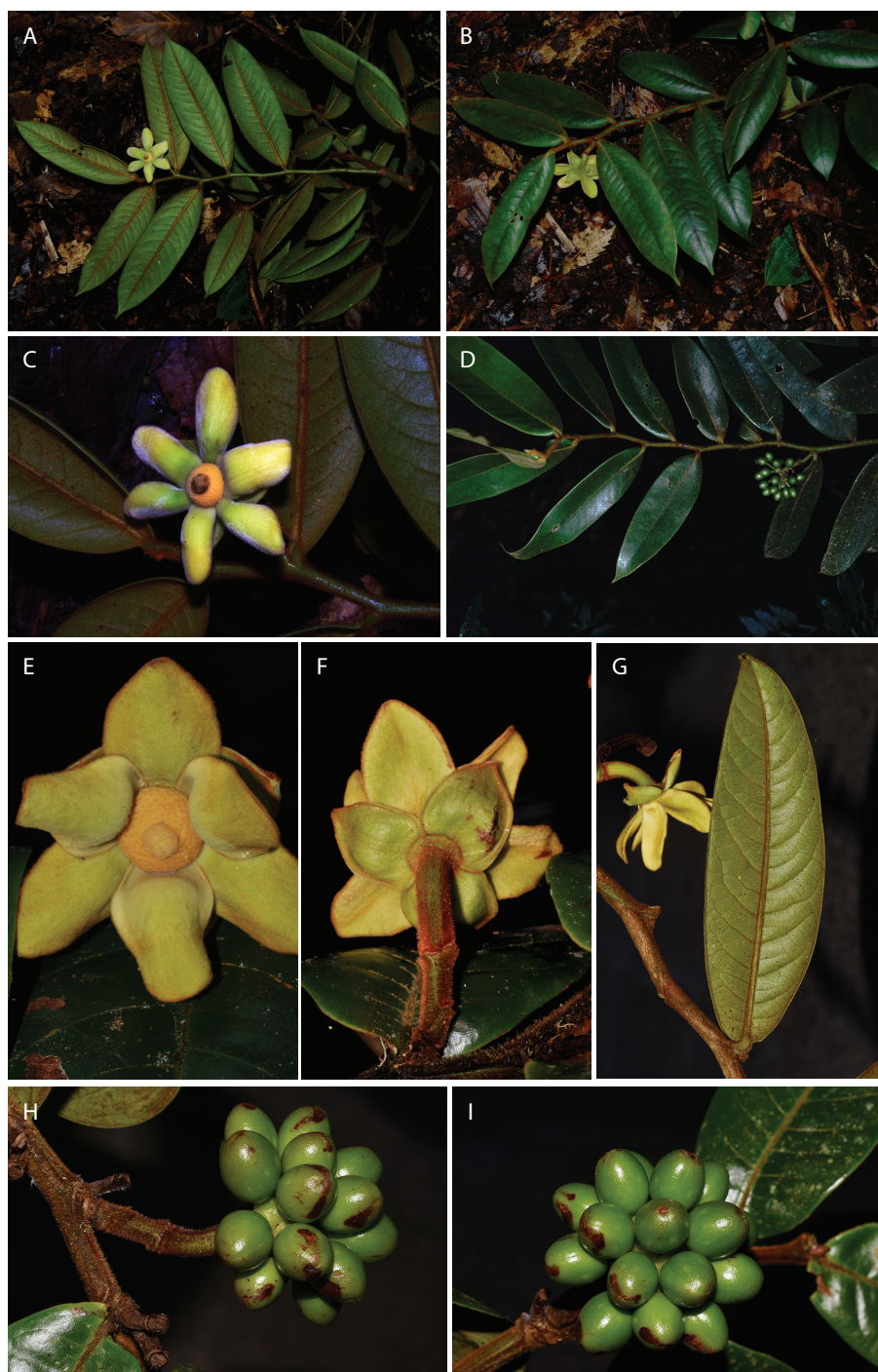


Figure 17. *Guatteria rubiginosa* N.Zamora & Maas. **A–C** Flowering branch **D** fruiting branch **E–G** flowers in different views **H, I** young fruit. (**A–C** *Monro et al.* 6108 **D** *Monro & Cafferty* 4925 **E, F** *Estrada et al.* 5979; **G–I** *Estrada et al.* 6406).

Distribution. Costa Rica and Panama (Fig. 9).

Habitat and ecology. In wet forest, sometimes cloud forest. At elevations of 400–1850 m on the Caribbean slope of the Talamanca mountain range. Flowering: March and July; fruiting: March, April, and July.

Notes. *Guatteria rubiginosa* can be recognised by its young twigs and the lower side of the lamina which are densely covered with long-persistent, erect, brown to reddish brown hairs. Moreover, the leaves are subsessile and densely verruculose on both sides. The monocarps are ellipsoid and shortly stipitate. Some material of *G. rubiginosa* was confused or misidentified as *G. talamancana* N.Zamora & Maas, due to the high resemblance of the vegetative parts of both species, especially the indument. Moreover, *G. rubiginosa* differs greatly in its much wetter habitat type on the Caribbean slope of the Talamanca Costa Rica-Panama mountain range.

Some Costa Rican collections of *G. rubiginosa* were previously assigned to the Colombian *G. elegantissima* R.E.Fr. (Zamora et al. 2000), which is a species that is very similar but it is restricted to tropical rain forest of the lowland Pacific coast of Colombia (0–350 m). It has much narrower leaves (width 2–3.5 vs. 3–5.5 cm in *G. rubiginosa*) and longer pedicels (20–40 vs. 5–20 mm).

Preliminary IUCN conservation status. LC. It was determined that this species has 5 locations but all of them lie within the boundaries of La Amistad International park and the National Park Palo Seco. Currently, no major threats to this species are known but also no information is available on the current population size and population trend of this species. Based on both EOO (1.583 km²) and AOO (40 km²) this species would classify as Endangered but given that we do not see any immediate threats to the size and quality of the distributional range and habitat we assess it as Least Concern.

Other specimens examined. **COSTA RICA. Limón:** Cantón de Talamanca, Coriña, base y ladera intermedia del Cerro Cruibeta, 9°25'15"N, 82°59'00"W, 700 m, 19 Jul 1989 (fl, fr), *Herrera 3307* (CR, MO, U); Sukut, de las juntas de Río Urén y Río Sukut 1.5 km aguas arriba sobre éste, 9°24'30"N, 82°58'10"W, 400 m, 9 Jul 1989 (fl), *Herrera 3228* (CR); Bratsi, Amubri, Alto Lari, Kivut, cuenca superior del Río Dapari, 9°24'15"N, 83°05'30"W, 1200 m, 9 Mar 1992 (fl), *Herrera 5249* (CR, U); Cantón de Limón, El Progreso, siguiendo el sendero de la avioneta, por la fila entre 1000 m y los 1300 m. Fila Matama, Valle de la Estrella, 9°47'18"N, 83°08'45"W, 1150 m, 21 Apr 1989 (sterile), *Herrera & Chacón 2701* (CR, U); El Progreso, entre Cerro Muchilla y Cerro Avioneta, Fila Matama, siguiendo la fila y los flancos. Valle de la Estrella, 9°47'40"N, 83°06'30"W, 850 m, 8 Apr 1989 (flower buds), *Herrera & Madrigal 2560* (CR). **PANAMA. Bocas del Toro:** Campamento la pata del Cedro como a 800 m hacia arriba, 9°03.966'N, 82°43.931'W, 1525 m, 10 Mar 2004 (fr), *Alfaro & Monro 5445* (INB); Campamento de Lucho, 9°05.052'N, 82°44.733'W, 1850 m, 17 Mar 2004 (fr), *Alfaro & Monro 5577* (INB); Caribbean slopes of Cerro Fabrega at foot of Falso Fabrega, in Palo Seco Reserve, second northernmost tributary of Culubre river, Pavón Camp, 9°09.51'N, 82°39.41'W, 1300 m, 23 Mar 2005 (fr), *Monro & Cafferty 4925* (CR); Changuinola Parque Internacional La Amistad (PILA), 10 km del refugio de guardaparques de Uri, 9°04'09"N, 82°42'28"W, 15 Apr 2008 (fr), *De Serdas et al.*

588 (CR). **Chiriquí:** Gualaca, Fortuna Forest Reserve of La Fortuna Watershed, close to Fortuna Dam, forest plot of Jim Dalling, 8°40'N, 82°13'W, 1150 m, 25 May 2004 (sterile), *Maas et al. 9516* (INB, U).

***Guatteria turrialbana* N.Zamora & Erkens, sp. nov.**

urn:lsid:ipni.org:names:77199058-1

Fig. 18

Diagnosis. *Guatteria turrialbana* resembles *Guatteria lucens* Standl. by the narrowly elliptic to narrowly obovate leaves but differs markedly by coriaceous vs. chartaceous leaves, the primary vein of which is flat to slightly raised (vs. impressed) above, and having yellow to creamy yellow, broadly ovate to orbiculate petals (vs. orange or yellowish orange and mostly oblong to obovate petals).

Type. COSTA RICA, Cartago: Turrialba, Área de Conservación Codillera Volcánica Central, Monumento Nacional Guayabo, Sendero natural, 1133 m, 9°58'15.2"N, 83°41'17.9"W, 7 Jul 2018 (fl), *Zamora & Espinoza 10363* (holotype: CR!; isotypes: B, L!, MO!).

Description. Tree 5–20 m tall, 20–50 cm diam.; young twigs slightly zig-zagging, sparsely covered with appressed hairs, soon glabrous. *Leaves:* petioles 5–10 by 1 mm; lamina narrowly elliptic to narrowly obovate, (10-)13–23 by 4–8.5 cm (leaf index 2.8–4.2), coriaceous, not verruculose, shiny above, grey to greyish green above, grey to greyish brown below, glabrous above, sparsely covered with appressed hairs below, mainly along primary vein, base long-acute to attenuate, apex acuminate (acumen 5–10 mm long) to acute, primary vein flat to slightly raised above, secondary veins distinct, 10–15 on either side of primary vein, slightly raised above, smallest distance between loops and margin 1–3 mm, tertiary veins strongly raised above, reticulate. *Inflorescence* 1–2-flowered, in axils of leaves or on leafless branchlets; pedicels 10–30(-40) by 0.5–1 mm, 1.5–3 mm diam. in fruit, rather densely covered with appressed hairs to glabrous, articulated at 0.4–0.5 from the base; bracts 5–6, soon falling, not seen; flower buds ovoid, slightly pointed; sepals free, broadly ovate-triangular to ovate-triangular, 5–8 by 3–8 mm, reflexed, outer side densely covered with appressed hairs; petals green, maturing yellow to cream *in vivo*, broadly ovate to orbicular, 10–15{-24} by 9–10{-18} mm, outer and inner side densely covered with appressed, greyish hairs; stamens ca. 2 mm long, connective shield papillate. *Monocarps* 30–100, green *in vivo*, black *in sicco*, ellipsoid, 8–11 by 3–6 mm, glabrous, apex rostrate to apiculate (apiculum ca. 1 mm long), wall 0.1–0.2 mm thick, stipes 5–10 by 1 mm. *Seed* ellipsoid, 7–9 by 3–5 mm, brown, pitted, raphe not distinct from rest of seed.

Distribution. Costa Rica, Caribbean slope (Fig. 9).

Habitat and ecology. In wet forest. At elevations of (700-)1000–1200(-1800) m, Flowering: January, May, and July; fruiting: March, October, November and December.

Notes. *Guatteria turrialbana* can be distinguished by its essentially glabrous, dark green, shiny and conspicuously reticulate leaves on both sides, especially upon drying,

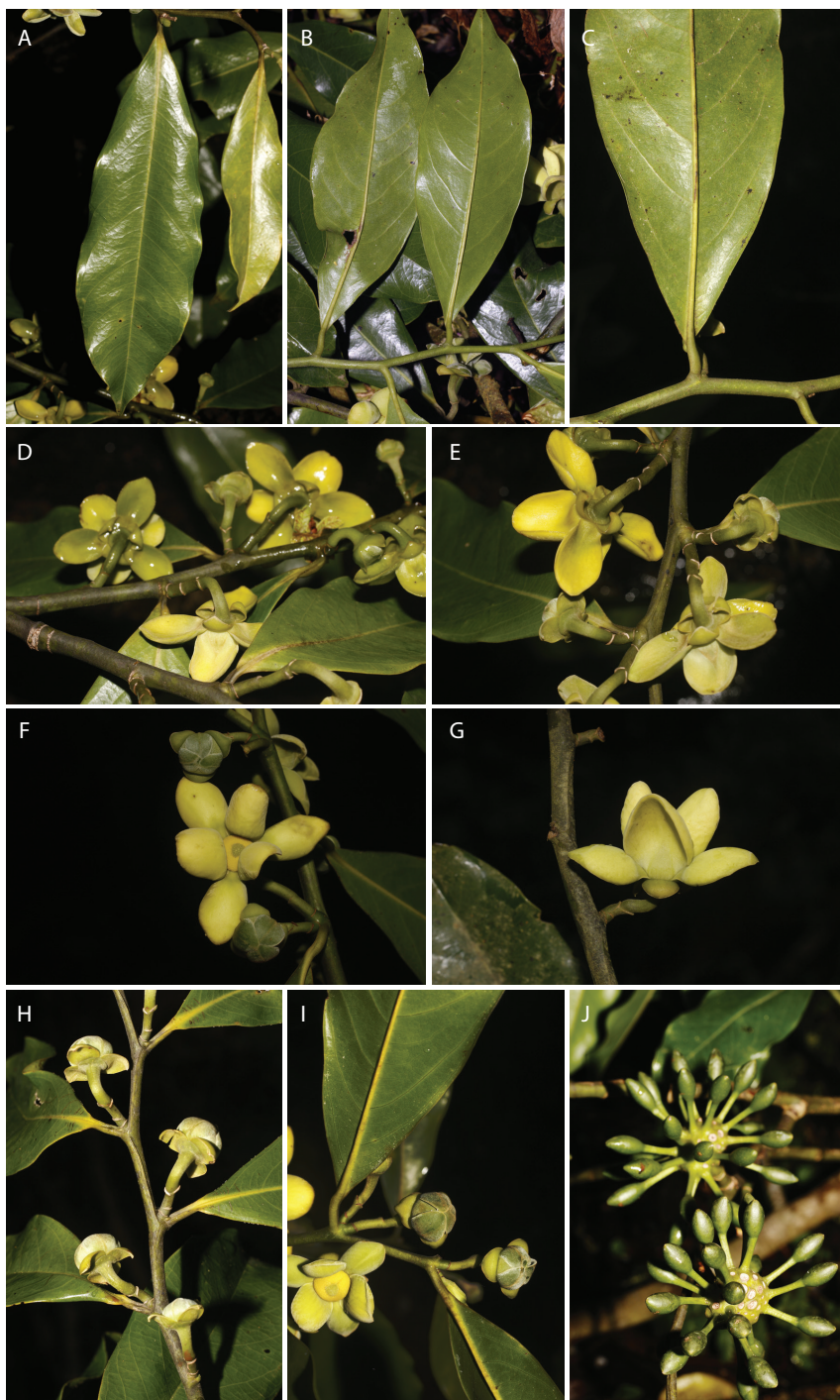


Figure 18. *Guatteria turrialbana* N.Zamora & Erkens. **A** Upper side of leaf **B** lower side of leaf **C** leaf base **D, E** flowering branches **F** flower seen from above **G** flower seen from aside **H, I** flower buds **J** young fruit. (**A–J** Zamora & Espinoza 10357 and 10363).

lamina commonly narrowly obovate with a flat to slightly raised primary vein above. The rostrate to apiculate apex of the monocarps is also a characteristic feature. Material of this species has previously been identified as *G. lucens* Standl. However, the lamina is not verruculose in *G. turrialbana* vs. up to densely verruculose in *G. lucens*. Other differences can be found in the monocarps: *G. turrialbana* has rostrate to apiculate ones vs. ellipsoid ones in *G. lucens*. Lastly, *G. lucens* is a lowland (0–900 m) species whereas *G. turrialbana* has mainly been recorded at higher elevations (Maas et al. 2015).

Preliminary IUCN conservation status. EN B1ab(iii)+2ab(iii). Both EOO (10 km²) and AOO (8 km²) would classify as Endangered. It was determined that this species has 3 locations, all of them in heavily deforested areas. Deforestation is therefore a major threat to this species and habitat quality is expected to decline in the near future. No information is available on the current population size and population trend of this species. Given all this we assessed this species as Endangered.

Other specimens examined. COSTA RICA. Cartago: Turrialba, Monumento Nacional Guayabo, Santa Teresita, sobre ríos Guayabo, Lajas y Torito, 9°57'50"N, 83°41'30"W, 700–1800 m, 8 May 1992 (fl), *Rivera 1693* (CR); Turrialba, Monumento Nacional Guayabo, 9°58'20"N, 83°41'45"W, 1100 m, 9 Oct 1993 (fr), *Vargas et al. 1492* (CR); Turrialba, Monumento Nacional Guayabo, cuenca del Río Reventazón, 9°58'19.7"N, 83°41'31.9"W, 1100–1200 m, 15 Mar 2003 (fr), *Kriebel 2977* (CR, L); Turrialba, Área de Conservación Codillera Volcánica Central, Guayabo, Guayabito de Santa Cruz, a lo largo del camino principal a Guayabo, 9°58'59"N, 83°42'54"W, 1350 m, 7 Jul 2018 (fl), *Zamora & Espinoza 10357* (CR); Turrialba, Jicotea, Finca de Israel Martínez, 9°47'05"N, 83°33'15"W, 1100–1200 m, 7 Dec 1994 (fr), *Cascante et al. 432* (CR). **Limón:** entre Dabagri y Sacabico y los bordes del mismo, 7 Nov 1984 (fr), *Gómez et al. 23305* (CR, U).

***Klarobelia rocioae* Chatrou, sp. nov.**

urn:lsid:ipni.org:names:77199059-1

Figs 19, 20

Diagnosis. *Klarobelia rocioae* is distinct from congeneric species by the combination of comparatively large leaves and large monocarps, and flowers that are hairy on the outer side.

Type. PERU, Pasco: Prov. Oxapampa, Distr. Palcazú, Comunidad Nativa Alto Lagarto, 10°06'15"S, 75°33'01"W, 800 m, 2 Jul 2007, *Rojas & Ortíz 4243* (holotype: HOXA!; isotypes: MO! [MO2465956], USM, WAG!).

Description. Tree 2–5 m tall; young twigs, lower side of petioles, and lower side of primary vein glabrous, sometimes sparsely covered with pale, appressed hairs 0.1–0.2 mm long. *Leaves:* petioles 8–12 by 2–4 mm, verrucose to rugulose, distinctly black; lamina elliptic to narrowly elliptic, 17–35 by 6.5–11.5 cm (leaf index 2.6–3.7), chartaceous, greyish to brownish green above, dark olive green to brown below, glabrous on both sides, primary vein impressed (to flat) above, base cuneate to

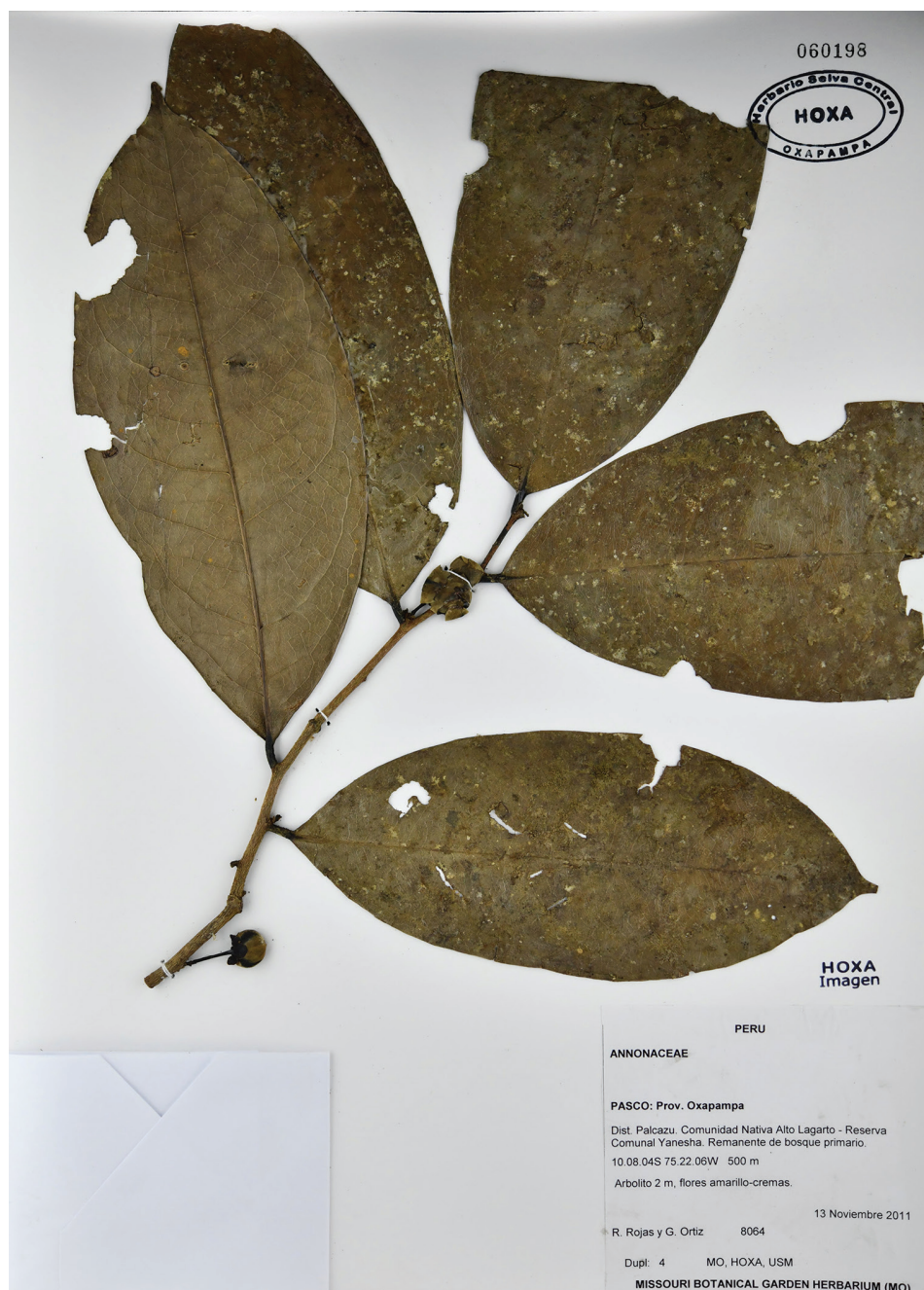


Figure 19. *Klarobelia rocioae* Chatrou. Flowering specimen (Rojas & Ortiz 8064, HOXA).

obtuse, rarely rounded, apex acuminate (acumen 5–20 mm long) to bluntly acute, secondary veins 8–9 on either side of primary vein, distance between secondary veins 25–50 mm, angles with primary vein (45-)60–80°, loop-forming at (right-)obtuse



Figure 20. *Klarobelia rocioae* Chatrou. Fruiting specimen (Rojas & Ortiz 7806, HOXA).

angles, distance between loops and margin 4–8 mm, tertiary veins raised above, reticulate. *Flowers* solitary, on leafy twigs, rarely on older branchlets; short shoot and bracts rather densely covered with reddish brown, appressed hairs 0.1–0.2 mm long;

short shoot 3–4.5 by 1–1.5 mm, to 3 mm in diam. when fruiting; bracts up to 3 on short shoot, 1.5–2 by 1 mm wide, apex obtuse, soon falling off; pedicels 14–18 by 1(–2) mm, to ca. 28 by 4 mm in fruit, sparsely covered with reddish brown, appressed hairs 0.1–0.2 mm long; flowers bisexual or male, plant androdioecious; flower buds (sub)globose, 12–14 mm in diam.; petals yellow to yellowish-cream *in vivo*, brown to black *in sicco*; sepals free, broadly ovate, 7–8 by 6–8 mm, black *in sicco*, ciliate, outer side glabrous, inner side sparsely to rather densely covered with yellowish to reddish brown, appressed hairs 0.1–0.2 mm long; petals (broadly) ovate to (broadly) elliptic, outer petals 15–17 by 12–14 mm, slightly concave, densely covered with hairs on both sides apart from basal, central part of outer side, inner petals 15–18 by 10–13 mm, densely hairy on both sides, strongly concave; stamens ca. 50 on bisexual flowers, ca. 200 on male flowers, 1.8–2.5 mm long, thecae 0.8–1.0 mm long, apical prolongation of connective papillate; carpels ca. 110, ovaries 1.8–2.2 mm long, glabrous, stigmas 0.6–0.8 mm long, densely covered with yellowish brown hairs ca. 0.2 mm long; flowering receptacle dome-shaped, ca. 4 by 5 mm, glabrous. *Monocarps* up to 30, yellow to orange *in vivo*, dark brown *in sicco*, (oblong-)ellipsoid, slightly asymmetrical, 20–27 by 10–12 mm, glabrous, verrucose, wall 0.1–0.2 mm thick, angles between longitudinal axis of monocarps and stipes 0–90°, stipes 25–37 by 1–1.5 mm, to 1.5(–2) mm in diam. apically, fruiting receptacle irregularly subglobose to transverse ellipsoid, 5–12 by 5–13 mm. *Seed* (oblong-) ellipsoid, 20–27 by 10–12 mm, pale golden-brown, shiny, raphe slightly sinuous, ruminations lamelliform with four, thin transverse plates.

Distribution. Peru, only known from a small area in the department of Pasco, districts of Palcazú and Villa Rica (Fig. 3).

Habitat and ecology. In primary forest. At elevations of ca 500–1400 m. Flowering: October and November; fruiting: between February and August (mature fruits collected in July and August).

Notes. *Klarobelia rocioae* is easy to recognise through its combination of large leaves, hairy flowers, and relatively large and ellipsoid monocarps. Of the Amazonian species of *Klarobelia* Chatrou, *K. napoensis* Chatrou has comparably large leaves, but differs in the flowers that are glabrous on the outer side, and in the globose monocarps. *K. pandoensis* Chatrou and *K. pumila* Chatrou are two other Amazonian species that share a small habit with *K. rocioae* (Chatrou 1998; Chatrou and Pirie 2003). With *K. rocioae* they share outer petals that are hairy on the outer side, giving the flowers a brown appearance rather than glabrous flowers in other species of *Klarobelia* that appear black when dried. *K. pumila* Chatrou, can easily be distinguished from *K. rocioae* by the smaller leaves (12–16 by 4–6 cm vs. 17–35 by 6.5–11.5 cm in *K. rocioae*) and smaller monocarps (9–15 by 6–8 mm vs. 20–27 by 10–12 mm). *K. pandoensis* Chatrou can be distinguished from *K. rocioae* by the smaller leaves (8.5–12.5 by 3–4.5 cm) and smaller monocarps (15–18 by 6–10 mm) too. Additionally, *K. pandoensis* can easily be distinguished from the two other short stature species by the dense indument on petioles, young twigs and inflorescences axes (glabrous to sparsely hairy in *K. rocioae* and *K. pumila*). The three species have non-overlapping areas of distribution in the

Amazonian lowlands and Andean foothills of central and southern Peru and northern Bolivia. Next to *K. napoensis* and *K. peruviana* (R.E.Fr.) Chatrou, *K. rocioae* is a third species within the genus reaching altitudes above 1000 m.

The longitudinal axis of the monocarps often makes an angle with the stipes that can be as large as 90°. The angle, however, is variable. As it is present in several specimens we do not consider it to be an artefact of pressing and drying.

Etymology. This new species is named in honour of Rocío del Pilar Rojas Gonzales, curator of Herbario Selva Central Oxapampa (HOXA), who collected all but one specimen of this new species.

Preliminary IUCN conservation status. EN B2ab(iii). EOO (56.695 km²) was too large to classify as threatened, but AOO (16 km²) would classify as Endangered. This species is estimated to have 3 locations. All of these lie in heavily deforested areas and deforestation is therefore a major threat to this species. Also, its habitat quality is expected to decline in the near future. No information is available on the current population size and population trend of this species. We assessed this species as Endangered, based on the above information.

Other specimens examined. PERU. Pasco: Prov. Oxapampa, Distr. Palcazú, Comunidad Nativa Alto Lagarto y 30 de Octubre, 10°09'20"S, 75°25'44"W, 1036 m, 25 Nov 2010, *Rojas & Ortiz* 7544 (HOXA, MO, USM, WAG); Parque Nacional Yanachaga-Chemillen, nacimiento del Río Santa Clara y Lagarto, 10°07'44"S, 75°26'11"W, 1388 m, 5 Aug 2011, *Rojas & Ortiz* 7806 (HOXA, MO, USM, WAG); Comunidad Nativa Alto Lagarto, Reserva Comunal Yanesha, 10°08'04"S, 75°22'06"W, 500 m, 13 Nov 2011, *Rojas & Ortiz* 8064 (HOXA, MO, USM, WAG); Comunidad Nativa Alto Lagarto, Reserva Comunal Yanesha, 10°08'04"S, 75°22'06"W, 500 m, 10 Feb 2012, *Rojas & Ortiz* 8174 (HOXA, MO, USM, WAG); Comunidad Nativa Alto Lagarto, Reserva Comunal Yanesha, 10°08'04"S, 75°22'06"W, 500 m, 30 Oct 2012, *Rojas et al.* 8731 (HOXA, MO, USM, WAG); Comunidad Nativa Alto Lagarto-Convento, Reserva Comunal Yanesha, 10°08'04"S, 75°22'06"W, 500 m, 30 Apr 2013, *Rojas & Ortiz* 9118 (HOXA, MO, USM, WAG); Comunidad Nativa Alto Lagarto-Convento, Reserva Comunal Yanesha, 10°08'04"S, 75°22'06"W, 500 m, 30 May 2013, *Rojas & Ortiz* 9196 (HOXA, MO, USM, WAG); Distr. Villa Rica, Cerro el Ascensor, bosque de protección San Matías-San Carlos, 10°45'28"S, 74°55'92"W 1355 m, 30 Jun 2003, *Perea & Mateo* 85 (HOXA).

***Tetrameranthus trichocarpus* Maas & Westra, sp. nov.**

urn:lsid:ipni.org:names:77199060-1

Figs 21, 22

Diagnosis. *Tetrameranthus trichocarpus* resembles *T. globuliferus* Westra from Ecuador in leaf shape and in the young twigs covered with brown, stellate hairs, but differs by 5-merous (vs. 6-merous) flowers and hairy (vs. glabrous) monocarps, and also by smaller leaves (16–28 vs. 27–37 cm long).

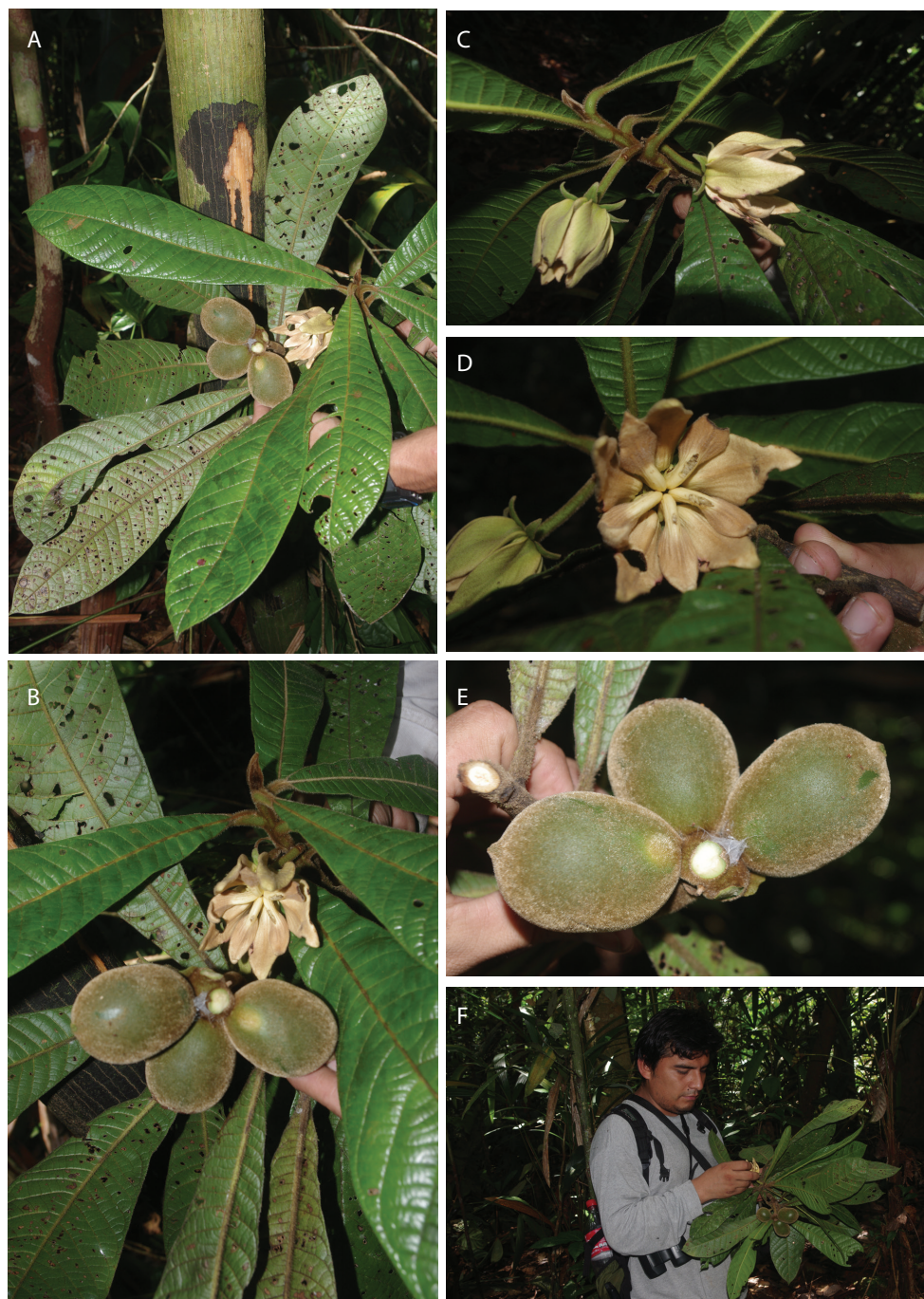


Figure 21. *Tetrameranthus trichocarpus* Maas & Westra. **A** Flowering and fruiting branch **B** detail of same **C** top of branchlet with 2 (young) flowers **D** flower **E** fruit **F** Isau Huamantupa holding collected material. Photographs by I. Huamantupa C.



Figure 22. *Tetrameranthus trichocarpus* Maas & Westra. Fruiting branch (M. Ríos et al. 2608, holotype F).

Type. PERU, Loreto: Prov. Maynas, Distr. Medio Putumayo, Inventario Rápido #25, Campamento Bajo Ere, 2°01'07.4"S, 73°15'13.4"W, 125–175 m, 22 Oct 2012, *Ríos et al.* 2608 (holotype: F! [F2321026]; isotypes: F!, L!).

Description. *Tree* ca. 10 m tall. Young twigs and petioles densely covered with stiff, brown, mostly stellate hairs to 1–2 mm long. *Leaves:* petioles 8–10 by 3–4 mm; lamina narrowly obovate, 16–28 by 5–8 mm (leaf index 2.5–4), bright shiny green above and pale green below *in vivo*, dark greenish grey above and greenish brown below *in sicco*, densely covered with brown hairs ≥ 1 mm long on primary vein and less densely so on secondary veins above, elsewhere rather densely to sparsely covered with stellate and simple hairs, to at last glabrous above, densely to rather densely covered on primary vein and secondary veins below, elsewhere sparsely covered with stellate and simple hairs mainly on lesser veins below, base narrowly acute, apex acuminate (acumen ca. 5 mm long), primary vein slightly prominent to almost flat above, becoming canaliculate *in sicco*, secondary veins 12–20 on either side of primary vein, mostly loop-forming, shortest distance between loops and margin 1–2 mm, tertiary veins percurrent. *Flowers* solitary in axils of leaves; peduncles 7–10 by 2 mm; pedicels 30–35 by 2{–3} mm, to 4 mm diam. in fruit, peduncles and pedicels densely covered with hairs as on twigs; bracts not seen; perianth in 5-merous whorls, petals pale greenish creamy suffused with purple, inner base of inner petals yellowish white, sepals (\pm) free, narrowly triangular, 4–5 by 10–12 mm, outer side densely covered with hairs as on pedicels to 1 mm long, the inner side same but less densely; outer petals narrowly elliptic-ovate or elliptic-oblong, 30–37 by 10–12 mm, inner side with basal callus to ca. 2/5 of the length and triangular in shape, inner petals narrowly obtriangular-elliptic, about as long as outer petals, slightly narrower than outer petals, markedly recurved about the middle, basal callus on inner side ca. 2/3 of the length and almost touching the side, all petals densely covered with similar though somewhat smaller hairs as on sepals, except for callose parts sparsely so; stamens ∞ , apical prolongation of connective shield-like, ca. 1 mm in diam., glabrous; carpels ca. 8, ca. 4 mm long, densely covered with erect hairs to 0.5 mm long on the abaxial side. *Monocarps* 4–6, pinkish green and somewhat shiny *in vivo*, brown and with shriveled wall *in sicco*, ovoid to globose, 4–4.5{–5} by 3–3.5{–4.5} cm, with a conical, obtuse apicule ca. 3–4 mm long, with an oblique constriction (2-seeded forms, only visible *in sicco*), densely to rather densely covered with stiffly, erect, whitish, stellate and simple hairs. *Seeds* (1-)2 per monocarp.

Distribution. Peru (Loreto) (Fig. 3).

Habitat and ecology. In moist forest on sandy soil. At an elevation of 125–175 m. Flowering and fruiting: October.

Notes. *Tetrameranthus trichocarpus* is very similar to *T. globuliferus* Westra, from Ecuador (Maas et al. 1988), and also a narrow endemic. Apart from being 5-merous in *T. trichocarpus* vs. 6-merous in *T. globuliferus*, the flowers of the two species resemble each other very much. Both these species share two features with the far-remote *T. guianensis* Westra & Maas, namely a thick fruit wall that shrivels with drying, and an indument of coarse, stellate and simple hairs on vegetative parts. To our knowledge, this is the only species of *Tetrameranthus* with permanently hairy fruits.

Preliminary IUCN conservation status. DD. This species is only known from one collection and therefore no AOO and EOO could be calculated. Also, no other assessment criterium could be used for this species since no information is available on the current population size and population trend of this species. The species seems to occur in a large, pristine forest area and habitat loss does not seem to be an immediate threat to *Tetrameranthus trichocarpus*. However, given the overall lack of data, it was assessed as Data Deficient.

***Xylopia longicaudata* Maas & Westra, sp. nov.**

urn:lsid:ipni.org:names:77199061-1

Fig. 23

Diagnosis. *Xylopia longicaudata* closely resembles *X. uniflora* R.E.Fr. mostly in the leaf size (leaf index 3.5–4.5 for both species), subglabrous stems and young twigs, solitary flowers with basally connate sepals (ca. 2 mm long in *X. longicaudata* and 3–4 mm long in *X. uniflora*), but it differs by the strongly shiny (vs. dull) leaves of which the apex is caudate vs. acuminate, and of which the leaf venation is strongly (vs. hardly) raised.

Type. COLOMBIA, Guainía: Maimachi, Serranía del Naquén, por el camino a Cerro Minas, 02°12'N, 68°13'W, 455 m, 9 Apr 1993, *Madriñan & Barbosa* 974 (holotype: NY!; isotype: L!).

Description. Tree 15–20 m tall, to ca. 35 cm diam.; young twigs glabrous. *Leaves:* petioles 3–10 by 0.5–1 mm; lamina narrowly elliptic to narrowly obovate, 8–18 by 2–5 cm (leaf index 2.5–3), chartaceous, strongly shiny above *in vivo*, dark brown *in sicco*, pale green below *in vivo*, brown below *in sicco*, glabrous on both sides, base acute, apex caudate (cauda 10–40 mm long), primary vein impressed above, secondary veins hardly countable, ca. 10 on either side of primary vein, strongly raised on both sides, not loop-forming, tertiary veins strongly raised on both sides, strongly reticulate. *Flowers* solitary in axils of leaves; pedicels 2–3 mm by 1 mm, sparsely covered with appressed hairs; bracts 4–5, depressed ovate, 1–2 mm long, outer side sparsely covered with appressed hairs; flower buds not seen; sepals basally connate, ovate-triangular, ca. 2 by 3 mm, outer side sparsely covered with appressed hairs; petals creamy yellow *in vivo*, narrowly triangular, 12–13 by 2–3 mm, inner petals narrowly triangular, 7–8 by 1–2 mm, outer side of petals densely covered with appressed, greyish hairs; stamens 1.5–2 mm long, apical prolongation of connective broadly ellipsoid. *Monocarps* and *seeds* not seen, but indicated on the label: “Fruto inmaduro verde claro vinosos, maduros externamente rubescente lustroso, internamente, rojo salmon. Semillas negras con arilo basal blanco”.

Distribution. Colombia (Guainía and Vaupés) (Fig. 3).

Habitat and ecology. In high rain forest or high caatinga forest. At elevations of 250–500 m. Flowering and fruiting: April.

Notes. *Xylopia longicaudata* is easily distinguished from other species by the caudate leaf apex. It slightly resembles *X. uniflora* R.E.Fr., described from caatinga forests



Figure 23. *Xylopia longicaudata* Maas & Westra. (Madriñán & Barbosa 974, isotype L).

in Amazonian Brazil (*Ducke RB 29017*, Brazil, Amazonas, Rio Curicuriary, Cajú cataracts, 29 February 1936), but the leaf venation in the latter species is much less raised than in *X. longicaudata* and the apex acuminate instead of caudate.

Preliminary IUCN conservation status. NT. EOO (35,750 km²) was too large to classify as threatened, but AOO (20 km²) would classify as Endangered. It was determined that this species has 5 locations, none of them in national parks and some in slightly fragmented areas of which the habitat is expected to decline in the near future. Overall, however, this species occurs in large stretches of pristine forest and although no information is available on the current population size and population trend of this species, we expect the population size to be rather large. Therefore this species was classified as Near Threatened.

Other specimens examined. COLOMBIA. Guainía: “Mitad del camino”, 2°51'127"N, 65°38'339"W, 500 m, 25 Feb 1995, *Córdoba et al.* 678 (COL); Sabana Nabuquén, 2°43'188"N, 68°55'312"W, 1 Mar 1995, *Córdoba et al.* 769 (COL); Mun. Maimachi, Serranía de Naquen, alrededores del campamento La Planada, 2°12'N, 68°12'W, 320 m, 14 Aug 1992, *Cortés et al.* 372 (COL). **Vaupés:** Serranía del Taraira, 10 km al N-W del raudal de la Libertad, 0°58'S, 69°45'W, 250 m, 29 Jul 1993, *Cortés & Rodríguez* 646 (COL).

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Appendix I

Identification list

Collections are identified by the first collector and number only. The abbreviations behind the collector number refer to the following taxa.

Ann cap = *Annona caput-medusae* Westra & H.Rainer

Ann ole = *Annona oleifolia* Westra & H.Rainer

Gua ali = *Guatteria aliciae* Maas & Erkens

Gua att = *Guatteria attenuata* Maas & Westra

Gua kam = *Guatteria kamakusensis* Maas & Westra

Gua psf = *Guatteria pseudoferruginea* Maas & Westra

Gua psr = *Guatteria pseudorotundata* Maas & Erkens

Gua rub = *Guatteria rubiginosa* N.Zamora & Maas

Gua tur = *Guatteria turrialbana* N.Zamora & Erkens

Kla roc = *Klarobelia rocioae* Chatrou

Tet tri = *Tetrameranthus trichocarpus* Maas & Westra

Xyl lon = *Xylopia longicaudata* Maas & Westra

Aldana 10: Gua psf - Alfaro 5445: Gua rub; 5577: Gua rub;

Barclay 3198: Gua psf;

Cabrera R. 1991: Gua psf; 2522: Gua psf – Carrión 517: Gua psr – Cascante 432: Gua tur – Chatrou 417: Ann ole – Córdoba 678: Xyl lon; 769: Xyl lon; 1369: Gua psf – Correa 2307: Ann cap – Correa-Gómez 87: Gua psf; 128: Gua psf; Cortés 372: Xyl lon – Cortés 646: Xyl lon;

De Serdas 588: Gua rub;

Fiaschi 2735: Gua att – Flores 1725: Gua psr - Fonnegra 5935: Ann ole;

Gómez 23305: Gua tur – Grijalva 637: Ann ole – Gudiño 1775: Ann ole;

Herrera 2560: Gua rub; 2701: Gua rub; 3228: Gua rub; 3307: Gua rub; 5249: Gua rub;

Ibañez 5770: Gua ali; 5799: Gua ali; 5813: Gua ali;

Kriebel 2977: Gua tur;

Maas 9516: Gua rub – Madriñan 974: Xyl lon – Monro 4925: Gua rub; 6108: Gua rub;

Perea 85: Kla roc – Pineda 15: Gua psr;

Ríos 2608: Tet tri – Rivera 1693: Gua tur – Rojas 4243: Kla roc; 7544: Kla roc; 7806: Kla roc; 8064: Kla roc; 8174: Kla roc; 8731: Kla roc; 9118: Kla roc; 9196: Kla roc;

Trujillo-C. 3298: Gua psf;

Vargas 1492: Gua tur – Vásquez 22963: Ann ole;

Wurdack 5874: Gua kam;

Zamora 10357: Gua tur; 10363: Gua tur;

Appendix 2

Index to scientific names

Annona L.

caput-medusae Westra & H.Rainer

oleifolia Westra & H.Rainer

quinduensis Kunth

Colpothrinax aphanopetala R.Evans

Guatteria Ruiz & Pav.

aliciae Maas & Erkens

attenuata Maas & Westra

elegantissima R.E.Fr.

ferruginea A.St.-Hil.

kamakusensis Maas & Westra

lucens Standl.

modesta Diels

pseudoferruginea Maas & Westra

pseudorotundata Maas & Erkens

rotundata Maas & Setten

rubiginosa N.Zamora & Maas

schomburgkiana Mart.

talamancana N.Zamora & Maas

turrialbana N.Zamora & Erkens

sp. 2 Maas & Westra

Klarobelia Chatrou

napoensis Chatrou

pandoensis Chatrou

peruviana (R.E.Fr.) Chatrou

pumila Chatrou

rocioae Chatrou

Raimondia Saff.

Rollinia A.St.-Hil.

Tetrameranthus R.E.Fr.

globuliferus Westra

guianensis Westra & Maas

trichocarpus Maas & Westra

Xylopia L.

longicaudata Maas & Westra

uniflora R.E.Fr.

The identity of *Prunus dielsiana* (Rosaceae)

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Abstract

The valid publication date of *Prunus dielsiana* was found to be later than that of *P. rufoides*, which has been considered a synonym of *P. dielsiana*. *Prunus dielsiana* is therefore reduced to a synonym of *P. rufoides*, instead of the reverse. In addition, all previously named varieties of *Prunus dielsiana*, including var. *abbreviata*, var. *conferta*, and var. *laxa*, as well as *P. carcharias* are also listed as synonyms of *P. rufoides* in the present paper.

Keywords

Prunus rufoides, *Prunus carcharias*, taxonomy, typification, China

Introduction

Prunus L. subg. *Cerasus* A. Gray, a group commonly known as cherries, is historically controversial in its taxonomy. As concluded by Wu et al. (2018), the taxonomy of this clade needs extensive study.

Prunus dielsiana C. K. Schneid. is a species widely distributed around central China and east China (Li and Bartholomew 2003). While reviewing the protologue of this species of *P.* subg. *Cerasus*, *P. dielsiana* C. K. Schneid. was found to be an invalid name. This name first appeared in Schneider's account in 1905. Schneider (1905) proposed a description of a cherry collection, *Wilson 308*, which he determined as "*Prunus szechuanica* var.?", indicating his uncertainty about its identification. Schneider stated that should this collection be a new species or a distinct variety of *Prunus szechuanica*, he would have proposed to name it as "*P. dielsiana*" or rather "var. *dielsiana*". Schneider set the varietal name in bold and also indicated acceptance of the varietal status by citing only "*Prunus*

szechuanica var. *dielsiana*” in the index. *Prunus szechuanica* var. *dielsiana* C. K. Schneid. was therefore validly published while *P. dielsiana* C. K. Schneid. was invalid.

Prunus dielsiana was validly published seven years later by Koehne (1912), who provided an entirely new description of the taxon. The name was ascribed to “Schneider in Fedde, Rep. Nov. Sp. I. 68 (1905)”, which should be treated as a reference to the basionym, and Koehne’s name should be considered as a new combination based on *Prunus szechuanica* var. *dielsiana* C. K. Schneid..

Unaware of the fact mentioned above, Yü and Li (1986) published a combination, *Cerasus dielsiana* (Schneid.) Yü et Li in “*Flora Reipublicae Popularis Sinicae*”, with a direct reference to “*Prunus dielsiana* Schneider (Fedde, Rep. Nov. Sp. I. 68 1905)” rather than to the correct varietal name. Nevertheless, this reference satisfies the requirements of Art. 41.5 of International Code of Nomenclature for algae, fungi, and plants (ICN), and the errors in the basionym citation are correctable under Art. 41.6 (Turland et al. 2018). Yü et Li’s name should be recognized as a combination based on *Prunus szechuanica* var. *dielsiana* C. K. Schneid. and should be cited as *Cerasus dielsiana* (C. K. Schneid.) Yü et Li.

Most recently, *Prunus rufoides* C. K. Schneid. was listed as a synonym of *Cerasus dielsiana* by Li and Bartholomew (2003). This is incorrect since *P. rufoides* C. K. Schneid. was validly published in 1905, while the earliest homotypic species-level synonym for *C. dielsiana* was published in 1912. Thus, Li and Bartholomew (2003) should have listed *C. dielsiana* (C. K. Schneid.) Yü et Li as a synonym of *P. rufoides* C. K. Schneid.

Three varieties have been published under *Prunus dielsiana*. *Prunus dielsiana* var. *conferta* and *P. dielsiana* var. *laxa* were described by Koehne (1912), based on specimens from western Hubei. They were thought to be different in their involucre (bracts subtending the inflorescence), with the involucre of *P. dielsiana* var. *conferta* described as erect and closed and those of *P. dielsiana* var. *laxa* described as open or sub-reflected. However, neither of these varieties was accepted as distinct in “*Flora Reipublicae Popularis Sinicae*” (Yü and Li 1986) and “*Flora of China*” (Li and Bartholomew 2003), where both were listed as synonyms of *Cerasus dielsiana*. In addition, *P. dielsiana* var. *conferta* was based on the same type as *P. szechuanica* var. *dielsiana*, making it a later homotypic synonym that cannot be validly published under Art. 22.2 of ICN (Turland et al. 2018).

Prunus dielsiana var. *abbreviata* Cardot was described by Cardot (1920) based on *Cavalerie et Fortunat* 2276 collected from Guizhou (Kouy-Tcheou). He stated that this variety was similar to *P. dielsiana* var. *conferta* Koehne, but different in its narrow involucre and very short peduncles hidden in the involucre. This variety was accepted as distinct in “*Flora Reipublicae Popularis Sinicae*” (Yü and Li 1986) and “*Flora of China*” (Li and Bartholomew 2003), but we disagree with this interpretation. The distinguishing trait is rather unstable, and even in the type specimen, not all the peduncles are hidden in the involucre. As mentioned by Wang (2014), *P. dielsiana* is a highly variable species. In our field and herbarium specimen observations, leaf and floral characters, including those of the involucre and peduncles that were used to distinguish these three varieties, exhibited extensive variation (Figure 1). Therefore, we deem that none of the three previously named varieties is worthy of taxonomic recognition.

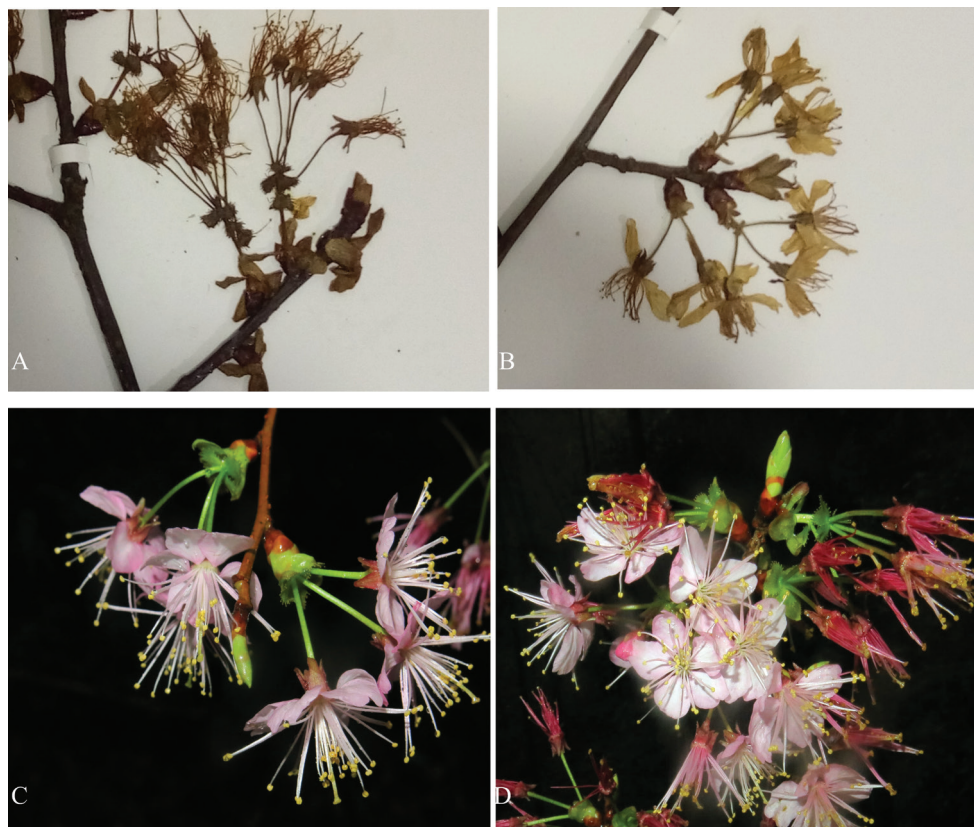


Figure 1. Variations of flora characters of *Prunus rufoidea*. **A** (Zhou et Song 1405020, CSFI026575) **B** (Zhou et Zhou 1403107, CSFI026572) specimens collected from Hunan, Suining County, Huangsang Reserve **C, D** photos taken by Dr. H. Z. Feng, in Guangxi, Rongshui county, from the same individual.

Prunus carcharias was described based on a leafy branch without flowers and fruit collected from China, Chongqing, Nanchuan County (Koehne 1912), and the name is still unresolved today (Li and Bartholomew 2003). This species was considered as a member of *P.* sect. *Microcerasus* (Spach) C. K. Schneid. by Koehne (1912) because its leaf shape and serration were very similar to *P. nakaii* H. Lév. (*P. japonica* var. *nakaii* (H. Lév.) Rehder). However, we believe that this branch must represent an adventitious shoot of *P. rufoidea* (Figure 2), a phenomenon commonly observed in Nanchuan. Leaf dimorphism often occurs in *P.* subg. *Cerasus*, such that the leaves on the adventitious shoots and summer shoots may be obviously different from typical leaves of the species. Therefore it is not advisable to describe new species of this clade based solely on differences in leaf morphology, and we consider *P. carcharias* Koehne to be a synonym of *P. rufoidea*.

Koehne cited three gatherings from Hubei, *Wilson 37*, *Wilson 37a* and *Wilson 68*, when describing *P. dielsiana* var. *laxa*. There are 12 sheets of these three gatherings that can be found in the Global Plant Database (JSTOR 2019), and we found that two



Figure 2. Adventitious shoot of *Prunus rufoidea* C. K. Schneid. (photograph by Dr. W. Y. Zhao).

sheets of *Wilson 37a*, both with identification slips from Koehne, were mixed species collections. One of them, HBG511107, contains a flowering branch of *P. conradinae* Koehne, while another one, US00623845, contains a leafy branch of *P. tomentosa* Thunb. Therefore, a lectotype was selected in agreement with Art. 9.3 and Art. 9.14 of ICN (Turland et al. 2018).

Taxonomic treatment

Prunus rufoidea C. K. Schneid., *Repert. Spec. Nov. Regni Veg.* 1: 55. 1905.

Type: China, Sichuan (Szetschwan), A. Henry 5780 (E [E00011284 image!], US [US00107992 image!]).

= *Prunus szechuanica* var. *dielsiana* C. K. Schneid., *Repert. Spec. Nov. Regni Veg.* 1: 68. 1905, syn. nov. \equiv *Prunus dielsiana* (C. K. Schneid.) Koehne, *Pl. Wilson.* (Sargent) 1(2): 243. 1912 \equiv *Prunus dielsiana* var. *conferta* Koehne, *Pl. Wilson.* (Sargent) 1(2): 244. 1912, nom. inval. \equiv *Cerasus dielsiana* (Koehne) Yü et Li in *Fl. Reipubl. Popularis Sin.* 38: 59. 1986.

Type: China, Hubei, Badong, April 1900, E. H. Wilson Veitch Exped. 308 (A [A00032048 image!], E [E00011281 image!], NY [NY00429944 image!], P [P01819046 image!]).

= *Prunus carcharias* Koehne, *Pl. Wilson.* (Sargent) 1(2): 267–268. 1912, syn. nov.

Type: China, Chongqing, Nanchuan, A. von Rosthorn s. n. (holotype: B; isotype: A [A00026999 image!]).

- = *Prunus dielsiana* var. *laxa* Koehne, Pl. Wilson. (Sargent) 1(2): 208. 1912, syn. nov.
 Type: China, Hubei, Xingshan, 1907, E. H. Wilson 68 (lectotype designated here: A [A00032051 image!]; isolectotype: A [A00032052 image!], E [E00011280 image!], HBG [HBG511108 image!], P[P01819047 image!], US [US00107951 image!]); China, Hubei, Badong, 1907, E. H. Wilson 37 (paratype: A [A00032049 image!], HBG [HBG511106 image!], US [US00623846 image!]); China, Hubei, Badong, 1907, E. H. Wilson 37a (paratype: A [A00032050 image!], HBG [HBG511107 in part, image!], US [US00623845 in part, image!]).
- = *Prunus dielsiana* var. *abbreviata* Cardot, Notul. Syst. (Paris) 4(1): 29. 1920, syn. nov.
 ≡ *Cerasus dielsiana* var. *abbreviata* (Cardot) Yü et Li, Fl. Reipubl. Popularis Sin. 38: 59. 1986.
 Type: China, Guizhou, Pingfa, 1905, Cavalerie et Fortunat, 2276 (syntype: P [P03357963 image!]); China, de la Touche 32 (syntype: E).

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- (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. *Regnum Vegetabile* 159. Glashütten: Koeltz Botanical Books. DOI <https://doi.org/10.12705/Code.2018>
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Appendix I

Additional specimens examined: **(The code of the herbaria and barcode numbers was proposed in the brackets) China, Chongqing:** Beibei, Chuanqiandui 142 (PE 00773209), Chuanqiandui 189 (PE 00773212); **Chengkou**, R. P. Farges s. n. (P 03357965, P 03357966, P 03357967, P 03357968, P 03357969, P 03357970, P 03357971, P 03357972, P 03357973, P 03357974, P 03357975, P 03357976, P 03357977, P 03357978, P 04149089, P 04167989); **Nanchuan**, Zhengyu Liu 15323 (P 03358066, PE 00773218), Jihua Xiong & Zilin Zhou 90010 (PE 00773198, PE 01438524), Jihua Xiong & Zilin Zhou 90016 (IBSC 0295268, IBSC 0295269, PE 00773216, PE 01438523), Jihua Xiong & Zilin Zhou 90679 (PE 00773217), ZhongguoxibukexueYuan 2867 (PE 00773196), ZhongguoxibukexueYuan 2877 (PE 00773211). **Wushan**, T. P. Wang 10628 (PE 00773197), Guanghui Yang 57654 (PE 00773204). **Fujian:** **Ningde**, Xiangxiu Su CSH15063 (CSH CSH0120724). **Guangxi:** **Rongshui**, Yuanbaoshan-zonghe-kaochadui Y1334 (IBK IBK00226390). **Guizhou:** **Daozhen**, Anonymous 16348 (PE 00773219); **Jiangkou**, Zhisong Zhang & Chengzhong Dang 400177 (HGAS 020949, PE 01296334, PE 01296335); **Qianyang**, Xuegen Li 202823 (IBSC 0295265), Xuegen Li 202918 (IBSC 0295264), Peixiang Tan 60529 (IBSC 0295266); **Suiyang**, Kaimin Lan 90-0678 (GZAC GZAC0016518, GZAC GZAC0016519); **Yinjiang**, Mingtai An YJ-0101 (GZAC GZAC0016714). **Hubei:** Gengguo Tang 231 (IBK IBK00063118); **Lichuan**, C.T.Hwa 0331 (PE 00773201), Zhichi Ye 471 (PE 00773202). **Hunan:** **Dayong**, Hui Zhou & Dasong Zhou 16031505 (CSFI CSFI044807, CSFI CSFI044808), Hui Zhou & Dasong Zhou 16031111 (CSFI CSFI044809, CSFI CSFI044810, CSFI CSFI044811), Hui Zhou & Jinlong Luo 15032711 (CSFI CSFI045002, CSFI CSFI045004, CSFI CSFI045005); **Hongjiang**, Xuegen Li 202823 (IBSC 0295265); **longshan**, Yan Xiao & Jianjun Zhou LS-079 (CSH CSH0102519); **Liuyang**, Xu Zhang 2015033004 (CSFI CSFI044828, CSFI CSFI044830, CSFI CSFI056935); **Shaoyang**, Lindong Duan 619 (PE 01438525); **Suining**, Jianjun Zhou & Dian Zhou 1403107 (CSFI CSFI026572, CSFI CSFI026576, CSFI CSFI026577), Jianjun Zhou & Zongping Song 1404091 (CSFI CSFI026574), Jianjun Zhou & Zongping Song 1405020 (CSFI CSFI048943, CSFI CSFI026575); **Xupu**, Hongsong Liao 98 (CSFI CSFI011565,

CSFI CSFI011566, CSFI CSFI011567); **Yongxing**, Jianggeng Xiao 1008 (CSFI CSFI011574); **Xinshao**, Bangyi Li 6437 (PE 01438526); **Yongshun**, HunannongxueYuan 3622 (PE 00773199). **Jiangxi: Fengxin**, Ceming Tan et al. 1506604 (JJF JJF00018547), Ceming Tan et al. 1506577 (JJF JJF00018548, JJF JJF00018549); **Jinggangshan**, Qiang Fan et al. JGS-1022 (SYS SYS00173104), Qiang Fan et al. JGS4004 (SYS SYS00172771), Qiang Fan et al. JGS4075 (SYS SYS00175310); **Lichuan**, Nonglinzhi 350 (JXAU JXAU0004787) Xiangxue Yang 650052 (IBSC 0295247); **Pingxiang**, Xinghua Shi 84004(JXAU JXAU0004770); **Tonggu**, Zhengming Tao 960074 (JXAU JXAU0004779); **Wuning**, Jihua Zhang TCM702 (JJF JJF00018545); **Yichun**, Wanyi Zhao et al. LXP13-10757 (SYS SYS00181906). **Sichuan: C.T.Hwa** 331 (NAS NAS00357021), C.T.Hwa 343 (NAS NAS00357022), Yang 3054 (PE 00773208); **Kangding** (Tachienlu), A. E. Pratt 807 (P 03357964); **Tianquan**, Guiling Qu 2304 (PE 00773195, PE 00773203, PE 00773207, PE 00773210); **Xuyong**, Xinfen Gao et al. HGX10091 (CDBI CDBI0226762), Xinfen Gao et al. HGX10188 (CDBI CDBI0226725). **Yunnan: Qiaojia**, Anonymous 19181 (PE 00773220).

The rediscovery and delimitation of *Elatostema setulosum* W.T.Wang (Urticaceae)

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Abstract

Of the 280 species of *Elatostema* documented in China, 189 are known only from a single collection. *Elatostema setulosum* is one such species, having been known only from the type collection for nearly half a century, until recent field investigations in Guangxi. Due to its morphological similarity to *E. huanjiangense* and *E. tetracephalum*, we undertook a critical review of all three species using morphological and molecular evidence. Our results suggest that all three names refer to the same species, which based on priority should be known as *Elatostema setulosum*. We recognize *E. huanjiangense* and *E. tetracephalum* as synonyms. A distribution map of *E. setulosum* and the extinction risk according to the IUCN criteria is provided. After recircumscription, the taxon must be considered as Least Concern (LC).

Keywords

Taxonomy, synonymy, *Elatostema huanjiangense*, *Elatostema tetracephalum*, China, Guangxi, Guizhou, Rosales, karst landscapes

Introduction

Elatostema J.R.Forst. & G.Forst. (Urticaceae) is one of two species-rich genera in the Urticaceae, comprising several hundred species of herbs and subshrubs that grow under shade in forests, gorges, stream-sides and caves (Wang 2014, Monro et al. 2018). *Elatostema* is distributed in tropical and subtropical Africa, Australia, Asia and Oce-

ania, but is absent from the Neotropics. Recent phylogenetic research demonstrates that *Elatostema* is a monophyletic group that includes most species of *Pellionia* and excludes *Elatostematoides* and *Procris* (Tseng et al. 2019).

The first revision of Chinese *Elatostema* was undertaken by Wang (1980), at which time 95 species were recognized. This was followed by a second revision in 1995 (Wang and Chen 1995) for Flora Reipublicae Popularis Sinicae, and a third in 2003 (Lin et al. 2003) for the Flora of China, which recognized 137 and 146 Chinese species, respectively. Since then, many new species have been collected and described. Wang (2014) recognized 280 species in the fourth revision of Chinese *Elatostema*. All revisions of the genus indicate southwestern China as the center of Chinese *Elatostema* diversity. This is likely because of its widespread karst landscape, with which 184 out of the 280 species are associated (Wang 2014), and its more tropical climate.

Karst landscapes are characterized by exposed rocks with shallow soils deficient in N and P, but with excessive Ca and Mg that are subject to seasonal droughts and an absence of surface water (Hao et al. 2015, Fu et al. 2017a) in which weathered material is exported subterraneously in solution (Bystriakova N. from The Natural History Museum, London, London, United Kingdom, personal communication), and soil is generated at a very slow rate (Pérez-García and Meave 2005). It is also rich in caves, whose cavern entrances are significant sources of *Elatostema* species diversity and discovery (Monro et al. 2018). Considering the importance of karsts to species discovery and the high frequency of point-endemics amongst karst species (Kong et al. 2017), it is important that this flora is well documented in order for the species conservation to be prioritized effectively and endangered species recognized (Fu et al. 2019a).

Collecting in karst, however, is difficult as there are relatively few roads and the terrain is steeply dissected, the very sharp eroded surfaces making it difficult and dangerous to traverse. As a consequence, there are relatively few collections from such areas and undescribed species are frequently known by only one or two collections. Based on Wang (2014), we find that 2/3 (67%) of species are known from a single collection, and 42% from a single specimen (holotype). Describing a species based on a single collection is problematic as there is no estimate of variation within the species and so there is a risk of applying too many names to the biota (Wei et al. 2011). The over-application of names can make it hard to communicate information about a taxon and to identify specimens. The over-application of names also results in high rates of synonymy that can make taxonomic revision challenging. This is compounded where many taxa in a genus are described from a single collection, as comparisons between taxa become, in effect, comparisons between individual herbarium specimens. Molecular data, however, can provide a means to use paraphyly to identify potentially conspecific groupings (Gao et al. 2012) and to evaluate the phylogenetic informativeness of morphological characters (Scotland et al. 2003).

Elatostema setulosum W.T.Wang was described from a single specimen (holotype) in 1982. This specimen was first identified as *Elatostema sessile* J.R.Forst. & G.Forst. var. *polycephalum* Wedd. in 1964, but later raised to specific rank by Wang in 1982.

No additional material was collected until June 2018, at which time a population was discovered close to the type locality. In identifying this recently collected material, we observed that it was morphologically very similar to several species, *E. pergameneum* W.T.Wang, *E. huanjiangense* W.T.Wang & Y.G.Wei and *E. tetracephalum* W.T.Wang, Y.G.Wei & F.Wen, the latter considered to be a synonym of *E. huanjiangense* by Wang (2014). Furthermore, our ongoing research into Chinese *Elatostema* also discovered two new populations of *E. huanjiangense* in Guizhou between 2014 and 2017.

Material and methods

In order to clarify the relationship among *E. huanjiangense*, *E. setulosum* and *E. tetracephalum*, we undertook a critical examination and comparison of all collections of these related species based on morphological and molecular evidence.

Sample collection

Fieldtrips in Guangxi and Guizhou were undertaken between 2007 and 2018 to collect specimens of *Elatostema huanjiangense*, *E. pergameneum*, *E. setulosum* and *E. tetracephalum* which were deposited at BM, IBK, K and PE. For all collections, samples of leaf material were dried in the field using silica gel for use in DNA extraction (Chase and Hills 1991).

Genomic DNA extraction, PCR amplification and sequencing

Two universal barcodes: the nuclear ribosomal internal transcribed spacer (ITS) region and the *trnH-psbA* intergenic spacer were used to establish hypotheses of evolutionary relationships due to their ability to detect variation at the species level (China Plant BOL Group 2011, Gao et al. 2012). The primers used to amplify the ITS region were those of the China Plant BOL Group (2011). The primers used to amplify the *trnH-psbA* intergenic spacer were those developed by Kress et al. (2005). Genomic DNA extraction, PCR amplification and sequencing followed Gao et al. (2012) and Tseng et al. (2019).

Taxon sampling

To elucidate phylogenetic relationships between the ingroup taxa, *Elatostema huanjiangense*, *E. pergameneum*, *E. setulosum* and *E. tetracephalum*, we analyzed three accessions of *E. huanjiangense*, and one of *E. pergameneum*, *E. setulosum* and *E. tetracephalum*. As outgroups, we selected *E. grijsii* (Hance) Y.H.Tseng & A.K.Monro and *E. scabrum*

Table 1. Species name, voucher specimen and accession numbers of *trnH-psbA* and ITS used in this study (*denoted newly generated sequences).

Speices name	Voucher specimen	<i>trnH-psbA</i>	ITS
<i>Elatostema grijsii</i> (Hance) Y.H.Tseng & A.K.Monro	Y.H. Tseng 1167	KC420504	KC420491
<i>Elatostema huanjiangense</i> W.T.Wang & Y.G.Wei	Y.G. Wei g124	KP858730	KP858875
<i>Elatostema huanjiangense</i> W.T.Wang & Y.G.Wei	A.K. Monro & L.F. Fu 7705	MK656519*	MK651815*
<i>Elatostema huanjiangense</i> W.T.Wang & Y.G.Wei	A.K. Monro & L.F. Fu 7719	MK656518*	MK651816*
<i>Elatostema pergameneum</i> W.T.Wang	Y.G.Wei 07298	MK656516*	MK651817*
<i>Elatostema scabrum</i> (Benth.) Hallier f.	Y.H. Tseng 1219	KC420503	KC420492
<i>Elatostema setulosum</i> W.T.Wang	L.F. Fu et al. FLF180606-01	MK656515*	MK651813*
<i>Elatostema tetracephalum</i> W.T.Wang, Y.G.Wei & F.Wen	A.K. Monro & L.F. Fu 7696	MK656517*	MK651814*

(Benth.) Hallier f. based on the most recent published phylogeny for *Elatostema*, *Elatostematoides* and *Procris* (Tseng et al. 2019). Genbank accession numbers for ITS and *trnH-psbA*, and voucher specimens information, are listed in Table 1.

Phylogenetic analysis

Sequence data were edited and assembled using the software Lasergene Navigator (DNASTar, Madison, Wisconsin, USA). Edited sequences were then aligned with the MEGA 5.1 (Tamura et al. 2011). The incongruence length difference (ILD) test was implemented in PAUP* 4.0b10 (Swofford 2002) to assess potential incongruence between ITS and *trnH-psbA*. The p-value (p = 1) suggested no significant incongruences between datasets. Therefore, we reconstructed the phylogenetic trees based on combined datasets. Phylogenetic analyses were performed using maximum parsimony (MP) and Bayesian inference (BI). MP analysis implemented in PAUP* 4.0b10 which followed Fu et al. (2017b). For BI analyses, the best-fit DNA substitution model HKY+I was selected in Modeltest v 2.7 (Posada and Crandall 1998) according to the Akaike Information Criterion (AIC). BI analyses were conducted in MrBayes 3.2.6 (Huelsenbeck and Ronquist 2001) which followed Wu et al. (2013).

Distribution map

Distribution map of *Elatostema huanjiangense*, *E. setulosum* and *E. tetracephalum* was made using the software ArcGIS 10.2 (ESRI, Inc.).

Morphology examination and conservation assessments

A morphological species concept was employed to compare the taxa based on Wei et al. (2011). Specimens were examined using dissecting microscopy followed Fu et al. (2014, 2017c, 2019b). Extinction threat assessments were undertaken using IUCN criteria (IUCN 2012).

Results and discussion

Molecular analysis

The combined matrix had a length of 1036 characters, 715 for ITS and 321 for *trnH-psbA*. Of the 208 (20.1%) variable characters, 117 (11.3%) were parsimoniously informative, including the indels. The maximum parsimony analysis on the combined matrix resulted in three equally parsimonious trees of 241 steps long, a consistency index (CI) of 0.959, retention index (RI) of 0.938 and homoplasy index (HI) of 0.041. MP and BI analyses have same topology (Fig. 1) showing the phylogenetic relationships between *Elatostema huanjiangense*, *E. pergamenium*, *E. setulosum* and *E. tetracephalum*. The result suggests *E. pergamenium* as sister to remaining ingroup taxa, from which it can readily be distinguished morphologically by its leaves narrower (width less than 30 mm) and adaxial surface glabrous (Wang 1982). Secondly, *E. setulosum* and *E. tetracephalum* are nested within a strongly supported clade that includes a paraphyletic *E. huanjiangense*. After consulting the original descriptions and the type specimens of all three species (Wang 1982, Wang and Wei 2007, Wang 2012), we agreed with the decision of Wang (2014) to consider *E. tetracephalum* as conspecific to *E. huanjiangense*. We were also unable to trace any obvious morphological differences between *E. huanjiangense* and *E. setulosum*, with the exception of leaf pubescence (strigose vs. setulose). Microscope images (Fig. 2) clearly show that the type specimens of both species share the same setulose trichome type. Based on the above, we believe that *E. huanjiangense* and *E. setulosum* represent the same species.

Taxonomic treatment

Elatostema setulosum W.T.Wang, 1982: 120

Figs 2, 3

Type. CHINA. Guangxi: Tianyang County, Anning Gongshe, *Anon.* 262 (holotype: IBK![IBK00200113]). = *Elatostema huanjiangense* W.T.Wang & Y.G.Wei, 2007: 816. Syn. nov. Type: China. Guangxi: Huanjiang County, Mulun, Hongdong, 19 April 2006, *Y.G. Wei* 06128 (holotype: PE![02050267]). = *Elatostema tetracephalum* W.T.Wang, Y.G.Wei & F.Wen, 2012: 1100. Syn. nov. Type: China. Guizhou: Huangping County, in forest of earth mount, 20 March 2010, *Y.G. Wei* & *F. Wen* 1067 (holotype: PE!, isotype: IBK!).

Description. Perennial herb, terrestrial, dioecious. Stem 50–250 × 2–3 mm, ascending or erect, simple or branched, glabrous. Stipule 2, persistent, 2–2.2 × 0.2 mm, lanceolate-linear, glabrous. Leaves distichous, alternate, sessile or short petiole; laminae 30–150 × 14–60 mm, length:width ratio 2.1–2.5:1, obliquely elliptic, papery; triplinerve or rarely semitriplinerve; abaxial surface glabrous, adaxial surface sparsely setulose; cystoliths densely scattered, bacilliform; base asymmetrical, broader-half rounded or auriculate, narrower-half cuneate; margin crenate; apex shortly acuminate or acuminate. Staminate and pistillate inflorescences not borne on the same stems. Staminate

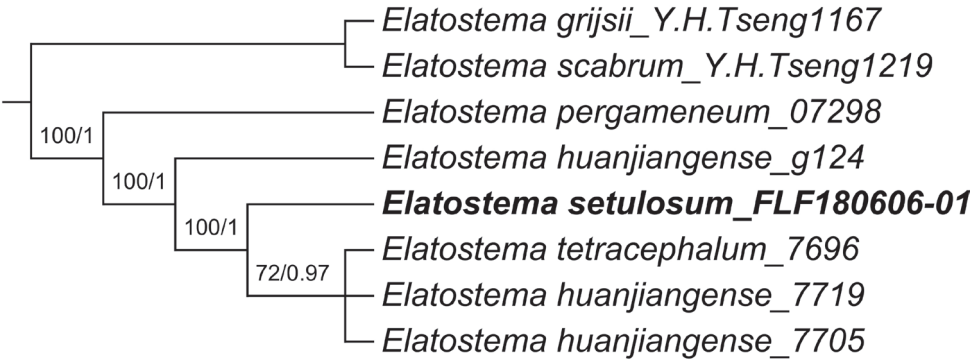


Figure 1. Maximum parsimony phylogenetic tree based on the combined *trnH-psbA* and ITS data, showing relationships of *Elatostema huanjiangense*, *E. pergameneum*, *E. setulosum* and *E. tetracephalum*. Numbers on the branches indicate bootstrap values ($\geq 60\%$) of the maximum parsimony analysis and the posterior probability (≥ 0.8) of Bayesian inference analysis.

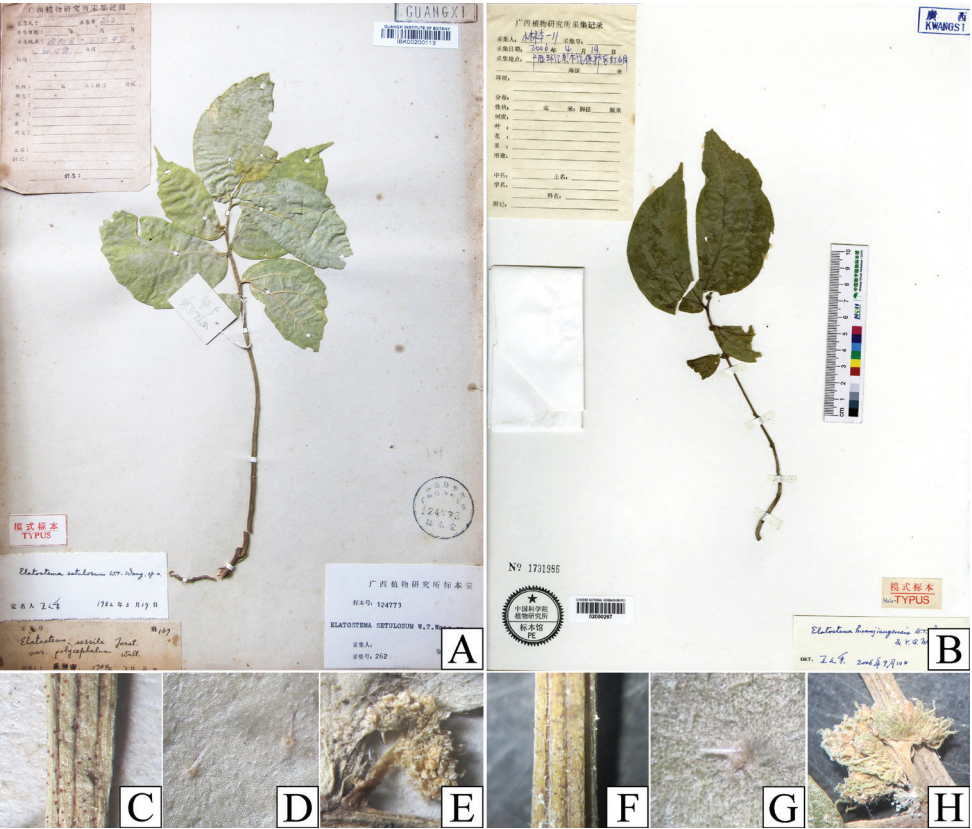


Figure 2. Comparison of type specimens between *Elatostema setulosum* (A, C–E) and *E. huanjiangense* (B, F–H): A, B habit C, F stem D, G leaf pubescence E, H pistillate inflorescence.

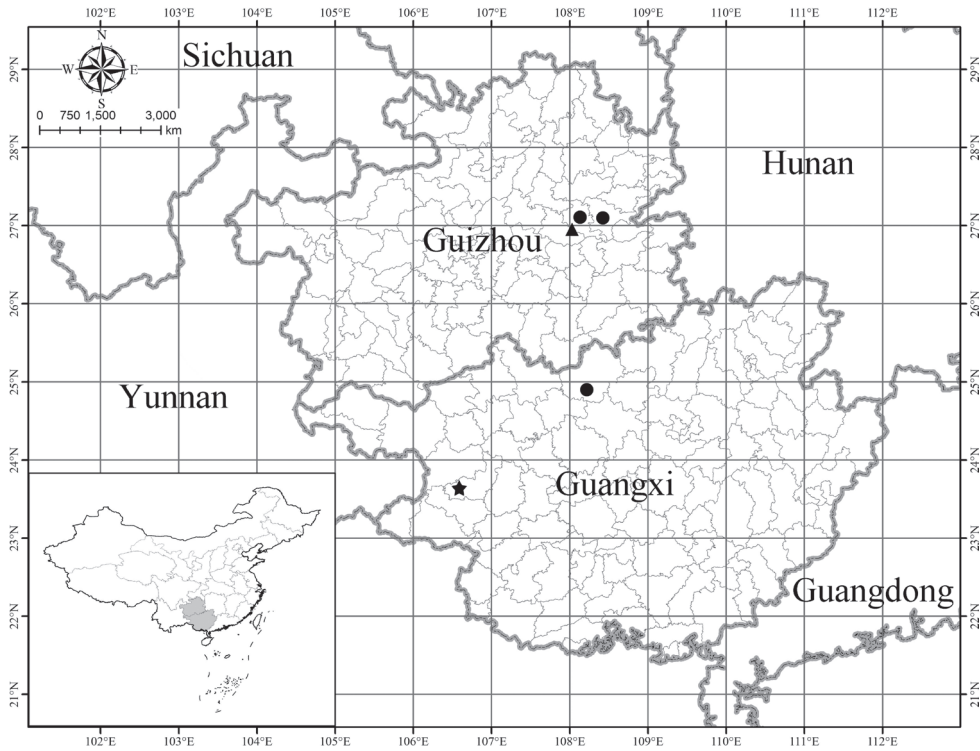


Figure 3. Distribution map of *Elatostema huanjiangense* (circle), *E. setulosum* (star) and *E. tetracephalum* (triangle).

inflorescences paired, axillary, cymiferous, bearing ca. 30 flowers, ca. 10 mm in diam., peduncle 1.6×0.4 mm, subglabrous; bracts membranous, linear-lanceolate or lanceolate-linear, $1.2\text{--}2.5 \times 0.3\text{--}1$ mm, sparsely ciliate; staminate flower bud ovoid, flowers ca. 1.6×1 mm, glabrous, tepals 5, subapical appendage ca. 1 mm, corniculate. Pistillate inflorescences paired, axillary, capitate, bearing ca. 20 flowers, inflorescences with three types: (1) simple capitulum, 1.5 mm in diam., receptacle inconspicuous, bracts ca. 10; (2) composite capitulum, comprised by four 2-branched simple capitulum; (3) simple capitulum, receptacle discoid-oblong, $2\text{--}3 \times 0.8\text{--}2$ mm, weakly divided into two lobes, glabrous, subtended by marginal bracts; bracts numerous, triangular, ca. $0.5 \times 0.2\text{--}0.3$ mm, glabrous; bracteoles 2 per flower, subequal, $0.5\text{--}1$ mm, linear, semi-transparent; Pistillate flowers: ovary ovoid, ca. 0.6 mm; achene $6.122\text{--}7.99 \times 3.891\text{--}5.119$ mm, length:width ratio 1.56–1.57:1, broadly ellipsoid, with 4 longitudinal ribs and tuberculate, two opposite longitudinal ribs winged.

Additional specimen examined. CHINA. Guangxi: Huanjiang County, Mulun nature reserve, Hongdong, 8 April 2009, *Y.G. Wei* g124 (IBK!, PE!); Huanjiang County, Mulun nature reserve, Leyi Village, Donglai, 3 May 2011, *Y.S. Huang, Y.B. Liao & R.C. Peng* y0216 (IBK!); Huanjiang County, Mulun nature reserve, Leyi Village,

Donglai, 18 April 2012, W.B. Xu, R.C. Peng & R.C. Hu ML1037 (IBK!); Huanjiang County, Mulun nature reserve, Hongdong, 16 April 2012, L.F. Fu FL004 (IBK!, PE!); Huanjiang County, Chuanshan Town, on the way from Hongdong to Zhonglun, 9 May 2006, Man-Fu Hou 117 (PE!); Tianyang County, Babie Village, Anning Village, 6 June 2018, L.F. Fu, Y.C. Liu & W.J. Xu FLF180606-01 (IBK!); Guizhou: Huangping County, Feiyun gorge, 17 May 2012, Y.H. Tseng & L.F. Fu Zn1217 (IBK!), 8 Nov. 2015, A.K. Monro & L.F. Fu 7696 (IBK!, K!); Shibing County, Yun Tai Mountain, 10 Nov. 2015, A.K. Monro & L.F. Fu 7705 (IBK!, K!); Zhen Yuan County, Tiexi Tourist Park, 10 Nov. 2015, A.K. Monro & L.F. Fu 7719 (IBK!, K!).

Conservation status. An Extinction Threat Assessment was undertaken using the IUCN methodology (2012). *Elatostema setulosum* is known from five localities in Guangxi (one population) and Guizhou (four populations), China. We estimate that the population of mature individuals is greater than 1000. The given surface area of a polygon including the known localities for this species is greater than 27,000 km² (Fig. 3); it is also likely that there remain as yet undiscovered populations. For these reasons we assess *E. setulosum* as Least Concern (LC).

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A key to the North American genera of Stipeae (Poaceae, Pooideae) with descriptions and taxonomic names for species of *Eriocoma*, *Neotrinia*, *Oloptum*, and five new genera: *Barkworthia*, *×Eriosella*, *Pseudoeriocoma*, *Ptilagrostiella*, and *Thorneochloa*

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Abstract

Based on earlier molecular DNA studies we recognize 14 native Stipeae genera and one intergeneric hybrid in North America. We provide descriptions, new combinations, and 10 illustrations for species of *Barkworthia* **gen. nov.**, *Eriocoma*, *Neotrinia*, *Oloptum*, *Pseudoeriocoma* **gen. nov.**, *Ptilagrostiella* **gen. nov.**, *Thorneochloa* **gen. nov.**, and *×Eriosella* **nothogen. nov.** The following 40 new combinations are made: *Barkworthia stillmanii*, *Eriocoma alta*, *E. arida*, *E. arnowiae*, *E. bloomeri*, *E. bracteata*, *E. contracta*, *E. coronata*, *E. curvifolia*, *E. hendersonii*, *E. latiglumis*, *E. lemmonii*, *E. lemmonii* ssp. *pubescens*, *E. lettermanii*, *E. lobata*, *E. nelsonii*, *E. nelsonii* ssp. *dorei*, *E. nevadensis*, *E. occidentalis*, *E. occidentalis* ssp. *californica*, *E. occidentalis* ssp. *pubescens*, *E. parishii*, *E. parishii* ssp. *depaupertata*, *E. perplexa*, *E. pinetorum*, *E. richardsonii*, *E. robusta*, *E. scribneri*, *E. swollenii*, *E. thurberiana*, *E. wallowaensis*, *×Eriosella caduca*, *Pseudoeriocoma acuta*, *P. constricta*, *P. editorum*, *P. eminens*, *P. hirticulmis*, *P. multinodis*, *Ptilagrostiella kingii*, and *Thorneochloa diegoensis*. A key to the native and introduced genera of North American Stipeae, and an overview of the tribe in North America and worldwide are given. Lectotypes are designated for *Eriocoma cuspidata* Nutt., *Fendleria rhynchelytroides* Steud., *Stipa bloomeri* Bol., *Stipa coronata* Thurb., *Stipa membranacea* Pursh, *Stipa mormonum* Mez, *Stipa richardsonii* Link, and *Stipa williamsii* Scribn. *Achnatherum* s.s. and *Piptatherum* s.s. are now restricted to Eurasia and the Mediterranean/Asia, respectively.

Resumen

Basados en estudios anteriores de ADN molecular, reconocemos 14 géneros nativos de Stipeae y un híbrido intergenérico en América del Norte. Se presentan descripciones, nuevas combinaciones, y 10 ilustraciones para las especies de *Barkworthia* **gen. nov.**, *Eriocoma*, *Neotrinia*, *Oloptum*, *Pseudoeriacoma* **gen. nov.**, *Ptilagrostiella* **gen. nov.**, *Thorneochloa* **gen. nov.** y \times *Eriosella* **nothogen. nov.** Se realizan las siguientes 40 nuevas combinaciones: *Barkworthia stillmanii*, *Eriocoma alta*, *E. arida*, *E. arnowiae*, *E. bloomeri*, *E. bracteata*, *E. contracta*, *E. coronata*, *E. curvifolia*, *E. hendersonii*, *E. latiglumis*, *E. lemmonii*, *E. lemmonii* ssp. *pubescens*, *E. lettermanii*, *E. lobata*, *E. nelsonii*, *E. nelsonii* ssp. *dorei*, *E. nevadensis*, *E. occidentalis*, *E. occidentalis* ssp. *californica*, *E. occidentalis* ssp. *pubescens*, *E. parishii*, *E. parishii* ssp. *depaupertata*, *E. perplexa*, *E. pinetorum*, *E. richardsonii*, *E. robusta*, *E. scribneri*, *E. swollenii*, *E. thurberiana*, *E. wallowaensis*, \times *Eriosella caduca*, *Pseudoeriacoma acuta*, *P. constricta*, *P. editorum*, *P. eminens*, *P. hirticulmis*, *P. multinodis*, *Ptilagrostiella kingii* y *Thorneochloa diegoensis*. Se presenta una clave para los géneros nativos e introducidos de las especies norteamericanas, y una visión general de la tribu en América del Norte y en todo el mundo. Se designan lectotipos para *Eriocoma cuspidata* Nutt., *Fendleria rhynchelytroides* Steud., *Stipa bloomeri* Bol., *Stipa coronata* Thurb., *Stipa membranacea* Pursh, *Stipa mormonum* Mez, *Stipa richardsonii* Link y *Stipa williamsii* Scribn. *Achnatherum* s.s. y *Piptatherum* s.s. ahora están con distribución restringida- a Eurasia y el Mediterráneo/Asia, respectivamente.

Keywords

Barkworthia, *Eriocoma*, \times *Eriosella*, Gramineae, *Neotrinia*, North America, Poaceae, *Pseudoeriacoma*, *Ptilagrostiella*, Stipeae, taxonomy, *Thorneochloa*

Introduction

The tribe Stipeae Dumort. comprises temperate, cool-season (C_3) grasses that generally occupy somewhat moist to predominantly dry open grasslands and steppe communities in all continents except Antarctica. They represent an ecologically and morphologically specialized lineage within the subfamily Pooideae including approximately 527 species in 28 genera (Tzvelev 1977; Watson and Dallwitz 1992, Barkworth 2007; Romaschenko et al. 2008, 2010, 2011, 2012, 2013; Soreng et al. 2015, 2017). Historically, delimitation of taxa within the American Stipeae was based on broad concepts of the genera *Stipa* L. and *Oryzopsis* Michx. Hitchcock (1935, 1951) accepted three native genera in North America: *Oryzopsis* (12 spp.), *Piptochaetium* J. Presl (1 sp.), and *Stipa* (34 spp. + 2 introduced), and *Nassella* (Trin.) E. Desv. (1 sp. as introduced). In the Flora of North America Barkworth (2007) recognized nine native Stipeae genera: *Achnatherum* P. Beauv., *Amelichloa* Arriaga & Barkworth, *Hesperostipa* (M.K. Elias) Barkworth, *Jarava* Ruiz & Pav., *Nassella*, *Oryzopsis*, *Piptatherum* P. Beauv., *Piptochaetium* J. Presl, *Ptilagrostis* Griseb., and a single hybrid genus \times *Achnella* Barkworth. Recent molecular DNA studies have greatly increased our understanding of the evolutionary relationships among members of this tribe worldwide and in North America. In addition to the genera listed previously for North America, we now recognize species belonging to *Pappostipa* (Speg.) Romasch., P.M. Peterson & Soreng, *Patís* Ohwi, and *Piptatheropsis* Romasch., P.M. Peterson & Soreng (Romaschenko et al. 2008, 2011, 2012). Molecular phylogenetic study of the Stipeae using nine plastid and nuclear ITS DNA markers

identified well-supported clades for ‘Stillmania’ (= *Barkworthia* gen. nov.), *Eriocoma* Nutt., ‘Miliacea’ (= *Oloptum* Röser & H.R. Hamasha), ‘Neotrinia’ [= *Neotrinia* (Tzvel-ev) M. Nobis, P. Gudkova & A. Nowak; Nobis et al. 2019], *Pseudoeriocoma* gen. nov., *Ptilagrostis kingii* (Bol.) Barkworth (= *Ptilagrostiella* gen. nov.) sister to the *Piptatheropsis* clade, and *Thorneochloa* gen. nov. (Hamasha et al. 2012; Romaschenko et al. 2012, 2013, 2014; Valdés Reyna et al. 2013). Table 1 provides an overview of the numbers of species in each Stipeae genus as applied in North America by Hitchcock (1951), Barkworth (2007), here, and Worldwide (updating Soreng et al. 2017).

Thomasson (1978, 1980, 1981, 1982, 1985) was the first to document the phylogenetic importance of the lemma epidermal pattern among the Stipeae genera, and Barkworth and Everett (1988) used this information to delineate relationships. Romaschenko et al. (2008, 2011, 2012, 2013) mapped lemma patterns onto DNA-derived phylogenetic trees and found two major types (first-named, described, typified, and tested): 1) the saw-like pattern common in Stipeae and widespread among grasses outside of this tribe, characterized by having long fundamental cells 2× longer than wide with sinuate to lobate sidewalls and cork cells usually paired with silica bodies; and 2) maize-like pattern confined only to achnatheroid grasses within Stipeae, characterized by having thin-walled fundamental cells that are approximately equal in length and width to shorter than wide with mostly straight sidewalls, and silica bodies that are similar in shape and alternate regularly with fundamental cells. The saw-like pattern is found in *Aciachne* Benth., *Ampelodesmos*, *Anatherostipa* (Hack. ex Kuntze) Peñail., *Barkworthia*, *Hesperostipa*, *Lorenzochloa* Reeder & C. Reeder, *Macrochloa* Kunth, *Neotrinia*, *Ortachne* Nees, *Orthoraphium* Nees, *Oryzopsis*, *Patis*, *Piptatheropsis*, *Piptochaetium*, *Ptilagrostiella*, *Ptilagrostis*, *Stipa*, and *Trikeria* Bor, while the maize-like pattern is found in *Achnatherum*, *Amelichloa*, *Anemanthele* Veldkamp, *Austrostipa* S.W.L. Jacobs & J. Everett, *Celtica* F.M. Vázquez & Barkworth, *Eriocoma*, *Jarava*, *Nassella*, *Oloptum*, *Pappostipa*, *Pseudoeriocoma*, *Thorneochloa*, and *Timouria* Roshev. (Romaschenko et al. 2012). The achnatheroid clade is a strongly-supported worldwide lineage (BS = 100, PP = 1.00) defined by the maize-like lemma epidermal pattern (Romaschenko et al. 2012).

We follow the results previously presented in our molecular studies and provide overall morphological evidence for all genera recognized in this manuscript (Romaschenko et al. 2012, 2013, 2014; Valdés Reyna et al. 2013). We circumscribe genera based on shared morphological characteristics and apply the concept of monophyly as supported by recent molecular DNA-derived phylogenies. We think it is unwise to recognize paraphyletic genera portrayed as grades, e.g., *Stipellula* Röser & H.R. Hamasha (Hamasha et al. 2012). Therefore, we recognize *Stipellula capensis* (Thunb.) Röser & H.R. Hamasha as the only species in this genus as originally described by Tzvelev (1974, 2012). One alternative classification for the Stipeae might be the recognition of a single genus, *Stipa*. However, we feel this would be inappropriate and not informative, as would the recognition of *Triticum* L. for all species within the Triticeae or *Poa* L. for all species within the family. As our title indicates, our key applies only to North American Stipeae. Our new classification presented here is globally coherent because our previous molecular studies are based on a worldwide comprehensive sample.

Table 1. Overview of numbers of species in each genus of Stipeae in North America north of Mexico (FNA), endemic to Mexico, and Worldwide with distribution.

Genus	Year Publ.	Hitchcock 1951	Barkworth 2007	Present in FNA Region	Mexico Endemic	World-wide	Distribution (* = genus introduced in NA, ^c = cultivated NA)
<i>Achnatherum</i>	1812	0	28	0	0	21	Mediterranean & Eurasia
<i>Aciachne</i>	1881	0	0	0	0	3	South America
<i>Amelichloa</i>	2006	–	3	3	0	5	Americas
<i>Anatherostipa</i>	1996	–	0	0	0	8	South America
<i>Anemanthele</i>	1985	–	0	1	0	1	New Zealand ^{*c}
<i>Austrostipa</i>	1996	–	2	2	0	64	Australia ^{*c}
<i>Barkworthia</i>	<i>here</i>	–	–	1	0	1	United States
<i>Celtica</i>	2004	–	1	1	0	1	Mediterranean ^{*c}
<i>Eriocoma</i>	1818	0	–	25	2	27	North America
<i>Hesperostipa</i>	1993	–	4	4	1	5	North America
<i>Jarava</i>	1794	0	3	1	1	33?	Latin America ^{*c}
<i>Lorenzochloa</i>	1969	–	0	0	0	1	South America
<i>Macrochloa</i>	1829	0	1	1	0	1	Mediterranean ^{*c}
<i>Nassella</i>	1854	1	10	10	3	117	Americas
<i>Neotrinia</i>	2019	–	–	1	0	1	Asia ^{*c}
<i>Oloptum</i>	2012	–	–	1	0	1	Mediterranean ^{*c}
<i>Ortachne</i>	1854	0	0	0	0	2	South America
<i>Orthoraphium</i>	1841	0	0	0	0	1	Southeast Asia
<i>Oryzopsis</i>	1803	12	1	1	0	1	North America
<i>Pappostipa</i>	2008	–	–	2	0	31	South America ^{*c}
<i>Patis</i>	1942	0	0	1	0	3	East Asia & North America
<i>Piptatheropsis</i>	2011	–	–	5	0	5	North America
<i>Piptochaetium</i>	1830	1	6	6	5	35?	Americas
<i>Piptatherum</i>	1812	0	7	0	0	32	Mediterranean and Asia
<i>Psammochloa</i>	1927	0	0	0	0	1	East Asia
<i>Pseudoeriacoma</i>	<i>here</i>	–	–	1	5	6	North America
<i>Ptilagrostiella</i>	<i>here</i>	–	–	1	0	1	United States
<i>Ptilagrostis</i>	1852	0	2	1	0	15	East Asia & North America
<i>Stipa</i>	1753	34 + 2	2	1	0	150+	Mediterranean & Eurasia ^{*c}
<i>Stipellula</i>	2012	–	–	1	0	1	Mediterranean & Eurasia [*]
<i>Thorneochloa</i>	<i>here</i>	–	–	1	0	1	Western North America
<i>Timouria</i>	1916	0	0	0	0	1	East Asia
<i>Trikeriaia</i>	1954	–	0	0	0	3	East Asia
× <i>Achnella</i>	1993	–	1	0	–	–	North America
× <i>Eriosella</i>	<i>here</i>	–	–	1	0	1	North America

In this paper we propose a new classification of the North American Stipeae, include a key to the native and introduced genera (and Ampelodesmeae) found in Canada, United States of America, and Mexico, and provide descriptions, new combinations, and 10 illustrations for the species of *Barkworthia* Romasch., P.M. Peterson & Soreng, *Eriocoma*, *Neotrinia*, *Oloptum*, *Pseudoeriacoma* Romasch., P.M. Peterson & Soreng, *Ptilagrostiella* Romasch., P.M. Peterson & Soreng, *Thorneochloa* Romasch., P.M. Peterson & Soreng, and the hybrid genus ×*Eriosella* Romasch.

Taxonomy

***Barkworthia* Romasch., P.M.Peterson & Soreng, gen. nov.**

urn:lsid:ipni.org:names:77199063-1

Type. *Barkworthia stillmanii* (Bol.) Romasch., P.M. Peterson & Soreng (\equiv *Stipa stillmanii* Bol.).

Diagnosis. *Barkworthia* differs from *Piptatherum* P. Beauv. in having spikelets with a pilose callus, paleas with prolonged veins, and 2-lobed lemma apices with lobes 1–3 mm long; and differs from *Achnatherum* in having saw-like lemma epidermal pattern, not the maize-like pattern characteristic of all achnatheroid grasses.

Description. Plants short-rhizomatous perennials. Culms 60–150 cm tall with 2–5 puberulent nodes, 2–5 mm thick below, often geniculate. Leaf sheaths mostly glabrous or distally ciliate; collars glabrous or pubescent; ligules 0.2–0.5 mm long, membranous, apex truncate; blades 15–30 cm long; 3–7 mm wide, scabrous. Panicles 10–24 cm long, 1.5–3 cm wide, contracted; branches appressed, ascending, lower branches 2–3.5 cm long. Spikelets 14–18 mm long, lanceolate, subterete with one fertile floret without rachilla extension, disarticulation above the glumes; glumes 14–18 mm long, single-awned, the awns 2–3 mm long; lower glumes 1–3-veined, upper glumes 3–5-veined; florets 8–10 mm long, fusiform; calluses 0.5–1.2 mm long, rounded, pilose; lemmas 3-veined, evenly hairy, the hairs about 1.5 mm long, apex 2-lobed, the lobes 1–3 mm long with awnlike tips, narrow; lemma epidermal pattern saw-like; fundamental cells of variable length with sinuous sidewalls 2–7 times longer than silica cells irregularly alternating; silica bodies elongated-rectangular with straight or very shallow contracted sidewalls; cork cells not prominent; lemmatal awns 18–30 mm long, terminal, awned from the sinus, scabrous, 1 or 2-geniculate, persistent; paleas as long or longer than lemmas, 2-veined, hairy, the veins 1–3 mm prolonged reaching almost to the tip of the lemma lobes; anthers 4–6 mm long, penicillate, 3 in number; lodicules 3; stigmas 2. Caryopses fusiform, pericarp adherent, hilum linear.

Etymology. The generic name honors Mary Elizabeth Barkworth, a well-known American agrostologist, who has contributed many papers investigating the taxonomy of the Stipeae.

***Barkworthia stillmanii* (Bol.) Romasch., P.M.Peterson & Soreng, comb. nov.**

urn:lsid:ipni.org:names:77199064-1

Stipa stillmanii Bol., Proc. Calif. Acad. Sci. 4: 169. 1872 [Basionym] \equiv *Achnatherum stillmanii* (Bol.) Barkworth, Phytologia 74(1): 14. 1993 – Type: USA, California, Sierra Nevada, Blue Cañon, Jul 1870, *H.N. Bolander, M.D. Kellogg & co. s.n.* (holotype: NY-00431576 [image!]; isotypes: GH-00017890 [image!], K-000873398 [image!], MO-3055652!, MO-3055653!, MO-3055654!, NDG-07159 [image!], US-556922!). Fig. 1A–F.



Figure 1. *Barkworthia stillmanii*: **A** habit **B** ligule **C** panicle **D** glumes **E** floret **F** floret (close up). *Eriocoma hymenoides*: **G** culm and panicle **H** panicle branch **I** glumes **J** floret **K** lemma awn **L** floret base (callus).

Distribution and habitat. *Barkworthia stillmanii* is distributed in scattered locations in northern California (Butte, El Dorado, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Tehama, Trinity, Tulare, and Yuba Counties) associated with yellow pine and red fir forests; 10–1500 m (Barkworth 2007; Calflora 2018).

Comments. In a molecular-derived phylogeny of the Stipeae using 10 DNA markers *Barkworthia stillmanii* is sister to a well-supported *Piptatherum* clade, which is strictly Old World in distribution, and has cauducous awns, and dark glossy lemmas in fruit (Romaschenko et al. 2012).

***Eriocoma* Nutt., Gen. N. Amer. Pl. 1: 40. 1818**

= *Fendleria* Steud., Syn. Pl. Glumac. 1: 419. 1854. Type: *Fendleria rhynchelytroides* Steud. (= *Eriocoma hymenoides*).

Type. *Eriocoma hymenoides* (Roem. & Schult.) Rydb. (\equiv *Stipa hymenoides* Roem. & Schult.).

Description. Plants perennial, sometimes short rhizomatous, tightly to loosely cespitose. Culms 10–230 cm tall, erect, unbranched above, nodes glabrous or pubescent, nodes 2–4 (5). Leaf sheaths glabrous, pubescent or pilose, glabrous or distally ciliate; collars glabrous or with a tufts of hairs; ligules 0.1–10 mm long, hyaline to membranous, apex truncate, obtuse, acute or narrowly acute; blades 0.1–7 mm wide, flat, convolute or involute, smooth, scabrous, glabrous or hairy. Panicles 2.5–60 cm long, up to 15 cm wide, usually contracted, sometimes open with divergent branches; branches straight, sometimes flexuous. Spikelets 5–21 mm long, usually lanceolate, sometimes obovoid, subterete, rarely laterally compressed, with one fertile floret without rachilla extension, disarticulation above the glumes; glumes 5–21 mm long, longer than the florets, unawned, 1(3)-veined, apex usually acuminate, sometimes acute; florets 2.5–10 mm long, usually fusiform, sometimes obovoid; calluses 0.3–2 mm long, blunt, sharp, or acute, hairy; lemmas usually coriaceous, sometimes indurate, usually evenly hairy, sometimes glabrous, or distally or with longer or shorter hairs than the body, apex usually entire or 2-lobed with lobes less than 2.1 mm long; lemma epidermal pattern maize-like; fundamental cells square with roundish corners and straight sidewalls subequal to silica cells or shorter, often regularly alternating; silica bodies square-cornered or sometimes rounded without contractions; cork cells scarce to absent; lemmatal awns 3–80 mm long, 1 or 2-geniculate; paleas $\frac{1}{4}$ to as long or longer than the lemma, 2-veined, usually hairy, sometimes glabrous, veins usually not prolonged, but if prolonged then not more than 0.3 mm long; anthers 1–5 mm long, usually penicillate, 3 in number; lodicules 2 or 3; stigmas 2. Caryopses fusiform, pericarp adherent, hilum linear.

Distribution. There are 27 species of *Eriocoma*, all occurring in western North America (Canada, Mexico, and the USA) and only *E. hymenoides* extends its range into northeastern USA (Gleason and Cronquist 1991).

Comments. Within our earlier and unpublished molecular analyses of *Eriocoma* there are three separate clades of *E. lobata* and one undescribed species (Romaschenko et al. 2012, 2014; Valdés Reyna et al. 2013; Romaschenko et al. in prep.). Species now included in *Eriocoma* were placed in *Oryzopsis* or *Stipa* (Hitchcock 1951), in *Stipa* (Espejo Serna et al. 2000), in *Achnatherum* (Barkworth 2007; Dávila et al. 2018), or in *Achnatherum* or *Eriocoma* (Sánchez-Ken 2018).

***Eriocoma alta* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199065-1

Stipa alta Swallen, Proc. Biol. Soc. Wash. 56: 79. 1943 [Basionym] \equiv *Achnatherum altum* (Swallen) Hoge & Barkworth, Phytologia 74(1): 5. 1993. Type: Mexico, Coahuila, mpio. Cuatro Ciénegas, Sierra de la Madera, Canon del Agua, rare in dry shrub zones of lower canyon, 10 Sep 1939, *C. H. Muller 3261* (holotype: US-2209361!; isotypes: GH-00024473 [image!], US-2871136!).

***Eriocoma arida* (M.E. Jones) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199066-1

Stipa arida M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 725. 1895 [Basionym] \equiv *Achnatherum aridum* (M.E. Jones) Barkworth, Phytologia 74(1): 6. 1993. Type: USA, Utah, Piute Co., Marysville, 6000 ft, 4 Jun 1894, *M.E. Jones 5377* (holotype: not located; isotypes: AHUC-13276 [image!], BM-001042155 [image!], G-00176508 [image!], MO-2151568 [image!], MSC-0092934 [image!], US-236787!).

= *Stipa mormonum* Mez, Repert. Spec. Nov. Regni Veg. 17: 209. 1921. Type: USA, Utah, Milford, 21 Jun 1880, 5000 ft, *M.E. Jones 2106* (lectotype: MO-2151566 [image!] **designated here**; isolectotypes: S-G-5821 [image!], US-866079 fragm. ex B! [image 00157472!]).

***Eriocoma arnowiae* (S.L. Welsh & N.D. Atwood) Romasch, comb. nov.**

urn:lsid:ipni.org:names:77199067-1

Stipa arnowiae S.L. Welsh & N.D. Atwood, Utah Fl. (ed. 3) 799. 2003 [Basionym] \equiv *Achnatherum arnowiae* (S.L. Welsh & N.D. Atwood) Barkworth, Sida 22(1): 496. 2006. Type: USA, Utah, Kane Co., T43S, R4W, S13, ca. 9 mi E of Johnson Canyon Jct., 1740 m, 30 May 2003, *S. L. Welsh & T. O'Dell 28062* (holotype: BRY; isotypes: GH-00247115 [image!], NY-00887984 [image!], US-3498681!).

***Eriocoma bloomeri* (Bol.) Romasch. comb. nov.**

urn:lsid:ipni.org:names:77199068-1

Stipa bloomeri Bol., Proc. Calif. Acad. Sci. 4: 168. 1872 [Basionym] \equiv *Oryzopsis bloomeri* (Bol.) Ricker, Contr. U.S. Natl. Herb. 11: 109. 1906 \equiv \times *Stiporyzopsis bloomeri* (Bol.) B.L. Johnson, Amer. J. Bot. 32: 602, f. 14–18. 1945 \equiv *Achnatherum* \times *bloomeri* (Bol.) Barkworth, Phytologia 74(1): 14. 1993 Type: USA, California, Bloody Canyon near Mono Lake, Sep 1866, *H.N. Bolander 6116* (lectotype: US-2947421! [US-00141573 image!] **designated here**, partial lectotype [collection number only] designated by Hitchcock Flora N. Amer. 17(6): 429. 1935;

isoelectotypes: CAS-0005671 [image!], K-000912826 [image!], K-000912827 [image!], MO-2151483 [image!], MO-2151484 [image!], UC-38998 [image!].

***Eriocoma bracteata* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199069-1

Stipa bracteata Swallen, J. Wash. Acad. Sci. 30(5): 213. 1940 [Basionym] \equiv *Achnatherum bracteatum* (Swallen) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 15. 2003. Type: Mexico, Baja California, collected on grassy flats 25 mi N of Ensenada, 4 Apr 1931, *I.L. Wiggins 5153* (holotype: US-1721797!; isotypes: CAS-0004680 [image!], CAS-0004681 [image!], GH-00024475 [image!]).

***Eriocoma contracta* (B.L. Johnson) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199070-1

Oryzopsis hymenoides var. *contracta* B.L. Johnson, Bot. Gaz. 107: 24. 1945 [Basionym] \equiv *Oryzopsis contracta* (B.L. Johnson) Y. Schechter, Brittonia 18: 342. 1967 \equiv *Stipa contracta* (B.L. Johnson) W.A. Weber, Phytologia 67(6): 428. 1989, nom. illeg. hom., non *Stipa contracta* Phil. \equiv *Achnatherum contractum* (B.L. Johnson) Barkworth, Phytologia 74(1): 6. 1993. Type: USA, Wyoming, Carbon Co., Freezeout Hills, *E. Nelson 4850* (holotype: RM-0000328 [image!]).

***Eriocoma coronata* (Thurb.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199071-1

Stipa coronata Thurb., Bot. California 2: 287–288. 1880 [Basionym] \equiv *Achnatherum coronatum* (Thurb.) Barkworth, Phytologia 74(1): 6. 1993. Type: USA, California, San Diego Co., in a cañon around springs on hillside near Julian City, Apr 1872, *H.N. Bolander, A. Kellogg & co. s.n.* (lectotype: US-745776 [accession no.!] & US-00406146 [image!] **designated here**; isoelectotypes: GH-00017898 [image!], MO-2151562 [image!], MO-2151563 [image!], MO-2151564 [image!]).

***Eriocoma curvifolia* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199072-1

Stipa curvifolia Swallen, J. Wash. Acad. Sci. 23(10): 456. 1933 [Basionym] \equiv *Achnatherum curvifolium* (Swallen) Barkworth, Phytologia 74(1): 7. 1993. Type: USA, New Mexico, Eddy Co., Guadalupe Mountains, in crevices of limestone cliff near mouth of North Fork of Rocky Arroyo, 29 Apr 1932, *H. Wilkens 1660* (holotype: US-1538063!; isotype: PH-00028074 [image!]).

***Eriocoma hendersonii* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199073-1

Oryzopsis hendersonii Vasey, Contr. U.S. Natl. Herb. 1(8): 267 [Basionym] \equiv *Oryzopsis exigua* var. *hendersonii* (Vasey) M.E. Jones, Contr. W. Bot. 14: 11. 1912 \equiv *Stipa hendersonii* (Vasey) Mehlenb., Canad. J. Bot. 49(9): 1568. 1971 \equiv *Achnatherum hendersonii* (Vasey) Barkworth, Phytologia 74(1): 7. 1993. 1893. Type: USA, Washington, North Yakima, Clements Mountain, 1892, *L.F. Henderson 2249* (holotype: US-81978!).

***Eriocoma hymenoides* (Roem. & Schult.) Rydb., Bull. Torrey Bot. Club 39(3): 102. 1912.**

Stipa hymenoides Roem. & Schult., Syst. Veg. 2: 339. 1817 [Basionym] \equiv *Stipa membranacea* Pursh, Fl. Amer. Sept. II: 728. 1814 nom. illeg., non *Stipa membranacea* L. \equiv *Oryzopsis membranacea* Vasey, U.S.D.A. Div. Bot. Bull. 12(2): 10, t. 10. 1891, nom. illeg. superfl. \equiv *Eriocoma membranacea* (Vasey) Beal, Grass. N. Amer. 2: 232. 1896, nom. illeg. superfl. \equiv *Oryzopsis hymenoides* (Roem. & Schult.) Ricker ex Piper, Contr. U.S. Natl. Herb. 11: 109. 1906 \equiv *Achnatherum hymenoides* (Roem. & Schult.) Barkworth, Phytologia 74(1): 7–8. 1993. Type: USA, on the banks of the Missouri River, *J. Bradbury no. 12* (lectotype: K-000912825 [image!]) **designated here**; isolectotype: PH-00008181 [image!]). Fig. 1G–L.

= *Eriocoma cuspidata* Nutt., Gen. N. Amer. Pl. 1: 40. 1818 \equiv *Milium cuspidatum* (Nutt.) Spreng., Syst. Veg. 1: 251. 1824 \equiv *Urachne lanata* Trin. & Rupr., Mem. Acad. Imp. Sci. Saint-Petersbourg, Ser. 6, Sci. Math., Seconde Pt. Sci. Nat. 3,1(2–3): 126. 1834, nom. Illeg. superfl. \equiv *Eriocoma membranacea* Steud., Nomencl. Bot. (ed 2) 1: 586. 1840, nom. inval., as syn. of *Urachne lanata* Trin. \equiv *Oryzopsis cuspidata* (Nutt.) Benth. ex Vasey, Grass. U.S. 23. 1883. Type: USA, Platte Plains, *T. Nuttall s.n.* (lectotype: BM-001042144 [image!]) **designated here**; isolectotype: LE-TRIN 1466.01 ex PH!).

= *Fendleria rhynchelytroides* Steud., Syn. Pl. Glumac. 1: 420. 1854. Type: USA, New Mexico, near Santa Fe, 1847, *A. Fendler 979* (lectotype: P-01941338 [image!]) **designated here**; isolectotypes: GH-00023719 [image!], K-000912824 [image!], NY [image!], S14-1154 [image!], US-823154 [image!], W-0029207 [image!], W-0029208 [image!], W-18890236595 [image!].

***Eriocoma latiglumis* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199074-1

Stipa latiglumis Swallen, J. Wash. Acad. Sci. 23(4): 198, f. 1. 1933 [Basionym] \equiv *Achnatherum latiglume* (Swallen) Barkworth, Phytologia 74(1): 8. 1993. Type: USA, California, Yosemite Valley, Camp Lost Arrow, 4000–4500 ft, 22 Jun 1911, *L. Abrams 4469* (holotype: US-992334!; isotype: US-59760!).

***Eriocoma lemmonii* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199075-1

Stipa pringlei var. *lemmonii* Vasey, Contr. U.S. Natl. Herb. 3(1): 55. 1892 [Basionym] ≡ *Stipa lemmonii* (Vasey) Scribn., Circ. Div. Agrostol. U.S.D.A. 30: 3. 1901 ≡ *Achnatherum lemmonii* (Vasey) Barkworth, Phytologia 74(1): 8. 1993. Type: USA, California, Plumas Co., Mohawk Valley, May 1889, *J.G. Lemmon 5456* (holotype: US-556900!).

= *Stipa columbiana* Macoun, Cat. Canad. Pl. 2(4): 191. 1888, nom. utique rej. under International Code of Botanical Nomenclature (ICBN 1988) Art. 56.1, (see ICNAFP 2018 - Appendix V; also Barkworth and Maze 1979). Type: Canada, British Columbia, Yale, on rocks, 17 May 1875, *J. Macoun 28940* (lectotype: CAN-9899 designated by Hitchcock, Contr. U.S. Natl. Herb. 24(7): 253. 1925; isolectotype: US-77975!).

***Eriocoma lemmonii* subsp. *pubescens* (Crampton) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199076-1

Stipa lemmonii var. *pubescens* Crampton, Leaf. W. Bot. 7(9): 220. 1955 [Basionym] ≡ *Achnatherum lemmonii* subsp. *pubescens* (Crampton) Barkworth, Phytologia 74(1): 8. 1993. Type: USA, California, Tehama Co., Whitlock Camp, Round Mt. area west of Paskenta, 4000 ft, 16 Jul 1954, *B. Crampton 2000* (holotype: AHUC-21077 [image!]; isotypes: AHUC-21078 [image!], CAS-0005669 [image!], US-2152024!).

= *Stipa lemmonii* var. *jonesii* Scribn., Bull. Div. Agrostol., U.S.D.A. 30: 4. 1901. Type: USA, California; Emigrant Gap, 28 Jun 1882, *M.E. Jones 3298* (holotype: US-556899! [US-00141633 image!]; isotypes: BR-0000006884598 [image!], CAS-0005668 [image!], GH-00017900 [image!], MO-2151560 [image!], NY-00431560 [image!]), POM-116527).

***Eriocoma lettermanii* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199077-1

Stipa lettermanii Vasey, Bull. Torrey Bot. Club 13: 53. 1886 [Basionym] ≡ *Stipa viridula* var. *lettermanii* (Vasey) Vasey, Contr. U.S. Natl. Herb. 3(1): 50. 1892 ≡ *Achnatherum lettermanii* (Vasey) Barkworth, Phytologia 74(1): 9. 1993. Type: USA, Idaho, Snake River, Aug 1885, *G.W. Letterman 102* (lectotype: US-556904! designated by Hitchcock, Manual. Grass. US ed. 1, 964. 1935 as to the collection no. 102, Barkworth & Maze identified the US specimen number, Taxon 31(2): 294 f. 6. 1982).

= *Stipa viridula* var. *minor* Vasey, Contr. U.S. Natl. Herb. 3(1): 50. 1892 ≡ *Stipa occidentalis* var. *minor* (Vasey) C.L. Hitchc., Vasc. Pl. Pacific NW 1: 714. 1969 ≡ *Stipa minor* (Vasey) Scribn., Bull. Div. Agrostol., U.S.D.A. 11: 46–47. 1898. Type:

USA, Colorado, Kelso Mountain near Torrey's Peak, 13000 ft, 13 Aug 1885, *G. W. Letterman* 95 (lectotype: US-556903! designated by Hitchcock, Contr. U.S. Natl. Herb. 24(7): 253. 1925).

***Eriocoma lobata* (Swallen) Romasch. comb. nov.**

urn:lsid:ipni.org:names:77199078-1

Stipa lobata Swallen, J. Wash. Acad. Sci. 23(10): 199, f. 2. 1933 [Basionym] ≡ *Achnatherum lobatum* (Swallen) Barkworth, Phytologia 74(1): 9. 1993. Type: USA, New Mexico, Guadalupe Co., Queen, Guadalupe Mts., on a rocky hill, Ranger Station, 6000–7000 ft, 3–6 Sep 1915, *A. S. Hitchcock* 13502 (holotype: US-905722!). Fig. 2A–G.

***Eriocoma nelsonii* (Scribn.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199079-1

Stipa nelsonii Scribn., Bull. Div. Agrostol., U.S.D.A. 11: 46. 1898 [Basionym] ≡ *Stipa columbiana* var. *nelsonii* (Scribn.) Hitchc., Contr. U.S. Natl. Herb. 24(7): 254. 1925 ≡ *Stipa columbiana* var. *nelsonii* (Scribn.) H. St. John, Fl. S.-E. Washington 61. 1937 ≡ *Stipa occidentalis* var. *nelsonii* (Scribn.) C.L. Hitchc., Vasc. Pl. Pacific NW 1: 715. 1969 ≡ *Achnatherum nelsonii* (Scribn.) Barkworth, Phytologia 74(1): 9. 1993. Type: USA, Wyoming, Albany Co., Woods Landing, 2600 m, 9 Aug 1898, *A. Nelson* 3963 (lectotype: US-556901! designated by Barkworth, Phytologia 74(1): 9. 1993; isoelectotype: MPU-026968 [image!]).

= *Stipa williamsii* Scribn., Bull. Div. Agrostol., U.S.D.A. 11: 45–46, t. 4. 1898. Type: USA, Wyoming, dry soil on W side of Big Horn Mt., near Monument Spring, 2200–2400 m, 3 Aug 1897, *T.A. Williams* 2804 (lectotype: US-556907! & US-00141714 [image!] **designated here**, partially lectotypified by Hitchcock, N. Amer. Fl., part 6. 422. 1935).

***Eriocoma nelsonii* subsp. *dorei* (Barkworth & J. Maze) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199080-1

Stipa nelsonii subsp. *dorei* Barkworth & J. Maze, Taxon 28(5/6): 623 [Basionym] ≡ *Stipa nelsonii* var. *dorei* (Barkworth & J. Maze) Dorn, Vasc. Pl. Wyoming 298. 1988 ≡ *Achnatherum nelsonii* subsp. *dorei* (Barkworth & J. Maze) Barkworth, Phytologia 74(1): 9. 1993. 1979. Type: Canada, Alberta, Dungarvan Creek, *W.G. Dore* 12136 (holotype: DAO-000465415 [image!]).

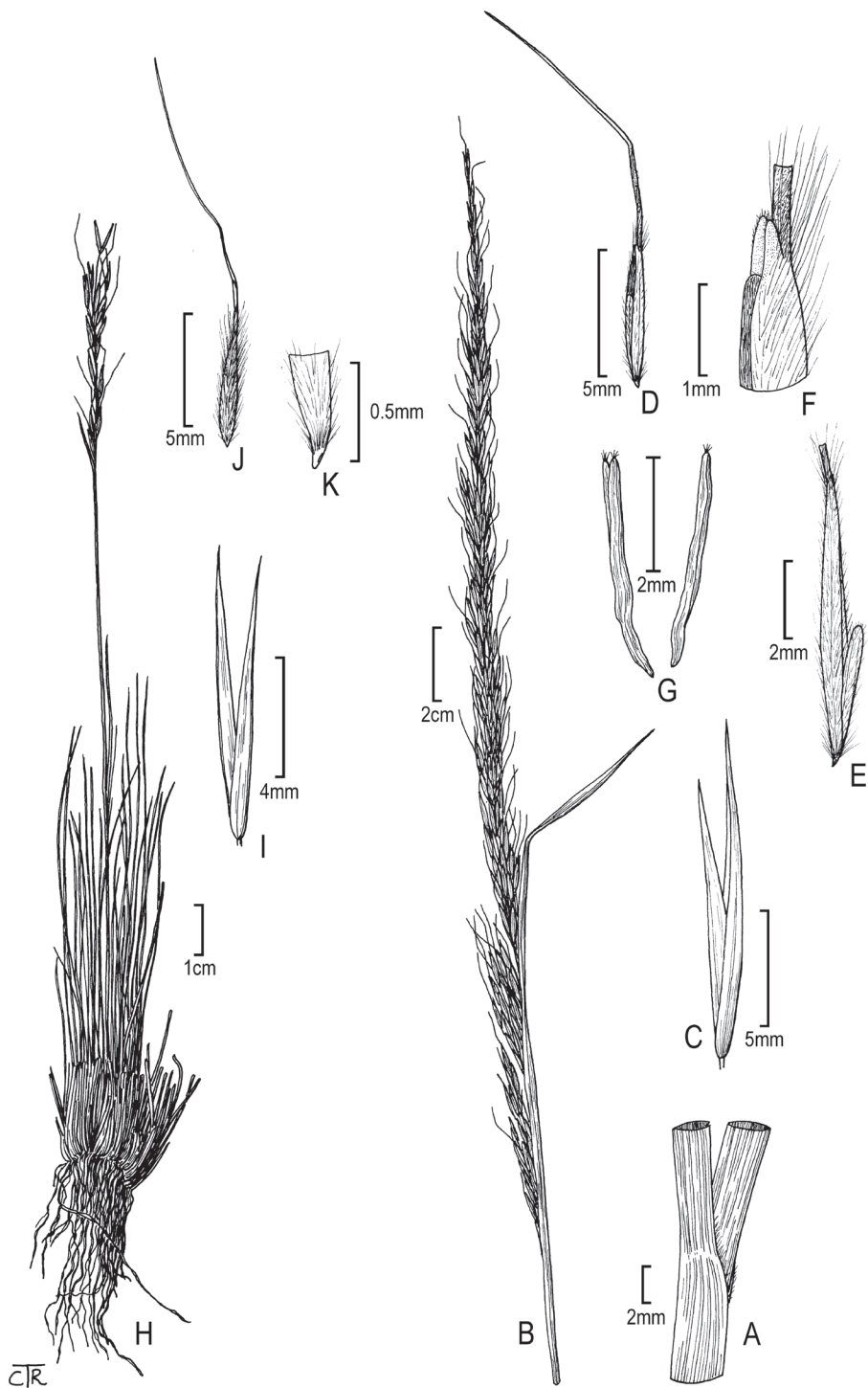


Figure 2. *Eriocoma lobata*: **A** sheath and blade **B** panicle **C** glumes **D** floret **E** floret (close up) **F** lemma apex **G** anthers. *Eriocoma pinetorum*: **H** habit **I** glumes **J** floret **K** floret base (callus).

***Eriocoma nevadensis* (B.L. Johnson) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199081-1

Stipa nevadensis B.L. Johnson, Amer. J. Bot. 49: 257. 1962 [Basionym] \equiv *Achnatherum nevadense* (B.L. Johnson) Barkworth, Phytologia 74(1): 9. 1993. Type: USA, California, Mono Co., Upper Twin Lake, near Bridgeport, 7096 ft, 29 Aug 1960, *B.L. Johnson 211* (holotype: UC-1936202 [image!]; isotypes: ARIZ-BOT-0005299[image!], DAV-181068 [image!], SD-00000116 [image!]).

***Eriocoma occidentalis* (Thurb. ex S. Watson) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199082-1

Stipa occidentalis Thurb. ex S. Watson, Botany (Fortieth Parallel) 380. 1871 [Basionym] \equiv *Stipa stricta* var. *sparsiflora* Vasey, Contr. U.S. Natl. Herb. 3(1): 51. 1892 \equiv *Stipa occidentalis* var. *montana* Merr. & Davy, Univ. Calif. Publ. Bot. 1: 62. 1902, nom. illeg. superfl. *Achnatherum occidentale* (Thurb. ex S. Watson) Barkworth, Phytologia 74(1): 10. 1993 \equiv Type: USA, California, Yosemite Trail, 8000 ft, 20 Aug 1866, *H.N. Bolander 5038* (lectotype: GH-22338! designated by Hitchcock, Contr. U.S. Natl. Herb. 24(7): 242. 1925; isoelectotypes: BM-000797606 [image!], G-00176505 [image!], MO-2151636 [image!], NY-00431565 [image!], NY-00431567 [image!], US-3441781, US-992306 ex GH!, US-745821!, W-18890217496 [image!], YU-244757 [image!]).

= *Stipa stricta* Vasey, Bull. Torrey Bot. Club 10: 42. 1883, nom. illeg. hom. non *S. stricta* Lam. \equiv *Stipa oregonensis* Scribn., Bull. Div. Agrostol., U.S.D.A. 17: 130, f. 426. 1899. Type: USA, "Oregon" [but from Washington, which became a state in 1889], 1882, *W.N. Suksdorf s.n.* (holotype: US-556921!).

***Eriocoma occidentalis* subsp. *californica* (Merr. & Burt Davy) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199083-1

Stipa californica Merr. & Burt Davy, Univ. Calif. Publ. Bot. 1: 61. 1902 [Basionym] \equiv *Stipa occidentalis* var. *californica* (Merr. & Burt Davy) C.L. Hitchc., Vasc. Pl. Pacific NW 1: 715. 1969 \equiv *Achnatherum occidentale* subsp. *californicum* (Merr. & Burt Davy) Barkworth, Phytologia 74(1): 10. 1993. Type: USA, California, San Jacinto Mts., north side of Fullers Ridge, 2100 m, Jul 1901, *H.M. Hall 2556* (holotype: unknown; isotypes: CAS-0005660 [image!], US-556911!).

= *Stipa nelsonii* var. *longiaristata* Barkworth & J. Maze, Taxon 28(5/6): 623. 1979 \equiv *Achnatherum nelsonii* subsp. *longiaristatum* (Barkworth & J. Maze) Barkworth, Phytologia 74(1): 9. 1993. Type: USA, Washington, 8–9 mi W of Spokane, 19 Jun 1940, *J.S. Swallen 6231* (holotype: DAO-000465413 [image!]; isotype: US-2303647!).

***Eriocoma occidentalis* subsp. *pubescens* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199084-1

Stipa viridula var. *pubescens* Vasey, Contr. U.S. Natl. Herb. 3(1): 50. 1892 [Basionym] \equiv *Stipa elmeri* Piper & Brodie ex Scribn., Bull. Div. Agrostol., U.S.D.A. 11: 46. 1898 \equiv *Stipa occidentalis* var. *pubescens* (Vasey) J. Maze, Roy L. Taylor & MacBryde, Canad. J. Bot. 56(2): 193. 1978 \equiv *Achnatherum occidentale* subsp. *pubescens* (Vasey) Barkworth, Phytologia 74(1): 10. 1993. Type: USA, Washington, on dry ground along the Columbia River, 1883, *W.N. Suksdorf s.n.* (lectotype: US-79560! [US-00036944 image!], designated by Hitchcock, Contr. U.S. Natl. Herb. 24(7): 241. 1925; isoelectotype: GH-00443467 [image!]).

***Eriocoma parishii* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199085-1

Stipa parishii Vasey, Bot. Gaz. 7(3): 33. 1882 [Basionym] \equiv *Stipa coronata* var. *parishii* (Vasey) Hitchc., Contr. U.S. Natl. Herb. 24: 227, t. 50, f. 13. 1925 \equiv *Achnatherum parishii* (Vasey) Barkworth, Phytologia 74(1): 11. 1993. Type: USA, California, San Bernardino Mts., Aug 1881, *S.B. Parish & W.F. Parish 1079* (lectotype: US-556918! & US-00406147 [image!] designated by Hitchcock, Contr. U.S. Natl. Herb. 24(7): 227. 1925).

***Eriocoma parishii* subsp. *depauperata* (M.E. Jones) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199086-1

Stipa parishii var. *depauperata* M.E. Jones, Contr. W. Bot. 14: 11. 1912 [Basionym] \equiv *Stipa coronata* var. *depauperata* (M.E. Jones) Hitchc., J. Wash. Acad. Sci. 24(7): 292. 1934 \equiv *Achnatherum parishii* subsp. *depauperatum* (M.E. Jones) Barkworth, Phytologia 74(1): 11. 1993. Type: USA, Utah, Detroit, 25 May 1891, *M.E. Jones s.n.* (holotype: RSA-0000500 [image!]; isotype: US-83026!).

***Eriocoma perplexa* (Hoge & Barkworth) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199087-1

Achnatherum perplexum Hoge & Barkworth, Phytologia 74(1): 11. 1993 [Basionym] \equiv *Stipa perplexa* (Hoge & Barkworth) Wipff & S.D. Jones, Phytologia 77(6): 461. 1995. Type: USA, New Mexico, Bernalillo Co., Cibola National Forest, 1.5 mi E of USFS road 413, 9 mi S of Tijeras on NM 14, 8 Sep 1985, *M.E. Barkworth 4764* (holotype: US-3239133!; isotype: RSA-0000391 [image!]).

***Eriocoma pinetorum* (M.E. Jones) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199088-1

Stipa pinetorum M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 724. 1895 [Basionym] \equiv *Achnatherum pinetorum* (M.E. Jones) Barkworth, Phytologia 74(1): 12. 1993. Type: USA, Utah, Panguitch Lake, 8400 ft, growing in open places among the pine forests, 8 Sep 1894, *M.E. Jones 6023* (holotype: RSA-0000501 [image!]); isotype: US-236788!). Fig. 2H–K.

***Eriocoma richardsonii* (Link) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199089-1

Stipa richardsonii Link, Enum. Pl. 2: 245. 1833 [Basionym] \equiv *Oryzopsis richardsonii* (Link) Beal, Bot. Gaz. 15(5)12: 111. 1890 \equiv *Achnatherum richardsonii* (Link) Barkworth, Phytologia 74(1): 12. 1993. Type: Habitat in America boreali occidentalis, cultivated in Hortus Berolensis from seed sent by Richardson (lectotype: LE-TRIN-1436.01 fragm. ex B! **designated here**).

***Eriocoma robusta* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199090-1

Stipa viridula var. *robusta* Vasey, Contr. U.S. Natl. Herb. 1(2): 56. 1890 [Basionym] \equiv *Stipa robusta* (Vasey) Scribn., Bull. Div. Agrostol., U.S.D.A. 5: 23. 1897 \equiv *Stipa vaseyi* Scribn., Bull. Div. Agrostol., U.S.D.A. 11: 46. 1898, nom. illeg. superfl. \equiv *Achnatherum robustum* (Vasey) Barkworth, Phytologia 74(1): 12. 1993. Type: USA, New Mexico, 1881, *G.R. Vasey s.n.* (conserved type: US-993051!). Fig. 3A–G.

***Eriocoma scribneri* (Vasey) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199091-1

Stipa scribneri Vasey, Bull. Torrey Bot. Club 11: 125. 1884 [Basionym] \equiv *Achnatherum scribneri* (Vasey) Barkworth, Phytologia 74(1): 13. 1993. Type: USA, New Mexico, Santa Fe Co., Santa Fe, collected on dry hillsides, Aug 1884, *G.R. Vasey s.n.* (lectotype: US-556905! & US-00141676 [image!] designated by Barkworth in Phytologia 74(1): 13. 1993; isoelectotypes: K-000873388 [image!], MO-2151550 [image!], MSC-0092941 [image!], NY-00431574 [image!], PH-00028089 [image!], US-84603!, W-19160026444 [image!]).

***Eriocoma swallenii* (C.L. Hitchc. & Spellenb.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199092-1

Oryzopsis swallenii C.L. Hitchc. & Spellenb., Brittonia 20: 164. 1968 [Basionym] \equiv *Achnatherum swallenii* (C.L. Hitchc. & Spellenb.) Barkworth, Phytologia 74(1): 14. 1993. Type: USA, Idaho, Clark Co., just N of Birch Creek, along Hwy. 28, near the Lemhi Co. line, 7 Jul 1965, *C.L. Hitchcock* 23868 (holotype: WTU-227273 & WTU-V-000041 [image!]; isotypes: CAS-0006990 [image!], COLO-00391284 [image!], DAV-38298 [image!], DAO-000465414 [image!], F-0046857F [image!], G-00176562 [image!], GH-00024084 [image!], ID-00157718 [image!], NCU-00000362 [image!], NY-00381560 [image!], OSC-0001820 [image!], RM-0000329 [image!], RSA-0000458 [image!], TEX-00370123 [image!], UBC-V116845 [image!], US-3465271! , V-047552 [image!]).

***Eriocoma thurberiana* (Piper) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199093-1

Stipa thurberiana Piper, Circ. Div. Agrostol. U.S.D.A. 27: 10. 1900, nom. nov [Basionym] \equiv *Stipa occidentalis* Thurb., U.S. Expl. Exped. 17: 483. 1874 non. *Stipa occidentalis* Thurb. ex S. Watson \equiv *Achnatherum thurberianum* (Piper) Barkworth, Phytologia 74(1): 14. 1993. Type: USA, Washington, North Branch of the Columbia River, *C. Pickering* & *W. D. Brackenridge s.n.* (holotype: GH-00017772 [image!]).

***Eriocoma wallowaensis* (J. Maze & K. Robson) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199094-1

Achnatherum wallowaense J. Maze & K. Robson, Madrono 43(3): 401, f. 1–2. 1996 [Basionym]. Type: USA, Oregon, Wallowa Co., Wallowa-Whitman National Forest, ca. 34 km N of Enterprise, near Boner Gulch along Forest Service road, 46, 45°43'41.16"N, 117°08'10.32"W (SW 1/4 of SE 1/4, sect 24, T3N, R45E), 1481 m, 26 Jun 1993, *J. Maze*, *E. Maze*, *K.A. Robson* & *T. Henn* 1007 (holotype: US-3323518!; isotypes: COLO-00339663 [image!], DAV-126946 [image!], DAV-128405 [image!], ID-00157713 [image!], MO-128384 [image!], NCU-00012752 [image!], NY-00039022 [image!], UBC-V209875 [image!]).

***Eriocoma webberi* Thurb., Bot. California 2: 283–284. 1880**

Eriocoma webberi Thurb., Bot. California 2: 283–284. 1880 [Basionym] \equiv *Oryzopsis webberi* (Thurb.) Benth. ex Vasey, Grass. U.S. 23. 1883 \equiv *Stipa webberi* (Thurb.)

B.L. Johnson, Bot. Gaz. 107: 25. 1945 \equiv *Achnatherum webberi* (Thurb.) Barkworth, Phytologia 74(1): 14. 1993. Type: USA, California, Sierra Valley, 1 May 1871, *H.N. Bolander, A. Kellogg & co. s.n.* (holotype: GH-00024083 [image!]; isotypes: MO-2151485[image!], NY-00381032 [image!], US-81935!).

\times *Eriosella* Romasch., nothogen. nov.

urn:lsid:ipni.org:names:77199095-1

Eriocoma Nutt. \times *Nassella* (Trin.) E. Desv. Type: \times *Eriosella caduca* (Beal) Romasch. (\equiv *Oryzopsis caduca* Beal)

Description. Plants perennial, caespitose, not rhizomatous. Culms up to 90 cm tall, nodes glabrous. Leaf sheaths mostly glabrous, margins sparsely ciliate, hairs longer apically; collars glabrous or with tufts of hairs; ligules 0.5–1.7 mm long, scarious, glabrous, apex truncate to obtuse; blades 1–3.5 mm wide, flat to convolute when dry, apices narrowly acute; basal blades to 40 cm long; flag blades longer than 10 cm. Panicles 15–18 cm long, narrow, branches ascending. Spikelets 6–8.5 mm long, fusiform, with one fertile floret without rachilla extension, disarticulation above the glumes; glumes 6–8.5 mm long, longer than the florets, saccate-lanceolate, 3–5-veined, apices attenuate from about the middle; upper glumes slightly narrower than the lower; florets 4–5 mm long, fusiform; calluses about 0.7 mm long, blunt; lemmas 7-veined, coriaceous, evenly hairy throughout, the hairs 1–2 mm long, apex minutely lobed; lemmatal awns 9–16 mm long, twisted, straight or 1-geniculate, readily deciduous, lower portion scabrous and without hairs; paleas 2.5–3.3 mm long, 2/3–3/4 as long as the lemma, hairy; stamens 2, anthers 1.2–2.3 mm long, variable in length within the floret, 2 in number indehiscent, penicillate, with only a few apical hairs. Caryopses not seen.

Etymology. The name, \times *Eriosella*, is a combination of the prefix ‘Erio’ from *Eriocoma* and the suffix ‘sella’ from *Nassella*.

Distribution. Known only from Montana, North Dakota, and western Wyoming (Johnson and Rogler 1943; Barkworth 2007).

\times *Eriosella caduca* (Beal) Romasch., comb. nov.

urn:lsid:ipni.org:names:77199096-1

Oryzopsis caduca Beal, Bot. Gaz. 15(5): 111. 1890 [Basionym] \equiv *Eriocoma caduca* (Beal) Rydb., Mem. New York Bot. Gard. 1: 25. 1900 \equiv *Stipa caduca* (Beal) Scribn., Contr. U.S. Natl. Herb. 3(1): 54. 1892 \equiv \times *Stiporyzopsis caduca* (Beal) B.L. Johnson & Rogler, Amer. J. Bot. 30: 55, f. 10, 14, 28–33. 1943 \equiv \times *Achnella caduca* (Beal) Barkworth, Phytologia 74(1): 15. 1993. Type: USA, Montana, Belt Mts., Sixteen Mile Cr., 11 Jul 1883, *F.L. Scribner s.n.* (holotype: US-745838!).

Comments. \times *Eriosella caduca* is thought to be a hybrid between *Eriocoma hymenoides* and *Nassella viridula*. It can be separated from *E. hymenoides* in having shorter hairs on the lemma and panicles with ascending branches (not divergent), and from *N. viridula* in having longer lemma hairs, paleas $2/3$ – $3/4$ as long as the lemma, and readily deciduous lemmatal awns (Barkworth 2007). Another species similar to \times *Eriosella caduca* is *Eriocoma bloomeri*. However, the latter species has glabrous sheaths, shorter ligules, 5-veined lemmas, awns with a sub-plumose lower section below the bend, and anthers with more numerous apical hairs (Johnson and Rogler 1943).

***Neotrinia* (Tzvelev) M. Nobis, P. Gudkova & A. Nowak, Turczaninowia 22 (1): 40. 2019**

Achnatherum sect. *Neotrinia* Tzvelev, Novosti Sist. Vyssh. Rast. 9: 55. 1972.

Type. *Neotrinia splendens* (Trin.) M. Nobis, P. Gudkova & A. Nowak (\equiv *Stipa splendens* Trin.).

Description. Plants perennial, caespitose, robust, not rhizomatous with intravaginal branching. Culms 40–250 cm tall, 2–5 mm thick below with 3–7 nodes, glabrous, smooth. Leaf sheaths glabrous, becoming fibrous below, margins ciliate, striate; collars glabrous; ligules membranous, glabrous; basal ligules 1–2.5 mm long, apex truncate to obtuse; upper ligules 2.5–12 mm long, apex acute; blades 20–60 cm long, 2–7 (–10) mm wide, flat or involute, deeply grooved, glabrous, abaxial surface smooth, adaxial surface scabrous. Panicles 15–50 cm long, (4–) 8–35 cm wide, ovate; ascending branches up to 15 cm long, crowded or loosely spreading, whorled at most nodes. Spikelets 4–7 (–8.5) mm long, lanceolate, subterete with one fertile floret without rachilla extension; disarticulation above the glumes; glumes 2.5–6.5 mm long, subequal, membranous, (1–) 3–5-veined, without keels; lower glumes 2.5–4.4 mm long, shorter than the upper, 1 (–3)-veined, margins hyaline; upper glumes 4–6.5 mm long, 3–5-veined, apex acute; florets 4.2–7.2 mm long; calluses 0.3–0.5 mm long, elliptic, bearded; lemmas 4.2–7.2 mm long, evenly hairy, the hairs up to 1.5 mm long, apex 2-lobed, the lobes 0.5–1.3 mm long; lemma epidermal pattern saw-like; fundamental cells of variable length with lobate sidewalls 3–10 times longer than silica cells, irregularly alternating; silica bodies round, paired with crescent-shaped cork cells; lemmatal awns 5–12 mm long, straight or indistinctly 1-geniculate, slightly twisted and flexuous; paleas about as long or slightly shorter than the lemmas, 2-veined, hairy; stamens 3, anthers 3.5–4.5 mm long, penicillate, yellow; lodicules 3; stigmas 2; ovary glabrous. Caryopses 2–4 mm long, fusiform, pericarp adherent, hilum linear. Chromosome number $2n = 42, 46, 48$ (Freitag 1985; Gohil and Koul 1986).

***Neotrinia splendens* (Trin.) M. Nobis, P. Gudkova & A. Nowak, *Turczaninowia* 22 (1): 40. 2019**

Stipa splendens Trin., Neue Entdeck. Pflanzenk. 2: 54. 1821 [Basionym] \equiv *Agrostis longiaristata* Herb. in Ross. ex Kunth, Enum. Pl. 1: 178. 1833, nom. illeg. \equiv *Lasiagrostis splendens* (Trin.) Kunth, Révis. Gramin. 1: 58. 1829 \equiv *Achnatherum splendens* (Trin.) Nevski, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 4: 224. 1937. Type: Russia, Transbaicalia, Siberia, *Fischer et Steven s.n.* (holotype: LE-TRIN1444.1!). Fig. 3H–K.

Distribution and habitat. The single species, *Neotrinia splendens*, is native to Asia in Afghanistan, India, Kazakhstan, Kyrgyzstan, China, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, and Uzbekistan (Wu and Phillips 2006). In North America *N. splendens* has been introduced as an ornamental (Barkworth 2007). The species occurs in cold, semi desert regions along drainages at 2100–3800 m (Freitag 1985).

Comments. *Psammochloa villosa* (Trin.) Bor is sister to *Neotrinia splendens* in our earlier molecular phylogeny (BS = 100, PP = 1.00) and both species share the following morphological features: basal fibrous sheaths, panicles with whorled primary branches arising from the rachis, (1–) 3–5-veined glumes with hyaline margins, short, obtuse to elliptic calluses, and evenly hairy lemmas with flexuous caudaceous awns that arise between the apical teeth (Freitag 1985; Wu and Phillips 2006; Barkworth 2007; Romaschenko et al. 2012). *Neotrinia splendens* differs from *Psammochloa villosa* in having cespitose culms without rhizomes, 4–7 (–8.5) mm long spikelets, 2.5–6.5 mm long glumes, 4.2–7.2 mm long lemmas that are evenly hairy with hairs up to 1.5 mm long, linear-lanceolate lodicules (versus flabellate), and 3.5–4.5 mm long anthers. It also differs from *Achnatherum* in having saw-like lemma epidermal pattern.

As noted by Barkworth (2007), the plants are rarely grazed upon, and sometimes form dense tall stands in Asia (RJS pers. obs.; Tzvelev 1976, p. 564 comment). *Achnatherum caragana* (Trin.) Nevski was treated as the only other *A.* sect. *Neotrinia* species (Tzvelev 1976), and may belong to the genus.

***Oloptum* Röser & H.R. Hamasha, *Pl. Syst. Evol.* 298: 365. 2012**

Type. *Oloptum miliaceum* (L.) Röser & H.R. Hamasha (\equiv *Agrostis miliacea* L.).

Description. Plants perennial, loosely cespitose, not rhizomatous with extravaginal branching. Culms 50–150 cm tall, erect or geniculate ascending, glabrous, often branching at lower cauline nodes. Leaf sheaths glabrous, persistent, margins hyaline above, smooth; ligules membranous; basal ligules 0.5–1.5 mm long, apex truncate; upper ligules 1.5–4 mm long, apex obtuse to acute; blades (5–) 10–30 cm long, 2–10 mm wide, flat, glabrous, smooth or scaberulous, margins scaberulous, apex attenuate. Panicles 10–40 cm long, 3–15 (–18) cm wide, ovate, open; lower branches 3–8 cm long, ascending and spreading, whorled, 3–8 at a node or with 15–30 or more at the lowest

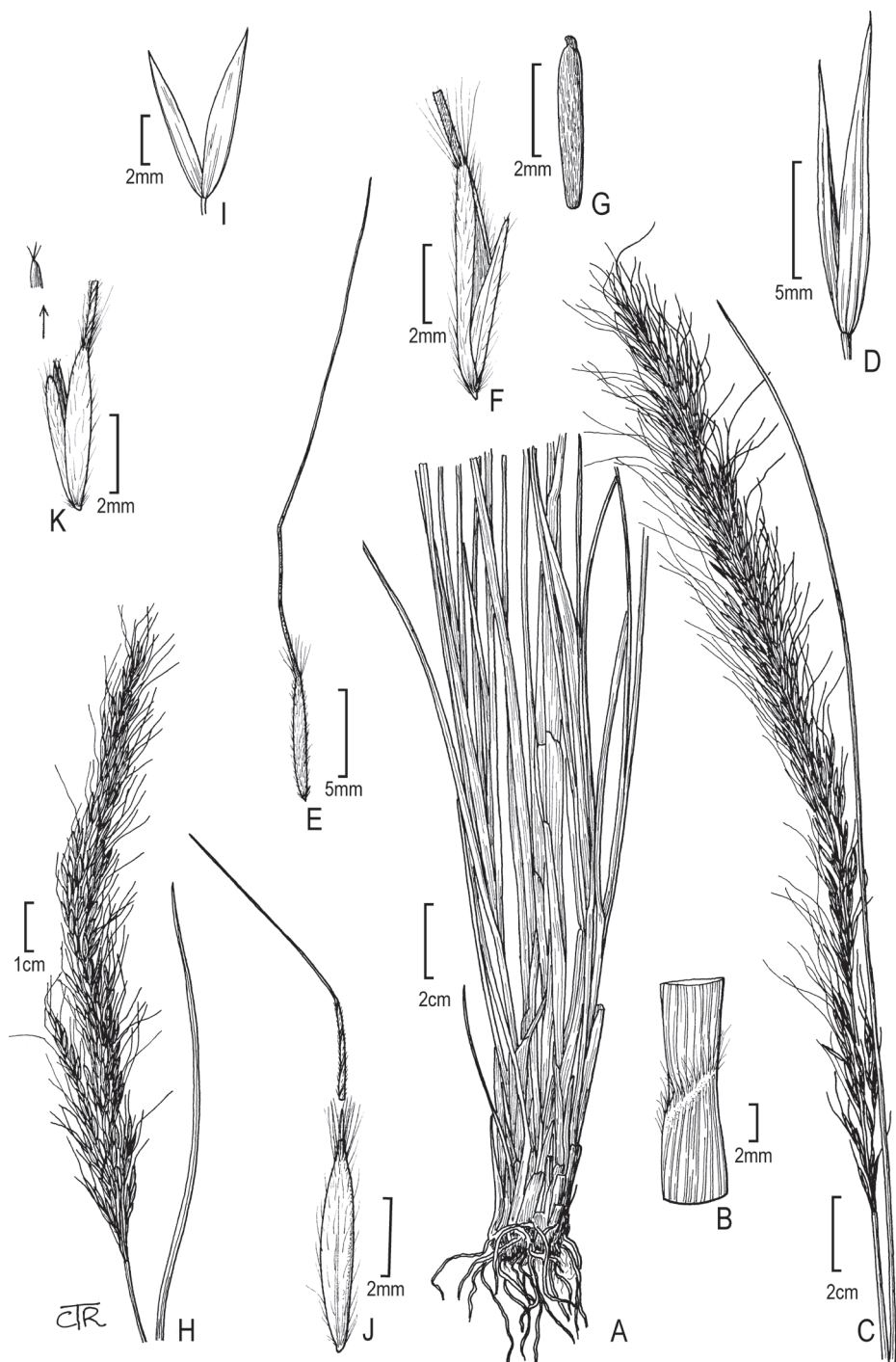


Figure 3. *Eriocoma robusta*: **A** habit **B** sheath and blade with a hairy collar **C** panicle **D** glumes **E** floret **F** floret (close up) **G** caryopsis. *Neotrinia splendens*: **H** panicle **I** glumes **J** floret **K** floret (close up) with anther tip (arrow).

node, these often with sterile spikelets. Spikelets 2.5–3.5 mm long, elliptic, dorsally compressed with one fertile floret without rachilla extension; disarticulation above the glumes; glumes subequal, longer than the florets, 3-veined without transverse veinlets, membranous, apices acuminate; florets 2–2.5 mm long, chartaceous; calluses about 0.3 mm long, with non-grooved circular disarticulation scar, glabrous; lemmas with narrow open borders, central vein not grooved, apex awned, the awns 3–5 mm long, flexuous, caudicous; lemma epidermal pattern maize-like; fundamental cells elongated with straight thin sidewalls 3–7 times longer than silica cells, irregularly alternating; silica bodies round; cork cells crescent-shaped scarce to absent; paleas about as long as the lemma, coriaceous, 2-veined; stamens 3, anthers 2–2.5 mm long, penicillate; lodicules 3; stigmas 2; ovary glabrous. Caryopses 1.5–1.7 mm long, fusiform, pericarp adherent, hilum linear about $\frac{1}{2}$ as long as the caryopsis. Chromosome number $2n = 24$ (Faruqi et al. 1987; Devesa et al. 1991; Luque and Lifante 1991; Verlaque et al. 1997).

***Oloptum miliaceum* (L.) Röser & H.R. Hamasha, Pl. Syst. Evol. 298(365): 2012**

Agrostis mileacea L., Sp. Pl. 1: 61. 1753 [Basionym] \equiv *Achnatherum miliaceum* (L.) P. Beauv., Ess. Agrostogr. 20, 146, 148. 1812 \equiv *Urachne miliacea* (L.) K. Koch, Linnaea 21(4): 439. 1848 \equiv *Piptatherum miliaceum* (L.) Coss., Notes Pl. Crit. 129. 1851 \equiv *Oryzopsis miliacea* (L.) Benth. & Hook. ex Asch. & Schweinf., Mém. Inst. Égypte 2: 169. 1887 \equiv *Stipa miliacea* (L.) Hoover, Leaf. W. Bot. 10(16): 340. 1966. Type: Sweden, Uppsala, *Anon. s.n.* (lectotype: LINN-HL84-2 [image!] designated by R.D. Meikle, Fl. Cyprus 2: 1794. 1985). Fig. 4A–E.

Distribution and habitat. *Oloptum miliaceum* is native to Europe, particularly the whole Mediterranean region, from northern Africa, Sinai to Western Asia (Arabian Peninsula, Cyprus, Egypt, Iraq, Iran, Israel, Jordan, Lebanon, Palestinian territories, Syria, and Turkey) [Freitag 1975; Soreng et al. 2003; Ibrahim et al. 2016]. It is naturalized in southern Africa, Australia, New Zealand, North America (Arizona, California, Maryland) and South America (Barkworth 2007), and has been cultivated in Mississippi, North Carolina, Tennessee, and Utah (see SEINet <http://swbiodiversity.org/seinet/collections/list.php?db=all&taxa=Achnatherum+miliaceum&usethes=1&taxontype=2&page=1>). The species occurs in various disturbed habitats along roadsides, ditches, borders of fields, dry river beds, and dumping grounds usually below 2000 m (Freitag 1975).

Comments. The unique morphological features of this taxon (glabrous lemma with a central vein not grooved, 3-veined glumes without transverse veinlets, and a callus with a circular disarticulation scar) were first recognized by Roshevitz (1951) and later officially named by Freitag (1975) as *Piptatherum* sect. *Miliacea* Roshev. ex Freitag. Lemma epidermal pattern of *Oloptum* is unusual among achnatheroid grasses resembling only that of *Celtica*. It is distinguished by having long fundamental cells irregularly alternating with silica bodies. In our earlier molecular analysis, *O. miliaceum* is sister to the Eurasian *Achnatherum* clade in the core *Achnatherum* clade, which also

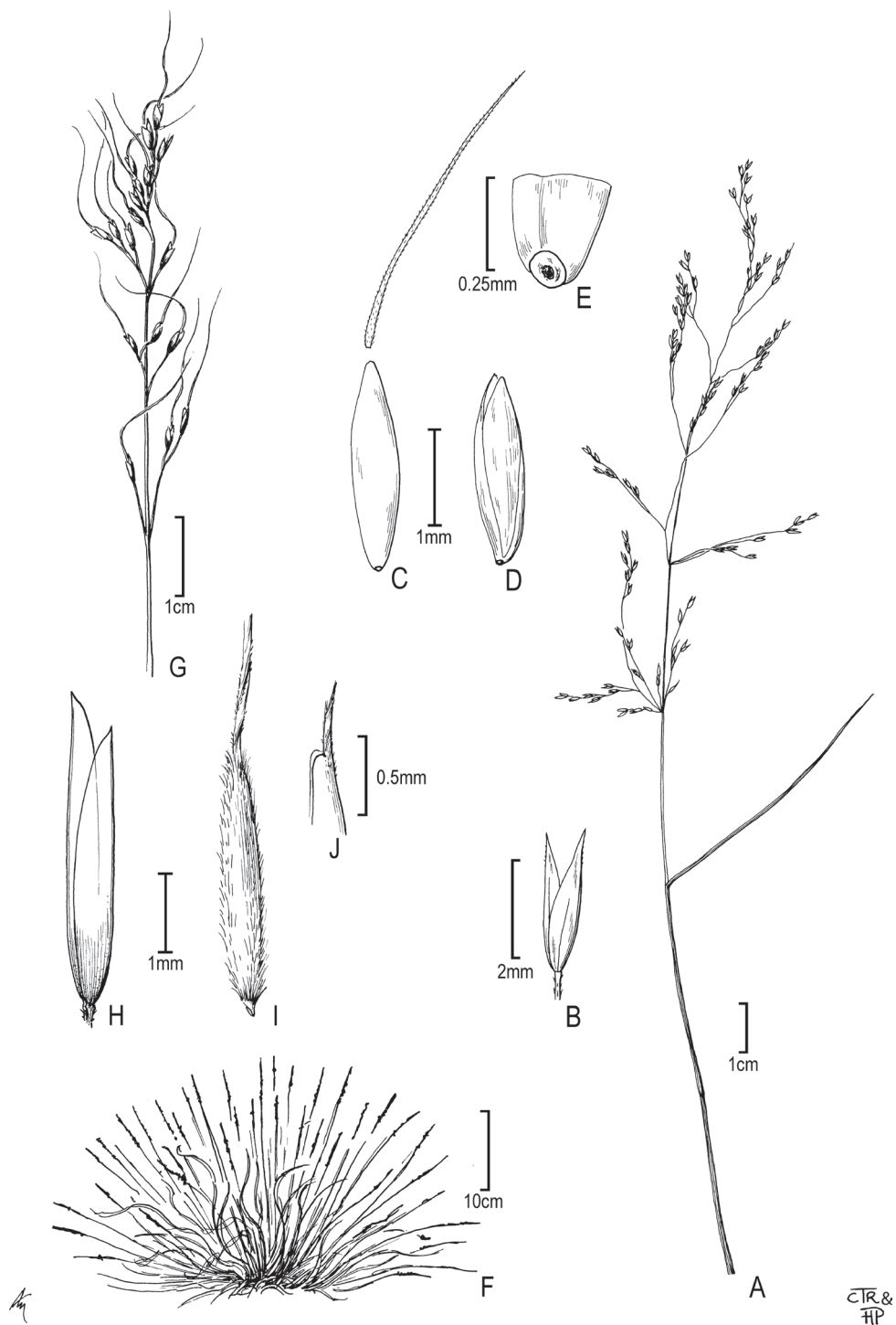


Figure 4. *Oloptum miliaceum*: **A** panicle **B** glumes **C** floret **D** lemma and palea **E** lemma base with disarticulation scar. *Ptilagrostiella kingii*: **F** habit **G** panicle **H** glumes **I** floret **J** lemma apex.

includes *Stipellula*, *Austrostipa* S.W.L. Jacobs & J. Everett, *Anemanthele* Veldkamp and *Celtica* F.M. Vázquez & Barkworth (Romaschenko et al. 2011, 2012).

Traditionally, two subspecies have been recognized. *Oloptum miliaceum* subsp. *thomasi* (Duby) Boiss. differs from the typical form in having densely verticillate panicles with 15–30 or more often sterile branches on the lowest whorl (Freitag 1975). There is genetic variation between these two subspecies in our earlier analyses (Romaschenko et al. 2011, 2012). A molecular study with a larger sample of the subspecies is necessary to fully explore evolutionary relationships.

***Pseudoeriocoma* Romasch., P.M.Peterson & Soreng, gen. nov.**

urn:lsid:ipni.org:names:77199097-1

Type. *Pseudoeriocoma eminens* (Cav.) Romasch. (\equiv *Stipa eminens* Cav.)

Diagnosis. *Pseudoeriocoma* differs from *Eriocoma* Nutt. in having bamboo-like culms commonly with up to 13 nodes, 3–6 mm thick below, with ramified branching at the middle and upper nodes.

Description. Plants perennial, caespitose, usually short rhizomatous from a knotty base. Culms 30–230 (often over 100) cm tall, erect or ascending, often geniculate, 3–6 mm thick and often woody and bamboo-like below with ramified and branching at the middle and upper nodes, with (2) 3–13 nodes, internodes glabrous or hairy. Leaf sheaths shorter than the internodes above to shorter or longer below, glabrous, pubescent or hirsute, sometimes ciliate on the margins and summit; collars glabrous or with a tuft of hairs; ligules 0.5–8 mm long, hyaline to membranous, apex truncate to acute or obtuse, often lacerate; blades (1.5–) 5–40 cm long, 1–4 mm wide, flat to tightly involute or convolute, glabrous or pubescent, usually scabrous. Panicles 8–45 (–55) cm long, usually rather narrow and less than 8.5 cm wide, loosely or densely flowered, branches ascending to spreading and naked near base; pedicles longer than the spikelets. Spikelets 8–15 mm long, lanceolate with one fertile floret without rachilla extension; disarticulation above the glumes; glumes (4–) 6–15 mm long, longer than the florets, subequal or unequal, hyaline to membranous, 1–7-veined, glabrous, acuminate; florets 4–7 mm long, usually fusiform; calluses 0.2–2 long, sharp, hairy; lemmas 4–7 mm long, fusiform, coriaceous, evenly hairy, the hairs 0.4–2 mm long, margins enveloping most of the palea, apex entire and awned; lemma epidermal pattern maize-like; fundamental cells squared, longitudinally compressed with straight thin sidewalls subequal to silica cells (silica bodies) or shorter, regularly alternating; cork cells absent; lemmatal awns 20–80 mm long, 2-geniculate, flexuous, the segments scabrous or pubescent; paleas 1–4.6 mm long, 1/3 to 3/4 as long as the lemmas, 2-veined, veins not prolonged, hairy; anthers 2.5–4 mm long, penicillate or not, 3 in number, lodicules 2 or 3; stigmas 2. Caryopses 3–4 mm long, fusiform, pericarp adherent, hilum linear.

Distribution and habitat. There are six species of *Pseudoeriocoma* occurring in southwestern North America (Mexico and USA). These species generally occur on steep rock outcrops in xerophytic vegetation; pinyon, pine, pine-oak woodlands, and spruce-fir forests; 600–3000 m (Barkworth 2007; Valdés Reyna 2015).

Comments. Within our preliminary molecular analyses of *Pseudoeriocoma* there are two clades each of *P. constricta*, *P. eminens*, and *P. multinodis* that require further study, and at least three species currently placed in *Jarava* from South America that align within *Pseudoeriocoma* (Romaschenko et al. 2012, 2014; Valdés Reyna et al. 2013; Romaschenko et al. in prep.).

***Pseudoeriocoma acuta* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199098-1

Stipa acuta Swallen, J. Wash. Acad. Sci. 30(5): 212. 1940 [Basionym] \equiv *Achnatherum acutum* (Swallen) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 15. 2003. Type: Mexico, Coahuila, on rocky soil on Carneras Pass, 21 mi S of Saltillo, 1 Sep 1938, *F. Shreve* 8545 (holotype: US-1760238!; isotype: ARIZ-BOT-0004856 [image!]).

***Pseudoeriocoma constricta* (Hitchc.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199099-1

Stipa constricta Hitchc., Contr. U.S. Natl. Herb. 24(7): 244, t. 51, f. 28–29. 1925 [Basionym] \equiv *Achnatherum constrictum* (Hitchc.) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 15. 2003. Type: Mexico, Hidalgo, Pachuca, collected on a rocky hill at 2400 m alt., 7 Sep 1910, *A.S. Hitchcock* 6742 (holotype: US-993345!; isotype: NY-00431580 [image!]).

***Pseudoeriocoma editorum* (E. Fourn.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199100-1

Stipa editorum E. Fourn., Mexic. Pl. 2: 75. 1886 [Basionym] \equiv *Achnatherum editorum* (E. Fourn.) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 16. 2003. Type: Mexico, in valle edita inter La Noria del Viejo et La Miquiguana, *W.F. von Karwinski* 1009c (holotype: P; isotypes: KFTA-0002846 [image!], US-866119A! fragm. ex P).

***Pseudoeriocoma eminens* (Cav.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199101-1

Stipa eminens Cav., Icon. 5: 42, t. 467, f. 1. 1799 [Basionym] \equiv *Achnatherum eminens* (Cav.) Barkworth, Phytologia 74(1): 7. 1993. Type: Mexico, Chalma, *L. Née s.n.* (holotype: MA-656523; isotype: US-866118!).

= *Stipa erecta* E. Fourn., Mexic. Pl. 2: 75. 1886, nom. illeg. hom., non *Stipa erecta* Trin. \equiv *Stipa erecta* E. Fourn., Biol. Cent.-Amer., Bot. 3: 536. 1885. nom. nud.

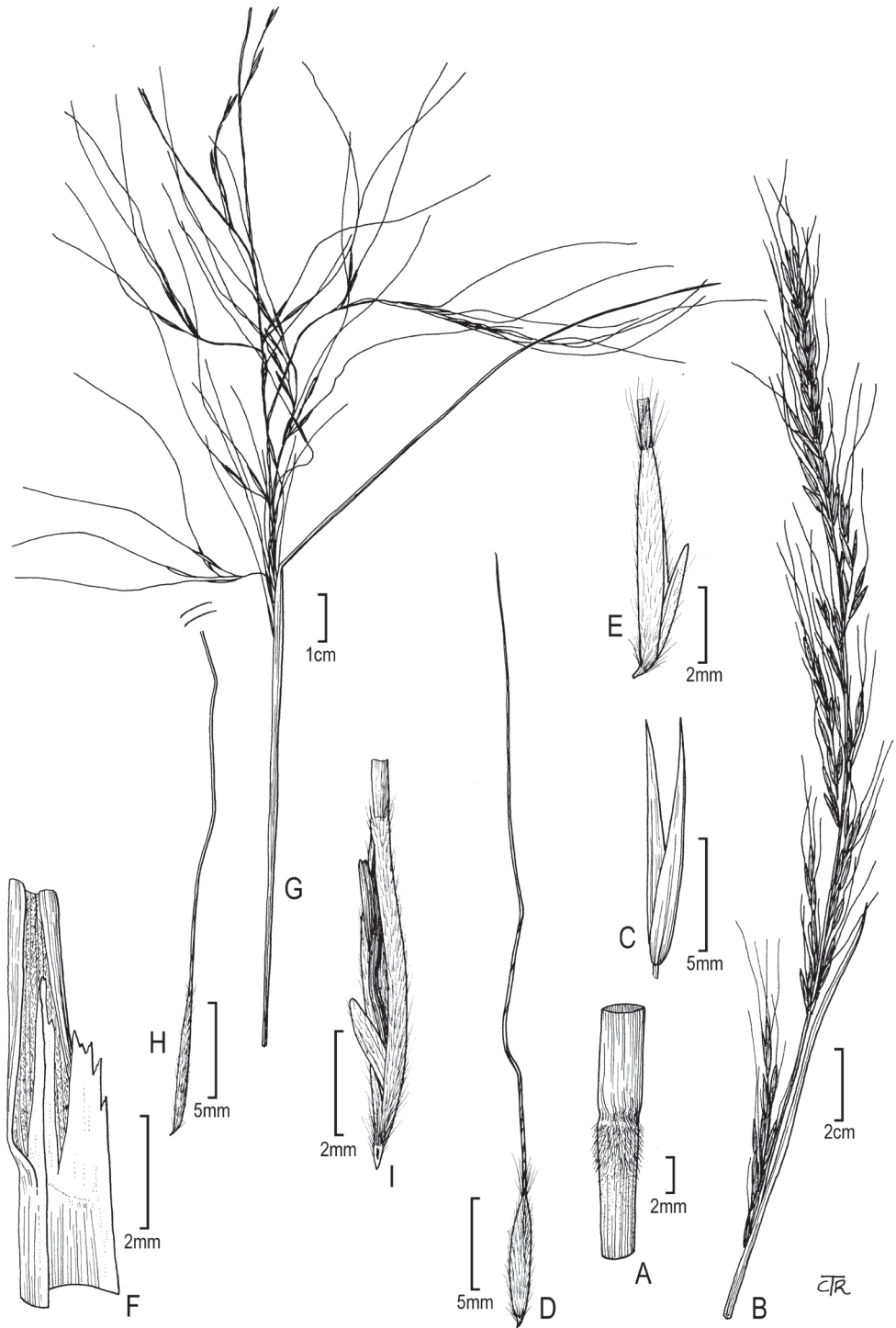


Figure 5. *Thorneochloa diegoensis*: **A** lower culm node **B** panicle **C** glumes **D** floret **E** floret (close up). *Pseudoeriocoma eminens*: **F** ligule **G** panicle **H** floret **I** floret (close up).

Type: Mexico, Tehuacán, Dec, *F.M. Liebmann 654* (holotype: C-10017241 [image!]; isotype: US-866117! fragm. ex C).

= *Stipa flexuosa* Vasey, Bull. Torrey Bot. Club 15: 49. 1888. Type: USA, western Texas, Chenate Mountains, 1887, *G.C. Nealley s.n.* (holotype: US-556913!; isotypes: NY-00431557 [image!], W-19160022725 [image!]). Fig. 5F–I.

***Pseudoeriocoma hirticulmis* (S.L. Hatch, Valdés-Reyna & Morden) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199102-1

Stipa hirticulmis S.L. Hatch, Valdés-Reyna & Morden, Syst. Bot. 11(1): 186–188, f. 1. 1986 [Basionym] ≡ *Achnatherum hirticulme* (S.L. Hatch, Valdés-Reyna & Morden) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 16. 2003. Type: Mexico, Nuevo León, 8 mi E of San Roberto Jct. along Hwy. 58 on the road to Galeana, 24°40'N, 100°14'W, 1890 m, 22 Aug 1983, *S. Hatch & J. Valdés Reyna 5007* (holotype: TAES; isotypes: ANSM-028729 [image!], CHAPA-0000220 [image!], ENCB-003270 [image!], MEXU-00415572 [image!], MO-123113 [image!], NY-00431581 [image!], TEX-00370148 [image!], US-3037668!).

***Pseudoeriocoma multinodis* (Scribn. ex Beal) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199103-1

Stipa multinodis Scribn. ex Beal, Grass. N. Amer. 2: 222. 1896 [Basionym] ≡ *Achnatherum multinode* (Scribn. ex Beal) Valdés-Reyna & Barkworth, Contr. U.S. Natl. Herb. 48: 17. 2003. Type: Mexico, Chihuahua, Santa Eulalia Mountains, 14 Aug 1885, *C.G. Pringle 385* (holotype: MSC-0092939 [image!]; isotypes: AC-00320221 [image!], BM-000938477 [image!], BR-0000006884895 [image!], JE-00001162 [image!], G-00168339 [image!], G-00168541 [image!], G-00168542 [image!], G-00168543 [image!], GH-00024478 [image!], K-000433421 [image!], KFTA-0000585 [image!], MO-123114 [image!], MO-123115 [image!], MO-5114652, NY-00431585 [image!], NY-00431586 [image!], NY-00431587 [image!], US-90985!, US-155154!, US-825176!, W-19160026109 [image!]).

***Ptilagrostiella* Romasch., P.M.Peterson & Soreng, gen. nov.**

urn:lsid:ipni.org:names:77199104-1

Type. *Ptilagrostiella kingii* (Bol.) Romasch. (≡ *Stipa kingii* Bol.).

Diagnosis. *Ptilagrostiella* differs from *Piptatheropsis* Romasch., P.M. Peterson & Soreng in having glumes without veins with obtuse apices, a sharp callus, and laterally compressed florets with lemma margins overlapping most of the palea at maturity; and

differs from *Ptilagrostis* Griseb. in having a sharp-pointed callus and lemmatal awns with very short hairs.

Description. Plants perennial, caespitose, not rhizomatous with intravaginal branching. Culms 15–40 cm tall, 0.4–0.8 mm in diameter, erect, glabrous, not branching above. Leaf sheaths open, glabrous to scaberulous; ligules 1–2.5 mm long, membranous, apex obtuse to acute; blades 3–15 cm long, 0.3–0.5 mm wide, convolute, filiform, flexuous. Panicles 4–10 cm long, loosely contracted; branches ascending and usually appressed. Spikelets 3–4.5 mm long, lanceolate with one fertile floret without rachilla extension; disarticulation above the glumes; glumes 3–4.5 mm long, usually longer than the florets, hyaline, without veins, apex obtuse; florets 2.8–4.2 mm long, laterally compressed; calluses 0.3–0.7 mm long, sharp, hairy; lemmas 2.8–4.2 mm long, membranous to chartaceous, evenly pubescent throughout, the hairs 0.3–0.5 mm long, margins overlapping most of the palea at maturity, apex 2-lobed, the lobes 0.1–0.4 mm long, awned; lemma epidermal pattern saw-like; fundamental cells of variable length with sinuous sidewalls 2–8 times longer than silica cells irregularly alternating; silica bodies elongated-rectangular, sometimes paired with square-shaped cork cells; lemmatal awns 10–14 mm long, strigillose in lower part; 1- or 2-geniculate, persistent; paleas 2.6–3.2 mm long, shorter to about as long as the lemma, chartaceous, 2-veined; stamens 3, anthers 0.5–1.5 mm long, penicillate; lodicules 3, membranous; stigmas 2; ovary glabrous. Caryopses 1.5–2.3 mm long, fusiform, pericarp adherent. Chromosome number $2n = 22$ (Johnson 1945).

***Ptilagrostiella kingii* (Bol.) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199105-1

Stipa kingii Bol., Proc. Calif. Acad. Sci. 4: 170. 1872 [Basionym] \equiv *Oryzopsis kingii* (Bol.) Beal, Grass. N. Amer. 2: 229. 1896 \equiv *Ptilagrostis kingii* (Bol.) Barkworth, Syst. Bot. 8(4): 417. 1983. Type: USA, California, Tuolumne Co., Mt. Dana and Tuolumne Meadows, 7000–12000 ft, Sep 1866, *H.N. Bolander 6097* (lectotype: CAS-0005666 [image!]) designated by M.E. Barkworth, Syst. Bot. 8: 417. 1983; isoelectotypes: BM-001042147 [image!], F-0047023F [image!], G-00176575 [image!], G-00176576 [image!], G-00176577 [image!], GH-00361770 [image!], NY-01785914 [image!], US-81910! [image!], YU-000920 [image!], YU-244788 [image!], W-18890217500 [image!]). Fig. 4F–J.

Distribution and habitat. *Ptilagrostiella kingii* is endemic to California known only in the Sierra Nevada (Fresno, Inyo, Madera, Mariposa, Mono, Tulare, and Tuolumne counties) and is associated with lodgepole and subalpine forests (Calflora 2018). The species grows along moist streambanks and open, wet to dry meadows; 2000–3650 m (Barkworth 1983, 2007).

Comments. In our earlier molecular analysis, *Ptilagrostiella kingii* is sister to a well-supported clade of *Piptatheropsis* (Romaschenko et al. 2011, 2012). As indicated by

Barkworth (1983), the similarities between *P. kingii* and *Ptilagrostis* may have resulted from convergent evolution in distantly related taxa growing under similar environmental conditions since the former species shares an immediate common ancestor with *Piptatheropsis* and does not align near the *Ptilagrostis* clade (Romaschenko et al. 2012). *Ptilagrostiella kingii* also lacks a blunt callus and the plumose awns characteristic of most *Ptilagrostis* species (Wu and Phillips 2006).

***Thorneochloa* Romasch., P.M.Peterson & Soreng, gen. nov.**

urn:lsid:ipni.org:names:77199107-1

Type. *Thorneochloa diegoensis* (Swallen) Romasch. \equiv (*Stipa diegoensis* Swallen).

Diagnosis. *Thorneochloa* differs from *Pseudoeriocoma* Romasch., P.M. Peterson & Soreng in having dense pubescence 3–9 mm below the lower nodes, the hairs retrorse, non ramified branching on the middle and upper culms, and pedicels usually shorter than the spikelets.

Description. Plants perennial, cespitose, not rhizomatous. Culms 70–140 cm tall, erect or ascending, often geniculate, 2–4 mm thick never bamboo-like or ramified above with (2) 3 nodes that are densely pubescent 3–9 mm below the lower nodes, the hairs retrorse, internodes usually pubescent. Leaf sheaths longer than the internodes below and shorter than the internodes above, glabrous or pubescent, ciliate on the margins and summit; collars with a tuft of hairs, the hairs 1.5–2 mm long; ligules 1–3 mm long, membranous and pubescent, apex truncate to obtuse; blades 15–40 cm long, 1–3.5 mm wide, flat to involute, scabrous below and pubescent above. Panicles 15–30 cm long, (2–) 4–8 cm wide, narrow, densely flowered, branches ascending appressed; pedicels usually shorter than the spikelets. Spikelets 8–11.5 mm long, lanceolate with one fertile floret without rachilla extension; disarticulation above the glumes; glumes 8–11.5 mm long, longer than the florets, subequal, hyaline, 3–5-veined, glabrous, acuminate; florets 5.5–7.5 mm long, usually fusiform; calluses 0.25–1.2 mm long, sharp, hairy; lemmas 5.5–7.5 mm long, fusiform, coriaceous, evenly hairy, the hairs 0.5–2 mm long, margins enveloping most of the palea, apex awned with minute apical lobes 0.2–0.4 mm long; lemma epidermal pattern maize-like; fundamental cells squared, longitudinally compressed with straight thin sidewalls subequal to silica cells (silica bodies) or shorter, regularly alternating; cork cells absent; lemmatal awns 20–50 mm long, 2-geniculate, flexuous, the segments scabrous, terminal segment straight; paleas 2.6–4 mm long, 1/2 to 3/4 as long as the lemmas, 2-veined, veins not prolonged, hairy; anthers 2.5–4 mm long, not penicillate, 3 in number; lodicules 2 or 3; stigmas 2. Caryopses 3.8–4 mm long, fusiform, pericarp adherent, hilum linear, embryo 1/4 the length.

Etymology. The generic name honors Robert Folgers Thorne (1920–2015), an American taxonomist who specialized in the evolution and classification of vascular plants, known as the Thorne system.

***Thorneochloa diegoensis* (Swallen) Romasch., comb. nov.**

urn:lsid:ipni.org:names:77199108-1 77199108-1

Stipa diegoensis Swallen, J. Wash. Acad. Sci. 30(5): 212, f. 2. 1940 [Basionym] ≡ *Achnatherum diegoense* (Swallen) Barkworth, Phytologia 74(1): 7. 1993. Type: USA, California, San Diego Co., Proctor Valley near Jamul, along vernal stream in chaparral, 23 May 1938, *F. F. Gander 5778* (holotype: US-1761177!; isotypes: AHUC-30095 [image!], CAS-0005662 [image!], DAO-000465418 [image!], F-0044439F [image!], SD-00000072 [image!]). Fig. 5A–E.

Distribution and habitat. *Thorneochloa diegoensis* is found in Channel Islands (Santa Barbara County), San Diego, and Ventura Counties and Baja California, Mexico in rocky soil along vernal streams and canyons in chaparral and coastal sage-scrub vegetation; usually below 500 m (Barkworth 2007; Calflora 2018).

Comments. Molecular sequence analysis reveals multiple origins of this taxon. In our preliminary ITS-derived phylogenetic tree *Thorneochloa diegoensis* aligns within *Nassella* whereas in the combined plastid-derived tree it aligns within *Pseudoeriacoma* (Valdés Reyna et al. 2013). Geographically, the most likely parents, if of hybrid origin, would be *Nassella mucronata* (Kunth) R.W. Pohl and *Pseudoeriacoma eminens*. A more detailed genetic study using low-copy nuclear genes would perhaps resolve this hypothesis.

A key to the native and introduced (marked with an asterisk) genera of Stipeae (and Ampelodesmeae) in North America (modified from Barkworth 2007)

- 1 Spikelets with 2–6 florets; cultivated as ornamental, a Mediterranean species escaped in California.....***Ampelodesmos Link**** (tribe Ampelodesmeae)
- Spikelets with 1 floret (tribe Stipeae); plants native or not.....**2**
- 2 Paleas sulcate, longer than the lemmas; lemma margins involute, fitting into the paleal groove; lemma apices not lobed.....***Piptochaetium***
- Paleas flat, from shorter than to longer than the lemmas; lemma margins convolute or not overlapping; lemma apices often lobed or bifid.....**3**
- 3 Prophylls exceeding the leaf sheaths; lemmas with 2 prominent lobes at apex (0.9–2 mm long); plants cultivated as ornamentals, not escaped.....**4**
- Prophylls concealed by the leaf sheaths; lemmas with mostly shorter lobed or unlobed apices; plants native, introduced from Mediterranean region, sometimes cultivated as ornamentals.....**5**
- 4 Panicles contracted; lemma awns once-geniculate, first segment plumose; style 1.....***Macrochloa****
- Panicles open; lemma awns twice-geniculate, segments glabrous; styles 2.....***Celtica****
- 5 Plants with multiple stiff branches from the upper nodes; pedicels sometimes plumose; Australian species cultivated as ornamentals in the Flora region.....***Austrostipa****

- Plants not branching at the upper nodes, or with a few, flexible branches (*Pseudoeriocoma*); pedicels never plumose; species native, established introductions, or cultivated as ornamentals **6**
- 6 Apices of the leaf blade sharp and stiff; caryopses obovoid, often with 3 smooth ribs at maturity; cleistogenes usually present in sheaths; plants adventive in California, native from Mexico southward..... ***Amelichloa***
- Apices of the leaf blades acute to acuminate, never both sharp and stiff; caryopses fusiform, ovoid or obovoid, without ribs; cleistogenes sometimes present in sheaths **7**
- 7 Lemma margins strongly overlapping over their whole length at maturity, lemma bodies usually rough throughout, apices with a membranous or indurate crown and not lobed; paleas $\frac{1}{4}$ – $\frac{1}{2}$ the length of the lemmas, without veins, glabrous; plants native to North America and southward, South American species sometimes cultivated as ornamentals and escaped ***Nassella***
- Lemma margins usually not or only slightly overlapping for some or all of their length at maturity, strongly overlapping in some species with smooth lemmas, lemma bodies usually smooth on the lower portion, apices often 1–2-lobed and never with a membranous or indurate crown; paleas from $\frac{1}{3}$ as long as to equaling or slightly exceeding the lemmas, 2-veined at least on the lower portion, usually with hairs or both lemmas and paleas glabrous **8**
- 8 Calluses 1.5–6 mm long, sharply pointed; plants perennial or annual, if perennial, awns 65–500 mm long, if annual, awns 50–100 mm long; panicle branches straight..... **9**
- Calluses 0.1–2 mm long, blunt to sharply pointed; plants perennial; awns 1–70 mm; panicle branches straight or flexuous..... **12**
- 9 Lower ligules densely hairy, upper ligules less densely hairy or glabrous; awns plumose in lower segment, glabrous above, unigeniculate; plants perennial..... ***Pappostipa***
- Ligules glabrous or inconspicuously pubescent, lower and upper ligules alike in vestiture; awns glabrous or pilose throughout or in lower segment; plants perennial or annual..... **10**
- 10 Plants perennial; florets 7–25 mm long; awns scabrous or pilose on the first 2 segments, the terminal segment scabrous, or if pilose, the hairs 1–3 mm long ***Hesperostipa***
- Plants annual or perennial, if perennial, the florets 18–27 mm long and the awns plumose on the terminal segment, the hairs 5–6 mm long..... **11**
- 11 Plants annual; glumes 12–20 mm long; florets 4–7 mm long; awn sparsely short hairy in basal segment only; plants adventive from Mediterranean, noxious weeds in Southern California ***Stipelulla****
- Plants perennial (sometimes short-lived); glumes 60–90 cm long; florets 18–27 mm long; the awns plumose on the terminal segment, the hairs 5–6 mm long; plants cultivated ornamentals from Eurasia, not escaped ***Stipa****
- 12 Panicles to 60 cm long, delicate, nodding, branches capillary, loosely spreading to spreading in distant whorls; lemmas 2 mm long, coarsely scabrous distally, mar-

- gins meeting or slightly gapped; callus with a brief ring of hairs; awns caducous, to 8 mm long, slender, scabrous, curved; anther 1, 0.8–1.4 mm long, apically thickened, not penicilliate; plants cultivated ornamentals from New Zealand, not escaped ***Anemanthele****
- Panicles of various lengths, and shapes (similar in *Oloptum*, but lemma surfaces smooth, margins widely gapped in middle and fused at base, callus glabrous); lemmas usually longer; awns various; anthers 3, not apically thickened, penicillate or not; plants sometimes cultivated **13**
 - 13 Florets usually dorsally compressed at maturity, sometimes terete; paleas as long as or longer than the lemmas and similar in texture and pubescence; lemma margins separate for their whole length at maturity **14**
 - Florets terete or laterally compressed at maturity; paleas often shorter than the lemmas, sometimes less pubescent, sometimes as long as the lemmas and similar in texture and pubescence; lemma margins often overlapping for part or all of their length at maturity **17**
 - 14 Callus barbed with a dense ring of flexuous hairs, hairs 1.0–1.5 mm long; style 1; lodicules 2; elongated leaf blades concentrated basally (above initial cataphylls), upper cauline leaves much reduced, only 0.8–1.8 cm long; lemma epidermal pattern saw-like ***Oryzopsis***
 - Callus glabrous or with short straight hairs forming a sparse ring, hairs 0.1–0.5 mm long; styles 2; lodicules 2 or 3; awn central; cauline leaves well developed, similar to basal leaves, or somewhat shorter but not strongly reduced; lemma epidermal pattern saw-like or maize-like **15**
 - 15 Glumes 5–9-veined, with faint or prominent transverse veinlets; basal leaf blades absent (leaves cataphyllous) then up to 2 cm long; mid- and upper cauline leaves several, up to 35 cm long and 2 cm wide ***Patis***
 - Glumes 1–3-veined, transverse veinlets absent (rarely present, never prominent); basal leaf blades well developed or not (leaves cataphyllous or not), mostly 2–90 cm long or reduced; cauline leaves similar to basal leaves, or sometimes shorter or rudimentary **16**
 - 16 Plants with well-developed basal tufts leaves, blades slender; central vein of the lemma not prominent; lower panicle branches never whorled; anther apices glabrous; lemma epidermal pattern Saw-like; awns caducous and straight and basally slightly twisted, or persistent and geniculate with a strongly twisted first segment; plants native ***Piptatheropsis***
 - Plants without basal tufts of leaves, blades 2–10 mm wide; central vein of the lemma prominent; lower panicle branches whorled with 3–30 or more per node; anther apices minutely bearded; lemma epidermal pattern Maize-like; awns persistent or caducous, straight, never twisted; plants adventive from Eurasia ***Oloptum****
 - 17 Glumes without evident venation, glume apices rounded to acute; plants subalpine to alpine, sometimes growing in bogs **18**
 - Glumes with 1–3(5) evident veins or the glume apices attenuate; plants growing from near sea level to subalpine or alpine habitats, not growing in bogs **19**

- 18 Awns strigillose in lower part; lemma lobes inconspicuous (0.1–0.4 mm); callus sharp; panicles narrow to loosely contracted; anthers penicillate, 0.5–1.5 mm long ***Ptilagrostiella***
 - Awns hairy throughout, lemma lobes prominent (up to 0.8 mm); callus blunt; the hairs on the lowest segment 1–2 mm long; panicles open with spreading branches these sometimes loosely contracted; anthers glabrous, 1.2–3 mm long ***Ptilagrostis***
- 19 Paleas with prolonged veins almost reaching the tip of the lemma lobes, the veins 1–3 mm long; lemma apices 2-lobed, narrow, the lobes 1–3 mm long ***Barkworthia***
 - Paleas without prolonged veins or if prolonged never more than 0.3 mm long; lemma apices unlobed or if lobed, the lobes usually obtuse and never more than 2.1 mm long **20**
- 20 Lemma bodies with hairs to 0.15 mm long over most of their length, and a tuft of pappus-like hairs at the apex to 3–4 mm long; awns glabrous; ligules with lateral tufts of hairs to 2 mm long; anthers 0.8 mm long; plants native from Mexico southward, infrequently cultivated as an ornamental ***Jarava***
 - Lemma bodies with evenly distributed hairs of similar length or completely glabrous, sometimes with longer hairs around the base of the awn; basal segment of the awns sometimes with hairs up to 2 mm long; ligules without lateral tufts of hairs; anthers mostly longer; plants of Mexico and northward, infrequently cultivated as an ornamentals **21**
- 21 Basal leaf sheaths becoming fibrous with age; panicle branches whorled below; apical lemma hairs 1–1.5 mm long; awns readily deciduous; upper culm ligules to 12 mm long; plants cultivated ornamentals from Asia, uncommon, not known to have escaped ***Neotrinia****
 - Basal leaf sheaths never fibrous, occasionally ribbon-like; panicle branches rarely whorled below; lemmas usually without apical lemmas hairs longer than those present on the body; upper culm ligules usually less than 5 mm long; plants native and widespread **22**
- 22 Plants with woody, sometimes scandent bamboo-like culms, 3–6 mm thick below with ramified branching (usually, but sometimes absent in immature specimens of *P. hirticulmis*) at the middle and upper nodes, with (2) 3 to 13 nodes ***Pseudoeriocoma***
 - Plants with neither woody nor scandent bamboo-like culms, usually less than 2 mm thick below and never with ramified branching at the middle and upper nodes, with 2 to 3 or up to 5 nodes in a few species **23**
- 23 Lower culm internodes densely pubescent for 3–9 mm below the nodes, the hairs retrorse with shorter hairs and less densely pubescent elsewhere; known only from southern California and Baja California ***Thorneochloa***
 - Lower culm internodes glabrous or if pubescent then only to 5 mm below the nodes, usually glabrous elsewhere or if hairy the hairs usually not retrorse; widely distributed in western North America ***Eriocoma***

Excluded name

***Stipa virlettii* E. Fourn., Mexic. Pl. 2: 75. 1886.**

Comments. The description of *Stipa virlettii* (Type: *Virlet 1376* from San Luis de Potosí, Mexico) appears to be a mixture of *Stipa mucronata* Kunth [= *Nassella mucronata*] awns and *Bromus laciniatus* Beal (= *Bromus carinatus* Hook & Arn.) as determined by A.S. Hitchcock (isotype: US-A866077 fragm. ex P-Fourn-163!). Notes by A.S. Hitchcock on the US sheet with two fragment packets indicate that there are two species of *Bromus* on the herb. Fournier sheet: A is *B. richardsonii* Link; B is *B. carinatus*, also annotated by ASH.

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Persicaria jucunda var. *rotunda* (Polygonaceae, Persicarieae), a distinct distylous taxa raised to specific rank

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Abstract

Persicaria jucunda (Meisn.) Migo var. *rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li was originally published in the genus *Polygonum* L. and treated as a variety of *P. rotundum* Meisn. [\equiv *Persicaria jucunda* (Meisn.) Migo]. After carefully comparing the macro- and micro-morphological characteristics of the achenes, leaf epidermis and tepals and the habitat between the variety and its typical variety, we confirmed that *P. jucunda* var. *rotunda* is clearly different from *P. jucunda* and should not be treated as a variety, but be raised to a specific rank as *P. rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li. The species is distylous and could be easily distinguished from all other *Persicaria* taxa by a combination of morphological characters, such as completely decumbent leafless basal branches, almost sessile leaves, linear-lanceolate with rounded leaf bases, spicate, short and dense inflorescences, slender pedicels longer than bracts and dimorphic flowers and achenes. *P. rotunda* is endemic to several large wetlands of eastern China and usually occurs as one of the dominant species in some plant communities.

Keywords

Distily, micro-morphology, new combination, *Polygonum*, variety

Introduction

Persicaria (L.) Mill., after separation from the former polyphyletic genus *Polygonum* L., is currently placed within the tribe Persicarieae of Polygonaceae. The genus contains approximately 150 species of annual or perennial herbs and occurs mainly

in temperate and subtropical regions of the Northern Hemisphere (Brandbyge 1993). *Persicaria* is characterised by having usually entire, ciliate or pectinate ocrea, many-flowered, spike-like or capitate inflorescences, 4–5-lobed tepals with trifid venation, 4–8 stamens, spheroidal pollen grains with reticulate exine and epidermis of pericarp with narrow rectangular cells and undulating anticlinal walls (Haraldson 1978, Ronse Decraene and Akeroyd 1988, Brandbyge 1993, Ronse Decraene et al. 2000). The genus has been subdivided into four sections on the basis of anatomical traits (Haraldson 1978), viz., sect. *Persicaria*, sect. *Cephalophilon* (Meisn.) H.Gross, sect. *Echinocaulon* (Meisn.) H.Gross and sect. *Tovara* (Adans) H.Gross, while Galasso et al. (2009) proposed to include another two sections, sect. *Amphibia* Tzvelev and sect. *Truelloides* Tzvelev, based on molecular phylogenetic studies. In *Persicaria*, a number of species have been observed or confirmed as distylous, such as *P. chinensis* (L.) H.Gross (\equiv *Polygonum chinense* L.) (Reddy et al. 1977), *P. japonica* (Meisn.) H.Gross (Hiratsuka and Nakao 1996), *P. jucunda* (Meisn.) Migo (\equiv *Polygonum rotundum* Meisn.) (Chen and Zhang 2010), *P. hastato-sagittatua* (Mak.) Nakai ex Mori (\equiv *Polygonum hastato-sagittatum* Mak.) (Chen 2012), *P. wugongshanensis* Bo Li (Li 2014) and *P. odorata* (Lour.) Soják subsp. *conspicua* (Nakai) Yonek. (Kong and Hong 2018). Distyly is a type of heterostyly which is characterised by the reciprocal placement of stigmas and anthers in two (distyly) or three (tristyly) floral morphs in a species (Lloyd and Webb 1992).

Persicaria jucunda var. *rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li (Li et al. 2013) was originally published in the genus *Polygonum* and treated as a variety of *P. rotundum* (\equiv *Persicaria jucunda*) (Zhou et al. 2007). The variety resembles *P. rotundum* in having glabrous stems and prostrate at base, densely spicate inflorescences, pinkish tepals, slender pedicels longer than bracts and trigonous achenes, but differs from the typical variety in having truncate and linear-lanceolate leaf blades with barely noticeable petioles (Zhou et al. 2007). However, when conducting a micro-morphological study of Chinese *Persicaria* species, we found that there are a number of distinct differences between the two taxa, including the shape of epidermal cells of both leaf sides, the occurrence of stomata on adaxial leaf surface, the stomatal type of abaxial leaf surface and the sculpture of achene surface. After re-examining the macro-morphology and the habitat of the two taxa, we confirmed that *P. jucunda* var. *rotunda* is clearly different from *P. jucunda* and should not be treated as a variety, but be raised to a specific rank as *Persicaria rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li.

Materials and Methods

The field investigations were carried out from 2014 to 2019. Fresh leaf materials and flowers of both *P. jucunda* and *P. rotunda* were collected and immediately fixed in FAA solution (formalin: acetic acid: alcohol = 18:1:1). The measurement of morphological characters was conducted based on both herbarium specimens (JXAU, acronym according to Thiers 2019) and living plants by using a micrometer and a stereomicroscope. To make a morphological comparison between *P. jucunda* and *P. rotunda*, the variability

of four quantitative characters (leaf length, leaf width, number of leaf lateral vein pairs, inflorescence length) was evaluated using univariate statistics (box plots) by SPSS 11.5 statistical software package (SPSS Inc., Chicago, IL, USA). To confirm the distyly in *P. rotunda*, the height of stigmas and anthers were measured for a single flower removed from 30 individuals per style morph. Methodology follows Chen and Zhang (2010).

For light microscopy (LM) observation of leaf epidermis, samples were taken from the mature leaves fixed in FAA solution, dissected under a OPTPro stereoscope (Chongqing Optec Instrument Co. Ltd., China), stained in a solution of 1% safranin, and cleaned in distilled water three times before being mounted in glycerine jelly. Observations and micrographs were conducted randomly from 5 prepared slides per species under LM. Terminology follows Hou (2006).

For scanning electron microscopy (SEM) observations, samples of achenes were removed from mature fruits and dried in silica gel. After cleaned in 95% ethanol, mounted on to cupreous stubs and coated by JFC-1100E sputter coater (JEOL Led., Japan), samples were examined under JSM-6360LV SEM (JEOL Led., Japan) at a voltage of 25 KV. Terminology follows Ronse Decraene et al. (2000).

Taxonomy

***Persicaria rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li, comb. & stat. nov.**

urn:lsid:ipni.org:names:77199242-1

Figures 1, 2

≡ *Polygonum jucundum* Meisn. var. *rotundum* Z.Z.Zhou & Q.Y.Sun, Acta Phytotax. Sin. 45(5): 714 (713–718; figs.). 2007. **Type:** CHINA. Anhui Province, Dongzhi County, Shengjin Lake, on riparian plains, Alt. 6–20 m, 4 October 2006, Z.Z.Zhou 0602 (holotype: PEI, isotype: ANU).

≡ *Persicaria jucunda* (Meisn.) Migo var. *rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li, Phytotaxa 91 (1): 24. 2013.

Diagnosis. This species is easily distinguished from other *Persicaria* taxa by its completely decumbent leafless basal branches, almost sessile leaves, truncate, linear-lanceolate leaf blades, spicate, short and dense inflorescences, pedicels longer than bracts and dimorphic flowers and achenes. It occurs as one of the dominant species of some lakeshore plant communities in several large wetlands of northern Jiangxi and southwestern Anhui provinces, eastern China.

Description. *Annual herbs.* *Stems* slender, glabrous, basal branches 6–26, completely decumbent, 3–15 cm long, leafless, dark brown, producing numerous fibrous roots at each node; 3–12 additional flowering shoots branched from the upper nodes of each basal branch, 6–65 cm high, prostrate to erect, green to purplish-red, nodes inflated, purple. *Leaves* nearly sessile; leaf blades narrowly lanceolate to linear-lanceolate, 1.5–12.5 cm long, 0.3–1.3 cm wide, lateral veins 9–16 pairs, both surfaces glabrous,

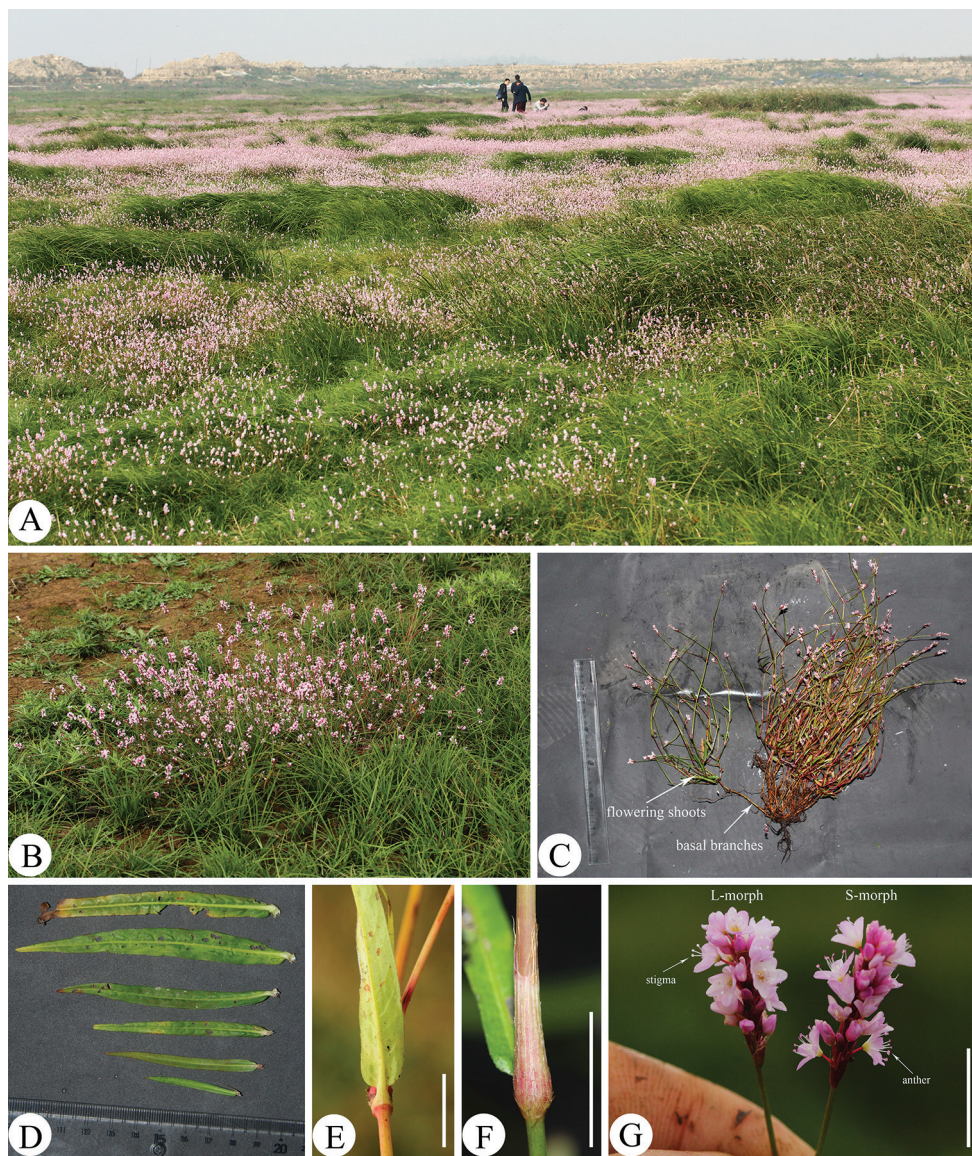


Figure 1. *Persicaria rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li **A** plant community with *P. rotunda* **B** close-up view of an individual in situ **C** an individual showing branches **D** leaves **E** leaf base **F** ocrea **G** inflorescences. Scale bars: 1 cm (**E**, **F**, **G**).

base round, apex acuminate, margin entire, shortly ciliate. *Ocrea* tubular, 4.5–11.5 mm long, membranous, sparsely appressed pubescent, apex truncate, fimbriate, cilia 2.2–5.3 mm long. *Inflorescence* terminal, erect, spicate, dense, 0.5–3.8 cm long; peduncle 3.5–6.5 cm long, glabrous; bracts purplish-red, funnel-shaped, sparsely pubescent, margin submembranous, shortly ciliate, each bract contains 4–7-flowers. *Pedice*l longer than bracts, 1.5–2.5 mm. *Flowers* dimorphic; perianth 5-parted, pinkish-white;

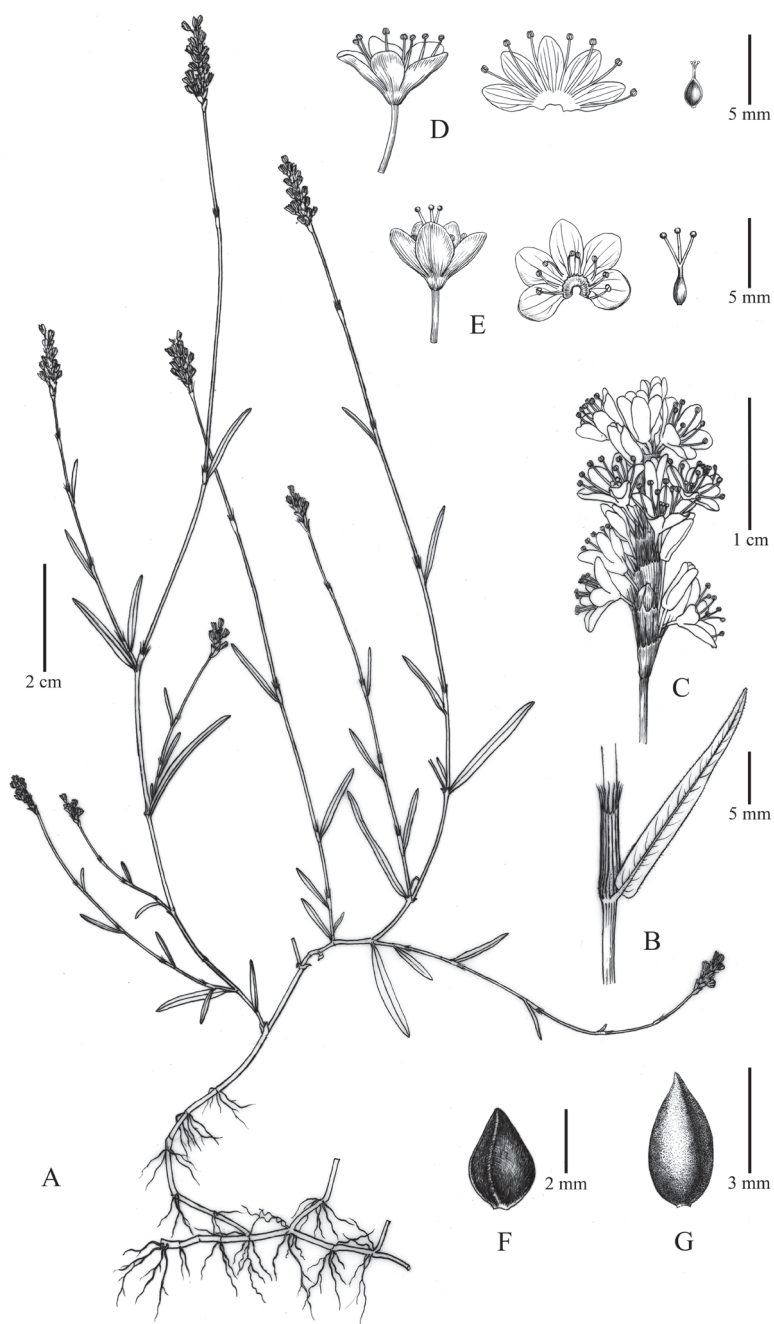


Figure 2. Line drawing of *Persicaria rotunda* (Z.Z.Zhou & Q.Y.Sun) Bo Li **A** branches and inflorescences **B** ocrea and leaf **C** inflorescence **D** S-morph flower and its pistil **E** L-morph flower and its pistil **F** S-morph achene **G** L-morph achene.

long-styled flowers (called as L-morph) 3.9–4.4 mm long, stamens 8, 2.6–3.2 mm, styles 3, connate to below middle, 4.3–5.1 mm, exserted; short-styled flowers (called as S-morph) 3.7–4.2 mm long, stamens 8, 3.8–4.9 mm, exserted, styles 3, connate to below middle, 2.4–2.9 mm; stigmas capitate; nectaries 8, arranged at the base of ovary. *Achenes* included in persistent perianth, dimorphic; L-morph dark brown, ellipsoid, trigonous, base rounded to broadly cuneate, apex acuminate, surface opaque, densely reticular - pitted, 3.6–4.2 mm long, 2.1–2.3 mm wide; S-morph black, ovoid, trigonous, base broadly cuneate, apex acute, surface opaque, densely pitted, 2.9–3.3 mm long, 1.8–2.1 mm wide.

Phenology. Flowering was observed from July to December and fruiting from late July to January.

Distribution and habitat. *Persicaira rotunda* is currently known only from several wetlands in north of Jiangxi Province and southwest of Anhui Province, eastern China and mainly grows in marshy and grassy areas around Daguan Lake, Lihu Lake, Longgan Lake, Poyang Lake Qingcao Lake, Shengjin Lake, Shimeng Lake and Wuchang Lake, which are several small to large lakes located near the Yangtze River. It usually occurs as one of the dominant species of some lakeshore plant communities (Fig. 1A).

Specimen examined. CHINA. Jiangxi Province, Xingzi County, Shenling Lake, on grassy lakeside, Alt. 10 m, 29.270044N, 116.040173E, 16 July 2008, *B.Li JX046* (IBSC); Jiangxi Province, Yongxiu County, Wucheng Town, Poyang Lake, in wet meadow, Alt. 14 m, 29.114364N, 116.032021E, 11 December 2017, *B.Li LB0778* (JXAU); Jiangxi Province, Yongxiu County, Wucheng Town, Poyang Lake, in wetland marsh, Alt. 6 m, 29.133935N, 116.053571E, 15 October 2018, *B.Li LB0901* (JXAU).

Notes. As noted by Zhou et al. (2007), *P. rotunda* is most similar to *P. jucunda* (Fig. 3) in gross morphology, particularly in having uninterrupted spicate inflorescences with dense flowers and slender pedicels longer than bracts. However, the authors did not notice that both of the species are distylous, which is another important similarity between the two taxa. The distyly of *P. jucunda* was firstly observed and confirmed by Chen and Zhang (2010). In the present study, we confirmed that *P. rotunda* is also a typical distylous species. The heights of the stigmas (4.63 ± 0.191 mm vs. 2.61 ± 0.056 mm, L-morph vs. S-morph) and anthers (2.74 ± 0.092 mm vs. 4.68 ± 0.178 mm, L-morph vs. S-morph) are reciprocal in the two morphs. However, *P. rotunda* is clearly different from *P. jucunda*, not only in some morphological traits (Fig. 4), but also in several micro-morphological characters (Table 1).

Besides the differences summarised by Zhou et al. (2007), such as leaf shape, leaf width, petiole length and stem diameter, we observed several additional morphological traits that are clearly distinct between *P. rotunda* and *P. jucunda*. The stems of *P. rotunda* have 6–26 basal branches which are leafless and completely decumbent with numerous fibrous roots at each node. On the upper nodes of each basal branch, there are 3–12 flowering shoots which are prostrate to erect and normally bearing leaves and inflorescences (Fig. 1C). However, the stems of *P. jucunda* are mostly erect or only prostrate at the base and the number of its branches are much fewer than those of *P. rotunda*. *Persicaria rotunda* also has more pairs of leaf lateral veins and much shorter inflorescences than *P. jucunda* (Fig. 4).

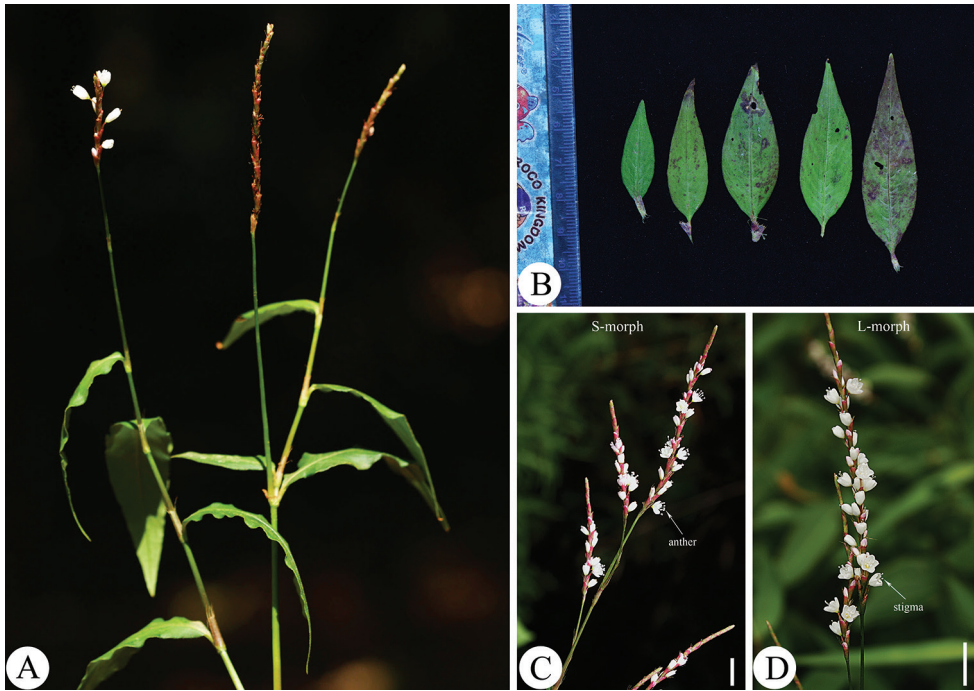


Figure 3. *Persicaria jucunda* (Meisn.) Migo **A** habit **B** leaves **C** S-morph inflorescences **D** L-morph inflorescences. Scale bars: 1 cm (**C**, **D**).

Table 1. Differences between *Persicaria rotunda* and *P. jucunda*.

	<i>Persicaria rotunda</i>	<i>P. jucunda</i>
Habitat	wetlands	forest margins, grassy slopes or moist valleys
Branches	the primary branches completely decumbent, leafless and the secondary branches prostrate to erect	ascending to erect, without leafless branches
Leaves		
Petiole	nearly absent	3–6 mm long
Shape	narrowly lanceolate to linear-lanceolate	lanceolate or elliptic-lanceolate
Lateral veins (pairs)	9–16	6–10
Adaxial epidermis	polygonal epidermal cells with straight anticlinal walls no stomata no glands	irregular epidermal cells with straight to curved anticlinal walls stomata mostly anisocytic or occasionally paracytic sparse two-celled peltate glands
Abaxial epidermis	irregular epidermal cells with curved to sinuate anticlinal walls stomata anisocytic plenty of four-celled peltate and spheroidal glands	irregular epidermal cells with sinuate to sinuate anticlinal walls stomata paracytic no glands
Length of Inflorescences (cm)	0.5–3.8	1.0–8.2
Tepals		
Length (mm)	L-morph 3.9–4.4, S-morph 3.7–4.2	L-morph 2.8–3.3, S-morph: 2.7–3.2
Epidermis	anticlinal walls of epidermal cells curved to sinuate 10–14 sinuate striates on cuticular layer	anticlinal walls of epidermal cells sinuate to sinuate 12–18 straight to sinuate striates on cuticular layer
Achenes		
Size (length × width, mm)	L-morph 3.6–4.2 × 2.1–2.3, S-morph 2.9–3.3 × 1.8–2.1	L-morph 2.1–2.6 × 1.6–1.8, S-morph 2.2–2.7 × 1.7–1.9
Surface	opaque, densely pitted	shiny, smooth
Epidermal ornamentations	reticulate	Indistinctly reticulate

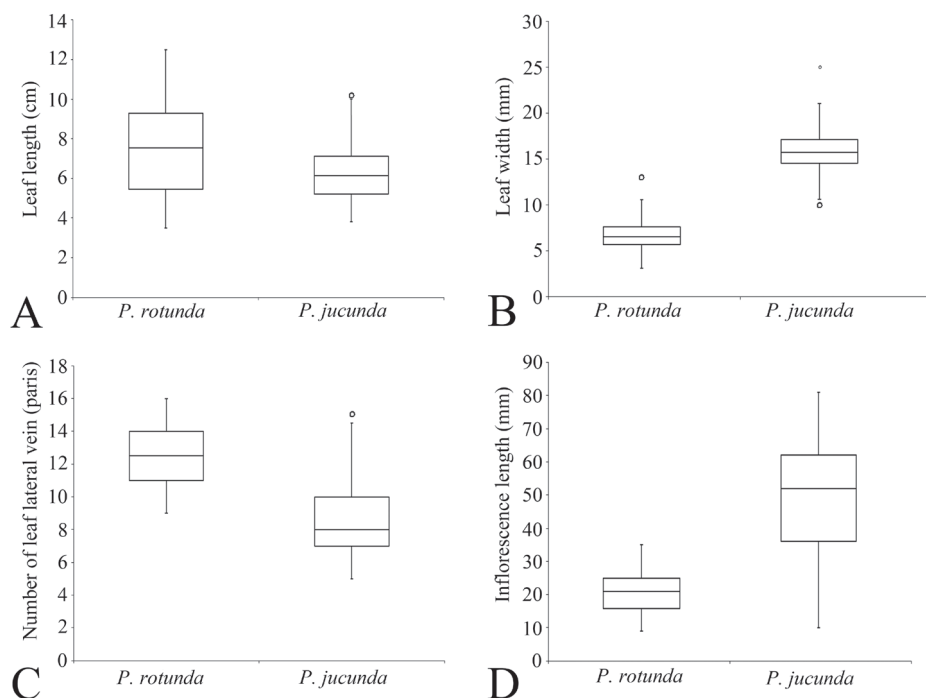


Figure 4. Box plots of four quantitative characters, leaf length (**A**) leaf width (**B**) number of leaf lateral vein pairs (**C**) and inflorescence length (**D**) of *Persicaria rotunda* and *P. jucunda*. The boxes (rectangle region) represent the interquartile range and the whiskers (vertical line) represent the range excluding the outliers (circles). The three upper, middle and lower lines on the boxes represent the 75%, 50% and 25% of the variables, respectively. The upper and lower ends of the whiskers represent the maximum and minimum values of the variable, respectively. The circles represent the single value, where the variable value exceeds 1.5 times the difference between the 75% and 25%.

Though both of *P. rotunda* and *P. jucunda* have dimorphic flowers, the achenes of *P. rotunda* are also dimorphic, with the L-morph ellipsoid in shape and dark brown in colour, whereas the S-morph achene is ovoid in shape and black in colour (Fig. 5A). Additionally, the L-morph achenes of *P. rotunda* have larger size and more raised reticulate epidermal ornamentations than those of the S-morph (Figs. 5B–E). In contrast, the achenes of *P. jucunda* are homomorphic with the same smooth surfaces in both morphs (Chen and Zhang 2010). Amongst the distylous taxa reported in *Persicaria*, *P. rotunda* is, so far, the only species that shows dimorphic features on achenes.

Leaf epidermis characters have been tested to be of important taxonomic significance in *Persicaria* (Hou 2006, Zhu et al. 2007, Yasmin et al. 2010). When observing the leaf epidermis of *P. rotunda* and *P. jucunda*, we found that there are significant differences in the leaf epidermal micro-morphology of the two taxa (Fig. 6). In *P. rotunda*, the adaxial leaf epidermal cells are polygonal in shape with the straight anticlinal walls and no stomatal apparatus or gland occurs on the surface (Fig. 6A). However, the adaxial leaf epidermis of *P. jucunda* is covered by irregular epidermal

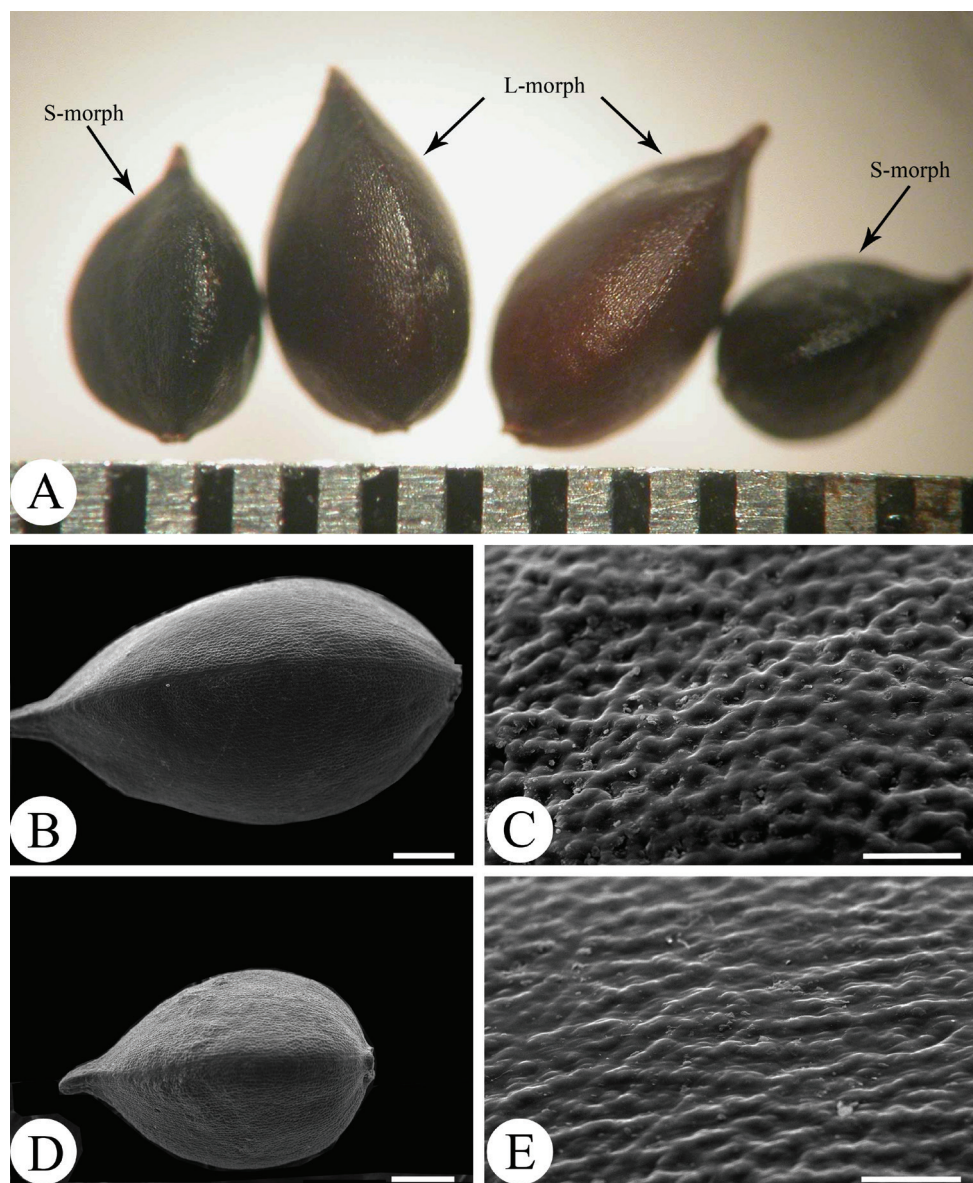


Figure 5. Achene morphology of *Persicaria rotunda* **A** dimorphic achenes under a stereoscope **B–C** SEM micrograph of L-morph achene **B** whole view **C** partial view showing its epidermis sculpture **D–E** SEM micrograph of S-morph achene **D** whole view **E** partial view showing its epidermis sculpture. Scale bars: 500 μ m (**B, D**); 50 μ m (**C, E**).

cells with the anticlinal walls straight to curved and has mostly anisocytic or occasionally paracytic stomata and sparsely two-celled peltate glands (Fig. 6C). On the abaxial leaf epidermis, plenty of four-celled peltate and spheroidal glands, anisocytic stomata and irregular epidermal cells with the anticlinal walls curved to sinuate were observed for *P. rotunda* (Fig. 6B), while in *P. jucunda*, no glands have been

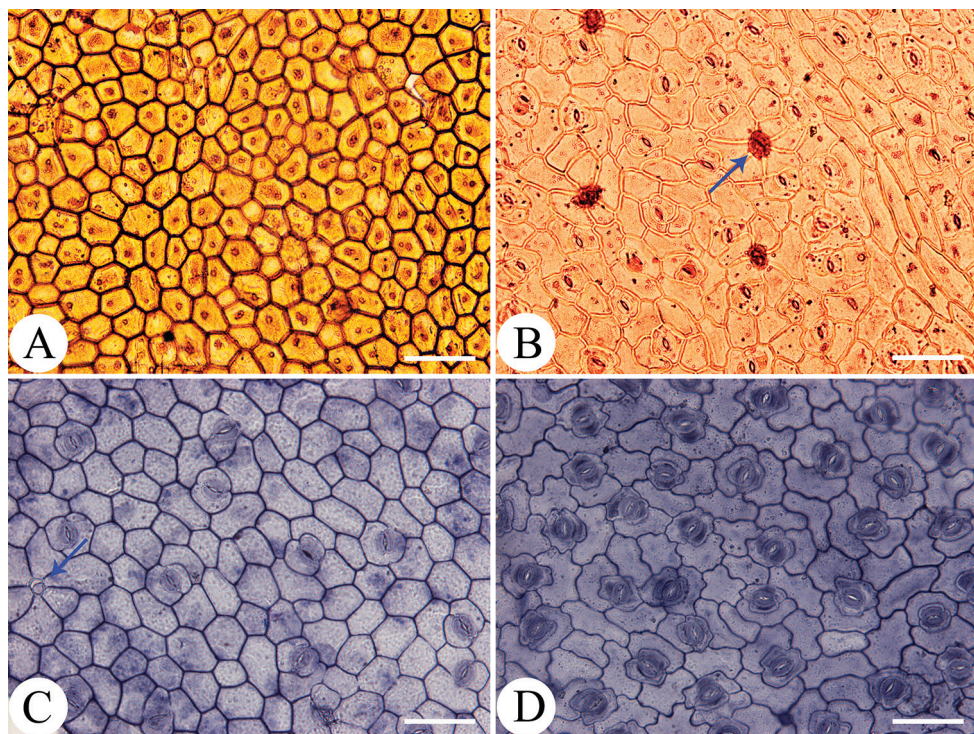


Figure 6. LM micrographs of leaf epidermis of *Persicaria rotunda* (**A, B**) and *P. jucunda* (**C, D**). **A, C** upper epidermis **B, D** lower epidermis. Arrow in **B** shows the four-celled peltate and spheroidal glands of *P. rotunda* and in **C** indicates the two-celled peltate glands of *P. jucunda*. Scale bars: 500 μ m.

found, the stomata are paracytic and the anticlinal walls of epidermal cells are sinuolate to sinuate (Fig. 6D).

In the protologue, Zhou et al. (2007) also investigated the tepal micro-characteristics of *P. rotunda* and *P. jucunda* and listed their differences: the anticlinal walls of epidermal cells are curved to sinuolate in *P. rotunda*, while sinuolate to sinuate in *P. jucunda*; the cuticular layer has longitudinally 10–14 of sinuate striates in *P. rotunda*, while 12–18 straight to sinuolate striates in *P. jucunda*. Taking all the above morphological and micro-morphological evidence together, we think that *P. rotunda* represents a distinct species in *Persicaria* and it should not be placed under *P. jucunda* as a variety, but be treated as a separate species.

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