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Additional contributions to taxonomy, nomenclature and biogeography of the Turkish *Crataegus* (Rosaceae) taxa

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Abstract

Crataegus azarolus L. has a wide distribution pattern from the western Mediterranean coasts to the eastern parts of Iran with several varieties adapted to local climatic conditions. *Crataegus azarolus* var. *senobaaensis* **var. nov.** is described as a new variety from southeast Turkey with characteristic deep leaf sinuses, mostly 3–4 pairs of lobes and leaves ovate-oblong in outline. Two varieties of the species are accepted under the name of *Crataegus azarolus* and the correct names are published here. *Crataegus monogyna* Jacq. var. *odemisii* **var. nov.** is described from İzmir, in the western part of Turkey. This new variety is distinguished by its orange fruit colour. An outstanding disjunct distribution pattern has been discovered for the recently described species, *Crataegus yaltirikii* Dönmez. Updated descriptions and infraspecific identification keys for *Crataegus azarolus* and *Crataegus monogyna* are given and pictures and distribution data for the new taxa are also supplied.

Keywords

Crataegus, endemism, new variety, Rosaceae, Turkey

Introduction

The genus *Crataegus* L. grows mostly in the northern hemisphere and prefers forest openings and open areas of steppe. The number of species in the genus is ca. 240 with around 170 species in the New World and 70 species in the Old World (Pojarkova 1939; Meikle 1966; Riedl 1969; Browicz 1972; Christensen 1992; Khatamsaz 1991; Gu and Spongberg 2003; Phipps et al. 2003; Dönmez 2013; Phipps 2018). Phylogenetic studies, based on DNA sequences from both chloroplast and nuclear markers by Campbell et al. (2007), Lo et al. (2007), Potter et al. (2007) and Li et al. (2012), clarified the intergeneric relationships amongst the genera of the tribe Maleae. Subsequent to the publication of a revision of the Old World *Crataegus* taxa by Christensen (1992), extensive field work, both in Turkey and neighbouring countries by Dönmez (2008), showed that the section *Crataegus* is extensively diversified, especially in Turkey (Dönmez 2004, 2005, 2007, 2013; Dönmez and Oybak Dönmez 2005). Although exhaustive field work and collections in the region have been undertaken, it is still possible to detect new populations, probably representing new taxa (e.g. Dönmez 2005; Shahbaz and Sadeq 2006; Dönmez 2007, 2013; Sharifnia et al. 2011).

Ongoing studies both in the field and herbarium resulted in the discovery of a new variety (Figure 1) and an outstanding distribution pattern of a recently described species *C. yaltirikii* Dönmez. Moreover, during plant collection for the study on the photochemistry of the Aegean *Crataegus* species (Özderin et al. 2016), an unusual population of *C. monogyna* Jacq. with distinct pure yellow fruits has been discovered by the second author (Figure 2). Further, studies on the populations in the following years by the authors revealed that the fruit character is related to genetic factors and not temporary environmental conditions. Consequently, both specimens are described here as new varieties.

Crataegus azarolus L. is an economically important fruit plant and its fruits have been used for food, jam and other traditional cuisines in the area. Although there is an extensive distribution from Spain to Iran, this species does extensively diversify in Turkey. Two varieties have been described by Browicz (1972) and they have been reduced to synonym by Christensen (1992). Based on the observations of the taxa in the field, it was found that both of them should be accepted as distinct taxa.

Materials and methods

The descriptions of *Crataegus azarolus* L. var. *senobaaensis* Dönmez and *Crataegus monogyna* var. *odemisii* Dönmez & Özderin are based on field collections of the new taxa at Şırnak, Bitlis and İzmir, observation on the habitat and examination of ca. 600 herbarium specimens from E, EGE, G, HUB, ISTO, K, LE and W (acronyms follow Index Herbariorum; http://sweetgum.nybg.org/science/ih/) by the authors. The preliminary conservation status of the new taxa was assessed using the IUCN (2017) criteria, according to field observations in the type localities and their environs.

Results

The descriptions of the species have been updated according to the relevant literature, field observations and collections, both from the mentioned herbaria and our own collections. The measurements are based on the herbarium materials.

Taxonomic treatment

***Crataegus azarolus* L., Sp. pl. 477. 1753.**

Description. Shrub or tree up to ca. 4 (-10) m tall. Twigs more or less lanate or lanate-tomentose. Thorns up to ca. 8 cm long, more or less stout. Buds 2–3 (-4.2) mm long, 2–3 (-4.8) mm in diameter. Leaf blades more or less coriaceous, more or less lustrous dark green and appressed-pubescent above, pale or greyish-green and glabrous or appressed pubescent beneath, attenuate, cuneate or rounded at base, lobes obtuse, acute or cuspidate, margin entire or serrate with more or less coarse teeth; basal pair of veins divergent, straight or convergent. Subterminal leaf blades of flowering shoots (10-) 15–30 (-80) × (7-) 10–25 (-70) mm, lobes 1–2 (-4) pairs, rarely absent, basal lobes sometimes extending to midrib, each lobe entire or with (1-) 2–3 (-6) teeth in distal half, lobe length 0.5–1 (-3) times to width; petiole (2-) 4–6 (-17) mm; stipules rarely absent or 3–5 (-10) × 0.5–1 (-3) mm, entire or with 1–3 teeth. Subterminal leaf blades of short shoots (10-) 15–30 (-70) × (10-) 15–25 (-50) mm, lobes 1–2 (-4) pairs, basal pair extending to midrib, basal lobe entire or with 3 (-6) teeth in the upper half; petiole (2-) 4–8 (-28) mm long; stipules mostly undeveloped or 2–3 (-5) × 0.5–1 mm. Leaf blades of elongate shoots (15-) 20–35 (-80) × 15–25 (-70) mm, lobes 1–3 (-4) pairs, basal pair entire or 1–4 (-8) teeth at upper half; petiole 2–10 (-20) mm; stipules 4–10 (-25) × (0-) 3–5 mm, with 3–5 (-10) teeth. Inflorescence (10-) 15–20 (-45) × 15–20 (-60) mm long, corymbose, (5-) 10–20 (-25) flowered, more or less lanate or lanate-tomentose; pedicels 2–5 (-10) mm; bracts 1–4 × 0.2–0.9 mm, caducous, linear or lanceolate, margin entire or denticulate with 1–6 teeth. Flowers (5-) 10–15 mm in diameter. Hypanthium 3–6 × 3–6 mm; sepals 1.2–3.5 × 1.6–3.9 mm, usually broadly triangular, margin entire, apex more or less acute; petals 3–7 × 4–7 mm; stamens 15–20 (-22), anthers purple; styles (1-) 2–3 (4). Fruit (6-) 8–12 (-35) mm, depressed-globose, globose or slightly pyriform, yellowish-green or orange, often tinged with red, when dried, often becoming dark red; the immature fruit crowned by the persistent erect or spreading sepals, at maturity sepals re-curved; pyrenes (4-) 5–7 × 6–8 (-20) mm, dorsally sulcate, ventrally smooth, hypostyle pilose.

***Crataegus azarolus* L. var. *dentata* (Browicz) Dönmez, comb. nov.**
urn:lsid:ipni.org:names:77197215-1

Basionym. *Crataegus aronia* L. var. *dentata* Browicz, Notes Roy. Bot. Gard. Edinburgh 31: 324. 1972. TYPE [Turkey] Muğla: Marmaris, Bayır, 15 iv 1965, *P.H.Davis* 41136 (holotype: E!; isotype: K!).

Crataegus azarolus L. var. *minuta* (Browicz) Dönmez, comb. nov.

urn:lsid:ipni.org:names:77197216-1

Basionym. *Crataegus aronia* var. *minuta* Browicz, Notes Roy. Bot. Gard. Edinburgh 31: 324. 1972. TYPE: [Turkey] Hatay: 8 km from Belen towards Antakya, ca. 600 m elev., 6 v 1965, *Coode & Jones* 521 (holotype: E!).

Crataegus azarolus L. var. *senobaaensis* Dönmez, var. nov.

urn:lsid:ipni.org:names:77197217-1
Figure 1

Diagnosis. This new variety differs from the other varieties (*Crataegus azarolus* L. var. *minuta* Browicz and *Crataegus azarolus* L. var. *dentata* Browicz and *Crataegus azarolus* L. var. *aronia* L.) by its deeply divided leaf sinuses, mostly 3–4 pairs of leaf lobes and mostly ovate-oblong leaves at outline.

Type. TURKEY. Şırnak: 20 km from Uludere to Şırnak, above Şenoba, steppe, ca. 1250 m elev., 28. September 2002, *A.A.Dönmez* 11139, (holotype: HUB, isoptypes, HUB, EGE). Paratypes: Bitlis: Tatvan, Koruklu village, Yenitoprak district, 1734 m elev., hedge, 02.10.2013. *A.A.Dönmez* 18745-*K.Özgişi*. (HUB!).

Distribution. (Figure 3). *Crataegus azarolus* var. *senobaaensis* is endemic to south-east Turkey and it is known from two different locations.

Ecology and habitat. *Crataegus azarolus* var. *senobaaensis* grows in dry steppes from 1250 to 1735 m elevation.

Etymology. The epithet denotes the type locality Şenoba.

Preliminary conservation status. *Crataegus azarolus* var. *senobaaensis* should be labelled as "Critically Endangered", (CR B1+D) according to the IUCN (2017) threat categories. The area of occupancy is estimated to be smaller than 100 km^2 and the number of examined mature individuals is less than 50. Besides this, all of the examined specimens are known from habitats which are not under threat.

Infraspecific key Turkish taxa of *C. azarolus*

1 Inflorescence and leaves up to 15 mm in length.. .... **C. azarolus var. minuta comb. nov.**
– Inflorescence and leaves longer than 15 mm **2**
2 Leaves one or rarely two shallowly lobed at apex; ovate or elliptic .... ***C. azarolus* var. *dentata* comb. nov.**
– Leaves 2–4 lobed, lobes more than half of the lamina **3**
3 Leaf lobes 1–2 times wide, sinuses 1/2 to 1/3 of lamina....***C. azarolus* var. *aronia***
– Leaf lobes 3–4 times wide, leaves deeply pinnatisect .... ***C. azarolus* var. *senobaaensis*, var. nov.**

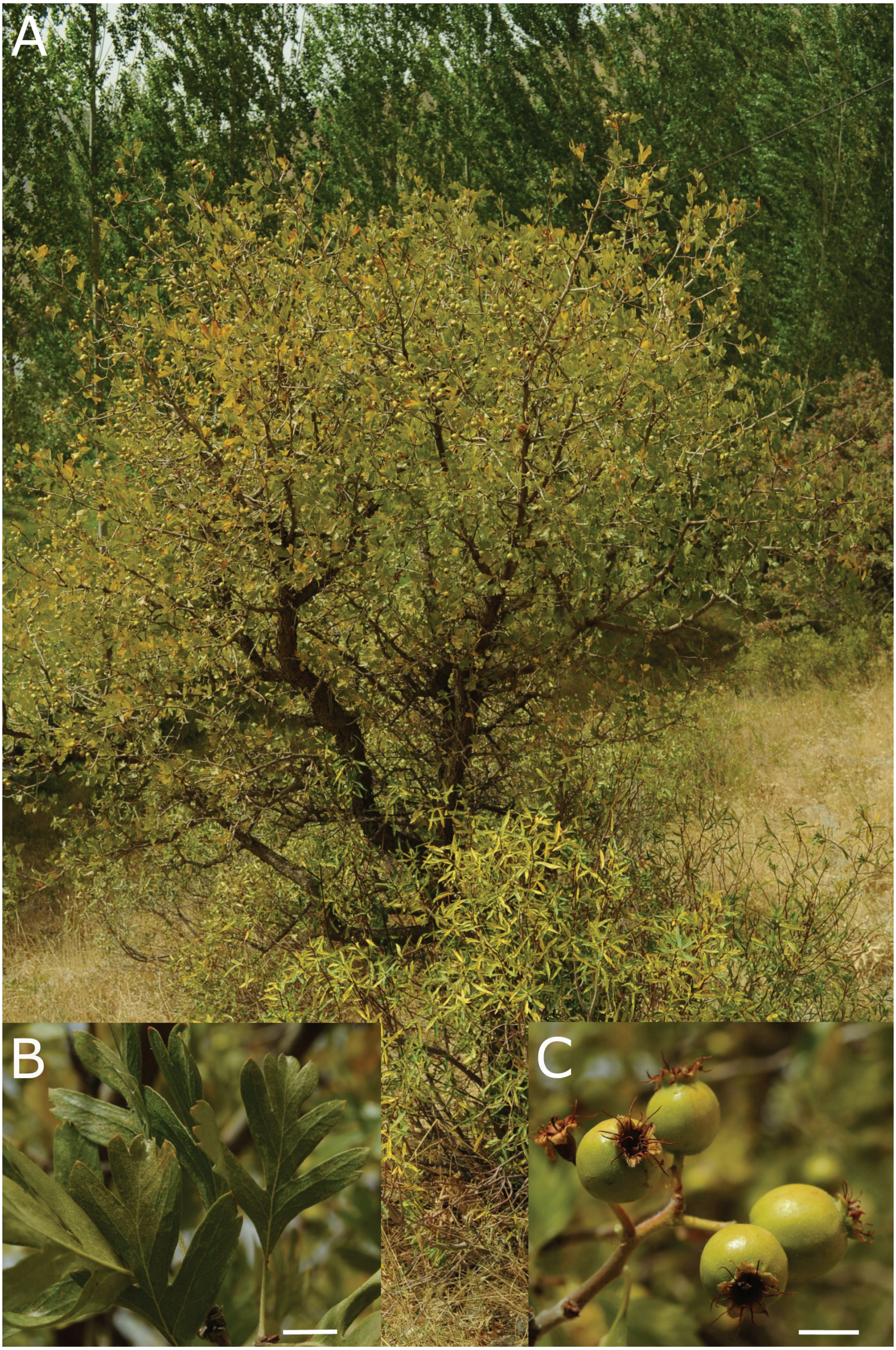

Figure 1. *Crataegus azarolus* var. *senobaaensis* Dönmez. **A** View of fruiting bush in steppe habitat **B** leaves of short shoot **C** mature fruits. (*A.A. Dönmez* 18745). Scale bar: 1cm.

Crataegus yaltirikii Dönmez Bot. J. Linn. Soc. 155(2): 239. 2007.

Lectotype. [Turkey] Şırnak: Beytüşşebap, above Günyüzü village, opening of deciduous forest, 37°27'N, 043°09'E, 1495 m elev., 28.ix.2002; *A.A.Dönmez* 11143-*B.Mutlu* (designated by Dönmez 2007).

Distribution. (Figure 3). *Crataegus yaltirikii* is a species native to Turkey where it is known from two locations namely Şırnak and Mersin which are far from each other, nearly 400 km distant.

Ecology and habitat. *Crataegus yaltirikii* grows in *Quercus brantii* Lindley forest openings at the type locality and amongst the maquis vegetation in Mersin, a recently discovered location.

Conservation status. "LC" threat category was assessed for *Crataegus yaltirikii* in the description of the species (2005). Based on the new distribution pattern of the species, the threat category of the species was re-evaluated and "LC" is still the appropriate category for the species.

Crataegus monogyna Jacq. Fl. Austriac. (Jacquin) 3: 50, t. 292, f. 1. 1775

Description. Trees or shrubs up to 10 m. Twigs glabrous rarely villose. Thorny or thornless, thorns up to 25 (-70) mm. Buds 1.1–2.8 × 1.1–2.5 mm. Leaves ±coriaceous, ±greyish below, glabrous to villose or villose on veins beneath, attenuate to widely cuneate at base, lobes obtuse to acute, entire to incised serrate at margin. Subterminal leaf blades of flowering shoots 10–35 (-57) × 8–30 (-60) mm, lobes (0-) 1–2 (-3) pairs, basal sinuses close to midvein, angles of basal vein at or wider than 45°, rarely narrower, basal lobes entire or with 2–4 (-9) serrate teeth in distal 1/2 to 3/4, petiole (1-) 5–15 (-30) mm; stipules (1-) 3–10 (-16) × 0.2–0.4 mm, entire or irregularly glandular serrate with 1–5 (-8) teeth. Subterminal leaf blades of short shoots (10-) 15–35 (-57) × (8-) 15–30 (-55) mm, lobes (0-) 1–2 (-3) pairs, basal sinuses reach to half lamina or close to midvein, lobes entire or with (2-) 4–8 (-14) teeth in the distal 1/3 to 1/8, petiole 5–15 (-45) mm, stipules undeveloped or (1-) 2–3 mm, entire or with 2–4 teeth. Middle leaf blades of elongate shoots 20–40 (-60) × 20–40 (-65) mm, 2–3 (-4) pairs, basal lobes with (0-) 3–5 (-16) teeth in distal 1/4 to 1/8, petiole (6-) 10–20 (-25) mm; stipules (4-) 8–15 (-20) × 2–4 (-8) mm, entire or irregularly serrate with 2–10 (-35) teeth. Inflorescence (10-) 15–35 (-50) × 15–45 mm, corymbose, lax, (5-) 8–15 (-20) flowered, glabrous to villose, pedicels 4–10 (-32) mm, bracts 0.5–8 (-10) × 0.1–0.5 mm, deciduous, linear-lanceolate, entire or denticulate with 1–4 teeth. Flowers (5-) 8–12 mm in diameter; hypanthium 2–4 × 2–3 mm; sepals 1.2–4 × 1.2–2.6 mm, widely triangular margin entire, acute or obtuse; petals (3-) 4–5 (-7) × 4–6 (-7) mm; stamens (15-) 18–20, anthers maroon; styles 1. Fruit 5–11 × 4–7 (-10) mm, globose to cylindrical, red to dark red, rarely orange, glabrous or sparsely villose, flesh yellowish, juicy to mealy, sepals recurved at maturity; pyrenes 4–6 (-9) × 3–5 (-8) mm, 1 (-2), dorsally and ventro-laterally entire or striate, hypostyle glabrous.

Crataegus monogyna **Jacq. var.** ***odemisii*** **Dönmez & Özderin, var. nov.**

urn:lsid:ipni.org:names:77197218-1
Figure 2

Diagnosis. This new variety differs from the other varieties (*Crataegus monogyna* Jacq. var. *monogyna* and *Crataegus monogyna* var. *lasiocarpa* (Lange) K.I.Christ.) sensu Christensen (1992) by its orange fruit colour in contrast to red fruits in the former.

Type. TURKEY. İzmir: Ödemiş, around Gölcük region, towards peak of Bozdağ, 1050–1120 m elev., 9 September, 2014, *A.A.Dönmez* 20263-*S. Özderin*, (holotype: HUB); isotypes: HUB, EGE). Paratypes: İzmir: Ödemiş, around Gölcük region, towards to peak of Bozdağ, 1050–1120 m elev., 8 October, 2013, *S. Özderin s.n.*; 22 May, 2015, *S. Özderin s.n.* (HUB).

Phenology. flowering in May and fruiting in September-October.

Habitat. in openings of *Pinus nigra* forest.

Distribution. (Figure 3). *Crataegus monogyna* var. *odemisii* is endemic to İzmir; it has a narrow distribution at Gölcük.

Ecology and habitat. *Crataegus monogyna* var. *odemisii* grows in openings of *Pinus nigra* forest between 1050 and 1120 m elevation. The basic vegetation type is maquis at lower elevations of the area. Besides this, *Pinus nigra* forest replaces it at higher altitudes and steppe vegetation dominates above the tree zone.

Etymology. The epithet of this new variety denotes the collection area, Ödemiş.

Preliminary conservation status. *Crataegus monogyna* var. *odemisii* should be assigned to "Critically Endangered", (CR B2ab(i,ii,iii,iv), D) according to the IUCN (2017) threat categories. The area of occupancy is estimated to be less than 10 km^2 and the examined specimens are known only from alongside the road. The location is close to the picnic area of the Gölcük Lake and is under threat from fire, cutting and other anthropogenic effects.

Discussion. Two new varieties have been published by Browicz (1972) from Turkey under the species name of *C. aronia* L. These two varieties were reduced to synonym by Christensen (1992) with their published name and he accepted the name *Crataegus azarolus* instead of *C. aronia*. Taxonomic decisions of Christensen have been based solely on herbarium material. During the taxonomic revision of the genus *Crataegus*, the first author had the opportunity to observe these varieties in their habitats alongside the complete set of morphological variations of the species. Moreover, morphological studies on the large set of herbarium material in the above-mentioned herbaria and fieldwork from Greece to Iran provided more opportunity to observe all kinds of variation of *C. azarolus* and the closely related taxa. Consequently, based on field observations and herbarium studies on the collected materials, these two varieties, namely *Crataegus azarolus* L. var. *dentata* (Browicz) Dönmez and *Crataegus azarolus* L. var. *minuta* (Browicz) Dönmez should be accepted as distinct taxa and they should be given as new combinations under the species name of *Crataegus azarolus*.

Crataegus monogyna is one of the most polymorphic species amongst the Eurasian *Crataegus* taxa with respect to leaf morphology and indumentum. Due to local

Figure 2. *Crataegus monogyna* var. *odemisii* Dönmez & Özderin var. nov. **A** View of flowering individual in habitat **B** flowers **C** mature fruit **D1** leaf of fertile shoot **D2** leaf of short shoot. (**A–B** *S.Özderin s.n.* **C–D** *A.A.Dönmez* 20263-*S.Özderin*). Scale bar: 1cm.

variations of the species and species concepts by the authors who studied *Crataegus*, many new taxa have been described. In addition, new combinations and alteration of their status have been made. Based on these taxonomic and nomenclatural novelties, both taxonomic and nomenclatural synonyms of about 200 names have been listed

Figure 3. Distribution of the taxa. (square)*Crataegus azarolus* var. *senobaaensis*; (star) *Crataegus monogyna* var. *odemisii* var. nov. (circle) *Crataegus yaltirikii* (Near East topographic map-blank.svg).

by Christensen (1992). In *C. monogyna*, extensive variations in leaf morphology and indumentum are present, whereas variations in fruit colour are limited. Fruit colour of *C. monogyna* is clearly red and/or with degrees of red. Specimens of the new variety, *C. monogyna* var. *odemisii* are yellow. Red and various degrees of red colour for fruit of infraspecific *C. monogyna* taxa have been observed by the second author and they have hundreds of representative specimens for these fruit colours in the above-mentioned herbaria. According to observations on the fruit colour of single pyrened *Crataegus* taxon, it is a constant character and unique in the infraspecific taxa of *C. monogyna*. Hence, it is worthwhile accepting this population as a separate taxonomic status, as a variety.

Crataegus yaltirikii Dönmez is a recently described new species from southeast Turkey and we found a new population of the species on the Taurus Mountain ranges, nearly 400 km away from the type locality. Climatic conditions of these two localities are different; the type locality is a cold and snowy area, whereas the recently discovered locality is characterised by hot and dry summers, rainy and warm winters. We have not yet obtained molecular works on these disjunct populations. Besides this, we assume that these populations should be local ecotypes of the species.

Infraspecific key to Turkish taxa of *Crataegus monogyna*

1 Fruit orange yellow; fertile leaf lobes with only few teeth, short shoot leaf lobes with many teeth .... ***C. monogyna* var. *odemisii* var. nov.**
– Fruit red to dark red; teeth of fertile and short shoot leaf lobes are similar..... **2**
2 Leaves, twigs and fruits sparsely villous or glabrous .... ***C. monogyna***
– Leaves, twigs and fruits densely villous..................................... ***C. lasiocarpa***

Selected additional specimens examined

Crataegus azarolus L. var. *dentata* (Browicz) Dönmez

TURKEY. Muğla: Datça, Taşlıca village, Karayurt district, limestone, 36° 37.7’N, 28° 6.1’E 208 m elev., 1 December 2001, *A.A.Dönmez* 10412 -*S.Işık* (HUB!). İçel: Tarsus, Kadıncık I Dam, 500 m elev., 11 May 1990, *Y.Gemici* 5480 (EGE!); Tarsus, Beylice village, 600 m elev., 10 August 1990, *A. Güner* 7951-*H.Karaca* (HUB!).

Crataegus azarolus L. var. *minuta* (Browicz) Dönmez

TURKEY. Denizli: around Pamukkale, 9 May 1975, *Browicz & Zielinskii* 104 (E!, LE!). Antalya: Kaş, Lengumen village, around Belpınarı, 1100 m elev., limestone, 9 September 1992, *A.A.Dönmez* 2963 (HUB!); Elmalı, y. 1300 m elev., 4 June 1961, *Howard C.Stutz* 1512 (W!). Konya: Ermenek, E of Ermenek ca. 1200 m elev., 27 May 1978, *M.Vural* 700 (ANK!). Mersin: Mut, Magras Mountain, 1100 m elev., 750 m elev., 11 May 1965, *Coode & Jones* 750 (E!, ISTO!). Kahramanmaraş: from Kahramanmaraş to Zeytin, Ahır Mountain, 1100 m elev., 8 May 1934, *Balls* 991 (E!). Kilis: 2 km from Kilis to Radar, slopes, *Quercus* çalılığı, ca. 800 m elev., 2 June 2000, *A.A.Dönmez* 7812 (HUB!).

Crataegus monogyna Jacq. var. *monogyna*

TURKEY. Edirne: Enez, Kılıçbey village, *Quercus* forest, 40°46.3"N, 26°32.61"E, 30 m elev., 8 May 2001, *A.A.Dönmez* 8704 (HUB!). Kırklareli: Demirköy Değirmendere district, 41°49.61"N, 27°45.25"E, 265 m elev., 9 May 2001, *A.A.Dönmez* 8778 (HUB!). Tekirdağ: Ganos Mt., Akçahalil village, ca. 500 m elev., 5 November 1999, *A.A.Dönmez* 6795 (HUB!). Çanakkale: Gelibolu, Bolayır, Koruköy, 40°33.65"N, 26°48.41"E, 60 m elev., 7 May 2001, *A.A.Dönmez* 8681 (HUB!). İstanbul: Büyükdere, Cumhuriyet street, amongst *Pinus nigra*, 41°9.6"N, 29°2.63"E, 50 m elev., 10 November 2001, *A.A.Dönmez* 10400 (HUB!). Kocaeli: Gebze, TÜBİTAK MAM campuse, ca. 100 m elev., 17 December 2002, *A.A.Dönmez* 11097. Bilecik: Taşçılar village, 40°14.5"N, 29°53.93"E, 600 m elev., 5 May 2001, *A.A.Dönmez* 8648 (HUB!). Bolu: Mengen, Çapak stream, *Pinus nigra* opening, ca. 550 m elev., 17 May 2002, *A.A. Dönmez* 10602 (HUB!). Ankara: Nallıhan, Kabaca village, 40°19.56"N, 31°21.19"E, 774 m elev., 24 August 2001, *A.A.Dönmez* 10004 (HUB!). Ankara: Ayaş road, amongst *Quercus-Pinus* plantation, 40°4.78"N, 32°27.95"E, 1050 m elev., 1 June 2001, *A.A.Dönmez* 8918 (HUB!). Karabük: between Karabük and Eskipazar, 41°19.05"N, 32°40.18"E, 289 m elev., 17 May 2002, *A.A.Dönmez* 10580 (HUB!). Kastamonu: Boyalı, Bahçeçiçek village, *Abies nordmanniana* opening, 41°9.12"N, 33°18.85"E, 993 m elev., 5 June 2001, *A.A.Dönmez* 9201 (HUB!). Amasya: Suluova, 630 m elev., M&D Zohary 2165 (E!). Tokat: between Koyulhisar and Reşadiye, *Quercus-Pinus* opening, 40°22.25"N, 37°33.2"E, 505 m elev., 25 May 2002, *A.A.Dönmez* 10569 (HUB!). Artvin: west of the city, 500 m elev., 3 June 1993, *A.A.Dönmez* 3244 (HUB!). Çanakkale: Biga, Gerlengeç village, ca. 5 m elev., *Quercus-Fraxinus* scrub, 07 April 1999, *A.A.Dönmez* 7532 (HUB!). İzmir: Bozdağ, from Ödemiş to Bozdağ *Quercus* scrub, 38°17.16"N, 28°3.18"E, 990 m elev., 4 April 2001, *A.A.Dönmez* 8356 (HUB!). Aydın: Nazilli, Yağdere village, 37°55.43"N, 28°12.85"E, 312 m elev., 4 April 2001, *A.A.Dönmez* 8339 (HUB!). Balıkesir: Akbaş village, *Quercus-Juniperus* scrub, 39°40.08"N, 27°31.96"E, 390 m elev., 6 May 2001, *A.A.Dönmez* 8662 (HUB!). Bilecik: Söğüt, *Quercus* opening, 39°58.16"N, 30°7.15"E, 1100 m elev., 5 April 2001, *A.A.Dönmez* 8378 (HUB!). Manisa: Kula, Sandal village, 38°59.16"N, 28°34.05"E, 504 m elev., 21 August 2001, *A.A.Dönmez* 9931 (HUB!). Kütahya: from Harmancı to Tavşanlı, 39°35.45"N, 29°24.76"E, 872 m elev., 22 August 2001, *A.A.Dönmez* 9957 (HUB!). Uşak: between Delihıdırlı and Karahallı, 38°20.58"N, 29°33.85"E, 879 m elev., 20 August 2001, *A.A.Dönmez* 9927 (HUB!). Afyon: Çay, 1000 m elev., 9 August 1992, *A.A.Dönmez* 2905 (HUB!). Denizli: Acıgöl, rocky places, 37°49.4"N, 29°45.26"E, 845 m elev., 23 May 2001, *A.A.Dönmez* 8909 (HUB!). Isparta: Eğirdir, Akpınar village, 37°50.2"N, 30°51.18"E, 1100–1400 m elev., 1 April 2001, *A.A.Dönmez* 8287 (HUB!). Konya: Beyşehir, Yeşildağ village, 37°34.01"N, 31°32.21"E, 1210 m elev., 19 August 2001, *A.A.Dönmez* 9910 (HUB!). Ankara: Beytepe, ca. 950 m. elev. 24 September 2000, *A.A.Dönmez* 8092 (HUB!). Kırıkkale: Delice, Baraklı village, 17 August 1993, *A.A.Dönmez* 3927 (HUB!). Yozgat: Saray, 39°43.23"N, 34°42.2"E, 1100 m elev., 4 April 2001, *A.A.Dönmez* 8388 (HUB!). Adana: Himmetli, Saimbeyli, Davis 26652 (E!). Adıyaman: Gölbaşı, between Meydan and Hamzalar village, 37°52.81"N, 37°40.33"E, 1035 m elev., 15 September 2001, *A.A.Dönmez* 10126 (HUB!). Elazığ: from Elazığ to Malatya, Gülmahmut village, 38°33.78"N, 39°3.03"E, 1188 m elev., 21 April 2002, *A.A.Dönmez* 10518 (HUB!). Erzincan: Kemah, Eriç-Tuztaşı, ca. 800–900 m elev., 28 May 1998, *A.A.Dönmez* 6451 (HUB!). Malatya: Elazığ road, Kapıkaya village, 38°20.65"N, 38°33.3"E, 930 m elev., 21 April 2002, *A.A.Dönmez* 10515 (HUB!). Aydın: from Nazilli to Ödemiş, Hisarcık village, 38°055"N, 28°23.45"E, 380 m elev., 22 September 2001, *A.A.Dönmez* 10156 (HUB!). Denizli: Babadağ, Göçükoluk pasture, 37°48.16"N, 28°51.1"E, 1300 m elev., 23 May 2001, *A.A.Dönmez* 8898(HUB!). İzmir: Beydağ, Mutalar village, 38°4.4"N, 28°14.35"E, 260 m elev., 22 September 2001, *A.A.Dönmez* 10158 (HUB!). Muğla: from Muğla to Denizli, 37°11.09"N, 28°37.63"E, 805 m elev., 21 September 2001, *A.A.Dönmez* 10152. Antalya: Kaş, Lengumen village, 1100 m elev., 9 September 1992, *A.A.Dönmez* 2965 (HUB!). Konya: from Beyşehir to Akseki, 37°32.06"N, 31°34.45"E, 1180 m elev., 20 April 2001, *A.A.Dönmez* 8613 (HUB!). Mersin: Fındıkpınarı, Turunçlu, 36°49.75"N, 34°26.2"E, 570 m elev., 8 March 2001, *A.A.Dönmez* 8186-*B. Mutlu* (HUB!). Adana: Çamardı, Yelyutan village, 1300 m elev., 18 May 1993, *A.A.Dönmez* 3183 (HUB!). Kahramanmaraş: between Andırın and Gebez, 1300 m elev., 21 May 1993, *A.A.Dönmez* 3205 (HUB!). Osmaniye: Düziçi, Düldül Mt., Çitli village, 37°19.16"N, 36°29.55"E, 1012 m elev., 22 June 2004, *A.A.Dönmez* 12041 (HUB!). Hatay: Belen, 36°31.41"N, 36°15.26"E, 1300 m elev., 28 June 2001, *A.A.Dönmez* 9469 (HUB!). Mardin: from Mardin to Diyarbakır, 1000 m elev., Davis 28718 (E!). Şırnak: from Şırnak to Eruh, 37°39.28"N, 42°19.25"E, 1550 m elev., 28 September 2002, *A.A.Dönmez* 11138 (HUB!).

***Crataegus monogyna* var. *lasiocarpa* (Lange) K.I.Christ.**

TURKEY. Edirne: İpsala, Sarpdere, 40°53.23"N, 26°24.68"E, 60 m elev., 8 May 2001, *A.A.Dönmez* 8732 (HUB!). Tekirdağ: Hayrabolu, Çarıklı village, ca. 150 m elev., 19 June 1999, *A.A.Dönmez* 6941 (HUB!). Bolu: between Göynük and Mudurnu, 40°26.9"N, 30°54.08"E, 1105 m elev., 7 July 2003, *A.A.Dönmez* 11662(HUB!). Aydın: Karacasu, 37°44.01"N, 28°37.45"E, 422 m elev., 3 March 2001, *A.A.Dönmez* 8332 (HUB!). Balıkesir: Susurluk, 39°46.31"N, 28°2.56"E, 300 m elev., 6 May 2001, *A.A.Dönmez* 8658 (HUB!). Kütahya: Sabuncu, Fındık village, 39°33.33"N, 30°13.13"E, 962 m elev., 23 August 2001, *A.A.Dönmez* 9984 (HUB!). Ankara: Botanik Park, ca. 1000 m elev., 06 October 2000, *A.A.Dönmez* 8140. Tunceli: Pülümür, Gökçekonak village, 39°23.65"N, 39°50.13"E, 1252 m elev., 1 June 2002, *A.A.Dönmez* 10871 (HUB!). Muğla: Fethiye, Kemer, Kayacık village, 890 m elev., 8 September 1992, *A.A.Dönmez* 2961 (HUB!). Antalya: Kaş, 1130 m elev., limestone, 9 September 1992, *A.A.Dönmez* 2967 (HUB!). Adana: Kozan, 800 m elev., 18 May 1993, *A.A.Dönmez* 3191 (HUB!). Osmaniye: Düziçi, Düldül Mt., Çitli village, 37°19.16"N, 36°29.55"E, 1012 m elev., 22 June 2004, *A.A.Dönmez* 12045 (HUB!).

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RESEARCH ARTICLE

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A new species of *Fordiophyton* (Sonerileae, Melastomataceae) from Yunnan, China

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Abstract

Fordiophyton jinpingense (Melastomataceae; Sonerileae), a species occurring in south-eastern Yunnan, China, is described as new, based on morphological and molecular data. Phylogenetic analyses, based on nrITS sequence data, showed that, except *F. breviscapum*, all species sampled in *Fordiophyton* formed a strongly supported clade in which two geographical lineages were recovered. The generic placement of *F. jinpingense* is well supported by phylogenetic analyses and a character combination of 4-merous flowers, distinctly dimorphic stamens and the connectives basally not calcarate. Molecular divergence and morphological evidence indicate that *F. jinpingense* is well separated from other members of the genus, thus justifying its recognition as a distinct species. *Fordiophyton jinpingense* is phylogenetically closest to *F. repens*, but differs markedly from the latter in stem morphology (short, obtusely 4-sided vs. long, 4-angular), habit (erect vs. creeping), leaf size (6–16.5 × 4.5–13 cm vs. 4–7.5 × 4–6.5 cm) and flower number per inflorescence (5–13 vs. 3–6).

Keywords

Fordiophyton, Melastomataceae, taxonomy, phylogeny

Introduction

In the study of Asian Sonerileae, Stapf established two new genera, *Fordiophyton* Stapf and *Gymnagathis* Stapf, based on three species in China (Stapf 1892). Both genera were accepted by subsequent authors (Krasser 1893; Diels 1932; Li 1944; Chen 1984a, b). Li

(1944) pointed out that *Gymnagathis* is an illegitimate generic name and proposed a new name *Stapfiophyton* Li to replace it. However, Hansen (1992) considered the type species of *Stapfiophyton*, *S. peperomiifolium* (Oliver) H. L. Li, to be similar to *Fordiophyton* and therefore placed *Stapfiophyton* in synonymy under *Fordiophyton*. Hansen's treatment was thereafter adopted by other authors (Deng and Wu 2004; Chen and Renner 2007).

Fordiophyton, as currently defined, is a small Asian genus of 13 species mainly occurring in southern China, with only one species extending to northern Vietnam (Chen and Renner 2007; Ning and Liu 2010; Zeng et al. 2016a, b). It is characterised by 4-merous flowers, eight unequal stamens, distinctly dimorphic anthers, connectives not calcarate at the base and anther base of longer stamens not forked, obtusely forked or forked and curved (Fig. 1). Ten species of *Fordiophyton* have been included in previous molecular phylogenetic studies (Zeng et al. 2016a, b; Zhou et al. in press). Amongst the species sampled in *Fordiophyton*, *F. breviscapum* (C. Chen) Y. F. Deng & T. L. Wu appeared to be close to *Phyllagathis tetrandra* Diels and *P. elattandra* Diels (Zhou et al. in press), while the remaining species, including the type species, *F. faberi* Stapf, formed a well-supported clade close to *Blastus*, *Bredia-Phyllagathis* clade 2 and *Plagiopetalum* (Zeng et al. 2016a, b; Zhou et al. in press).

During a field survey, we encountered a distinct plant in the forests of Ma-an-di, Fenshuiling National Nature Reserve in Jinping County, south-eastern Yunnan. This plant had eight distinctly dimorphic stamens and connectives not calcarate at the base, which are typical characteristics of *Fordiophyton*. It was distinct from all known species of *Fordiophyton* in the combination of short stems with distinct internodes, basal rosette of leaves, unwinged, densely villous petioles, umbellate inflorescence and anther base of longer stamens distinctly forked and curved (Figs 2, 3). We suspected that it represented an undescribed species.

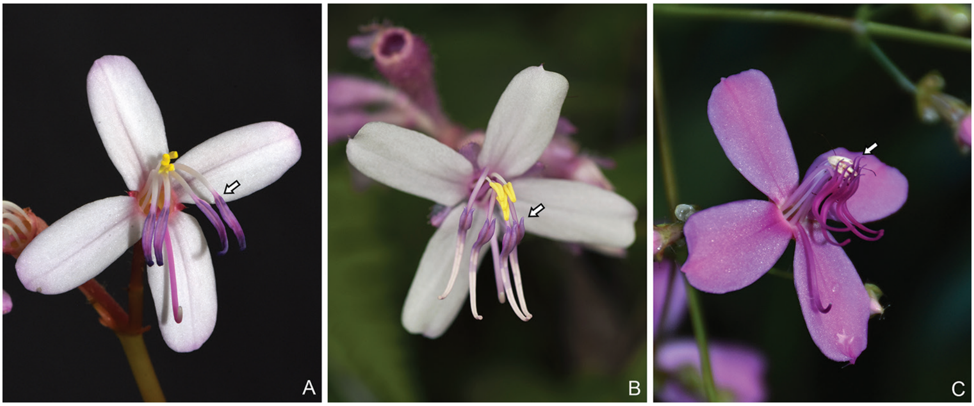

Figure 1. Flowers of *Fordiophyton* showing anther morphology of the longer stamens. **A** *F. peperomiifolium* from Qingyuan, Guangdong, China, anther base not forked **B** *F. faberi* from Hengshan, Hunan, China, anther base forked **C** *F. strictum* from Pingbian, Yunnan, China, anther base forked and curved. Arrows indicate the anther base of the longer stamens.

To evaluate the specific status and phylogenetic position of this species in *Fordiophyton*, phylogenetic analyses were performed, based on DNA sequence data of the nuclear ribosomal internal transcribed spacer (nrITS). The results confirmed our suspicions that these plants represented a previously unrecognised species, *F. jinpingense*, which we describe below as new. A key to separate it from other species of *Fordiophyton* is also provided.

Materials and methods

For phylogenetic analyses, the nrITS sequences of *F. longipes* and *F. jinpingense* were newly sequenced, while the sequences of other species were downloaded from GenBank. The final dataset contained 131 accessions representing 106 species and three varieties from 19 genera in Sonerileae/Dissochaeteae and one in tribe Blakeeae. *Blakea schlimii* (Naudin) Triana was selected as an outgroup according to previous studies (Clausing et al. 2000; Clausing and Renner 2001; Renner et al. 2001; Goldenberg et al. 2012; Zhou et al. in press). In total, twelve species of *Fordiophyton* (85.7%) were sampled in the analyses. The source of the materials and GenBank accession numbers are given in Suppl. material 1.

Total DNA was extracted from fresh leaves using the modified CTAB procedure (Doyle and Doyle 1987). The nrITS region of *F. longipes* and *F. jinpingense* were amplified and sequenced using universal primers (White et al. 1990), following the procedure described in Zou et al. (2017).

Sequences were aligned using SeqMan v.7.1.0 (DNASTAR Inc., Madison, WI). The best-fitting nucleotide substitution model was determined using the Akaike Information Criterion in Modeltest version 3.7 (Posada and Crandall 1998) prior to phylogenetic analyses. The substitution model GTR+I+G was selected. Bayesian Inference (BI), Maximum Likelihood (ML) and Maximum Parsimony (MP) analyses were performed according to Zhou et al. (in press).

Results

The aligned sequence matrix contained 766 characters. Statistics of sequences sampled are summarised in Suppl. material 2. Trees generated by ML, MP and BI analyses were highly similar in topology, except that some nodes with weak support in ML analyses collapsed in MP or BI analyses. The tree resulting from ML analysis is shown in Suppl. material 3, with BI posterior probability (PP), ML bootstrap support values (BS) and MP bootstrap support values (PBS) labelled at nodes. As shown in Fig. 4, *F. breviscapum*, *P. tetrandra* and *P. elattandra* comprised a clade with weak support (PP = 0.72, BS = 42%, PBS = 49%), while the remaining 11 species formed the well-supported *Fordiophyton* clade (PP = 1.0, BS = 100%, PBS = 99%). The sister relationship of these two clades was only weakly supported in BI and ML analyses (PP = 0.19, BS= 15%). Two subgroups were recovered within the *Fordiophyton* clade with strong support. One subgroup included seven species, namely *F. brevicaule* C. Chen, *F. chenii* S. Jin Zeng & X. Y. Zhuang, *F. cordifolium* C. Y. Wu ex C. Chen, *F. faberi*, *F. huizhouense* S. Jin Zeng & X. Y. Zhuang, *F. peperomiifolium* (Oliv.) C. Hansen and *F. zhuangiae* S. Jin Zeng & G. D. Tang (PP = 1.0, BS = 100%, PBS = 100%); the other contained *F. longipes* Y. C. Huang, *F. repens* Y. C. Huang, *F. strictum* Diels and the new species, *F. jinpingense* (PP = 1.0, BS = 90%, PBS = 93%) (Fig. 4).

Discussion

Phylogeny of *Fordiophyton*

Phylogenetic analyses recovered two subclades in the *Fordiophyton* clade (Fig. 4). The grouping of species shows weak correlation with morphology. Both subclades are quite variable in habit (short stem with a basal rosette of leaves/long and leafy stem) and morphology of the leaf blade (ovate, cordate to lanceolate), petiole (hairy/glabrous, winged/unwinged) and inflorescence (umbellate/cymose paniculate). However, the subclades represent two geographic lineages. Six out of the seven species in subclade 1 are narrowly endemic to south-eastern China (Guangdong and Hongkong), whereas three out of the four species in subclade 2 are endemics of south-western China (Yunnan).

The currently circumscribed *Fordiophyton* is not monophyletic, as *F. breviscapum* appears to be related to *Phyllagathis tetrandra* and *P. elattandra*, rather than to other members of the same genus. *Fordiophyton breviscapum* is morphologically most closely related to *F. degeneratum* (C. Chen) Y. F. Deng & T. L. Wu, which was not included in the phylogenetic analyses. These two species, as well as *P. tetrandra* and *P. elattandra,* have been treated in *Stapfiophyton* (Li 1944; Chen 1984a, b). Interestingly, these four species share some common features, such as hypanthium distinctly 4-sided and the inner whorl of stamens greatly reduced (*F. breviscapum*), sterile (*F. degeneratum* and *P. elattandra*) or undeveloped (*P. tetrandra*) (Fig. 5). As the relationships amongst these species are only weakly supported, their generic placement remains unclear, pending further study.

Fordiophyton damingshanense S. Y. Liu & X. Q. Ning is another species which was not sampled in previous and present phylogenetic studies. It highly resembles *F. faberi* in habit, leaf morphology and stamen morphology. Geographically, it occurs in Guangxi, where *F. faberi* also occurs. Morphology and distribution imply that *F. damingshanense* is probably a member of subclade 1.

Phylogenetic position and specific status of *F. jinpingense*

The generic placement of *F. jinpingense* is supported by morphological and phylogenetic data. Its 4-merous flowers, eight distinctly dimorphic stamens and the connectives basally not calcarate fit perfectly well with the morphological circumscription of

Fordiophyton. Phylogenetic analyses also showed that *F. jinpingense* was nested within the same clade, together with the type of *Fordiophyton*, *F. faberi*.

At the molecular level, pairwise sequence divergence at the nrITS region between *F. jinpingense* and other species of *Fordiophyton* ranges from eight to 42 nucleotide substitutions, which is equivalent to the number of substitutions between other species of *Fordiophyton* (ranging from 14 to 47 nucleotide substitutions). Molecular divergence, therefore, indicates that *F. jinpingense* is well diverged from other members of the genus. Morphologically, the basal rosette of leaves of *F. jinpingense* makes it quite distinct from species with erect, leafy stems, viz. *F. cordifolium*, *F. faberi*, *F. longipes* and *F. strictum*. It closely resembles *F. brevicaule*, *F. chenii*, *F. huizhouense*, *F. peperomiifolium* and *F. zhuangiae* in habit, but differs from *F. chenii* and *F. zhuangiae* in the unwinged, villous petioles (vs. winged and glabrous), from *F. huizhouense* and *F. peperomiifolium* in stems with distinct internodes (vs. indistinct) and from *F. brevicaule* in longer petioles (3–16 cm vs. 1–3 cm), larger leaf blades (6–16.5 × 4.5–13 cm vs. 3.5–8 × 2–5 cm) and umbellate inflorescence (vs. cymose paniculate). In fact, the phylogenetic analyses showed that *F. jinpingense* is most closely related to *F. repens* rather than to the above species. *Fordiophyton repens* is narrowly endemic to Pingbian County, south-eastern Yunnan. The two are similar in having villous petiole and leaf blade, umbellate inflorescence and anther base of longer stamens forming a forked spur. Nevertheless, they differ markedly in stem morphology (short, obtusely 4-sided vs. long, 4-angular), habit (erect vs. creeping) (Fig. 6), leaf size (6–16.5 × 4.5–13 cm vs. 4–7.5 × 4–6.5 cm) and flower number per inflorescence (5–13 vs. 3–6). Therefore, both molecular and morphological evidence justify the recognition of *F. jinpingense* as a distinct species.

Taxonomic treatment

Fordiophyton jinpingense J.H.Dai & Z.Y.Yu, sp. nov.

urn:lsid:ipni.org:names:60478839-2
Figures 2, 3

Type. CHINA. Yunnan: Jinping County, Ma-an-di town, 900–1900 m alt., damp but well drained places in forest, 10 Mar 2019, Ying Liu 728 (holotype: A; isotype: SYS).

Diagnosis. Differs from *F. repens* in having slightly obtusely 4-sided short stem (vs. 4-angular, long and creeping), mature leaves 6–16.5 × 4.5–13 cm (vs. 4–7.5 × 4–6.5 cm) sparsely and shallowly dentate leaf margin with each tooth having a caducous terminal seta (vs. densely denticulate, persistent) and inflorescence 5–13-flowered (vs. 3–6-flowered).

Description. Perennial herbs, 10–14 cm tall (including inflorescence). Stems 2–5 cm long, slightly obtusely 4-sided, sometimes branched, villous with multiseriate hairs. Petiole 3–16 cm long, densely villous with multiseriate hairs; leaf blade ovate-oblong to ovate-orbicular, 6–16.5 × 4.5–13 cm, papery, adaxially green to dark green, abaxially pale green or sometimes purplish-red, villous with multiseriate hairs on veins, both sur-

Figure 2. *Fordiophyton jinpingense*, all from Y. Liu 728 (SYS, A). **A** Habitat **B** a flowering individual **C** adaxial leaf surface **D** abaxial leaf surface **E** petiole villous with multiseriate hairs **F** young inflorescence **G** young inflorescence dissected showing the position and morphology of bracts. Scale bar: 2 cm (**G**).

Figure 3. Detail of inflorescence, flower, stamens, ovary and fruit of *Fordiophyton jinpingense*, all from Y. Liu 728 (SYS, A). **A** Mature inflorescence **B** side view of a flower **C** top view of a flower **D** longitudinal section of a flower showing dimorphic stamens and ovary crown **E** anther morphology in detail **F** transection of ovary at young fruit stage, showing the very short-stalked, nearly sessile placenta **G** young fruit showing the crown not exserted from hypanthium. Scale bars: 5 mm (**D–F**).

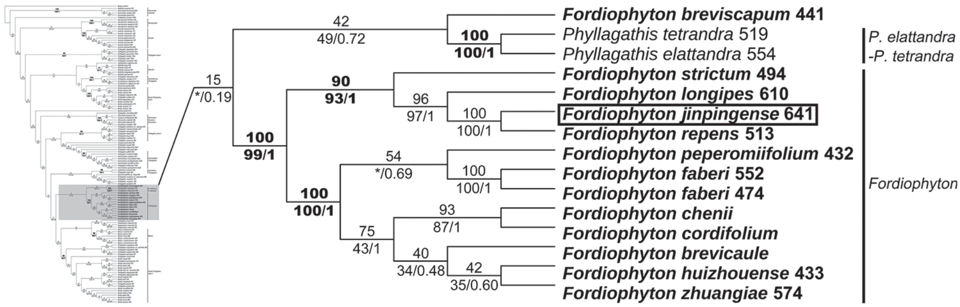

Figure 4. Phylogenetic relationships amongst species of *Fordiophyton*. Part of the Maximum Likelihood (ML) phylogenetic tree based on nrITS sequence data. Numbers above branches are bootstrap values obtained from maximum likelihood analyses, and those below branches are Bayesian posterior probabilities (right) and bootstrap values (left) resulting from maximum parsimony analyses. Box denotes the new species; asterisk denotes a branch collapsed in Bayesian inference or maximum parsimony analyses.

Figure 5. Stamen number and morphology of *Fordiophyton breviscapum*, *Phyllagathis elattandra* and *P. tetrandra*. **A** *F. breviscapum* from Ruyuan, Guangdong, China, 8 stamens with the shorter stamens greatly reduced **B** *P. elattandra* from Guiping, Guangxi, China, 8 stamens with the shorter stamens sterile **C** *P. tetrandra* from Xichou, Yunnan, China, 4 stamens. Arrows indicate anther of the shorter stamens.

faces inconspicuously pubescent with very short, appressed uniseriate hairs, secondary veins 3 or 4 on each side of midvein, base cordate, margin sparsely and shallowly dentate with each tooth having a terminal seta when young but caducous at maturity, apex short acute, obtuse or retuse. Inflorescences terminal and axillary, umbellate, 5–13-flowered; peduncle 9–14 cm long, sometimes white maculate, bearing several multiseriate hairs at nodes, otherwise glabrous; bracts caducous, oblong, 1–3 cm long, one pair (rarely two) in middle or lower part and another two pairs enclosing the flowers. Pedicels 4–10 mm long, glabrous. Hypanthium funnel-shaped, ca. 10 mm long, obtusely 4-sided, glabrous. Calyx lobes narrowly triangular-ovate, 2–5 × 1–2 mm, margin entire, apex obtuse or acute, caducous. Petals pink, obovate, ca. 16 × 8 mm, oblique. Longer stamens pink; filaments ca. 9 mm; anthers ca. 13 mm long, linear, curved, base lengthened

Figure 6. A Y. Y. Hu and S. K. Wen 580300 (KUN) collected from Pingbian County, Yunnan, China, holotype of *Fordiophyton repens* **B** Y. Liu 728 (A) collected from Ma-an-di, Jinping County, Yunnan, China, holotype of *Fordiophyton jinpingense*.

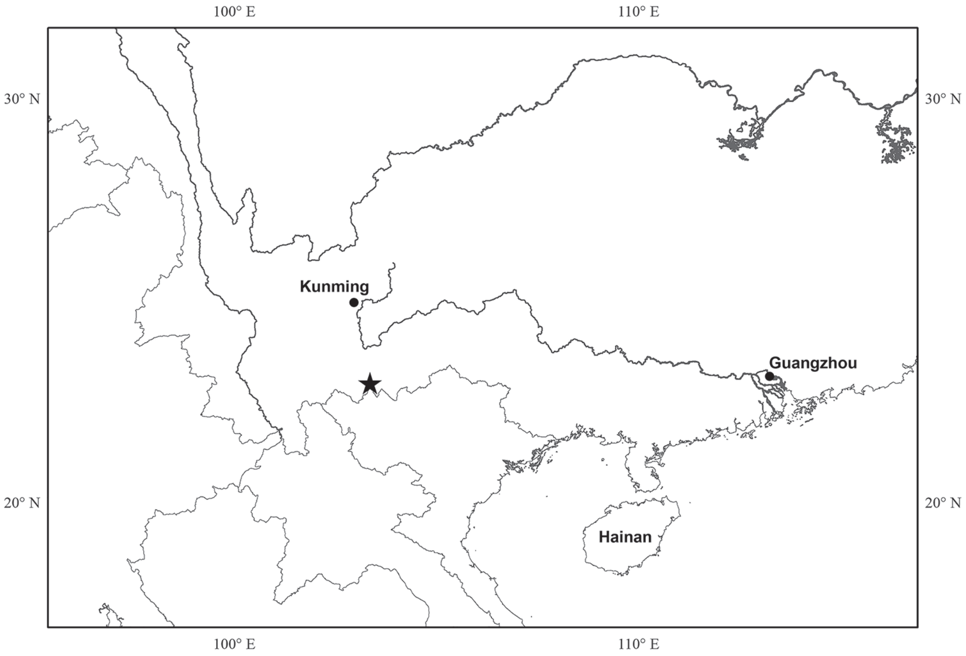

Figure 7. Distribution of *Fordiophyton jinpingense*.

into a forked, curved spur, connective bulging basally. Shorter stamens yellowish; filaments ca. 6 mm long; anthers oblong, 3–4 mm long, base obtusely forked, connective base slightly bulging. Ovary obovate, apex with a membranous ciliate, 4-lobed crown. Capsule funnelform-campanulate, ca. 6 mm in diam., apex 4-lobed, crown not exserted from calyx; hypanthium exceeding capsule, glabrous. Seeds numerous.

Phenology. Flowering March–April, fruiting April–May.

Etymology. The specific epithet is derived from Jinping County, the type locality of *Fordiophyton jinpingense*.

Distribution. *Fordiophyton jinpingense* is currently known only from Jinping County, south-eastern Yunnan, China (Fig. 7). It occurs in dense or open forests, often in damp, shaded, but well drained places, such as on steep slopes, at 900–1900 m alt.

Key to the species of *Fordiophyton*

1 Leaves in a basal or sub-basal rosette **2**
– Leaves cauline **7**
2 Petiole winged and glabrous **3**
– Petiole unwinged, densely or sparsely hairy **4**
3 Petioles 8–18 cm long; leaf blade 9–13 × 9–12 cm; secondary veins 4 on each side of midvein; hypanthium and calyx lobes hairy .... ***F. chenii***
– Petioles 2–4 cm long; leaf blade 4–9 × 2–4 cm; secondary veins 2 or 3 on each side of midvein; hypanthium and calyx lobes glabrous .... ***F. zhuangiae***
4 Internodes of stems distinct **5**
– Internodes of stems indistinct **6**
5 Internodes glabrous; petioles 1–3 cm long; leaf blade 3.5–8 × 2–5 cm; inflorescence cymose-paniculate; anthers of longer stamens forming an obtuse forked spur at base .... ***F. brevicaule***
– Internodes hairy; petioles 3–16 cm long; leaf blade 6–16.5 × 4.5–13 cm; inflorescence umbellate; anthers of longer stamens forming a forked, curved spur at base .... ***F. jinpingense***
6 Hypanthium glabrous; calyx lobes lanceolate, 6 × 2 mm; base of connective of longer stamens prolonged .... ***F. huizhouense***
– Hypanthium sparsely hairy; calyx lobes triangular, 1 × 2 mm; base of connective of longer stamens not prolonged .... ***F. peperomiifolium***
7 Stem creeping .... ***F. repens***
– Stem erect or at least erect in upper part **8**
8 Stem less than 20 cm long **9**
– Stem more than 30 cm long **10**
9 Stem winged; secondary veins 1 on each side of midvein; inner 4 stamens fertile .... ***F. breviscapum***
– Stem not winged; secondary veins 3 or 4 on each side of midvein; inner 4 stamens sterile .... ***F. degeneratum***

10 Leaves of a pair highly unequal and asymmetric; petioles often less than 1 cm long; bracts cordate, ca. 4 mm long .... ***F. strictum***

– Leaves of a pair equal or slightly unequal; petioles more than 2 cm long; bracts more or less ovate, often more than 1 cm long **11**

11 Leaf blade cordate to ovate-cordate, secondary veins 4 or 5 on each side of midvein .... ***F. cordifolium***

– Leaf blade broadly lanceolate, oblong, ovate, oblong-lanceolate to elliptic; secondary veins 2 or 3, rarely 4 (*F. damingshanense*) on each side of midvein. **12**

12 Inflorescences umbellate, peduncle winged .... ***F. longipes***

– Inflorescences cymose-paniculate, umbellate or a pleiochasium, peduncle not winged **13**

13 Inflorescences cymose-paniculate, umbellate, 13–20 cm long .... ***F. faberi***

– Inflorescences pleiochasia, ca. 10 cm long .... ***F. damingshanense***

Acknowledgements

We thank Ms. Xiao-Lan Wang for providing the photo of *F. faberi*, Dr. David E. Boufford for his valuable comments on the manuscript and the staff of Fenshuiling National Nature Reserve for their help in the field. This work was supported by the National Natural Science Foundation of China (31770214) and the Science and Technology Planning Project of Guangdong Province (2015A030302011).

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Supplementary material 1

Table S1. Source of materials studied and GenBank accession numbers for nrITS
Authors: Jin-Hong Dai, Qiu-Jie Zhou, Zhi-Yong Yu, Ren-Chao Zhou, Ying Liu
Data type: molecular data
Explanation note: Newly generated sequences are indicated in bold.

Link: https://doi.org/10.3897/phytokeys.122.35260.suppl1

Supplementary material 2

Table S2. Summary statistics of sequences used for phylogenetic analyses
Authors: Jin-Hong Dai, Qiu-Jie Zhou, Zhi-Yong Yu, Ren-Chao Zhou, Ying Liu
Data type: phylogenetic analyses
Explanation note: PIS, parsimony-informative sites.

Link: https://doi.org/10.3897/phytokeys.122.35260.suppl2

Supplementary material 3

Figure S1. Maximum likelihood phylogenetic tree of Sonerileae based on nrITS sequences.

Authors: Jin-Hong Dai, Qiu-Jie Zhou, Zhi-Yong Yu, Ren-Chao Zhou, Ying Liu

Data type: Figure

Explanation note: Numbers above branches are bootstrap values obtained from maximum likelihood analyses and those below branches are Bayesian posterior probabilities (right) and bootstrap values (left) resulting from Bayesian inference and maximum parsimony analyses, respectively. Species of *Fordiophyton* are indicated in bold; box denotes the new species; asterisk denotes a branch collapsed in Bayesian inference or maximum parsimony analyses.

Link: https://doi.org/10.3897/phytokeys.122.35260.suppl3

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RESEARCH ARTICLE

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Páramo *Calamagrostis* s.l. (Poaceae): An updated list and key to the species known or likely to occur in páramos of NW South America and southern Central America including two new species, one new variety and five new records for Colombia

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Abstract

Calamagrostis (syn. *Deyeuxia*), as traditionally circumscribed, is one of the most speciose genera from páramo grasslands of northwest South America and southern Central America and often dominates these high-elevation habitats. However, it remains difficult for researchers to accurately identify the species due to a lack of floristic treatments for most of the countries containing páramo, with the distribution of many species still very poorly known. In an effort to ameliorate this, we present an updated list and identification keys in English and Spanish (as electronic appendix) to the species of *Calamagrostis* s.l. known or likely to occur in the páramos of Peru, Ecuador, Colombia, Venezuela, Costa Rica and Panama. Fifty-four species are accepted, constituting 47 species currently circumscribed in *Calamagrostis* and seven species recently transferred to *Deschampsia*. Included within this are two new species, *Calamagrostis crispifolius* and *Deschampsia santamartensis*, which are described and illustrated. Both new species are found in páramos of the Sierra Nevada de Santa Marta (departamento Magdalena), on the northernmost tip of Colombia, with *C. crispifolius* also found in the Serrania de Perija on the border with Venezuela. *Calamagrostis crispifolius* differs from all other species of *Calamagrostis* s.l. by the presence of strongly curled, readily deciduous leaf blades, amongst numerous other characteristics including open inflorescences with generally patent branches, small spikelets, (3.5–)4–5.5 mm long, with sessile florets and a rachilla prolongation reaching from 2/3 to almost the apex of the lemma, with short hairs (< 1 mm long). *Deschampsia santamartensis* is similar to *Deschampsia hackelii* (=*Calamagrostis hackelii*) from austral South America but differs by its broad, rigid and erect, strongly conduplicate blades, 1.5–2.5 mm wide when folded, ligules of innovations 0.5–1 mm long, truncate or obtuse, ligules of upper flowering culms 3–4 mm long, broadly shouldered with an attenuate central point, ellipsoid spike-like panicle, 3–5.5 long × 1.5–2.5 cm wide, lemma surfaces moderately to lightly scabrous between the veins, lemma apex acute to muticous, entire, rachilla extension often absent and inside of the floret often with hyaline shiny sinuous trichomes to 1 mm long, emerging from the base of the ovary. We also present a broader circumscription of the common species *Deschampsia podophora* (=*Calamagrostis podophora*), with the new variety *D. podophora* var. *mutica* described and illustrated. *Deschampsia podophora* var. *mutica* principally differs from var. *podophora* by florets lacking awns and larger habit i.e. multiple taller culms with longer and wider leaf blades forming tussocks, with inflorescences often held within sheaths. Nomenclatural changes are presented, with *Deyeuxia macrostachya* newly synonymised under *C. macrophylla* and *C. pittieri*, *C. pubescens* and *Deyeuxia pubescens* newly synonimised under *C. planifolia*. Lectotypes are designated for *Agrostis antoniana*, *Calamagrostis pisinna*, *Deyeuxia macrostachya* and *Deyeuxia sodiroana*. We also document and give notes on five new records of *Calamagrostis* for Colombia: *C. carchiensis*, *C. guamanensis*, *C. heterophylla*, *C. pisinna* and *C. rigida*.

Resumen

Calamagrostis (syn. *Deyeuxia*), como traditionalmente está delimitado, es uno de los géneros con mayor número de especies registradas para las zonas paramunas de Sudamérica y el sur de Centroamérica, en donde a menudo es un elemento dominante en hábitats de alta montaña tropical. Sin embargo, es aun difícil para investigadores identificar con precisión las especies de este género, principalmente por la falta de tratamientos florísticos para la mayoría de países que contienen páramo, con la distribución de muchas especies todavía poca conocida. Con el fin de realizar un aporte al conocimiento de las gramíneas tropicales, se presenta una lista actualizada de nombres y claves de identificación taxonómica en inglés y español (como appendice electrónico) de las especies de *Calamagrostis* s.l. conocidas o que probablemente se encuentran en los páramos de Perú, Ecuador, Colombia, Venezuela, Costa Rica y Panamá. Como resultado, 54 especies son aceptadas, de las cuales 47 especies están circunscritas en *Calamagrostis* y siete especies están recientemente transferidas a *Deschampsia*. Como novedades taxonómicas, se presentan dos nuevas especies, *Calamagrostis crispifolius* y *Deschampsia santamartensis*, las cuales están descritas e ilustradas. Estas nuevas especies crecen en páramos de la Sierra Nevada de Santa Marta (departamento de Magdalena), en la punta más al norte de Colombia, con *C. crispifolius* también presente en la Serranía de Perijá en la frontera con Venezuela. *Calamagrostis crispifolius* difiere de las otras especies de *Calamagrostis* s.l. por la presencia de láminas foliares fuertemente crispadas y fácilmente caducas, entre otras características incluyendo inflorescencias abiertas con ramas generalmente patentes, espiguillas pequeñas, (3.5–)4–5.5 mm long., con antecios sésiles y una prolongación de la raquilla llegando desde 2/3 hasta casi el ápice de la lema, con tricomas cortos (< 1 mm long.). *Deschampsia santamartensis* es parecida a *Deschampsia hackelii* (=*Calamagrostis hackelii*) de Sudamérica austral, pero difiere por sus láminas foliares siendo anchas, rígidas y rectas, y fuertemente conduplicadas, 1.5–2.5 mm de ancho cuando plegada, lígulas de las innovaciones 0.5–1 mm long., truncadas u obtusas, lígulas de la parte superior de las cañas floríferas 3–4 mm long., anchas con un punto central atenuado, panojas elipsoides y espiciforme, 3–5.5 long. × 1.5–2.5 cm de ancho, superficies de las lemas moderada a levemente escabroso entre las venas, ápices de las lemas agudas a múticas, enteras, prolongación de la raquilla a menudo ausente, y la presencia de tricomas hialinos, brillantes, y sinuosos de hasta 1 mm long., los cuales salen de la base del ovario. Por último, se presenta una circunscripción más amplia de la especie común *Deschampsia podophora* (=*Calamagrostis podophora*), con la nueva variedad *D. podophora* var. *mutica*, la cual es descrita e ilustrada. *Deschampsia podophora* var. *mutica* difiere principalmente de la var. *podophora* porque en sus antecios las aristas están ausentes, y su hábito es más grande i.e. con múltiples cañas largas con láminas foliares más largas y anchas, con inflorescencias a menudo escondidas dentro de las vainas. Los cambios nomenclaturales que se presentan son *Deyeuxia macrostachya* sinonimizada bajo *C. macrophylla*, y *C. pittieri*, *C. pubescens* y *Deyeuxia pubescens* sinonimizada bajo *C. planifolia*. Designamos los lectotipos para *Agrostis antoniana*, *Calamagrostis pisinna*, *Deyeuxia macrostachya* y *Deyeuxia sodiroana*. También documentamos y damos notas de cinco nuevos registros de *Calamagrostis* para la flora de Colombia: *C. carchiensis*, *C. guamanensis*, *C. heterophylla*, *C. pisinna*, y *C. rigida*.

Keywords

Andes, checklist, Costa Rica, *Deschampsia*, *Deyeuxia*, Ecuador, Gramineae, grassland, Panama, pastizal, Peru, taxonomia, taxonomy, Venezuela

Introduction

Páramos are vast, mesic, grass-dominated ecosystems found above the treeline in northwest South America and southern Central America, with their distribution stretching more-or-less continuously along the Andes from northern Peru to Venezuela, while also being found as more isolated 'islands' in Costa Rica and Panama (Luteyn 1999; Peyre et al. 2018). These grasslands are considered to be one of the world's biodiversity hotspots hosting exceptional levels of diversity and endemism, but are facing unprecedented habitat degradation and loss (Myers et al. 2000; Pérez-Escobar et al. 2018). Despite grasses being the dominant ecosystem-modulating component of páramos (Rangel-Churio 2000, 2010), they remain poorly studied within these ecosystems, with Ecuador, Colombia and Venezuela still lacking floristic treatments to the cool-season grasses, Pooideae and there only being a few genera that have received attention (e.g. *Festuca* L.; Stančík and Peterson 2007).

Calamagrostis Adans. is considered one of the most speciose genera of páramo grasses, with 35 (Laegaard 2005) to 37 species reported for páramos (Luteyn 1999) and the only other genus with possibly larger number of species found in the páramo being *Festuca* with 56 species (Stančík and Peterson 2007). It is also considered to be one of the most dominant genera in páramo grasslands, with certain species such as *Calamagrostis effusa* (Kunth) Steud. dominating biomass (Rangel-Churio 2000, 2010; Peyre et al. 2018). Taxonomic research focussed on *Calamagrostis* from páramos is limited to various country or regional checklists (Colombia: Giraldo-Cañas 2011, 2013; Giraldo- Cañas et al. 2016. Ecuador: Jørgensen and Ulloa Ulloa 1994; Jørgensen and León-Yánez 1999. Venezuela: Hokche et al. 2008; Bono 2010. Costa Rica: Morales Quirós 2003), with Luteyn (1999) providing a list of species for all páramos. Species descriptions and a means to differentiate species have been limited to original protologues and revisions from Costa Rica (Morales Quirós 2003), Peru (Tovar 1993), a synoptic treatment for Venezuela (Briceño 2010), as well as Hitchcock's (1927) synoptic treatment of grasses from Peru, Ecuador and Bolivia. Unfortunately, countries with the highest proportion of páramo, Ecuador, Colombia and Venezuela, still lack revisions of *Calamagrostis*.

The taxonomy of *Calamagrostis* has been disputed over a long period, with many authors placing South American species in *Deyeuxia* Clarion ex P. Beauv. (e.g. Rúgolo de Agrasar 2012). However, recent phylogenetic research does not support the separation of *Deyeuxia* s.s. from *Calamagrostis* s.s. (Saarela et al. 2010, 2017; Kellogg 2015; Soreng et al. 2015, 2017). The most recent phylogenetic research by Saarela et al. (2017) found *Calamagrostis* s.l. to be polyphyletic and highlighted that its circumscription needs reassessment. *Ammophila* Host was found to be nested within a large *Calamagrostis* s.s. clade, while other taxa of *Calamagrostis* and *Deyeuxia* were nested within other lineages of the broader Agrostidinae + Brizinae + Calothecinae clade (part of Calothecinae of Soreng et al. 2015 reapportioned to subtribe Echinopogoniniae, these collectively united in supersubtribe Agrostidodinae of Soreng et al. 2017) or the *Deschampsia* P. Beauv. clade of the Holcinae p.p. (Aristaveninae of Soreng et al. 2017), bringing the monophyly of the whole Agrostidinae into question (Saarela et al. 2017). Another group of Latin American, mainly South American, taxa placed in *Calamagrostis* or *Deyeuxia* align in the Koeleriinae subtribe (Saarela et al. 2017); Koeleriinae was included in Aveniinae s.l. by Soreng et al. (2017). A reticulate relationship, involving species of this set of *Calamagrostis*, Koeleriinae and the newly described African-Asian polyploid genus *Trisetopsis,* was detected by Wölk and Röser (2014, 2017).

Examples of this taxonomic upheaval can be seen in *Calamagrostis effusa*, a widespread species dominating páramos of Colombia, Venezuela and Ecuador, that was found to be strongly supported as sister to *Chascolytrum* Desv. of the Calothecinae p.p., a genus with inflated multiflowered spikelets that bears little resemblance to *Calamagrostis* (Saarela et al. 2017). Similarly, the North American species *Calamagrostis coarctata* Eaton is placed in a new, albeit weakly supported, clade alongside *Dichelachne* Endl., *Echinopogon* P. Beauv. (Agrostidinae p.p.) and *Relchela* Steud. (Echinopogonineae of Soreng et al. 2017), all with largely varying morphologies (Saarela et al. 2017), but often with pubescent ovaries (Soreng et al. 2017). Saarela et al. (2017) also found most, but not all, species of *Calamagrostis* sect. *Deyeuxia* subsect. *Stylagrostis* (Mez) Escalona to be placed in a clade with species of *Deschampsia* (Holcinae p.p.; Aristaveninae of Soreng et al. 2017), a polyploid genus of 30–40 species distributed in temperate regions of the northern and southern hemispheres (Kellogg 2015). *Deschampsia* has been traditionally separated from *Calamagrostis* by the presence of 2–3 florets per spikelet, amongst other characters, while taxa of *Calamagrostis* subsect. *Stylagrostis* usually have only one floret with an additional floret rarely found. *Calamagrostis* subsect. *Stylagrostis* was traditionally delineated from other members of *Calamagrostis* by the presence of an extended rachilla internode between the glumes and the floret, i.e. floret stipitate. However, placement of *Calamagrostis pisinna* Swallen in a separate clade to that of

Deschampsia taxa in analyses by Saarela et al. (2017) points towards multiple origins of the stipitate floret used to define *Calamagrostis* subsect. *Stylagrostis* (Saarela et al. 2017). Taxa, previously circumscribed in *Calamagrostis* subsect. *Stylagrostis*, which have been transferred to *Deschampsia*, all exhibit a combination of stipitate florets and lustrous, smooth glumes or sparsely scabrous on the glume keels, although these characteristics are also shared by taxa placed in other clades e.g. *C. pisinna*.

Although recent phylogenetic research, most notably that of Saarela et al. (2017), has shown *Calamagrostis*, as traditionally circumscribed, to be polyphyletic and that eventually many taxa will need to be transferred to other genera, ecologists, botanists and others interested in the natural history of the páramo need to know what species are present in these ecosystems and have the means to identify them. We present a guide to the species of *Calamagrostis* s.l., as traditionally circumscribed, from the páramos of northwest South America and southern Central America. We include identification keys in English and Spanish (as electronic appendix), an updated species list, describe and illustrate two new species and one new variety and give notes on five new records of *Calamagrostis* s.l. for Colombia.

Methods

The species list and dichotomous keys cover all species of *Calamagrostis* s.l. listed in the most recent checklists for Colombia (Giraldo-Cañas 2011, 2013; Giraldo- Cañas et al. 2016), Ecuador (Jørgensen and Ulloa Ulloa 1994; Jørgensen and León-Yánez 1999), Venezuela (Hokche et al. 2008; Bono 2010), Costa Rica (Morales Quirós 2003), páramos in general (Luteyn 1999), species mentioned for these countries in the Catalogue of New World Grasses (Soreng and Greene 2003; Soreng et al. 2003 and onwards) and species that potentially occur but are so far recorded only from drier high-elevation Puna vegetation further south (Zulma Rúgolo de Agrasar, pers. comm.). Accepted species follow Soreng et al. (2003 and onwards). Excluded or ambiguous species are listed after the species list.

Type specimens and protologues were seen, where possible, for most of the species, with herbarium revision being done at AAU, COL, FMB, HUA, JUMA, K, UPTC and US. Floristic treatments were consulted from Argentina (Rúgolo de Agrasar 1978, 2006, 2012), Chile (Rúgolo de Agrasar 1978), Bolivia (Hitchcock 1927; Villavicencio 1995, 1998), Peru (Hitchcock 1927; Tovar 1993), Ecuador (Hitchcock 1927; Laegaard 1998), Venezuela (Dorr et al. 2000; Briceño 2010; Dorr 2014), Costa Rica (Pohl 1980; Morales Quirós 2003) and Central America (Pohl and Davidse 1994). Taxonomic treatments of *Calamagrostis* subsect. *Stylagrostis* (Escalona 1988a, b, 1991) were also consulted. Specimen localities are cited by country (uppercase letters), political region (also historically called 'departamento' in Colombia, 'provincia' in Ecuador and 'estado' in Venezuela; in bold in the 'Specimens examined' sections) and then (where possible) municipality. Coordinates are given in Degrees and Decimal Minutes (DDM).

In this treatment, glabrous means without pubescence ('pubescence' in the sense of slender, relatively soft hairs). Smooth indicates no prickle-hairs with broad bases and/or hooked or pointed apices (i.e. pubescence can occur on a smooth surface and a rough or scabrous surface can be glabrous). The term “florets being stipitate” refers to the floret (first, proximal floret in rare cases where two florets are present in a spikelet) being inserted on a distinctly elongated lowermost rachilla internode that is present above the glumes, while the term “florets being sessile” refers to the absence of the aforementioned elongated lowermost rachilla internode.

Results

Key to species of *Calamagrostis* s.l. known or likely to occur in the páramos of north-west South America and southern Central America

This key covers the 54 páramo species currently accepted (see ‘species list’ below). Species not included in the key can be found in the section ‘excluded or ambiguous species’ below. A Spanish version of the key, “Supplementary Key (in Spanish): Clave a las especies de *Calamagrostis* s.l. conocidas o que probablemente ocurrirán en los páramos de noroeste Sudamerica y el sur de Centroamerica”, can be found as an electronic appendix.

1 Florets always stipitate (lowermost rachilla internode distinctly elongated between the glumes and the floret) (the first floret stipitate), stipe 0.4–4 mm long (sometimes a little shorter, to 0.2 mm, in *Deschampsia parodiana*, *D. santamartensis*, *Calamagrostis boyacensis* and *C. ramonae*; so various spikelets should be checked), cylindrical, dilated towards its apex (can be seen at the base of the glumes after the floret has fallen); leaves with or without a ligular stipule present at the junction between the sheath and blade **2**

– Florets usually sessile (lowermost rachilla internode not, or not noticeably, prolonged between the glumes and the floret) (the first floret sessile), stipe less than 0.3 mm long; leaves without a ligular stipule present at the junction between the sheath and blade.. **21**

2(1) Florets lacking awns... **3**

– Florets awned, awn straight or twisted and bent (cf. *Deschampsia aurea* sometimes mucronate)... **4**

3(2) Plants 9–20 cm tall, leaves forming a basal mat to 12 cm tall that is much shorter than the exerted culms; leaf blades short and broad, 2.5–8 cm long, 1.5–2.5 mm wide as folded, strongly conduplicate; inflorescence spike-like, 3–5.5 cm long, 1.5–2.5 cm wide; rachilla prolongation absent or small and glabrescent.. ***Deschampsia santamartensis***

– Plants 26–110 cm tall, leaf blades both basal and cauline, forming medium sized tussocks with some cauline blades often surpassing the inflorescence; leaf blades of innovations and lower flowering culm 11–22 cm long, 0.35–1.2 mm wide when rolled or folded, narrow and conduplicate or filiform involute or convolute, rarely completely flat; leaf blades of upper flowering culm 2.9–25 cm long, 2–7 mm wide when opened out, flat, conduplicate or convolute towards the apices; inflorescence open to semi-contracted, 10–25 cm long, (3–)5–8 cm wide; rachilla prolongation present and with hairs from ¾ to the apex of the lemma.................. ***Deschampsia podophora* var. *mutica***

4(2) Inflorescences dense and spike-like, usually < 3 cm wide........................... **5**

– Inflorescences open to semi-contracted, usually > 3 cm wide (*C. cleefii*, *C. guamanensis* and *C. pisinna* sometimes to 1 cm wide, but generally lax and few-flowered)... **13**

5(4) Callus hairs usually < 1 mm long or absent, not reaching the middle of the lemma; awn bent, twisted, > 5 mm long.. **6**

– Callus hairs reaching from ½ the length to surpassing the apex of the lemma (sometimes shorter in *C. teretifolia* and *Deschampsia podophora*); awn straight, < 5 mm long (twisted and bent, 5.5–8 mm long in *C. boyacensis*).............. **8**

6(5) Calluses glabrous; awn ca. 5 mm long; leaf blades glabrous, scabrous; lemma 3.7–5 mm long, apex bifid... ***C. chaseae*** (in part)

– Calluses pilose, hairs usually < 1 mm long; awn (5–)6–7(–8.8) mm long; leaf blades ciliate (*C. violacea*) or densely pilose (*C. mollis*); lemma 3.8–6 mm long, apex 4-dentate (*C. violacea*) or terminating in 4 thin setae (*C. mollis*) 7

7(6) Anthers 0.4–0.6 mm long; lemma apex terminating in 4 thin setae; leaf blades densely pilose abaxially and adaxially... ***C. mollis***

– Anthers 1.6–2.2(–2.4) mm long; lemma apex 4-dentate; leaf blades glabrous on their surfaces but margin usually ciliate................................ ***C. violacea***

8(5) Awns 5.5–8 mm long, twisted and bent, clearly passing the glumes; anthers 0.5–0.7 mm long; spikelets (5–)6–7.5 mm long; rachilla hairs reaching the lemma apex or briefly surpassing it....................................... ***C. boyacensis***

– Awns < 5.5 mm long, straight, not reaching to slightly passing the apices of the glumes; anthers 0.5–2.6 mm long (only 0.5–0.6 mm long in *D. ovata*, rarely 0.7 mm long in *D. podophora*); spikelets 3.5–14 mm long; rachilla hairs reaching from 2/3 to surpassing the apex of the lemma............................ **9**

9(8) Inflorescences greenish-purple, often interrupted, oval to narrowly elliptic; spikelets 3.5–6 mm long; rachilla hairs reaching from 2/3 to almost the apex of the lemma.. **10**

– Inflorescences golden and shining, continuous and without interruption, oblong, ovoid, ellipsoid, subspherical, cylindrical or capitate; spikelets (5–)7–14 mm long; rachilla hairs usually reaching or surpassing the lemma apex, rarely shorter.. **11**

10(9) Inflorescences usually interrupted and with a lobulate outline, oval to elliptic, 10–25 cm long × 3–8 cm wide; glumes 3.5–5.5 mm long; lemma 2.4–3.5 mm long; callus hairs reaching from 1/3 the length of the lemma to almost the lemma apex; rachilla hairs reaching from 4/5 to almost the apex of the lemma.. ***Deschampsia podophora*** (in part)

– Inflorescences usually only slightly interrupted, narrow-elliptic, 5–6 cm long × ca. 1 cm wide; glumes ca. 6 mm long; lemma ca. 3.5 mm long; callus hairs ca. ½ the length of the lemma; rachilla hairs reaching from 2/3 to 4/5 the length of the lemma.. ***C. teretifolia***

11(9) Anthers 0.5–0.6 mm long; glumes (6.2–)7.8–14 mm long; ligules (ligular stipules) acuminate, 6–18 mm long .... ***Deschampsia ovata***

– Anthers 1–2.6 mm long; glumes 5–8 mm long; ligular stipules acuminate (*D. chrysantha*) or ligules with a bifid apex (*D. aurea*), 0.7–20 mm long **12**

12 (11) Florets generally ½ or < ½ the length of the glumes; anthers 0.9–1.6 mm long; callus hairs reaching from ½ to ¾ the length of the lemma; awn inserted in the upper 1/3 of the lemma but not surpassing the lemma apex or inserted in the lower 1/3 and surpassing the apex of the lemma, sometimes absent; ligular stipule inconspicuous (rarely completely absent in some leaves); ligules with a bifid apex, 0.7–20 mm long .... ***Deschampsia aurea***

– Florets usually longer than ½ the length of the glumes; anthers 1.6–2.6 mm long; callus hairs almost reaching or surpassing the apex of the lemma; awn inserted in the lower 1/3 of the lemma, not surpassing the apex of the lemma or briefly surpassing it; ligular stipule conspicuous, hyaline, acuminate, with 2 conspicuous keels that fade towards the apex, (0.7–)7–20 mm long........... .... ***Deschampsia chrysantha***

13(4) Awns straight or slightly curved, 1.5–4 mm long, usually not passing the apices of the glumes or passing them only briefly; spikelets more or less glomerate in the distal part of the inflorescence branches **14**

– Awns twisted and bent, > 5 mm long, easily passing the apices of the glumes (sometimes straight in *C. boyacensis* and *C. cleefii* but then > 5 mm long); spikelets not glomerate.. **16**

14(13) Anthers 0.4–0.5 mm long; rachilla 1–1.2 mm long, sparsely pilose with hairs usually not reaching the apex of the palea; inflorescences golden and shining, lax, with pendant branches and spikelets glomerate in the distal part of the branches; plants usually 50–80 cm tall .... ***Deschampsia parodiana***

– Anthers (0.7–)1.2–2.5 mm long; rachilla (0.8–)1–2.5 mm long, sparsely pilose with hairs that usually do not reach the apex of the palea (*D. eminens*) or pilose with long hairs that reach the apex of the palea or lemma or amply pass them (*D. podophora*); inflorescences golden and shining (*D. eminens*) or greenish with purple tints (*D. podophora*), lax with pendant branches and spikelets glomerate in the distal part of the branches or semi-spikelike with spikelets from the base; plants 20–130 cm tall **15**

15(14) Inflorescences golden and shining, lax with pendant branches and spikelets clustered in distal or proximal glomerules of 1–2 cm diameter; anthers 1.6–2.5 mm long; rachillas (0.8–)1–1.8 mm long., sparsely pilose, with hairs that usually do not reach the apex of the palea; plants (36–)50–130 cm tall......... .... ***Deschampsia eminens***

– Inflorescences greenish with purple tints, lax with pendant branches and spikelets glomerate in the distal part of the branches or semi-spikelike with spikelets from the base; anthers (0.7–)1.2–1.5(–1.9) mm long; rachillas (1.2–)1.4–2.5 mm long, pilose with hairs that reach the apex of the palea or lemma or amply pass them; plants 20–75(–110) cm tall.. ....***Deschampsia podophora*** (in part)

16(13) Lemmas bifurcated with a deep cleft that reaches almost the middle of the lemma, the awn arising from the base of the deep cleft between the two lobes **17**

– Lemmas dentate, not noticeably bifurcate (i.e. with a deep cleft); the awn arising from the dorsal surface of the lemma and not from the base of a deep cleft in the lemma.. **18**

17(16) Junction between the leaf blade and the sheath swollen; leaf blades folded, 2–3 mm wide when opened out; keels of the glumes smooth; callus hairs reach or surpass ½ the length of the lemma; rachilla usually capitate, reaching to ¾ the length of the lemma or more, with hairs greatly surpassing the apex of the lemma...***C. guamanensis*** (in part)

– Junction between the leaf blade and the sheath not swollen; leaf blades flat or folded, 1–5.2 mm wide when opened out; keels of the glumes scabrous; callus hairs do not reach more than 1/3 the length of the lemma; rachilla not capitate, usually reaching ½ the length of the lemma, with hairs usually only reaching the apex of the palea (reaching or passing the apex of the lemma in specimens from the east of Colombia) .... ***C. pisinna*** (in part)

18(16) Hairs of the callus and rachilla twisted; anthers ca. 0.5 mm long; junction between the leaf blade and the sheath swollen; awn twisted (usually more than 2 times) and bent in the direction of the base of the lemma, ca. 5 mm long; keels of the glumes scabrous; plants 30–50 cm tall; leaf blades long and flat, 8–19 cm long, 3–4 mm wide, scabrous adaxially and abaxially ....***C. ramonae***

– Hairs of the callus and rachilla straight; anthers 1–2.4 mm long; junction between the leaf blade and the sheath not swollen; awn twisted and bent, briefly twisted at the base and curved or straight, facing outwards and away from the base of the lemma, (5–)5.4–8(–8.8) mm long; keel of the glumes smooth or scabrous; plants 10–30(–37) cm tall; leaf blades shorter, 1.5–11(–14) cm long, narrow or broad, convolute, subinvolute, conduplicate or flat, at least the adaxial surface smooth **19**

19(18) Lemmas (3.8–)4.4–5(–5.8) mm long; anthers 1.6–2.2(–2.4) mm long; awn twisted (usually more than two times) and bent, inserted 1–1.6 mm from the base of the lemma; keel of the glumes scabrous or ciliate; ligules (1.2–)1.6–3.2(–3.8) mm long .... ***C. violacea***

– Lemmas 2.2–2.8 mm long; anthers 1–1.5 mm long; awn briefly twisted at the base and curved or straight, inserted close to the base of the lemma (*C. cleefii*) or in the middle third of the lemma (*C. boyacensis*); keel of the glumes smooth; ligules ca. 0.5 mm long (*C. cleefii*) or 5–17 mm long (*C. boyacensis*) **20**

20(19) Awn inserted close to the base of the lemma, ca. 5 mm long; ligules ca. 0.5 mm long.; leaf blades 2–5 cm long .... ***C. cleefii***

– Awn inserted in the middle third of the lemma, 6–7 mm long; ligules 5–17 mm long; leaf blades 5–11 cm long ....***C. boyacensis***

21(1) Rachilla prolongation absent; callus rounded, not recurved; callus hairs reaching from ½ to ¾ the length of the lemma; lemma apex obtuse and briefly cleft; glumes lanceolate; panicles open; leaf blades flat....... ***C. llanganatensis***

– Rachilla prolongation present, well-developed and pilose to short and glabrous (sometimes very short in e.g. *C. bogotensis*); callus rounded, acute or recurved; combination of the other characters mentioned above not present............ **22**

22(21) Callus hairs reaching from ½ to more than the length of the lemma; panicle lax and open, usually pyramidal, sometimes with very few spikelets.......... **23**

– Callus hairs reaching up to 1/3 the length of the lemma; panicle lax and open to dense and spike-like... **27**

23(22) Calluses recurved; lemmas 3.5–4 mm long; anthers 0.4–0.8 mm long; leaf blades flat or rarely subconvolute; plants 60–130 cm tall **24**

– Calluses rounded or rarely acute, not recurved; lemmas 2–3 mm long; anthers 0.8–1.5 mm long; leaf blades flat, conduplicate, convolute or involute; plants ca. 60 cm (*C. steyermarkii*) or 6–25 cm tall.................................... **25**

24(23) Callus hairs slightly shorter than the lemma, exceptionally reaching the lemma apex; the glumes only surpass the floret briefly, by 0.5–0.6 mm; awn inserted in the middle third of the lemma; ligules 1–4 mm long .... ***C. rupestris***

– Callus hairs surpassing the lemma apex; the glumes amply surpass the length of the floret by 1.5–6 mm; awn inserted in the upper third of the lemma; ligules generally 1–1.5 mm long .... ***C. viridiflavescens***

25(23) Plants forming tussocks ca. 65 cm tall; leaf blades convolute, 15–25 cm long; inflorescence ca. 18 cm long; ligules obtuse, 2–2.5 mm long; calluses with dense hairs reaching from ½ to ¾ the length of the lemma; floret sessile, lowermost rachilla internode not prolonged between the glumes and the floret .. .. ***C. steyermarkii***

– Plants forming a short basal lawn 6–25 cm tall; leaf blades convolute, conduplicate or flat, 2–8 cm long; ligules truncate to obtuse, < 1mm long; calluses with dense hairs reaching from ½ the length of the lemma to surpassing the lemma apex; floret short-stipitate, lowermost rachilla internode prolonged between the glumes and the floret by 0.1–0.3(–1) mm **26**

26(25) Anthers 1.1(–1.5) mm long; awn ca. 5 mm long; callus hairs reaching the lemma apex; rachilla ca. 2 mm long, with hairs reaching the lemma apex .... ***C. cleefii***

– Anthers 0.8–1 mm long; awn 7–9 mm long; callus hairs reaching half the length of the lemma; rachilla ca. 1.5 mm long, with hairs surpassing the lemma apex.. ***C. guamanensis*** (in part)

27(22) Panicles lax and open, usually pyramidal, generally larger than 8 cm long, with verticillate or semi-verticillate branching, branches divergent, straight or flexuous, sometimes the lower contracted and pendulous or with lower branches distanced between each other and much longer than the upper, sometimes pendulous (*C. mandoniana*).. **28**

– Panicles spikelike or semi-spikelike, fusiform, elliptical or capitate, lateral branches contracted, few- to many-flowered, frequently interrupted towards the base.. **37**

28(27) Awns suprabasal, inserted 0.3–0.6 mm from the base of the lemma; lemma 3–4 mm long **29**

– Awns basal or medial, inserted 1–2.5 mm from the base of the lemma; lemma 3–7 mm long **30**

29(28) Rachillas ca. 0.9 mm long, glabrescent; lemma apex bifid; awn equalling or shorter than the lemma, not surpassing the glumes; ligule 1.5–2 mm long .... ***C. divergens***

– Rachillas 1.5–2 mm long, sparsely pilose with long hairs; lemma apex dentate with the lemma veins briefly excurrent; awn briefly surpassing the glumes; ligule oblong, > 4 mm long .... ***C. naiguatensis***

30(28) Rachillas glabrous except for a few short hairs at the base that usually do not reach ½ the length of the lemma; glumes 5–6 mm long; lemma ca. 5 mm long; lemma apex diminutely bifid; awn ca. 4.5 mm long .... ***C. scaberula***

– Rachillas pilose with short or long hairs that, in both cases, reach from ¾ the length of the lemma to surpassing the lemma apex; combination of the other characters mentioned above not present **31**

31(30) Rachilla prolongation (not including the hairs) reaching from ¾ to almost the apex of the lemma, generally with hairs < 1 mm long, that usually do not reach the lemma apex; awns (2–)4.5–7 mm long; glumes 3–4(–5) mm long; lemmas 3–3.9(–4.8) mm long, lemma apex truncate, irregularly dentate or bidentate; inflorescence branches and pedicels usually smooth, rarely scaberulous; inflorescence branches patent; anthers 2–2.3 mm long **32**

– Rachilla prolongation (not including the hairs) up to ½ the length of the lemma (sometimes up to 2/3 in *C. macrophylla* and *C. planifolia*), with hairs > 1 mm long, reaching or briefly passing the lemma apex in *C. mandoniana* and *C. planifolia* or reaching the apex of the palea in *C. macrophylla*, *C. pisinna* and *C. secunda* (*C. planifolia* sometimes with hairs reaching only 2/3 but then has (1–)2 anthers); awns 5–9 mm long; glumes 3–8.2 mm long; lemmas 3.4–6.2 mm long; lemma apex cleft, 2-lobed, or denticulate; inflorescence branches and pedicels scaberulous or scabrous; inflorescence branches flexuous, slightly divergent (pendulous in *C. mandoniana*); anthers 0.8–2.8 mm long **33**

32(31) Leaf blades strongly curled, forming a basal mat to 20 cm tall in mature plants and much shorter than half the length of the flowering culms; leaf blades readily deciduous at maturity and covering the ground around the tufts .... ***C. crispifolius***

– Leaf blades straight, forming tussocks 40–60(–107) cm tall with the leaves greater than half the length of the flowering culms; leaf blades not obviously deciduous .... ***C. effusa***

33(31) Lemmas bifurcated with a deep cleft that reaches almost the middle of the lemma, the awn arising from the base of the deep cleft between the two lobes; anthers 2(–3), 0.9–1 mm long; spikelets 3.5–5(–6) mm long .... ***C. pisinna*** (in part)

– Lemmas not strongly bifurcate (i.e. with a deep cleft); the awn arising from the dorsal surface of the lemma and not from the base of a deep cleft in the lemma; anthers 2 (*C. planifolia*) or 3; spikelets 3–8.2 mm long **34**

34(33) Anthers 2, rarely 1, 1–1.4(–2) mm long; glumes (3–)3.6–6 mm long; lemma 3.4–4.5(–5.5) mm long; lemma apex 2-lobed, lobes bidentate; basal leaf blades generally flat, 1.8–7 mm wide .... ***C. planifolia*** (in part)

– Anthers 3, 2–2.8 mm long; glumes (5–)5.8–8.2 mm long; lemma (4.4–)5–7 mm long; lemma apex briefly cleft and 4-dentate (*C. mandoniana*), bifid with aristulate teeth (*C. macrophylla*) or bifid and 4-dentate (*C. secunda*); basal leaf blades usually cylindrical or subcylindical, involute or convolute, sometimes the upper blades opening to become flat (*C. macrophylla*, *C. mandoniana*).........**35**

35(34) Rachilla hairs usually reaching the lemma apex or briefly passing it; inflorescence (24–)28–52 cm long, with pendulous branches; lower branches 10–16 cm long; lemma apex cleft and 4-dentate; ligules 2-12 mm long; leaf blades flat or cylindrical and involute, ca. 3.3–3.6 mm wide when opened out........ .... ***C. mandoniana***

– Rachilla hairs reaching from ½ to 4/5 the length of the lemma, usually not passing the apex of the palea; inflorescence 15–30 cm long, with divergent to ascending branches; lower branches usually < 10 cm long; lemma apex bifid, often with aristulate teeth; ligules 3–6 (possibly longer?) mm long; leaf blades cylindrical or subcylindical, involute or convolute, sometimes the upper blades opening out to become flat...**36**

36(35) Upper leaf blades often opening out to become flat, generally wide, 2–4 mm wide, involute in the lower portion of the plant; ligule bifid, with the segments lanceolate, smooth, 3–6 (possibly longer?) mm long; lemmas 5–7 mm long, apex bifid with aristulate teeth .... ***C. macrophylla***

– Leaf blades generally cylindrical or subcylindical, involute or convolute, ca. 2 mm wide when opened out; ligule subtrigonous, slightly scabrous, ca. 4 mm long; lemmas ca. 4.7 mm long, apex bifid with 4 teeth but without aristulate teeth... ***C. secunda***

37(27) Anthers 0.2–0.6 mm long, generally adherent to the apex of the caryopsis, flowers generally cleistogamous (NB. *C. jamesonii* and *C. curta* usually chasmogamous but anthers measure 0.4–0.6 mm long); lemma apex terminating in 4 aristulas or 4 awned or erose deltoid teeth; stylopodium well-developed, 0.4–0.6 mm long (stylopodium absent or brief in *C. curta* and *C. jamesonii*).............**38**

– Anthers > 1 mm long, free, flowers chasmogamous; lemma apex cleft or erose, 2–4-dentate, teeth regular or irregular, not awned; stylopodium not differentiated, brief or incipient if present..**48**

38(37) Rachillas sparsely pilose or glabrous, if pilose the hairs short, indistinct, not reaching past the middle of the lemma..**39**

– Rachillas with long well-developed hairs reaching from 2/3 to the apex of the lemma (*C. curta* and *C. sclerantha* have shorter hairs that reach from ½ to ¾ the length of the lemma)...**45**

39(38) Awn straight or slightly curved, inserted in the middle third of the lemma, generally not reaching past the apices of the glumes; flowering culms rigid, thickened, slightly curved, with inflorescence generally subincluded in the flag leaf sheath; rachilla glabrous or glabrescent .... ***C. rigescens***

– Awn twisted and bent, inserted in the lower third of the lemma, surpassing the apices of the glumes; flowering culms slender, erect and straight, with inflorescences generally exerted; rachilla sparsely pilose with short hairs, hairs sometimes found only at the apex **40**

40(39) Leaf blades, at least those of the flowering culms, flat, tender and glabrous (or rarely with ciliate margins) **41**

– Leaf blades all convolute or folded, junciform, rigid, curved or flexuose **43**

41(40) Lemmas (2.2–)3–3.5(–4.2) mm long, usually scabrous throughout; leaf blades heteromorphic, those of the flowering culms flat, tender and glabrous (or rarely with ciliate margins), usually wider than the blades of the tillers, which are usually convolute, pilose on both sides or only with the margen pilose .... ***C. heterophylla***

– Lemmas (4.5–)5–7 mm long, smooth at least at the base (*C. brevipaleata* scabrous towards the apex); leaf blades all flat, isomorphic (*C. hirta*) or heteromorphic but not differentiated in width and size but only in that the blades of the tillers are pilose while those of the flowering culm are glabrous (*C. brevipaleata*) **42**

42(41) Lemmas smooth throughout; leaf blades isomorphic, those of the flowering culm and those of the tillers similar, flat and pilose, 1–11 cm long..... ***C. hirta***

– Lemmas smooth proximally and scabrous towards their apices; leaf blades heteromorphic, the blades of the flowering culm are glabrous while those of the tillers are villous, 10–25 cm long.................................... ***C. brevipaleata***

43(40) Plants 1–5 cm tall, forming dense cushions; leaf blades obtuse, < 1 cm long, curved against the ground; inflorescences exerted, formed of 3–10 spikelets . ... ***C. minima***

– Plants (1.5–)4–50 cm tall, forming lax mats, not dense cushions; leaf blades conduplicate, acute or navicular, straight or curved but not prostrate against the ground; inflorescences exerted or subincluded in the sheaths, formed of few or many spikelets **44**

44(43) Leaf blades filiform, 0.2–0.4 mm wide when opened out, involute, curved or flexuose, exceptionally straight; rachilla 0.4–0.9(–1.2) mm long, sparsely pilose with hairs to 1.3 mm long that usually do not reach ½ the length of the lemma; lemma (2.6–)3.1–5.8 mm long .... ***C. vicunarum***

– Leaf blades > 1 mm wide when opened out, folded, usually straight; rachilla (0.8–)1–2 mm long, with hairs usually 0.5–1 mm long that barely reach ½ the length of the lemma; lemma 4.5–5 mm long .... ***C. fibrovaginata***

45(38) Glume keels ciliolate..***C. jamesonii***

– Glume keels scaberulous to scabrous **46**

46(45) Lemma apex with 4 scabrous aristulas 1–2.1 mm long, that equal or pass the apices of the glumes or at least the upper glume........................ ***C. setiflora***

– Lemma apex with 4 membranaceous deltoid teeth 0.2–0.5(–0.7) mm long, not aristulate, shorter than the glumes **47**

47(46) Flowers cleistogamous; stylopodium present, 0.5–0.6 mm long; inflorescence 1.7–5 cm long, with many spikelets, sub-spikelike; glumes 4.5–5.2 mm long, 1-veined, exceptionally the upper glume 3-veined.................... ***C. sclerantha***

– Flowers chasmogamous; stylopodium absent; inflorescence to 2 cm long, with few spikelets, subglobose; glumes 4.8–6.5 mm long, the lower 1-veined, the upper 3-veined... ***C. curta***

48(37) Florets awnless .... ***C. ecuadoriensis***

– Florets awned, awn dorsal or subapical... **49**

49(48) Rachillas with long dense hairs that generally equal or surpass the lemma apex, exceptionally only reaching the apex of the palea in *C. planifolia* and *C. rigida* (*C. planifolia* sometimes with hairs reaching only 2/3 but can be distinguished by having only (1–)2 anthers).. **50**

– Rachillas with short hairs or glabrous, if pilose then the hairs generally reaching to 4/5 the length of the lemma, but not reaching the apex of the palea (N.B. *C. macrophylla* sometimes has hairs reaching the apex of the palea) . **55**

50(49) Leaf blades generally flattened, becoming convolute upon drying, 2–7 mm wide; androecium formed of (1–)2 stamens; anthers 0.8–1.4(–2) mm long.... .... ***C. planifolia*** (in part)

– Leaf blades permanently involute or strongly conduplicate for their entire length; androecium formed of 3 stamens; anthers (1.8–)2–3 mm long **51**

51(50) Leaf blades recurved or slightly arching, 1–5(–9) cm long; leaves forming a basal mat shorter than half the length of the flowering culms; plants 5–35(–50) cm tall, forming small to medium sized mats, sometimes forming lax or dense cushions; inflorescences generally < 5 cm long; awn not surpassing the apex of the glumes .... ***C. spicigera***

– Leaf blades rigid, erect, tough, sharply pointed, (6–)10–30 cm long; leaves not forming a notable basal mat, usually forming tussocks greater than half the length of the flowering culms (*C. killipii* can be variable); plants (0.15–)0.3–1.3 m tall, generally forming medium or large tussocks; inflorescences (5–)9–30 cm long (5–8 cm in *C. killipii*); awn not surpassing the apex of the glumes or greatly exerted from the glumes **52**

52(51) Inflorescences 5–8 cm long; plants small, < 30 cm tall; ligules ca. 0.8 mm long .... ***C. killipii***

– Inflorescences (8–)9–20(–30) cm long; plants generally large, (15–)23–100 cm tall; ligules (1–)1.5–15 mm long... **53**

53(52) Inflorescences sub-spikelike, erect, oval in outline, with tinges of gold and bronze, branches contracted, densely flowered from the base, sometimes lobulate and subnutant; leaf blades conduplicate, 1–1.4 mm wide as folded; ligule coriaceous to chartaceous, with an obtuse to acute apex, 1–10 mm long........ ....***C. glacialis***

– Inflorescences flexuose, greenish or violaceous, discontinuous, branches more or less contracted, generally lacking spikelets proximally; leaf blades convolute or conduplicate, ca. 1 mm wide as folded; ligules membranous, acuminate, generally 8–15 mm long..**54**

54(53) Lemmas (4.2–)4.5–5.2(–5.4) mm long; awn 4–5.8 mm long, reaching the apex of the glumes or briefly passing it; rachilla with hairs that reach from ¾ the length of the lemma to the lemma apex .... ***C. rigida***

– Lemmas (5–)5.4–6.2(–6.6) mm long; awn 5.4–7.4 mm long, amply surpassing the apex of the glumes; rachilla with hairs that amply surpass the lemma apex, exceptionally equalling it... ***C. intermedia***

55(49) Awns 0.7–4.5(–5) mm long, included within or scarsely passing the glumes, delicate and straight to slightly twisted (bent and emerging from between the glumes in *C. scabriflora* and *C. chaseae*); rachilla and callus glabrous or sparsely pilose, the hairs to 0.8 mm long and not reaching ½ the length of the lemma...**56**

– Awns 5.5–9 mm long, exerted from the glumes, twisted and/or sometimes bent; rachilla usually with hairs that reach from ½ to ¾ the length of the lemma or the apex of the palea (hairs sometimes short in *C. involuta* and *C. fuscata* but awns measure > 5.5 mm long) **60**

56(55) Awns inserted in the lower third of the lemma; anthers 1..........................**57**

– Awns inserted in the middle or above the middle of the lemma; anthers 1–2 (*C. carchiensis,* possibly *C. chaseae*) or 3..**58**

57(56) Awns inserted 0.3–0.7 mm from the base of the lemma, (2.3–)3–4 mm long, straight or slightly bent ....***C. bogotensis***

– Awns inserted ca. 1 mm from the base of the lemma, ca. 1.7 mm long, bent and emerging from between the side-margins of the glumes .... ***C. scabriflora***

58(56) Awns 0.7–1 mm long; anthers 1 (rarely 2 in material from eastern Colombia) ....***C. carchiensis***

– Awns ca. 3–5 mm long; anthers 3 (possibly 1 in *C. chaseae*, although further revision needed)...**59**

59(58) Calluses scarcely pilose with short hairs ca. 0.1 mm long; floret sessile; awn ca. 3 mm long, inserted 3/5 from lemma base..............................***C. fulgida***

– Calluses glabrous; floret stipitate, with the lowermost rachilla internode prolonged between the glumes and the floret by ca. 0.2 mm; awn ca. 5 mm long, inserted medially.. ***C. chaseae*** (in part)

60(55) Leaf blades curved, recurved, flexuose or straight; plants with leaves forming a basal mat generally shorter than half the length of the flowering culms; mats small or medium sized with flowering culms 11–32 cm tall; inflorescences generally 5–12 cm long; rachilla sparsely pilose, the hairs usually reaching the middle of the lemma and not passing the apex of the palea **61**

– Leaf blades rigid, erect, tough, sharply pointed; plants forming dense tussocks with leaves greater than half the length of the flowering culms, 10–180 cm tall; inflorescences 9–31 cm long; rachilla with hairs reaching from ½ to ¾ the length of the lemma or apex of the palea **62**

61(60) Awns inserted in the lower third of the lemma; rachilla 1.3–1.4 mm long, sparsely pilose with short hairs or almost glabrous; anthers 0.7–1 mm long; lemma 3–4.1 mm long; old basal sheaths fibrous; ligules 0.5–1.5 mm long; glumes 5–5.7 mm long .... ***C. involuta***

– Awns inserted in the middle third of the lemma; rachilla (1.4–)1.6–2.5 mm long, lightly pilose with hairs not reaching the apex of the palea; anthers ca. 1.5 mm long; lemma (3.8–)4–4.6 mm long; old basal sheaths not fibrous; ligules 1.2–2(–2.5) mm long; glumes 5.6–6.2 mm long................ ***C. fuscata***

62(60) Upper leaf blades opening to become flat, generally wide, 2–4 mm wide, involute in the lower portion of the plant; panicle slightly open..... ***C. macrophylla***

– Leaf blades convolute or conduplicate for their entire length, 0.3–2 mm wide as folded; panicle dense (*C. recta*) or slightly open (*C. tarmensis*)............... **63**

63(62) Upper glumes 3-veined, lateral veins brief, reaching to 1/3 the full length; inflorescence erect, sub-spikelike, lateral branches short and appressed; leaf blades scabrous, erect, sharply pointed, rigid; glumes 5.4–8(–8.5) mm long ......***C. recta***

– Upper glumes 3-veined, lateral veins longer, surpassing ½ the full length (shorter in *C. tarmensis* var. *tarijensis*); inflorescence with lateral branches somewhat flexuose; leaf blades erect and rigid with the adaxial surface scabrous or scabrous-pubescent or blades somewhat flexuose with the adaxial surface scaberulous (*C. tarmensis* var. *tarijensis*); glumes (4.4–)4.8–6.2(–7) mm long .... ***C. tarmensis***

Species list of Calamagrostis s.l. known and likely to occur in the páramos of northwest South America and southern Central America

Fifty-four species of *Calamagrostis* s.l., constituting 47 species currently circumscribed in *Calamagrostis* and seven species currently circumscribed in *Deschampsia*, are here accepted as known or likely to occur in the páramos of northwest South America. Compared to the previous checklist of páramo taxa (Luteyn 1999) that documented 37 species, we accept 21 additional species (marked below with an asterisk (*), although two of these still need verification [*Calamagrostis glacialis* (Wedd.) Hitchc., *C. mandoniana* (Wedd.) Pilg.], while placing four species accepted by Luteyn (1999) as synonyms [*Calamagrostis nuda* (Pilg.) Pilg., *C. coarctata* (Kunth) Steud., *C. pittieri* (Kunth) Trin. ex Steud., *C. weberbaueri* Tovar].

Accepted species are in **bold**. Species which are not mentioned in the previous páramo checklist (Luteyn 1999) are marked with an asterick (*). Excluded or ambiguous species are listed and discussed below. Notable basionyms or synonyms are included. Countries where the species is recorded are shown with the following codes: AR=Argentina, BO=Bolivia, CHI=Chile, CO=Colombia, CR=Costa Rica, EC=Ecuador, MEX=Mexico, PAN=Panama, PE=Peru, VE=Venezuela. Countries where the species is likely to occur, but so far has not been recorded, are noted with a question mark (?). Information on the elevational range is taken from relevant literature, herbarium specimen revision and field observations.

Calamagrostis bogotensis (Pilg.) Pilg.; basionym: *Deyeuxia bogotensis* Pilg.; syn.: *Calamagrostis nuda* (Pilg.) Pilg., *Deyeuxia nuda* Pilg.; distr.: CO, CR, EC, PAN?, PE, VE; alt.: 2300–4400 m.

Calamagrostis boyacensis Swallen & García-Barr.; syn.: *Calamagrostis weberbaueri* Tovar, *Deyeuxia weberbaueri* (Tovar) Rúgolo ex Luteyn; distr.: CO, EC, PE; alt.: 3000–4800 m.

****Calamagrostis brevipaleata*** Swallen; distr.: EC; alt.: 2800–5000 m.

Calamagrostis carchiensis Lægaard; distr.: COL, EC; alt.: 3200–3900 m.

Calamagrostis chaseae Luces; distr.: VE; alt.: 3000–4000 m.

Calamagrostis cleefii Escalona; distr.: CO, EC; alt.: 3300–4500 m.

****Calamagrostis crispifolius*** Sylvester; distr.: CO, VE; alt.: 2700–3570 m.

****Calamagrostis curta*** (Wedd.) Pilg.; basionym: *Deyeuxia curta* Wedd.; distr.: AR, BO, EC; alt.: 4200–5000 m.

Calamagrostis divergens Swallen; distr.: CO; alt.: 3100–3200 m.

Calamagrostis ecuadoriensis Lægaard; distr.: EC; alt.: 3450–4500 m.

Calamagrostis effusa (Kunth) Steud.; basionym: *Deyeuxia effusa* Kunth; syn.: *Calamagrostis areantha* (Pilg.) Pilg., *Calamagrostis funckii* Steud., *Deyeuxia araeantha* Pilg., *Deyeuxia areantha* Pilg., *Deyeuxia funckii* Steud. ex Wedd.; distr.: CO, EC, VE; alt.: 3000–4700 m.

Calamagrostis fibrovaginata Lægaard; basionym: *Deyeuxia coarctata* Kunth; syn.: *Calamagrostis coarctata* (Kunth) Steud. [nom. illeg., hom., blocked by *Calamagrostis coarctata* Eaton]; distr.: CO, EC, PE, VE; alt.: 2500–4700 m.

****Calamagrostis fulgida*** Lægaard; distr.: EC; alt.: 2500 m.

****Calamagrostis fuscata*** (J. Presl) Steud.; basionym: *Deyeuxia fuscata* J. Presl.; distr.: BO, EC, PE; alt.: 3900–4500 m.

****Calamagrostis glacialis*** (Wedd.) Hitchc.; basionym: *Deyeuxia glacialis* Wedd.; distr.: BO, EC?, PE; alt.: 3900–5000 m.

Calamagrostis guamanensis Escalona; distr.: COL, EC; alt.: 3300–4400 m.

Calamagrostis heterophylla (Wedd.) Pilg.; basionym: *Deyeuxia heterophylla* Wedd.; syn.: *Calamagrostis calvescens* Pilg., *Calamagrostis macbridei* Tovar; *Calamagrostis mulleri* Luces; *Calamagrostis swallenii* Tovar, *Deyeuxia swallenii* (Tovar) Rúgolo; distr.: AR, BO, CHI, COL, EC, PE, VE; alt.: 3100–4650 m.

Calamagrostis hirta (Sodiro) Lægaard; basionym: *Deyeuxia hirta* Sodiro; distr.: EC; alt.: 2900–4600 m.

Calamagrostis intermedia (J. Presl) Steud.; basionym: *Deyeuxia intermedia* J. Presl; syn.: *Calamagrostis agapatea* Steud. ex Lechl.; distr.: BO, CO, CR, EC, MEX, PAN, PE; alt.: 2400–5000 m.

Calamagrostis involuta Swallen; distr.: CO; alt.: 3700–3800 m.

Calamagrostis jamesonii Steud.; syn: *Calamagrostis stuebelii* (Pilg.) Pilg., *Deyeuxia jamesonii* (Steud.) Munro ex Wedd., *Deyeuxia stuebelii* Pilg.; distr.: BO, CO, EC, PE, VE; alt.: 3600–4900 m.

Calamagrostis killipii Swallen; distr.: CO, VE; alt.: 3500–4200 m.

Calamagrostis llanganatensis Lægaard; distr.: EC; alt.: 3500–4000 m.

Calamagrostis macrophylla (Pilg.) Pilg.; basionym: *Deyeuxia macrophylla* Pilg.; syn.: *Deyeuxia macrostachya* Sodiro; distr.: CO, EC, PE; alt.: 3000–4000 m.

****Calamagrostis mandoniana*** (Wedd.) Pilg.; basionym: *Deyeuxia mandoniana* Wedd.; distr.: BO, PE; alt.: 3200–4100 m.

****Calamagrostis minima*** (Pilg.) Tovar; basionym: *Calamagrostis vicunarum* var. *minima* Pilg.; syn.: *Deyeuxia minima* (Pilg.) Rúgolo; distr.: AR, BO, EC, PE; alt.: 4300–4600 m.

Calamagrostis mollis Pilg.; syn: *Deyeuxia mollis* (Pilg.) Sodiro; distr.: EC, PE?; alt.: 3200–5100 m.

****Calamagrostis naiguatensis*** Swallen; distr.: VE; alt.: 2300–2800 m.

Calamagrostis pisinna Swallen; distr.: CO, VE; alt.: 3200–4400 m.

Calamagrostis planifolia (Kunth) Trin. ex Steud.; basionym: *Deyeuxia planifolia* Kunth; syn.: *Calamagrostis pittieri* Hack.; *Calamagrostis pubescens* (Pilg.) Pilg.; distr.: BO, CO, CR, EC, PE, VE; alt.: 2600–4400 m.

Calamagrostis ramonae Escalona; distr.: EC, VE; alt.: ca. 3950 m.

Calamagrostis recta (Kunth) Trin. ex Steud.; basionym: *Deyeuxia recta* Kunth; syn.: *Calamagrostis humboldtiana* Steud., *Calamagrostis pallens* (J. Presl) Steud., *Deyeuxia pallens* J. Presl, *Deyeuxia stricta* Kunth, *Deyeuxia sulcata* Wedd.; distr.: BO, CO, EC, MEX, PE, VE; alt.: 2700–4900 m.

Calamagrostis rigescens (J. Presl) Scribn.; basionym: *Agrostis rigescens* J. Presl; syn.: *Calamagrostis bromidioides* (Griseb.) Pilg., *Calamagrostis cajatambensis* Pilg., *Calamagrostis imberbis* (Wedd.) Pilg., *Deyeuxia cajatambensis* Pilg. ex Zuloaga, Nicora, Rúgolo, Morrone, Pensiero & Ciald., *Deyeuxia imberbis* Wedd., *Deyeuxia rigescens* (J. Presl) Türpe; distr.: AR, BO, CHI, EC, MEX, PE; alt.: 3300–4600 m.

Calamagrostis rigida (Kunth) Trin. ex Steud.; basionym: *Deyeuxia rigida* Kunth; syn.: *Calamagrostis antoniana* (Griseb.) D.M. Moore, *Calamagrostis antoniana* Steud., *Calamagrostis crassifolia* Hack. ex Sodiro, *Calamagrostis gracilis* (Wedd.) Henrard, *Calamagrostis gracilis* (Wedd.) Pilg., *Calamagrostis gusindei* Pilg. ex Skottsb., *Calamagrostis sandiensis* Pilg., *Deyeuxia antoniana* (Griseb.) Parodi, *Deyeuxia crassifolia* Sodiro, *Deyeuxia gracilis* Wedd., *Deyeuxia gusindei* (Pilg.) Parodi; distr.: AR, BO, CHI, COL, CR, EC, PAN?, PE, VE?; alt.: 2900–4900 m.

****Calamagrostis rupestris*** Trin.; syn.: *Calamagrostis beyrichiana* Nees ex Döll, *Calamagrostis longearistata* (Wedd.) Hack. ex Sodiro, *Calamagrostis montevidensis* var. *linearis* Hack., *Deyeuxia beyrichiana* (Nees ex Döll) Sodiro, *Deyeuxia heterophylla* var. *elatior* Wedd., *Deyeuxia longearistata* Wedd., *Deyeuxia rupestris* (Trin.) Rúgolo; distr.: AR, BO, CO, EC, PE, VE, widespread in eastern South America; alt.: 700–3400 m.

***Calamagrostis scaberula** Swallen; distr.: EC; alt.: ca. 2900 m.

***Calamagrostis scabriflora** Swallen; distr.: VE; alt.: ca. 2500 m.

***Calamagrostis sclerantha** Hack.; syn.: *Calamagrostis spiciformis* Hack., *Deyeuxia sclerantha* (Hack.) Rúgolo, *Deyeuxia spiciformis* (Hack.) Türpe; distr.: AR, BO, EC, PE; alt.: 2500–4600 m.

***Calamagrostis secunda** (Pilg.) Pilg.; basionym: *Deyeuxia secunda* Pilg. ; distr.: EC; alt.: ca. 4000 m.

***Calamagrostis setiflora** (Wedd.) Pilg.; basionym: *Deyeuxia setiflora* Wedd.; syn.: *Calamagrostis coronalis* Tovar; distr.: AR, BO, EC, PE; alt.: 3600–5000 m.

Calamagrostis spicigera (J. Presl) Steud.; basionym: *Deyeuxia spicigera* J. Presl; syn.: *Deyeuxia obtusata* Wedd., *Deyeuxia subsimilis* Wedd.; distr.: AR, BO, CHI, CO, EC, PE; alt.: 3600–5000 m.

Calamagrostis steyermarkii Swallen; distr.: EC; alt.: 3400–4200 m.

Calamagrostis tarmensis Pilg.; syn: *Calamagrostis tarijensis* Pilg., *Deyeuxia tarmensis* (Pilg.) Sodiro; distr.: AR, BO, EC, PE; alt.: 2400–4700 m.

Calamagrostis teretifolia Lægaard; distr.: EC; alt.: 4300–4900 m.

Calamagrostis vicunarum (Wedd.) Pilg.; basionym: *Deyeuxia vicunarum* Wedd.; syn.: *Calamagrostis pentapogonodes* Kuntze, *Calamagrostis pulvinata* Hack., *Calamagrostis spiciformis* var. *acutifolia* Hack. ex Buchtien, *Deyeuxia pulvinata* (Hack.) Türpe; distr.: AR, BO, CHI, CO?, EC, PE, VE; alt.: 3200–4900 m.

***Calamagrostis violacea** (Wedd.) Hack. ex Buchtien; basionym: *Deyeuxia violacea* Wedd.; syn.: *Calamagrostis violacea* (Wedd.) Hitchc.; distr.: AR, BO, EC, PE; alt.: 4000–4900 m.

***Calamagrostis viridiflavescens** (Poir.) Steud.; basionym: *Arundo viridiflavescens* Poir.; syn.: *Calamagrostis splendens* (Brongn.) Steud., *Calamagrostis viridescens* (Poir.) Steud., *Deyeuxia splendens* Brongn., *Deyeuxia viridiflavescens* (Poir.) Kunth; distr.: AR, BO, CHI, CO, EC, MEX, PE, widespread in eastern South America; alt.: 800–2500 m.

Deschampsia aurea (Munro ex Wedd.) Saarela; basionym: *Deyeuxia aurea* Munro ex Wedd.; syn.: *Calamagrostis aurea* (Munro ex Wedd.) Hack. ex Sodiro, *Stylagrostis longigluma* (Pilg.) Mez; distr.: EC, PE?; alt.: 2900–4900 m.

***Deschampsia chrysantha** (J. Presl) Saarela; basionym: *Deyeuxia chrysantha* J. Presl; syn.: *Calamagrostis chrysantha* (J. Presl) Steud., *Stylagrostis chrysantha* (J. Presl) Mez, *Stylagrostis leiopoda* (Wedd.) Mez; distr.: AR, BO, CHI, CO?, EC?, PE, VE; alt.: 3500–5000 m.

Deschampsia eminens (J. Presl) Saarela; basionym: *Deyeuxia eminens* J. Presl; syn.: *Calamagrostis eminens* (J. Presl) Steud., *Stylagrostis elegans* (Wedd.) Mez, *Stylagrostis eminens* (J. Presl) Mez; distr.: AR, BO, CO, CHI, PE; alt.: 3600–4500 m.

***Deschampsia ovata** (J. Presl) Saarela; basionym: *Deyeuxia ovata* J. Presl; syn.: *Calamagrostis ovata* (J. Presl) Steud., *Calamagrostis pflanzii* Pilg., *Deyeuxia anthoxanthum*

Wedd., *Deyeuxia capitata* Wedd., *Deyeuxia nivalis* Wedd., *Stylagrostis nivalis* (Wedd.) Mez, *Stylagrostis ovata* (J. Presl) Mez; distr.: BO, EC, PE; alt.: 4000–5200 m.

Deschampsia parodiana Saarela; basionym: *Deyeuxia ligulata* Kunth [name blocked by *Deschampsia ligulata* (Stapf) Henrard]; syn.: *Calamagrostis ligulata* (Kunth) Hitchc.; distr.: CO, EC, PE, VE; alt.: 3700–4850 m.

****Deschampsia podophora*** (Pilg.) Saarela; basionym: *Calamagrostis podophora* Pilg.; syn.: *Deyeuxia podophora* (Pilg.) Sodiro; distr.: CO, EC, PE, VE; alt.: 3500–4100 m.

****Deschampsia santamartensis*** Sylvester & Soreng; distr.: CO; alt.: 4300–4500 m.

Excluded or ambiguous species

Calamagrostis meridensis (Luces) B. Briceño, Bot. Ecol. Monocot. Páramos Venezuela. 2: 590. 2010. *Agrostis meridensis* Luces, Bol. Soc. Venez. Ci. Nat. 15(80): 11. 1953.

Type. VENEZUELA. Mérida: coleccionado en el bosque de la Laguna Negra, Páramo de Muchuchies, alt.: 3500 m, 25 Nov. 1943, Zoraida Luces de Febres 267 (holotype: VEN; isotype: MO (MO1086043! [image!]) fragm. ex VEN)

Comments. Briceño (2010) proposed the new combination of *Calamagrostis meridensis* for a taxon endemic to páramos of Venezuela. Briceño (2010) transferred the species from *Agrostis* to *Calamagrostis* based on the upper glume having 2–3 veins and anatomical characters such as all vascular bundles having a double sheath and without a notably angular shape and short cells over the veins can be solitary, in pairs or in short series. However, the species habit is noted as long rhizomatous to stoloniferous with geniculate culms, a habit unknown in *Calamagrostis* or *Deschampsia*, which are tufted or very-short rhizomatous and tussock-forming. This taxon is most likely a species of *Podagrostis* (Griseb.) Scribn. & Merr. based on the small spikelets (2.6–3.8 mm long), palea subequal to the lemma, awn often lacking, a rachilla extension that is usually absent or, when present, very short and glabrescent, a callus glabrous or rarely with scarce short hairs and short anthers 0.7–1 mm long. The number of veins of the upper glume has been considered as a distinguishing character to differentiate *Podagrostis* from *Calamagrostis* (e.g. Rúgolo de Agrasar 2012) but the recent discovery of *Podagrostis colombiana* Sylvester & Soreng (Sylvester et al. in press) from the Colombian Andes with well-developed lateral veins of the upper glume, large anthers and tussock-forming habit has shown these characters to be labile in *Podagrostis*.

Deyeuxia sodiroana Hack. ex Sodiro, Revista Col. Nac. Vicente Rocafuerte 12: 64. 1930. *Calamagrostis sodiroana* Hack., Anales Univ. Centr. Ecuador 3(25): 481. 1889, nom. nud.

Type. ECUADOR. Pichincha: Crece en los pajonales de los montes Pichincha, Chimborazo y El Altar [occid. M. Pichincha, Tablahuasi], Aug. 1888, L. Sodiro 25/10 (**lectotype, designated here**: W (W1916-0037841 [image!]); isolectotype: W (W1916-0037840 [image!])).

Comments. Known only from the type collected in Ecuador, *Calamagrostis sodiroana* likely belongs to *Deschampsia* sensu Saarela et al. (2017), earlier to *Calamagrostis sect. Deyeuxia* subsect. *Stylagrostis* due to the rachilla internode being extended between the glumes and floret. This species bears affinities to *Deschampsia parodiana* and *Deschampsia podophora* due to its open panicle and straight awn that usually does not or only slightly surpasses the glumes and blades usually much shorter than the flowering culms (Sodiro 1930: 70; Zulma Rúgolo de Agrasar, pers. comm.).

"*Calamagrostis* sp. A" (Dorr 2014: 221).

Comments. This taxon was first noted as "*Calamagrostis chaseae* auct., non Luces" by Dorr et al. (2000 [2001]: 56) and subsequently called "*Calamagrostis* sp. A" in the Flora of Guaramacal (Venezuela): Monocotyledons (Dorr 2014) but its identity remains ambiguous and needs further study. The species habit is noted as stoloniferous, a habit not known from *Calamagrostis* or *Deschampsia*, which are tufted or very-short rhizomatous and tussock-forming. The mention of short spikelets (3–4.4 mm long), florets (appearing to) almost reach or equal the length of the glumes and 1-veined upper glumes in the brief description by Dorr (2014: 221) makes it possible that this taxon belongs to *Podagrostis* or *Agrostis*, although mention of a puberulent callus and presence of a fairly long awn (3.5–6 mm long) makes it less likely that this species is a *Podagrostis*.

Calamagrostis spruceana (Wedd.) Hack. ex Sodiro, Gram. Ecuator. (Anal. Univ. Quito) 3(25): 481. 1889. *Deyeuxia spruceana* Wedd., Bull. Soc. Bot. France 22: 178, 180. 1875. *Deyeuxia toluccensis* Munro ex Wedd., Bull. Soc. Bot. France 22: 180. 1875, nom. inval.

Type. ECUADOR. [without precise locality], 1859, Jameson s.n. [#59] (holotype: P (P00740364 [image!])).

Comments. Known only from the type collected in Ecuador, the identity of this taxon remains ambiguous. *Calamagrostis spruceana* bears similarities to *C. macrophylla, C. secunda* and *C. macrostachya* due to its open inflorescence, short hairs of the callus, rachilla hairs not reaching the apex of the palea and awn inserted slightly above the middle of the lemma (Sodiro 1930: 70; Zulma Rúgolo de Agrasar, pers. comm.).

Deyeuxia pendula Sodiro, Revista Col. Nac. Vicente Rocafuerte 12: 65. 1930.

Type. ECUADOR. Crece en las pajonales del Pichincha entre 3650 y 4200 m, Sodiro s.n. (not located).

Comments. Known only from the type and the identity of this taxon remains ambiguous.

Nomenclatural changes (new synonyms)

Calamagrostis planifolia **(Kunth) Trin. ex Steud., Nomencl. Bot. (ed. 2) 1: 251. 1840.** ***Deyeuxia planifolia*** **Kunth, Nov. Gen. Sp. (quarto ed.) 1: 145. 1815[1816].** ***Arundo planifolia*** **(Kunth) Poir., Encycl. 4: 707. 1816.**

Type. PERU. In montanis Andinum Peruvianorum prope Guangamarca, 1250 hexap. [2286 m], 1833, Bonpland s.n. (holotype: P (P00729787 [image!]); isotype: BAA (BAA00001855 [image!]) fragm. ex P, P (P030106 [image!]) fragm., LE (LE-TRIN-1801.01!) fragm. ex Herb. Willd. 176).

= *Deyeuxia pubescens* Pilg., Bot. Jahrb. Syst. 25(5): 712. 1898, syn. nov. *Calamagrostis pubescens* (Pilg.) Pilg., Bot. Jahrb. Syst. 42: 60. 1908, syn. nov. Type: COLOMBIA. [Crescit in monte ignivomo Pasto] Volcán de Pasto, 3400 m alt., 9 Dec. 1869, Stübel 389b (lectotype, designated by Vega and Rúgolo de Agrasar (2013: 28): BAA (BAA00000811 [image!]) fragm. ex B; isolectotype: US (US00406355!) fragm. ex B).

= *Calamagrostis pittieri* Hack., Oesterr. Bot. Z. 52(3): 108. 1902, syn. nov. Type: COSTA RICA. Cerro de Buena Vista, pres du sommit, [prope cacumen, Valle du General], 3100 m alt., 19 Jan. 1891, Pittier s.n. Pl. Costaric. Exs. 3359 (holotype: W (W19160029198 [image!]); isotypes: B, BR (BR0000006865702 [image!]), BAA (BAA00000766 [image!]) fragm. ex B).

Comments. *Calamagrostis pittieri*, recorded for Costa Rica, Colombia and Venezuela (Morales Quirós 2003; Hokche et al. 2008; Giraldo-Cañas 2011, 2013; Giraldo-Cañas et al. 2016) is synonymised under *Calamagrostis planifolia* as no satisfactory characteristics were found to separate the two. Both have spikelets with florets bearing a pilose rachilla extension with hairs reaching from ¾ to passing the apex of the lemma, an awn inserted in the upper half of the lemma, 2 anthers that usually are short, ca. 1–1.4 mm long and leaf blades that are usually flat (sometimes drying convolute) with variable indumentum.

Calamagrostis pubescens was considered an endemic species to Colombia (Giraldo-Cañas 2013) and only known from the type specimen that was collected in southern Colombia from hills surrounding Pasto of departamento Narino. The B holotype was destroyed during World War II, with fragments only remaining at BAA and US. The BAA fragment consists of spikelets whose size and characteristics match *C. planifolia* (Zulma Rúgolo de Agrasar, pers. comm.), and the description of vegetative characteristics in the protologue also matches *C. planifolia* and so we consider *C. pubescens* a synonym of *C. planifolia*. Nevertheless, further study is needed for the *C. planifolia* complex in Colombia and there are certain crucial characters, such as number of stamens that need to be verified in these taxa. The *C. pubescens* BAA fragment lacked anthers (Zulma Rúgolo de Agrasar, pers. comm.) and Pilger (1898: 712) did not describe them.

Calamagrostis macrophylla (Pilg.) Pilg., Bot. Jahrb. Syst. 42: 60. 1908. _Deyeuxia macrophylla_ Pilg., Bot. Jahrb. Syst. 25(5): 711–712. 1898.

Type. ECUADOR. Pinchincha: Verdecuchu, Aug. 1879 [7 Aug. 1870], A. Stübel 34 (lectotype, designated by Vega and Rúgolo de Agrasar (2013: 27): BAA (BAA00000810 [image!] fragm. ex B; isolectotypes: S (S-R-823 [image!]) fragm., US (US00153721!, US00133532!)).

= *Deyeuxia macrostachya* Sodiro, Revista Col. Nac. Vicente Rocafuerte 12: 64. 1930, syn. nov. Type: ECUADOR. In pasq. M. Chimbarazo [En los pajonales de los montes Pichincha y Chimborazo], Nov. [Dec.] 1890, L. Sodiro 265 [s.n.] (lectotype, designated here: US (US00406351!); isolectotype: S (S-R-1460 [image!])).

Comments. *Deyeuxia macrostachya* is known only from the type specimen collected by Sodiro in páramo grasslands close to mount Pichincha and Chimborazo, Ecuador. We found no noticeable differences between this and Pilgers specimens. The large, lax panicle with semiverticillate branches, similar spikelet morphology including the lemma apex bifid with aristulate teeth and rachilla hairs only reaching the apex of the palea, support *D. macrostachya* being synonymised under *C. macrophylla*.

Two new species and a revised description and new variety of *Deschampsia podophora*

Both of the new species are found in the páramos of Sierra Nevada de Santa Marta, at the northernmost tip of Colombia, with *Calamagrostis crispifolius* also being found in the Sierra de Perija, on the border between Venezuela and Colombia, suggesting that these two high elevation environments, although fairly isolated from each other, share certain floristic affinities. The discovery of *Deschampsia santamartensis* adds a further endemic grass species to the Sierra Nevada de Santa Marta alongside *Podagrostis colombiana* Sylvester & Soreng (Sylvester et al. in press), and *Agrostopoa wallisii* (Mez) P. M. Peterson Soreng & Davidse and *A. barclayae* Davidse, Soreng & P. M. Peterson, of the only endemic genus of Colombia, *Agrostopoa* Davidse, Soreng & P.M. Peterson (Davidse et al. 2009), and highlights the necessity for further collecting expeditions to be made to this isolated massif on the northernmost tip of Colombia.

A number of Colombian specimens of *Deschampsis podophora* (= *Calamagrostis podophora*) were also discovered that lacked certain diagnostic characters of the species and prompted the more comprehensive circumscription of the species presented here that includes description of the new variety *Deschampsia podophora* var. *mutica*.

Calamagrostis crispifolius Sylvester, sp. nov.
urn:lsid:ipni.org:names:60478840-2
Fig. 1

Type. COLOMBIA. Magdalena: flanco occidental de la Sierra Nevada de Santa Marta, páramo, abundantisima, cubre gran parte del páramo, 3140 m alt., 29 Jan.

1959, R. Romero Castañeda 7141 (holotype: COL (COL000172001!); isotype: US (US01246667!)).

Diagnosis. Differs from all other species of *Calamagrostis* s.l. by a combination of strongly curled, readily deciduous leaf blades in mature plants that form a basal mat to 20 cm tall, open inflorescences with generally patent branches, spikelets (3.5–)4–5.5 mm long, with sessile florets and a rachilla prolongation (not including hairs) reaching from 2/3 to almost the apex of the lemma, with short hairs < 1 mm long and an awn inserted just above the middle of the lemma, 5–7.2 mm long, anthers 1.5–2.7 mm long.

Description. Plants perennial, tufted, forming short dense tufts, mats to 40 cm wide, with short vertical or oblique rhizomes. Bases covered with fibrous old basal sheaths, with fallen curled leaf blades often forming large masses on the ground between tufts. **Tillers** intravaginal. **Culms** 48–64 cm tall, 1.5–2.2 mm wide, striate, erect, greatly exerted from the basal foliage, nodes and internodes terete, smooth but becoming scabrous below the nodes and towards the inflorescence, with dense scabrocities just below the inflorescence; (0–)1 node exposed at flowering; uppermost internodes 38–42 cm long. **Sheaths** striate, moderately keeled; **flag leaf sheaths** 20–25 cm long; **upper culm sheaths** glabrous and smooth with minute papillae present on the adaxial surface; **basal leaf sheaths** 4–12 cm long, shorter than the internodes, glabrous and lightly scabrous. **Ligules** not stipulate**; upper culm ligules** 2.5–10 mm long, acute with a rounded or bidentate apex, scarious to coriaceous, 2-veined but without notable lateral keels, apices denticulate, fimbriate or short ciliate, ligule abaxial surface lightly to densely scabrous with short scabers; **ligules of innovations** 2.2–10 mm long, strongly decurrent with the sheaths, truncate to acute, scarious to coriaceous when shorter, lightly to densely scabrous on the abaxial surface. **Leaf blades** 5–15(–30) cm long, 0.5–1.5 mm wide, cylindrical in outline, when rolled the blades form a basal mat to 20 cm tall and much shorter than the exerted culms, strongly curled in mature plants [or when dry?], appearing readily deciduous and snapping off when the plant reaches maturity leaving an abscission zone and the ligule exposed, sometimes recurved to straight in immature plants [or when moist?], conduplicate to convolute, rigid, glabrous, abaxially finely scabrous, adaxially densely scabrous, edges smooth or slightly scaberulous, apex pungent; **flag leaf blade** ca. 2.9 cm long, recurved, slightly narrower than the basal blades. **Panicles** (5.5–)9–20 cm long, 3–10 cm wide, open, rarely contracted in young specimens, exerted or rarely subincluded in the flag leaf, open and diffuse, oval, greenish-purple or golden-purple; **main panicle axis** terete, glabrous, lightly to moderately scabrous, spikelets found diffusely on the proximal half of the primary branches, lower internodes 2–4 cm long; **panicle branches** spreading to slightly ascending, rarely contracted; **primary panicle branches** 2–6 cm long, bearing 1–10 spikelets per branch, verticillate in clusters of 2–5, terete, glabrous, almost smooth to scabrous; **pedicels** (3–)6–22 mm long, usually much longer than the spikelets, glabrous, lightly to moderately scabrous. **Spikelets** 1-flowered, not strongly laterally compressed, disarticulating above the glumes; glumes, lemma and palea not noticeably asymmetrical. **Glumes** (3.5–)4–5.5 mm long, subequal, the lower glume ca. 0.3 mm shorter than the upper glume, narrowly lanceolate, membranous, pur-

Figure 1. *Calamagrostis crispifolius*; **A** lower portion of plant, showing basal tuft of curled leaves **B** lígular area **C** upper portion of plant showing inflorescence and flag leaf blade **D** primary branch of the inflorescence **E** lower glume, dorsal view **F** upper glume, dorsal view **G** spikelet, with floret already fallen, lateral view **H** spikelet, with floret, lateral view **I** lemma, dorsal view **J** lemma, lateral view **K** stylar branch and stigma **L** palea ventral view, showing the ovary, stamens and lodicules **M** ovary and lodicules, ventral view **N** immature caryopsis, dorsal view showing embryo; drawn by Alice R. Tangerini from the isotype, R. Romero Castañeda 7141 (US).

plish, lustrous, dorsal surface smooth or scaberulous distally, keels lightly scabrous distally or scabrous throughout, apices acute, finely denticulate, erose; **lower glume** 1-veined; **upper glume** 3-veined, lateral veins reaching from ¼ to past half the length of the glume, 1 or 2 cross veins between the keel and lateral vein infrequently present in ca. 10% of spikelets seen (requires 50× magnification). **Floret** sessile, almost reaching the apex of the glumes, sometimes passing the apex of the lower glume. **Lowermost rachilla internode** not prolonged between the glumes and the floret. **Lemmas** 3.7–4.6 mm long, 5-veined, veins not evident; the same consistency as the glumes, golden, glabrous, scaberulous throughout or lustrous and faintly to densely muriculate with the apex sometimes becoming scaberulous, apex shortly emarginate with lobes finely denticulate, awns 5–7.2 mm long, amply passing the glumes, twisted at the base, slightly curved, densely scabrous throughout, inserted just above the middle of the lemma, at 2.2–2.5 mm from the lemma base. **Paleas** 0.3–0.8 mm shorter than the lemma, of the same consistency and colour, keels smooth and notable, apex bidentate. **Callus** rounded, short, articulation oblique, with a basal tuft of short hairs 0.2–0.7(–0.8) mm long. **Rachilla** (2–)3–3.5 mm long, reaching from 2/3 to almost the apex of the lemma, with copious short hairs 0.5–1 mm long, the hairs reaching from 4/5 to almost the apex of the lemma and usually surpassing the palea. **Lodicules** 2, 0.4–0.6 mm long, membranous, 2-lobed, acute to slightly acuminate. **Stamens** 3, anthers 1.5–2.7 mm long. **Ovary** ca. 0.5 mm long, small, styles 2, stigmas plumose with secondary branching, short. **Caryopsis** ca. 1.8 mm long, ca. 0.7 mm wide, elliptic, rounded triangular in transection, hilum narrowly elliptic, ventral groove shallow and not conspicuous, pale brown, embryo ca. 0.3 mm long, apex with remains of styles and stigmas; **endosperm** firm.

Distribution and ecology. Colombia, Venezuela. Known from páramos of the Sierra Nevada de Santa Marta, northern Colombia and the Sierra de Perija, Venezuela. For the Sierra Nevada de Santa Marta, specimens are known from páramo vegetation on both the western and eastern flanks of the massif. For the Sierra de Perija, specimens are known from both the northern and southern extents of the mountain range. It is found growing between 2700–3570 m in páramos with dry soils that are often subject to fires. The plant forms dense cushion-like mats or clumps and it is a dominant component of certain páramos. The type specimen label includes “Abundantisima, cubre gran parte del páramo”, i.e. highly abundant and covers a large part of the páramo. The specimen label of Barclay and Juajibuoy 6545 (US) also states “the dominant grass on these slopes, extending up to the top of ridge”, thus implying that it is a dominant component of the páramos of the Sierra Nevada de Santa Marta.

The degree of curling of leaf blades in the different specimens studied may relate to the level of maturity of the plant or also the local microclimate, with the specimen label of Barclay and Juajibuoy 6545 (US) stating “leaves very fine and rolled, when dry they curl”. The characteristic of readily deciduous leaf blades is also interesting, with the specimen label of Barclay and Juajibuoy 6545 (US) also mentioning that “large masses of these [the fallen curled blades] on the ground between clumps [of the plant]”.

Other specimens examined. COLOMBIA. **Magdalena**: Sierra Nevada de Santa Marta, Laguna Chubdula, 3480 m alt., 10°55'N; 73°53'W, 29 Dec. 1972, Kirkbridge & Forero 1775 (MO); Sierra Nevada de Santa Marta, alrededores de cabeceras del Río Sevilla, 3050–3300 m alt. [US specimen label states 'The dominant grass on these slopes, extending up to the top of ridge. West and north facing slopes, on south side of river above campsite, sta.1,6., alt. 3320–3570 m'], 20 Jan. 1959, H.G. Barclay & P. Juajibioy 6545 (MO, US-3652630); Sierra de Perija, east of Manuare, Sabana Rubia, páramo, 3000–3100 m alt., 6 Nov. 1959, J. Cuatrecasas & R. Romero Castañeda 25021 (US [3 sheets]).

VENEZUELA. **Zulia**: Maracaibo Distr., Sierra de Perija, Serranía de Valledupar, Campamento Monte Viruela, on tepuí-like limestone massif 5×2.5 km in size, on the international boundary, 10°25.2167'N; 72°52.7'W, 3100 m alt., 25–28 Dec. 1974, S.S. Tillett 747-882 (MO); Perijá Distr., Sierra de Perija, Serranía de los Motilones, mesa below international boundary on main ridge, headwaters of Río Negro, Campamento Frontera II, 10°0.2167'N; 72°58.4167'W, 3000 m alt., 27 Nov.–5 Dec. 1974, S.S. Tillett & K.W. Hönig 746-618 (MO); Serranía de Valledupar, international boundary, headwaters of Río Guasare, 10°23.13'N; 72°52.0833'W, 2700–3300 m alt., 10–19 Dec. 1974, S.S. Tillett 747-1072 (MO).

Preliminary conservation status. Vulnerable (VU). Despite the species being known from seven collections spanning two Cordilleras, the páramos of Colombia are currently facing threats principally from mining (Pérez-Escobar et al. 2018) and an uncertain future. Our preliminary conservation status of VU is deemed adequate until further research is done.

Etymology. The species epithet refers to the strongly curled leaf blades which make it distinct from all other páramo taxa of *Calamagrostis* s.l. with open panicles.

Notes. To our knowledge, there are no species of *Calamagrostis* s.l. with readily deciduous leaf blades that snap off when the plant reaches maturity leaving an abscission zone and the ligule exposed and covering the ground surrounding the plant tufts. This, coupled with the strongly curled nature of the leaf blades, makes this species unique. The character of curled leaf blades is very uncommon in the genus *Calamagrostis*, with the closest resembling species with this character being *Calamagrostis crispa* (Rúgolo & Villav.) Soreng, a species found in dry Andean grassland of Bolivia, Chile, Peru and Northeast Argentina (Rúgolo de Agrasar 2012: 193). The blades of mature plants of *C. crispa* are generally curved rather than strongly curled, as in *C. crispifolius*. *Calamagrostis crispa* also differs from *C. crispifolius* by the short, few-flowered, inflorescences that are included within the basal foliage, large spikelets with glumes 5–8 mm long and lemmas (4.4–)5–5.5 mm long, amongst other characters.

Calamagrostis crispifolius also shares certain similarities with *C. effusa* in terms of characters of the inflorescence i.e. the open panicles with verticillate panicle branches, the short glumes to 5.5 mm long, the awn being inserted in the upper half of the lemma and, most importantly, the long rachilla usually extending past the apex of the palea and bearing short hairs < 1 mm long. *Calamagrostis crispifolius* and *C. effusa* also share a peculiar character of cross veins between the lateral veins and keel of the upper glume, but these are only noticeable at 50× magnification in about 1 in 10 spikelets. A more exhaustive search for this character in other taxa within *Calamagrostis* s.l. should be done to check its exclusiveness to *C. crispifolius* and *C. effusa*. *Calamagrostis crispifolius* can be easily distinguished from *C. effusa* by the strongly curled leaf blades with pungent apices which form a basal mat to 20 cm high that is usually much shorter than the flowering culms, while *C. effusa* has stiffly erect blades with obtuse apices forming tussocks 40–60(–107) cm tall. Ligule characteristics also differ, with *C. crispifolius* having ligules 2.2–10 mm long with acute apices, while *C. effusa* has ligules 1–2 mm long with truncate apices. In a recent molecular analysis, *Calamagrostis effusa* was found to be sister to *Chascolytrum* Desv. (Saarela et al. 2017), possibly warranting its own generic placement. Further collecting of this new species, with a focus on molecular sampling, should be done to clarify its phylogenetic affinities.

Specimens of *C. crispifolius* from the Sierra Nevada de Santa Marta, Colombia, differ from Venezuelan specimens in a number of attributes and may represent a subspecies, although further collections and studies need to be made to confirm this. Colombian specimens have narrower leaf blades (0.5–0.75 mm wide), shorter ligules (2.2–4 mm long), usually longer anthers (to 2.7 mm long) and rachillas with short hairs that often reach the apex of the lemma. Venezuelan specimens have broader leaf blades (to 1.5 mm wide), longer ligules (4–10 mm long), shorter anthers (1.5–2 mm long) and rachillas with short hairs that usually do not reach the apex of the lemma.

Deschampsia santamartensis Sylvester & Soreng, sp. nov.
urn:lsid:ipni.org:names:60478841-2
Fig. 2

Type. COLOMBIA. Magdalena: Sierra Nevada de Santa Marta, valley descending south-western from Picos Reina and Ojeda, rocky and sandy páramos above Laguna Naboba and Laguna Reina, superpáramo, 4300–4500 m alt., 5 Oct. 1959, J. Cuatrecasas & R. Romero Castañeda 24607 (holotype: COL (COL000184738!); isotype: US (US01240776!)).

Diagnosis. *Deschampsia santamartensis* is similar to *Deschampsia hackelii* (Lillo) Saarela, but differs in having broad, rigid and erect, strongly conduplicate blades, 1.5–2.5 mm when folded (vs. filiform and curved leaf blades 0.5–1 mm wide when folded), ligules short and often truncate or obtuse with ligules of innovations 0.5–1 mm long and ligules of upper flowering culms 3–4 mm long (vs. ligules long and acuminate 3.5–7 mm long), ellipsoid spike-like panicles 3–5.5 long × 1.5–2.5 cm wide (vs. capituliform spherical panicles 1–3 cm long × 1–2 cm wide), lemma surfaces moderately to lightly scabrous between the veins (vs. smooth), lemma apices acute to muticous and entire (vs. truncate and irregularly dentate), rachilla extension often absent (vs. always present, 0.5–1 mm long) and inside of the floret often with hyaline shiny sinuous trichomes to 1 mm long emerging from the base of the ovary (vs. lacking trichomes).

Description. Tufted perennial forming short dense tufts with vertical rhizomes and papyraceous, fibrous basal sheaths, leaves form a basal mat to 12 cm tall and

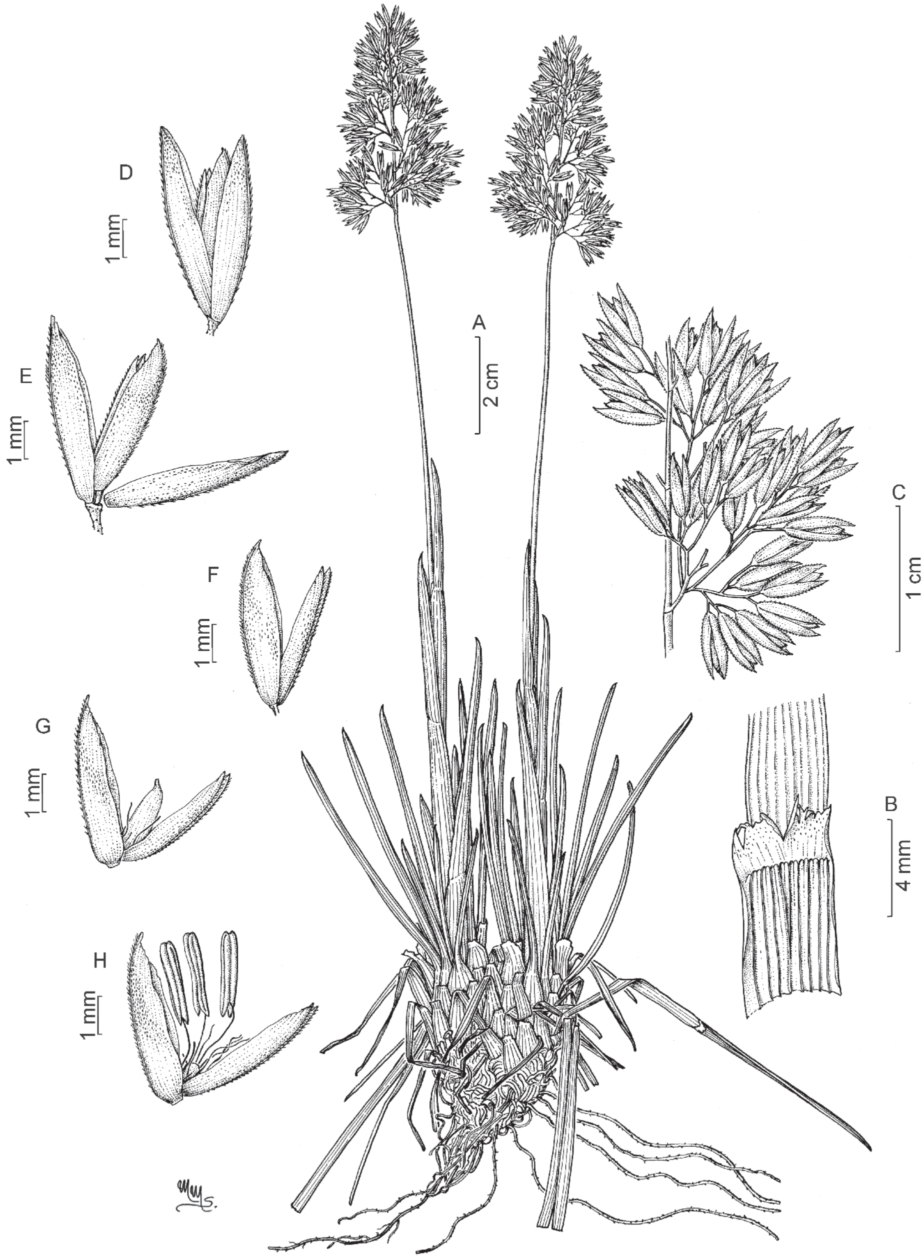

Figure 2. *Deschampsia santamartensis*. **A** Habit **B** Ligule **C** Panicle branch **D** Spikelet **E** spikelet, with lower glume pulled away to reveal the stipitate floret (extension of the lowermost rachilla internode) **F** floret **G** floret, with palea and lemma slightly separated to reveal the ovary in a late stage of development and surrounded by long filamentous trichomes **H** floret, with palea and lemma slightly separated to reveal the stamens and ovary at an earlier stage of development and surrounded by long filamentous trichomes; drawn by Marcela Morales from the holotype, J. Cuatrecasas & R. Romero Castañeda 24607 (COL).

much shorter than the exerted culms. **Tillers** intravaginal. **Culms** 9–20 cm tall, 1–1.5 mm wide, erect, exerted from the basal foliage, not obviously striate, densely papilliate; nodes and internodes terete, densely papilliate, not lustrous, nodes hidden in the sheaths with no nodes exposed at flowering; uppermost internodes 10–18 cm long, longer than the sheaths. **Sheaths** weakly striate, slightly keeled; **flag leaf sheaths** 7–10 cm long; **upper culm sheaths** lax, glabrous, smooth, densely papilliate; **basal leaf sheaths** 2–3 cm long, longer than the internodes, glabrous, smooth or slightly scabrous, densely papilliate, older basal sheaths papyraceous and fibrous with the fibres becoming slightly curly as the sheaths decay and leave just the fibres. **Ligules** not stipulate; **upper culm ligules** 3–4 mm long, regularly decurrent with the sheaths, broadly shouldered with an attenuate central point, hyaline, without notable lateral keels, apices entire or irregularly dentate, abaxial surface smooth and sparsely papilliate; **ligules of innovations** 0.5–1 mm long, strongly decurrent with the sheaths, broadly shouldered and sometimes with a lateral extension or lobe that extends ca. 1 mm long, the centre of the ligule truncate to obtuse and irregularly dentate, hyaline, without notable lateral keels, abaxial surface scabrous with distinct, mostly retrorse, spinules, with spinules tending to run down the throat and occur on the collar margin. **Leaf blades** 2.5–8 cm long, 1.5–2.5 mm wide when folded, gradually reduced up the culm, strongly conduplicate with margins frequently inrolled, weakly keeled, erect to slightly divergent, glabrous, abaxial blade surface smooth, strongly papilliate, adaxial blade surface scabrous mainly in the centre in lines along the veins, veins pronounced, margins moderately scaberulous, apex naviculate with a slightly pungent mucronate point; **flag leaf blade** 1.7–3 cm long, slightly narrower than lower culm blades. **Panicles** 3–5.5 cm long, 1.5–2.5 cm wide, dense, ellipsoid, golden-purple, densely spiculate, sometimes interrupted towards the base, spikelets present from near the base; **main panicle axis** terete, glabrous, smooth, lower internode ca. 1 cm long; **panicle branches** short, ascending; **primary panicle branches** 1–2 cm long, bearing 15–50 spikelets per branch, verticillate in clusters of 1–3, terete, glabrous, almost smooth to lightly scabrous, papilliate; **pedicels** 0.5–1.5 mm long, much shorter than the spikelets, glabrous, lightly scabrous, papilliate. **Spikelets** 1-flowered, strongly laterally compressed, disarticulating above the glumes (not seen); glumes, lemma and palea slightly asymmetrical. **Glumes** 4.6–5.5 mm long, subequal or rarely unequal, lower glumes 0.5–1.5 mm shorter than the upper glumes, membranous, purplish grading to a scarious golden-bronze margin, sub-lustrous, papilliate, very sparsely scabrous on the keels, edges smooth, apices acute to acuminate, entire to infrequently irregularly denticulate; **lower glume** 1-veined; **upper glume** 3 or sometimes faintly 5-veined, lateral veins reaching half the length of the glume. **Florets** stipitate, single, included in the glumes, subequalling the apex of the lower glume. **Lowermost rachilla internode** (0.25–)0.4–0.5 mm long, prolonged between the glumes and the floret, terete, slightly dilated at its apex, glabrous, smooth. **Lemmas** 4–4.5 mm long, of the same consistency as the glumes, golden-purple with a broad scarious margin and apex, glabrous, long scabrous to pectinate scabrous along the keel for most its length, lemma surface moderately to sparsely scabrous between the veins distally for up to ¾ the length of the lemma, apex slightly falcate, acute to muticous, entire, apex margins broadly scarious and somewhat incurved, 5-veined, veins generally not evident, sometimes apparent towards the base; awn absent. **Paleas** slightly shorter than the lemma, of the same consistency, golden, scarious, keels closely spaced with the keel flanges twice as broad as the gap between the keels, one keel more pronounced than the other, regularly scabrous and notable in the upper 2/3 of the length, scabrous between the keels, apex sometimes inconspicuously bidentate. **Callus** base rounded and slightly dorsally compressed above, glabrous. **Rachilla** absent or to 0.6(–1) mm long, glabrescent with a few short hairs at the apex. **Lodicules** 2, ca. 0.4 mm long, as broad as long, membranous, flabellate, with an acute lobe. **Stamens** 3, anthers 2–2.2 mm long. **Ovary** ca. 0.6 mm long, small, styles 2, stigmas plumose with secondary branching, short, often with scarce hyaline, shiny and sinuous trichomes to 1 mm long emerging from the base of the ovary. **Caryopsis** ca. 2 mm long, ca. 0.6 mm wide, obovate, laterally compressed in cross section, hilum 0.2 mm long, circular to obovate, ventral groove shallow and narrow and not conspicuous, pale honey brown, embryo ca. 0.4 mm long, apex with remains of style bases < 0.1 mm long, with remains of short plumose stigmas attached; **endosperm** liquid.

Distribution and ecology. Known only from the type specimen that was collected from a southwest facing valley descending from Picos Reina and Ojeda in the centre of the Sierra Nevada de Santa Marta. The specimen was collected from high elevation rocky and sandy superpáramo vegetation above 4300 m.

Preliminary conservation status. Data Deficient (DD). Currently known only from a single specimen. Further expeditions are needed to the Sierra Nevada de Santa Marta to document its distribution.

Etymology. The species epithet refers to the type locality of the Sierra Nevada de Santa Marta.

Notes. *Deschampsia santamartensis* clearly belongs to *Calamagrostis* subsect. *Stylagrostis* (=*Deschampsia* sensu Saarela et al. 2017) due to the presence of an extended rachilla internode between the glumes and the floret. *Deschampsia santamartensis* can be easily distinguished from all other members of *Calamagrostis* subsect. *Stylagrostis* with dense, spike-like panicles by its florets lacking awns, a glabrous callus and the absence of a rachilla extension (or rarely with a diminutive glabrescent rachilla extension). The only other member of *Calamagrostis* subsect. *Stylagrostis* with dense spike-like panicles, glabrescent callus, glabrescent short rachilla extensions and which occasionally lack awns is *Deschampsia hackelii* (Lillo) Saarela (= *Calamagrostis hackelii* Lillo), a species known from high-Andean regions of northwest Argentina and Chile (Rúgolo de Agrasar 2012: 201). *Deschampsia hackelii* differs by its capituliform panicles, 1–3 cm long × 1–2 cm wide (vs. ellipsoid spike-like panicles 3–5.5 long × 1.5–2.5 cm wide), filiform and curved leaf blades 0.5–1 mm wide when folded (vs. broad, rigid and erect, strongly conduplicate blades 1.5–2.5 mm when folded), long acuminate ligules 3.5–7 mm long (vs. ligules short and often truncate or obtuse with ligules of innovations 0.5–1 mm long and ligules of upper flowering culms 3–4 mm long), lemma surfaces smooth (vs. moderately to lightly scabrous between the veins), lemma apex truncate and irregularly dentate (vs. acute to muticous and entire), rachilla extension always present 0.5–1 mm long (vs. often absent) and inside of the floret lacking trichomes (vs. often with hyaline shiny sinuous trichomes to 1 mm long emerging from the base of the ovary).

Deschampsia aurea, a species originally described from Ecuadorian páramos but which also occurs in Peruvian Jalca vegetation, is another member of *Calamagrostis* subsect. *Stylagrostis* that has dense, spike-like panicles and spikelet lemmas that occasionally lose the thin weak dorsally-inserted awn (Zulma Rúgolo de Agrasar, pers. comm.). *Deschampsia aurea* has well-developed callus and rachilla hairs, with callus hairs surpassing more than half the length of the lemma and rachilla hairs reaching or surpassing the lemma apex, as well as other characters to help differentiate it from *D. santamartensis* such as the floret being noticeably shorter (2.9–3 mm long) than the large glumes (5.5–7.5 mm long), amongst other characters. *Calamagrostis chrysostachya* (E. Desv.) Kuntze, a species known from high-Andean regions of northwest Argentina and Chile, also shares these attributes and has also been included as a member of *Calamagrostis* subsect. *Stylagrostis* (Rúgolo de Agrasar 2012, pers. comm.). Both these species, however, have a pilose callus and rachilla, with *C. chrysostachya* having poorly developed callus and rachilla hairs to 1 mm long, but thin conduplicate or convolute leaf blades 0.8–1.2 mm wide when unfolded and a ligular stipule 0.5–1.5 mm long. The short, strongly conduplicate leaf blades with navicular apices are also reminiscent of *Poa trachyphylla* Hack. which also inhabits high-elevation superpáramo of Colombia (Sylvester et al. in press).

Deschampsia podophora **(Pilg.) Saarela, PhytoKeys 87: 90. 2017.** ***Deyeuxia podophora*** **(Pilg.) Sodiro, Rev. Col. Nac. Vicente Rocafuerte 11: 79. 1930.** ***Calamagrostis podophora*** **Pilg., Bot. Jahrb. Syst. 42 (1): 66. 1908.**

Type. PERU. Junín: Berge Westlich von Huacapistana [Prov. Tarma, in montibus prope Huacapistana ad occid. in stepposis], 3500 m alt., 18 Jan. 1903, A. Weberbauer 2231 (lectotype, designated by Vega and Rúgolo de Agrasar (2013: 28): BAA (BAA00000767 [image!]) fragm. ex B; isolectotype: US (US00149282!)).

Description. Tufted perennial with vertical rhizomes forming short solitary tufts to medium-sized tussocks, with leaf blades mostly basal with inflorescences usually greatly exerted from basal foliage or both basal and cauline with some cauline blades often surpassing the inflorescence. **Tillers** intravaginal. **Culms** 20–75(–110) cm tall, to 3 mm wide, erect, striate, nodes and internodes terete, smooth and lustrous; nodes hidden in the sheaths with no nodes exposed at flowering; uppermost internodes 20–32.5 cm long, as long or longer than the sheath. **Sheaths** striate; **flag leaf sheaths** 22–38 cm long; **upper culm sheaths** lax, glabrous and smooth; **basal leaf sheaths** 4.5–20 cm long, longer than the internodes, glabrous and smooth. **Ligules** not stipulate; **upper culm ligules** 7.5–22 mm long, strongly decurrent with the sheaths, long acuminate, membranous to slightly coriaceous, without notable lateral keels, apices entire, erose or narrowly bifid, sometimes fimbriate, abaxial surface smooth; **ligules of innovations** 4–15(–20) mm long, slightly to strongly and broadly decurrent with the sheaths, long acuminate, membranous to slightly coriaceous, lateral keels sometimes notable, apices entire or a narrow bifid point, sometimes slightly erose, abaxial surface smooth or sometimes slightly scabrous at the apex. **Leaf blades** (2.5–)5–22 cm long, 0.6–7 mm wide when opened out, flat, conduplicate or involute/convolute and filiform and cylindrical to subelliptical in outline, sometimes opening out to become flat at their apices, straight and erect to slightly curved, glabrous, isomorphic or more or less dimorphic, when dimorphic those of the innovations filiform and cylindrical to subelliptic in outline while those of the upper flowering culm are usually wider and flat, conduplicate or convolute towards the apices, abaxially smooth, adaxially smooth or lightly scaberulous along the veins, sometimes becoming densely scabrous towards the apex, edges smooth or slightly scaberulous, veins usually pronounced, numerous and tightly packed, apex obtuse to slightly pungent; **flag leaf blades** 2.9–6 cm long, 2–7 mm wide when opened out. **Panicles** 10–25 cm long, 3–8 cm wide, open to slightly condensed, oval, greenish-purple with spikelets tending to be laxly glomerate on the distal half of the inflorescence branches with the proximal half usually lacking spikelets, largely exerted to moderately included in the uppermost sheath and/or blade; **main panicle axis** terete to slightly compressed, usually with a narrow groove running down both sides, glabrous, smooth to lightly scaberulous, internodes tending to be long, lower internode 3–11.5 cm long; **panicle branches** 1.5–8 cm long, bearing 10 to over 50 spikelets per branch, flexuous, spreading, pendulous or divergent at a 45° angle to slightly ascending, verticillate in clusters of 2 or 3, terete or slightly grooved, glabrous, almost smooth to scabrous; **pedicels** 0.5–2.5 mm long, usually shorter than the spikelets, glabrous, lightly to densely scabrous. **Spikelets** 1-flowered, sometimes with a rudimentary floret at the apex of the rachilla that appears like a slightly broader section of the rachilla covered in sparse diminute hairs, not strongly laterally compressed, disarticulating above the glumes with the florets disarticulating from the apex of the extended rachilla internode, this remaining attached to the glumes. **Glumes** 3.5–5.5 mm long, subequal, the lower glume 0.2–0.6 mm shorter than the upper glume, lanceolate, membranous, purplish-green, lustrous, smooth or sometimes lightly scabrous throughout the keel of the upper glume; **lower glumes** 1-veined, apex acuminate or bidentate, less frequently finely denticulate or erose; **upper glumes** 3-veined, lateral veins either short < ½ length of glume or reaching from ½ to 2/3 the length of the glume, apex usually acuminate, sometimes finely denticulate. **Floret** stipitate, much shorter than the glumes, never passing the apex of the lower glume. **Lowermost rachilla internode** 0.4–0.7 mm long, prolonged between the glumes and the floret, often slightly geniculate at its apex and bent in a ca. 30°–45° angle, slightly dilated at its apex, usually glabrous, less often with a few long hairs ca. 0.7 mm long emerging from it, smooth. **Lemmas** 2.4–3.5 mm long, of the same consistency as the glumes, light green with purple tinges towards apex, becoming golden at maturity, glabrous, smooth with the keel apex rarely scaberulous, apex truncate and denticulate, usually with 4 clearly distinguished teeth, 0.3–0.5 mm long and erose between the teeth, 5-veined, veins not evident; awns 1.5–4 mm long, sometimes absent, inserted in the middle or lower third of the lemma, usually as long as the lemma or passing the glume apex by as much as

1.5 mm. **Paleas** 0.5–0.8 mm shorter than the lemma, of the same consistency and colour, keels sparsely scabrous and notable, apex bidentate or 4-dentate. **Callus** rounded, short, with a basal tuft of hairs 0.5–2.2 mm long, reaching from 1/3 the length of the lemma to almost the lemma apex. **Rachilla** 1.5–2.5 mm long, reaching from 2/3 to 4/5 the length of the lemma, with copious short to medium-sized hairs 0.5–1.4 mm long, the hairs reaching from 4/5 to sometimes passing the apex of the lemma, apex of rachilla sometimes clavate. **Lodicules** 2, ca. 0.5 mm long, membranous, acute. **Stamens** 3, anthers (0.7–)1.2–1.9 mm long. **Ovary** ca. 0.5 mm long, small, styles 2, stigmas plumose, short. **Caryopses** 1–1.4 mm long, dorsally slightly gibbose, surcus not noticeable, embryo short, hilum basal, oval; **endosperm** dry.

Distribution and ecology. Colombia, Ecuador, Peru, Venezuela. The ecology of this species is distinct compared to many *Calamagrostis* s.l. species as it is usually found in very damp, swamp-like conditions by the side of high-elevation lakes or watercourses in Andean páramo or jalca vegetation, less often in humid open páramo.

Other specimens examined. COLOMBIA. **Boyacá**: Below Las Playas de Ritacuba in the Cocuy mountains above Guican, on the banks of a fast-flowing stream coming off the snow fields and passing through thinly vegetated moraine covered country, 4100 m alt., 24 Jun. 1984, J.R.I. Wood 4457 (K). **Cauca**: Purace National Park, Laguna de San Rafael, in open boggy páramo in the lake basin, particularly in banks by ditches, 3300 m alt., 6 Apr. 1985, J.R.I. Wood 4803 (K); Volcan Purace, above Pilimbala, frequent in bog pools in high páramo, 3700–4000 m alt., 5 Apr. 1985, J.R.I. Wood 4787 (K).

ECUADOR. **Pichincha:** road Olmedo-Laguna San Marcos, W of the pass, 0°5'N; 78°1–2'W, 3600 m alt., 10 Jul. 1980, B. Øllgaard et al. 34406 (K); Along road to Refugio, Volcan Cayembe, páramo and swamp, 00°04'S; 77°54'W, 4300 m alt., 2 Mar. 1988, S. Renvoize 70510 (K). **Napo**: Eastern Cordillera, Llanganati Mountains, by Lake Aucacocha, on stream sides in bog, forming large tussocks up to 20 cm across, 3750 m alt., 16 Aug. 1969, P.J. Edwards 127 (K); Eastern Cordillera, Llanganati Mountains, by Lake Aucacocha, growing in the wettest area of the bog, in clusters of tufts, sheath bases submerged in peat, 3700 m alt., Aug. 1969, P.J. Edwards 62 (K).

Notes. *Deschampsia podophora* has been traditionally treated as belonging to *Calamagrostis* subsect. *Stylagrostis* due to the presence of an extended rachilla internode between the glumes and the floret. *Deschampsia podophora* is closely related to *D. parodiana* (=*Calamagrostis ligulata*) and has been placed as a synonym of this in previous works (Escalona 1988a, 1988b; Tovar 1993; Luteyn 1999; Bono 2010; Briceño 2010). The principal differentiating characters that separate *Deschampsia parodiana* from *D. podophora* are the smaller anthers, 0.4–0.5 mm long (vs. (0.7–)1.2–1.5(–1.9) mm long in *D. podophora*) and the shorter rachilla, 1–1.2 mm long, that is sparsely pilose with hairs not usually reaching the apex of the palea (vs. (1.2–)1.4–2.5 mm long, with copious hairs that usually surpass the lemma in *D. podophora*). Characters of shape and density of the inflorescence mentioned in Laegaard (1998: 27) were found to be not good for differentiating the two species. While *D. parodiana* only has a lax open inflorescence with long pendant branches and spikelets glomerate on the distal part of the branches, *D. podophora* exhibits both denser semi-spikelike inflorescences with inflorescence branches having spikelets from the base as well as open inflorescences with pendulous branches and spikelets glomerate on the distal part of the branches like that of *D. parodiana*.

Some specimens from Colombia were found to be generally larger than those from Ecuador, in terms of the number and length of the culms with mainly cauline leaf blades that were longer and wider. These specimens had a habit appearance similar to var. *mutica* being larger tussock-forming plants with multiple culms and inflorescences held within sheaths.

Deschampsia podophora **(Pilg.) Saarela var.** ***mutica*** **Sylvester, var. nov.**

urn:lsid:ipni.org:names:60478842-2
Fig. 3

Type. COLOMBIA. Cundinamarca: Mun. Santa Rosa-Usme, Sumapaz páramo, by Laguna Larga, in swamp at the edge of the lake in open páramo country, 3700 m alt., 19 Aug. 1985, J.R.I. Wood 5033 (holotype: FMB (FMB11918!); isotypes: COL (COL000434793!), K [2 sheets]!).

Diagnosis. *Deschampsia podophora* var. *mutica* differs from *D. podophora* by the lemmas being muticous and lacking awns (vs. lemmas usually with a well-developed dorsal awn inserted in the lower or middle third of the spikelet, measuring 1.5–3.5(–4) mm long and usually not surpassing the glumes), tussock-forming habit with multiple culms and leaves mainly cauline, without a basal mat clearly shorter than the flowering culms (vs. plants forming short isolated tufts with solitary culms and the leaves forming a short basal mat clearly shorter than the largely exerted flowering culms), inflorescences often sub-included in the sheaths and blades (vs. flowering culms largely exerted from basal mats); leaf blades 11–22 cm long, 0.35–0.6 mm wide when rolled, often dimorphic, those of the innovations filiform and cylindrical to subelliptic in outline, while upper flowering culm blades 6.5–25 cm long, 2–7 mm wide when opened out, usually wider and flat, conduplicate or convolute towards the pungent apices (vs. leaf blades 5–8 cm long, 2–3 mm wide, not clearly dimorphic, with all blades flat or conduplicate, apices obtuse), ligules 4–11 mm long (vs. ligules generally longer, 10–22 mm long), anthers (1.4–)1.8–1.9 mm long (vs. anthers (0.7–)1.2–1.5 mm long), upper glume lateral veins reaching from ½ to 2/3 the length of the glume (vs. upper glume lateral veins short, < ½ length of glume).

Description. Tufted perennial with vertical rhizomes forming medium-sized tussocks with leaf blades both basal and cauline and some cauline blades often surpassing the inflorescence. **Culms** 26–110 cm tall, to 3 mm wide, erect, striate, nodes and internodes terete, smooth and lustrous; nodes hidden in the sheaths with no nodes exposed at flowering; uppermost internodes 23–32.5 cm long, not, or not pronouncedly, longer than the sheath; **Sheaths** striate; **flag leaf sheaths** 22–38 cm long; **upper culm sheaths** lax, glabrous and smooth; **basal leaf sheaths** 4.5–20 cm long, glabrous

Figure 3. *Deschampsia podophora* var. *mutica*. **A** whole plant **B** anther **C** spikelet at maturity with anthers **D** lemma, abaxial view **E** palea, abaxial view **F** upper glume, abaxial view **G** lower glume, abaxial view **H** floret **I** spikelet and pedicel, lateral view **J** ligule; drawn by Juliet Beentje from the isotype, J.R.I. Wood 5033 (K).

and smooth, longer than the internodes. **Ligules** not stipulate; **upper culm ligules** 7.5–11 mm long, strongly decurrent with the sheaths, long acuminate, membranous to slightly coriaceous, without notable lateral keels, apices erose or narrowly bifid, sometimes fimbriate, abaxial surface smooth; **ligules of innovations** 4–9 mm long, slightly to strongly decurrent with the sheaths, long acuminate, membranous to slightly coriaceous, lateral keels sometimes notable, apices a narrow bifid point, sometimes slightly erose, abaxial surface smooth or sometimes slightly scabrous at the apex. **Leaf blades** sometimes dimorphic, those of the innovations filiform and cylindrical to subelliptic in outline while those of the upper flowering culm are usually wider and flat, conduplicate, or convolute towards the apices; **leaf blades of innovations** 11–22 cm long, 0.35–1 mm wide when rolled or folded, narrow and conduplicate or filiform involute or convolute and cylindrical to subelliptical in outline, rarely completely flat, sometimes opening out to become flat at their apices, straight and erect, glabrous, abaxially smooth, adaxially lightly scaberulous along the veins or rarely smooth, edges smooth or slightly scaberulous, apex obtuse to slightly pungent; **leaf blades of lower flowering culm** to 1.2 mm wide when rolled or folded, similar to those of the innovations or slightly wider; **leaf blades of upper flowering culm** 6.5–25 cm long, 2–7 mm wide when opened out, flat, conduplicate or convolute towards the apices, glabrous, abaxially smooth to finely scaberulous, sometimes becoming densely scabrous at the apex, adaxially smooth or scaberulous towards the margins, veins pronounced, numerous and tightly packed, edges smooth or slightly scaberulous, apex acute to pungent; **flag leaf blade** ca. 2.9 cm long, recurved, slightly narrower than the basal blade. **Panicles** 10–25 cm long, 5–8 cm wide, open and diffuse with main axis having long internodes, oval, usually slightly to moderately included in the uppermost sheath and/or blade, greenish-purple, spikelets tending to be laxly glomerate on the distal half of the inflorescence branches with the proximal half usually lacking spikelets; **main panicle axis** terete to slightly compressed, usually with a narrow groove running down both sides, glabrous, smooth to lightly scaberulous, internodes tending to be very long, lower internode 5.5–11.5 cm long; **panicle branches** flexuous, spreading, pendulous or divergent at a 45° angle to slightly ascending; primary panicle branches 1.5–8 cm long, bearing 10 to over 50 spikelets per branch, terete and slightly grooved, verticillate in clusters of 2 or 3, glabrous, almost smooth to lightly scabrous; **pedicels** 0.5–2.5 mm long, usually shorter than the spikelets, glabrous, lightly scabrous. **Glumes** 4.5–4.9 mm long, subequal, the lower glume 0.3–0.6 mm shorter than the upper glume, membranous, purplish-green, lustrous, smooth or sometimes lightly scabrous throughout the keel of the upper glume; **lower glume** 1-veined, apex usually bidentate, less frequently finely denticulate or erose; **upper glume** 3-veined, lateral veins reaching from ½ to 2/3 the length of the glume, apex usually acuminate, sometimes finely denticulate. **Floret** stipitate, much shorter than the glumes, never passing the apex of the lower glume. **Lemmas** 2.8–3.4 mm long, of the same consistency as the glumes, light green with purple tinges towards apex, becoming golden at maturity, glabrous, smooth with the keel apex rarely scaberulous, apex truncate and denticulate, usually with 5 clearly distinguished teeth, 0.3 mm long, and erose between the teeth, 5-veined, veins not evident; muticous and lacking an awn. **Rachilla** 1.5–2.5 mm long, reaching from 2/3 to 4/5 the length of the lemma, with copious short to medium-sized hairs 0.5–1.4 mm long, the hairs reaching from 4/5 to almost the apex of the lemma and usually surpassing the palea, apex of rachilla often clavate. **Stamens** 3, anthers (1.4–)1.8–1.9 mm long.

Distribution and ecology. Endemic to Colombia. Known from páramos of the Cordillera Oriental and Cordillera Central of the Colombian Andes. For the Cordillera Oriental, the species is known from Departamento Cundinamarca municipalities Usme and Santa Rosa and Páramo Pisba of Departamento Boyacá. For the Cordillera Central, the species is known from Páramo del Quindio and Páramos de la Laguna del Mosquito of Departamento Caldas. Found in humid, swampy areas, often by rivers or lakes and less often in more mesic habitats, such as road verges (presumed damp). The type specimens were collected from swampy areas bordering the Laguna Larga of the Sumapaz páramo in Cundinamarca. The holotype shows signs of grazing, with blades and culms abruptly cut.

Other specimens examined. COLOMBIA. **Boyacá**: Mun. Socota: Páramo Pisba, Peña Negra, lagoon "Choro Negro", páramo with *Calamagrostis effusa*, *Espeletia* sp., *Chusquea* sp., *Diplostephium* sp. etc., swampy, 3500 m alt., 11 Feb. 1999, D. Stančik & S. Medina 2351 (COL-000184768; FMB-051200); Páramo Pisba, Alto de Calarca, humid grassy páramo with *Calamagrostis effusa*, *Espeletia* sp., *Chusquea* sp. et bunch Grass, 3600 m alt., 11 Feb. 1999, D. Stančik & S. Medina 2331 (FMB-046617). **Caldas**: Páramo del Quindio, swale in páramo valley, 3700–4200 m alt., 15–20 Aug. 1922, F.W. Pennell & T.E. Hazen 9949 (K); Cordillera Central, cabeceras del río Otúm, bajando del Nevado de Santa Isabel, páramos de la Laguna del Mosquito, 3820 m alt., 26 Nov. 1946, J. Cuatrecasas 23233 (K). **Cundinamarca**: Mun. Usme: Laguna Chizaca, hierba creciendo al lado de la carretera que conduce a la laguna, 26 Jul. 1986, A. Betancur & M. Palacio 44 (HUA-47083); Páramo de Chisaca, growing in marsh near lagoon, 3750 m alt., 30 Sep. 1966, T.R. Soderstrom 1273 (K).

Preliminary conservation status. Vulnerable (VU). Despite the species being known from several collections from the Central and Eastern Cordilleras of the Colombian Andes, the páramos of Colombia are currently facing threats of habitat degradation and loss, principally from mining (Pérez-Escobar et al. 2018) and so a preliminary conservation status of VU is given.

Etymology. The varietal epithet refers to the absence of an awn inserted in the dorsal surface of the lemma.

Notes. Certain specimens were encountered which exhibited a mix of the characters mentioned in the diagnosis for separating *D. podophora* from *D. podophora* var. *mutica*. For example, specimen Cuatrecasas 23233 from the Cordillera Central of Colombia had isomorphic flat leaf blades which formed a basal mat much shorter than the exerted culms but also had awnless spikelets. A few other specimens exhibited the larger habit, i.e. multiple longer culms with longer and wider leaf blades forming tussocks and inflorescences included within sheaths, but with awned spikelets.

Specimens of *Deschampsia podophora* var. *mutica* were commonly misidentified as *Poa* L. in herbaria, most likely due to the lemmas lacking awns. There are very few South American *Calamagrostis* s.l. that consistently lack awns (see 'notes' of *Deschampsia santamartensis* sp. nov. above) and, of the species not belonging to subsect. *Stylagrostis* (=*Deschampsia*), the closest resembling species is *Calamagrostis ecuadoriensis* Laegaard (1998), which also has short florets with a pilose rachilla extension and which lack awns. However, *C. ecuadoriensis* can be differentiated from *Deschampsia podophora* var. *mutica* by, amongst other things, a) habit, being small tussocks, 20–30 cm high, with leaves mostly basal; b) culms, panicle branches and pedicels densely hispid; c) panicles narrow, ca.1 cm wide; d) anthers 0.8–1 mm long; e) florets only shortly stipitate, with the stipe < 0.15 mm long at the base of the glumes.

Five new records of *Calamagrostis* for Colombia

***Calamagrostis* cf. *carchiensis* Lægaard, Novon 8(1): 23–25, f. 1A. 1998.**

Fig. 4

Type. ECUADOR. Napo [Sucumbíos]: Páramo de Mirador above Cocha Seca, lower páramo zone, burned, 00°34'N; 77°39'W, 3700–3900 m alt., 23 May 1985, S. Lægaard 54413 (holotype: AAU!; isotypes: K (K000308461!), MO (MO05100301 [image!]), QCA (QCA78857 [image!]), QCNE, US (US00588939!)).

Comments. Previously considered endemic to Ecuador with a global conservation status of VU B1ab(iii) - Vulnerable (León Yánez et al. 2011). The voucher specimen collected matches the species description in every aspect apart from its having two anthers as opposed to one. The number of anthers is taxonomically informative in the genus *Calamagrostis* and it may be that the Sylvester 3049 specimen should be considered as a distinct taxon, although further research including molecular analysis is needed to clarify this. Laegaard (1998) noted that *Calamagrostis carchiensis* bears affinity to *Calamagrostis bogotensis* (Pilg.) Pilg., especially in terms of florets with a single anther.

Specimens examined. COLOMBIA. **Boyacá:** Mun. Duitama, páramo de Agueros, via que conduce a Vereda de Avendanos, 05°54.527'N; 73°03.761'W, 3445 m alt., 28 Oct. 2017, S. P. Sylvester, W. Bravo & J. Aguilar 3049 (COL, FMB, K, US).

***Calamagrostis guamanensis* Escalona, Phytologia 65(5): 340, f. 2. 1988.**

Fig. 5 A, B

Type. ECUADOR. Napo: [road Quito-Baeza at the telecomunication antenna, N of the Guamani paramo, in the oriental Andes, 0°10.2'S; 78°23.4'W], 4260 m alt., 3 Mar. 1985, [grass forming loose tufts in cushion plants of *Distichia muscoides*], F.D. Escalona & Gallegos 390 (holotype: ISC; isotypes: K!, MO (MO115961), QCA, US!, VEN).

Comments. Previously considered endemic to Ecuador (Luteyn 1999).

Figure 4. *Calamagrostis* cf. *carchiensis* Lægaard general habit (scale bar 5 cm) and spikelet. Scale bar: 1 mm; S.P. Sylvester 3049 (FMB).

Specimen examined. COLOMBIA. **Nariño**: Mun. Pasto, Volcan Galeras, frequent growing in cushion plants and similar damp protected places at high altitudes in base high páramo, 1°13.6417'N; 77°21.8718'W, 4000 m alt., 29 Nov. 1983, J.R.I Wood 4064 (FMB, K).

Calamagrostis heterophylla **(Wedd.) Pilg., Bot. Jahrb. Syst. 42: 64. 1908.** ***Deyeuxia heterophylla*** **Wedd., Bull. Soc. Bot. France 22: 177, 180. 1875.**
Fig. 5 C, D

Type. Bolivia. [Potosí], A. D'Orbigny 202 (lectotype, designated by Rúgolo de Agrasar (2012: 201): P (P00729766 [image!]); isolectotypes: BAA (BAA00001845 [image!]), US (US00133531!), W (W18890120011 [image!])).

= *Chaetotropis andina* Ball, J. Linn. Soc. Bot. 22: 58. 1885. Type: Peru. Ex Saxosis Andium Peruviae juxta Paquim Chicla, 12000–13000' s.m. [3658–3962 m alt.], 21–23 Apr. 1882, J. Ball s.n. (holotype: P; isotypes: BAA (BAA00001704 [image!]) fragm., K, US (US00344798!) fragm. ex K & ex LE).

= *Calamagrostis heterophylla* (Wedd.) Pilg. var. *robustior* Pilg., Bot. Jahrb. Syst.: 64. l908. Type: Peru. Puno: Azangaro, in saxosis calcareis, 4000 m alt., Feb. 1902, A. Weberbauer 474 (holotype: B (not found); isotype: US (US00153711!)).

= *Calamagrostis heterophylla* (Wedd.) Pilg. var. *pubescens* Pilg., Bot. Jahrb. Syst.: 64. 1908. Type: Peru. Puno: in provincia Sandia, supra Cuyocuyo, in campis fructisibus nonnullis intermistix, 3700–3800 m alt., May 1902, A. Weberbauer 905 (holotype: B (not found); isotype: US (US00153712!)).

= *Calamagrostis calvescens* Pilg., Bot. Jahrb. Syst. 42: 65. 1908. Type: Peru. Ancash: Prov. Cajatambo, 3000-3300 m alt., 13 Apr. 1902, A. Weberbauer 2842 (lectotype, designated by Nicora and Rúgolo de Agrasar (1998: 168): BAA (BAA00000758 [image!]) fragm. ex B; isolectotypes: MOL, US (US00131526!)).

= *Calamagrostis mulleri* Luces, Bol. Soc. Venez., Cienc. Nat. 15 (80):9. 1953. Type: Venezuela. Edo. Mérida: Páramo de Mucuchíes, 4000 m alt., 11 Nov. 1939, A.S. Müller 897 (holotype: VEN (VEN20682 [image!]); isotypes: MO, US (US00149289!)).

= *Calamagrostis macbridei* Tovar, Mem. Mus. Javier Prado 11:63. 1960. Type: Perú. Pasco, Huarón, northern part Cerro Pasco, northeastern slope, 14000 ft. [4267 m] alt., 12 Jun. 1922, J.F. Macbride & W. Featherstone 998 (holotype: US (US00153707!); isotypes: F (F0040679F [image!]), SI (SI000619 [image!]) fragm.).

= *Calamagrostis swallenii* Tovar, Mem. Mus. Hist. Nat. "Javier Prado" 11: 66. 1960. *Deyeuxia swallenii* (Tovar) Rúgolo, Rev. ~Deyeuxia~ Bolivien 128. 1995. Type: Peru. Huancavelica: Prov. Huancavelica: Tausiri, cerca a Manta, pajonal de Puna, 4500 m alt., 31 Mar. 1953, O. Tovar 1168 (holotype: US (US00133195!); isotypes: GH (GH00023323 [image!]), K (K000308446!), MO (MO115821 [image!]), USM (USM000722 [image!])).

Comments. Previously known from high Andean regions of Venezuela (Hokche et al. 2008; Bono 2010; Briceño 2010), Peru (Tovar 1993), Bolivia (Villavicencio 1995, 1998), northern Chile and northwest Argentina (Rúgolo de Agrasar 2012). The specimens collected exhibit characters of both *Calamagrostis heterophylla* and *Calamagrostis brevipaleata* Swallen, an Ecuadorian endemic, with both species having heteromorphic leaf blades, the cauline glabrous and those of the innovations pilose. The species bear more affinity to *C. heterophylla* as the lemmas measure less than 4.2 mm (> 5 mm long in *C. brevipaleata*) and the leaf blades measure < 10 cm long (10–25 cm long in *C. brevipaleata*). However, the specimens do have characteristics of *C. brevipaleata* in terms of the lemma surfaces, which are smooth proximally and scabrous distally and no great differentiation in width between the cauline and tiller leaf blades.

Specimen examined. COLOMBIA. **Boyacá**: Mun. Chiscas, páramo El Penon, borde de bosque de *Polylepis* creciendo sobre roca, 6°36.0714'N; 72°26.229'W, 3917 m alt., 5 Mar. 2018, S.P. Sylvester, R.J. Soreng, W. Bravo & L.E. Cuta 3158 (COL, FMB, K, US).

Calamagrostis pisinna **Swallen, Contr. U.S. Natl. Herb. 29(6): 257–258. 1948[1949].**

Fig. 5E, F

Type. Venezuela. Mérida: rocky ridges, higher paramos, near El Gavilon, 4200 m alt., 25 Jan. 1929, H. Pittier 13277-1/2 (**lectotype, designated here**: US (US00149283! [A-two flowering culms are the type, B-on left side of sheet is unknown])).

Comments. Previously considered endemic to Venezuela (Escalona 1988a) but specimens have been found in the Sierra Nevada del Cocuy of the Cordillera Oriental of Colombia. Specimen *Sylvester 3107* differed slightly from the species described from Venezuela in that the leaf blades were densely pilose and often found to be conduplicate (Fig. 5E, F). As only one flowering specimen was encountered of this morphotype and specimens being found growing out of fairly inaccessible crag ledges, more collections need to be made to ascertain whether this may be a distinct species. All specimens from the Sierra Nevada del Cocuy have a rachilla extension with hairs that reach or surpass the apex of the floret, while Venezuelan specimens have rachilla hairs which usually do not surpass the apex of the palea (Escalona 1988a). Saarela et al. (2017) found one of the specimens of *C. pisinna* that we cite here (*Cleef 8653*) to have an unusual placement in plastid analyses (no nuclear ribosomal data was obtained) as a basally diverging lineage in a moderately to strongly supported clade that also contained *Lagurus ovatus* L., Aveninae s.str., and Koeleriinae excluding *L. ovatus.* However, there is a phylogenetic discrepancy between matK and PsbK sequences reported by Saarela et al. (2017) for *C. pisinna* that needs to be evaluated before any taxonomic conclusions can be drawn.

There is a sterile tuft on the left side of the Pittier type sheet that is a different species and quite possibly a different genus, having acicular involute blades and longer acute ligules that are decurrent (p.p. b). Thus, we lectotypify to the two flowering tufts on the right side of the type sheet (p.p. a), which are identical and fit the description in the type protologue.

Specimens examined. COLOMBIA. **Boyacá**: Mun. Chiscas, páramo de Chacaritas, limit between páramo and superpáramo, growing out of rock ledge, 6°37.6794'N; 72°23.6616'W, 4072 m alt., 4 Mar. 2018, S.P. Sylvester, R.J. Soreng, W. Bravo & L.E.

Figure 5. A general habit and a spikelet of *Calamagrostis guamanensis* Escalona, J.R.I. Wood 4064 (FMB), *Calamagrostis heterophylla* (Wedd.) Pilg., S.P. Sylvester 3158 (US), *Calamagrostis pisinna* Swallen, S.P. Sylvester 3107 (US), and *Calamagrostis rigida* (Kunth) Trin. ex Steud., S.P. Sylvester 3125 (US). Habit scale bar 5 cm; spikelet scale bar 1 mm.

Cuta 3107 (US); Sierra Nevada del Cocuy, Páramo Cóncavo, Cueva de los Hombres, 3 km N del Morro Púlpito del Diablo, 4350 m alt., 28 Feb. 1973, A. Cleef 8610 (US-01234789); 4350 m alt., A. Cleef 8653 (US-01234736).

***Calamagrostis rigida* (Kunth) Trin. ex Steud., Nomencl. Bot. (ed. 2) 1: 251. 1840. *Deyeuxia rigida* Kunth, Nov. Gen. Sp. (quarto ed.) 1: 144. 1815[1816]. *Arundo rigida* (Kunth) Poir., Encycl. 4: 705. 1816.**
Fig. 5 G, H

Type. ECUADOR. In planitie frigida Antisanae [inter speluncam, Machay de Antisana], et Chussulongo, 2200 hexap. (4023 m alt.)], Regni Quitensi [Pichincha], 1833, A.J.A. Bonpland 2271 [s.n.] (holotype: P (P00729827 [image!]); isotypes: BM (BM000938560 [image!]), GH (GH00023418 [image!]) fragm., LE (LE-TRIN-1804.01!) fragm. ex Herb. Humb., P (P00129585 [image!], P00740362 [image!], P026296 [image!]), US (US00406356!) fragm., W???).

= *Deyeuxia gracilis* Wedd., Bull. Soc. Bot. Fr. 22: 179. 1875. *Calamagrostis gracilis* (Wedd.) Pilg., Bot. Jahrb. Syst. 42: 71. 1908. *Calamagrostis gracilis* (Wedd.) Henrard, Mede. Rijks-Herb. 40: 61. 1921, nom. illeg. hom. Type: BOLIVIA. Province de Larecaja, Cordillera de Sorata, 1851 [1857], Weddell s.n. (holotype: P (P00729786 [image!]); isotypes: P (P030111 [image!]), S (S-R-1458 [image!]), US (US00479086!, US00479087!)).

= *Deyeuxia sulcata* Wedd., Bull. Soc. Bot. Fr. 22: 178–180. 1875. Type: BOLIVIA. Prov. Larecaja, viciniis Sorata [Andes de Sorata], Puerta del Inca, prope trincheras Chiliata, in Scopulosos, Reg. Alp., 3800 m alt., Mar. [Apr.] 1858 [1868], G. Mandon 1308 bis. (holotype P; isotypes: GH (GH00023431 [image!]), JE (JE00014185 [image!]) fragm., L (L0044085 [image!], L0044083 [image!]), NY (NY380547 [image!]), P (P030105 [image!]), S (S-R-1469 [image!]), US (US00149252!) fragm.).

= *Calamagrostis antoniana* Steud. ex Lechler, Berberid. Amer. Austr. 56. 1857, nom. nud.

= *Agrostis antoniana* Griseb., Abh. Königl. Ges. Wiss. Göttingen 24: 293. 1879. *Calamagrostis antoniana* (Griseb.) Hack. ex Dusén, Rep. Princeton Univ. Exp. Patagonia, Botany, Suppl. 8: 42. 1915. *Calamagrostis antoniana* (Griseb.) Steud. ex Hitchc., Contr. U.S. Natl. Herb. 24(8): 378. 1927. *Deyeuxia antoniana* (Griseb.) Parodi, Revista Argent. Agron. 20: 14. 1953. *Calamagrostis antoniana* (Griseb.) D.M. Moore, Fl. Tierra del Fuego 310. 1983, comb. illeg. hom. Type: ARGENTINA: Salta: Umgebung des Nevado del Castillo [Alrededores del Nevado del Castillo], 10–13000 ft [3048–3962 m alt.], 19–23 Mar. 1873, P.G. Lorentz & G.H.E.W. Hieronymus 67 + 72 (lectotype, designated here: GOET (GOET006107 [image!]); isolectotypes: GOET (GOET006106 [image!], GOET006108 [image!]); P.G. Lorentz & G.H.E.W. Hieronymus 67 isolectotypes: BAA (BAA00001327 [image!]) fragm., CORD (CORD00004685 [image!], CORD00004686 [image!]); P.G. Lorentz & G.H.E.W. Hieronymus 72 isolectotypes: BAA (BAA00001326 [image!]) fragm., CORD (CORD00004687 [image!], CORD00004688 [image!], CORD00004689 [image!]), K [cited by Rúgolo de Agrasar 2012: 208, but not seen], US (US00406312!, US00406404!)). Other original material: BOLIVIA [PERU]. Viciniis Sorata, prope Milipaya, in scopulosis, reg. alpina, 3700 m alt., Mar.–May 1861, G. Mandon 1308 (GOET (GOET006230 [image!])). PERU. In graminosis pr. San Antonio rara, Jun. [1854], [W. Lechler s.n.], W. Lechler Pl. Peruv. 1800 (BAA (BAA00001648 [image!]) fragm., BR (BR0000006865757 [image!]), G (G00099542 [image!], G00099543 [image!]), GOET (GOET006109 [image!]), K (K000308438 [image!]), LE (LE00009360 [image!], LE00009361 [image!]), M?, P (P00729795 [image!], P00729844 [image!], P00740472 [image!]), S (S-R-7637 [image!]), TUB (TUB009259 [image!]), US (US00131135!), W (W1889-0241764 [image!])).

= *Calamagrostis sandiensis* Pilg., Bot. Jahrb. Syst. 42: 68. 1908. Type: PERU. Prope Cuyocuyo, provincia Sandia, 3700–3800 m alt., 3 May 1902, Weberbauer 906 (lectotype, designated by Vega and Rúgolo de Agrasar (2013: 28): MOL; isolectotypes: BAA (BAA00000768 [image!] fragm. ex B, S (S-R-834 [image!]), US (US00149279!) fragm.).

= *Calamagrostis gusindei* Pilg. ex Skottsberg, Acta Horti Gothob. 2: 29. 1926. *Deyeuxia gusindei* (Pilg ex Skottsb.) Parodi, Revista Argent. Agron. 20: 14. 1953. Type: CHILE. Feuerland, Beagle [Beagle Kanal, zwischen (between) Steinen am Ufer; Tierra del Fuego, Remolino, Canal de Beagle], Mar. 1923, P. Gusinde 40 (holotype: BG; isotypes: BAA (BAA00000761 [image!]) fragm., W (W1941-0001573 [image!])).

= *Deyeuxia crassifolia* Hack. ex Sodiro, Revista Col. Nac. Vicente Rocafuerte 12: 64, 73. 1930. Type: ECUADOR. Crece en los pajonales del Monte Pichincha, Sep. [Jun.] 1887 [1886], Sodiro 25/9 [s.n.] (holotype: Q; isotypes: QPSL, S (S-R-1457 [image!]), US (US00406342!), W (W1916-0038065 [image!], W1916-0038066 [image!])).

Comments. Previously considered to have its northernmost distribution in Ecuador (Rúgolo de Agrasar 2012), although Luteyn (1999) mentions its presence in Costa Rica, this is the first record of *C. rigida* for Colombia. It has been erroneously determined as *Calamagrostis recta* (Kunth) Trin. ex Steud. The latter differs from *C. rigida* by the rachilla hairs reaching up to ¾ the length of the lemma (as opposed to usually reaching to slightly surpassing the lemma apex in *C. rigida*), the awns being generally longer (6.2–7.5 mm as opposed to 4–6 mm in *C. rigida*) and only slightly surpassing the glumes, the lemma apex being slightly bidentate (as opposed to bifid in *C. rigida*) and the ligule being generally truncate and shorter, 1–5(–6.6) mm long (as opposed to long acuminate, (3–)8–12 mm long in *C. rigida*), amongst other things.

There has been discrepancy regarding the typification of *Agrostis antoniana*, with previous research (e.g. Rúgolo de Agrasar 2012) citing the specimen P.G. Lorentz and G.H.E.W. Hieronymus 72 housed at CORD herbarium from Argentina as holotype, while the protologue mentions this (although not explicitly giving collector and number) as well as three other collections: Spruce pl. ecuad. 5927 presumably from Ecuador, G. Mandon 1308 from Bolivia [Peru] and W. Lechler 1800 from Peru. A further specimen, P.G. Lorentz and G.H.E.W. Hieronymus 67, makes a total of at least five syntypes for this name, although the three GOET Lorentz and Hieronymus syntypes were annotated by Grisebach with “67 + 72”. Hitchcock (1927) gave a partial lectotypification by dictating the type as Lechler 1800, but did not indicate the herbarium. The Lechler 1800 specimen was distributed with the following label annotated by Hohenacker: “W. Lechler Pl. Peruvian. Ed. R. F. Hohenacker 1800 Calamagrostis Antoniana Steud. Ipse [“he himself said it”]. In graminosis pr. San Antonio rara Jun. m.”. As no annotations by Grisebach were found on any of the Lechler 1800, Mandon 1308 or Lorentz and Hieronymus 67 and 72 CORD specimens (Spruce pl. ecuad. 5927 specimens not found), with only Lechler 1800 specimens at P being verified by Steudel, we lectotypify to the best of the three GOET Lorentz and Hieronymus 67 + 72 syntypes annotated by Grisebach and consider syntypes Lorentz and Hieronymus 67 and Lorentz and Hieronymus 72 to be isolectotypes.

Specimens Examined. COLOMBIA. **Boyacá**: Mun. Chiscas, páramo de Chacaritas, asociado a rocas de 4 m de altura, 6°37.3362'N; 72°23.424'W, 4192 m alt., 4 Mar. 2018, S.P. Sylvester, R.J. Soreng, W. Bravo & L.E. Cuta 3119 (COL, FMB, US, UPTC); Mun. Chiscas, páramo de Chacaritas, arribando a la morrena, 6°37.0674'N; 72°23.3394'W, 4354 m alt., 4 Mar. 2018, S.P. Sylvester, R.J. Soreng, W. Bravo & L.E. Cuta 3125 (COL, FMB, K, SI, UPTC, US); Mun. Chiscas, páramo de Chacaritas, arribando a la morrena, 6°37.0674'N; 72°23.3394'W, 4354 m alt., 4 Mar. 2018, S.P. Sylvester, R.J. Soreng, W. Bravo & L.E. Cuta 3126 (US). Dep. Santander: Páramo de la Angostura, Vereda El Mortino, Ubicada en borde de quebrada, 6°57.5'N; 72°43.5'W, 3605 m alt., 17 Nov. 2007, M.C. Gomez 1 (US).

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Supplementary material 1

Supplementary key (in spanish)

Authors: Steven P. Sylvester, Robert J. Soreng, William J. Bravo-Pedraza, Lia E. Cuta-Alarcon, Diego Giraldo-Cañas, Jose Aguilar-Cano, Paul M. Peterson

Data type: species data

Explanation note: Spanish version of identification key to the 54 species of *Calamagrostis* s.l. known or likely to occur in the páramos of north-west South America and southern Central America.

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RESEARCH ARTICLE

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Hemiboea albiflora, a new species of Gesneriaceae from Guizhou, China

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Abstract

Hemiboea albiflora X.G.Xiang, Z.Y.Guo & Z.W.Wu, **sp. nov.**, a new species of Gesneriaceae from Guizhou, China, is described and illustrated. This species was previously listed informally as a variety of *H. gamosepala*, but it differs significantly from *H. gamosepala* by its 5-parted calyx from the base, longer peduncle, white corolla and longer pistil. Based on recent extensive observations, this new species is similar to *H. cavaleriei* var. *paucinervis* and *H. subcapitata* but differs from them by its longer petiole, larger involucre, white corolla and longer staminal filaments. The conservation status of this species is considered to be "Vulnerable" (VU) according to the IUCN Red List Categories and Criteria.

Keywords

Hemiboea, Gesneriaceae, limestone flora, new species

Introduction

Hemiboea C.B. Clarke is a medium-sized genus of Gesneriaceae distributed in central to southern China, northern Vietnam and Southern Japan (Li and Wang 2004). Recently, nine new species and one new variety were found in Guangxi, Guizhou and Yunnan province of China (Li and Liu 2004; Wei 2010; Xu et al. 2010, 2012; Huang et al. 2011; Wen et al. 2011, 2013; Pan et al. 2012; Zhou et al. 2013; Zhang et al. 2014; Li et al. 2018; Chen et al. 2018). Meanwhile, Weber et al. (2011) transferred two species of the Chinese endemic genus *Metabriggsia* W. T. Wang (1983) to *Hemiboea,* based on molecular and morphological evidence. In addition, Huang et al. (2017) treated *H. subcapitata var. pterocaulis* Z.Y. Li as a distinct species *H. pterocaulis,* based on molecular and morphological evidence. In total, the genus *Hemiboea* comprises at least 36 species and 5 varieties.

During our expedition to Xingyi City, Guizhou Province, China in 2017, we collected two populations of *Hemiboea gamosepala* var. *albiflora* C. Y. Deng & M. T. An, nom. nud. invalidly published in Deng and An (2006) (Fig. 1). However, we found that this variety differs significantly from *Hemiboea gamosepala* Z. Y. Li, especially by the calyx of the variety which is 5-parted from the base. After consulting *Hemiboea* specimens deposited in PE, KUN, IBK and QNUN and relevant literature (Li 1987; Wang 1983; Li and Wang 2004; Wei 2010), we concluded that it is a distinct species and hence we describe it as *Hemiboea albiflora*.

Material and methods

Morphological observations and measurements of the new species were carried out, based on living plants and dry specimens (PE, QNUN and XIN). The photographs were taken in the field. All morphological characters were studied under dissecting microscopes and are described using the terminology presented by Wang et al. (1998).

Figure 1. Distribution of *Hemiboea albiflora* in China.

Taxonomic treatment

Hemiboea albiflora X.G.Xiang, Z.Y.Guo & Z.W.Wu, sp. nov.

urn:lsid:ipni.org:names:60478837-2
Figs 2, 3

Type. China. Guizhou: Xingyi City, Maling River Valley, 26°8.47'N, 104°57.27'E, altitude 967 m, on rock faces near the river, 12 October 2017, *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017061* (holotype: PE!; isotypes: PE!, QNUN!).

Diagnosis. *H. albiflora* differs significantly from *H. gamosepala* by its 5-parted calyx from the base (vs. 5-lobed from middle), longer peduncle, 3–6 cm (vs. 0.2–0.4 cm), white corolla (vs. pink corolla) and longer pistil, 2–2.5 cm (vs. ~ 1.5 cm). After extensive observations, *Hemiboea albiflora* is close to *H. cavaleriei* var. *paucinervis* W. T. Wang et Z. Y. Li and *H. subcapitata* C.B. Clarke, but differs from them through its longer petiole, 3–6 cm; larger involucre, 2–3 cm in diameter; white corolla, glabrous outside; and longer staminal filaments, 1.8–2 cm long. The detailed morphological comparisons are listed in Table 1.

Description. Perennial herbs. Stems ascending, subterete, 40–100 cm tall, 2–5 mm in diameter, simple, sparsely purple-spotted, glabrous, juicy when fresh, nodes 5–10, not swollen. Leaves opposite, herbaceous; petiole 3–6 cm long, about 2 mm in diameter, almost terete, adaxially valleculate, margin erect and rounded, glabrous, green; leave blade oblong-lanceolate or ovate-lanceolate, 7–15 cm long, 3–5.5 cm wide, apex acuminate, rarely acute, margin repand-crenate, base usually oblique, adaxial surface green, sparsely pubescent, abaxial surface pale green, glabrous; lateral veins 5–9 on each side of midrib. Cymes subterminal, sometimes axillary, 4–8-flowered; peduncle 2–3 cm long, 3–4 mm in diameter glabrous, sparsely purple-spotted; involucre subglobose or broad ovoid, 2–3 cm in diameter, yellow-green, glabrous, apex acute. Pedicel 3–5 mm long, 2–3 mm in diameter, glabrous. Calyx white, 5-parted from the base, lobes equal, ovate-lanceolate, 1.2–1.6 cm × 0.3–0.4 cm, glabrous. Corolla white, with mauve lines and spots inside, 4–5.5 cm long, glabrous. Corolla tube 3.5–4.5 cm long, 1–1.4 cm in diameter at the mouth, 4–5 mm in diameter at the base, purple-spotted at throat, densely glandular-pubescent inside adaxial gibbous side of the tube, inside with a ring of hairs adnate to 7–8 mm above the corolla tube base; limb 2-lipped; adaxial lip 0.8–1.0 cm long, 2-lobed at apex, lobes equal, nearly semi-orbicular, abaxial lip 1–1.2 mm long, 3-parted, lobes subequal, oblong. Stamens 2, anthers fused by adaxial surfaces, adnate to 0.8–1 cm above the corolla base; filaments linear, glabrous, geniculate from the middle, 1.8–2 cm long, about 1 mm wide; anthers ovate-elliptic, glabrous, ca. 2–3 mm long, 2 mm wide, coherent at apex. Staminodes 2, glabrous, adnate to 1.2–1.5 cm above the corolla base, thick, 1.2–1.4 cm long, about 1 mm wide, apex capitellate, separate. Pistil 2–2.5 cm long; ovary linear, 0.7–0.9 cm long, 1.5–2.2 mm in diameter, glabrous; style 1.3–1.6 mm long, glabrous; stigma capitate, about 2 mm in diameter. Capsule linear-lanceolate, 2–3 cm long, 2–4 mm in diameter, glabrous, slightly curved.

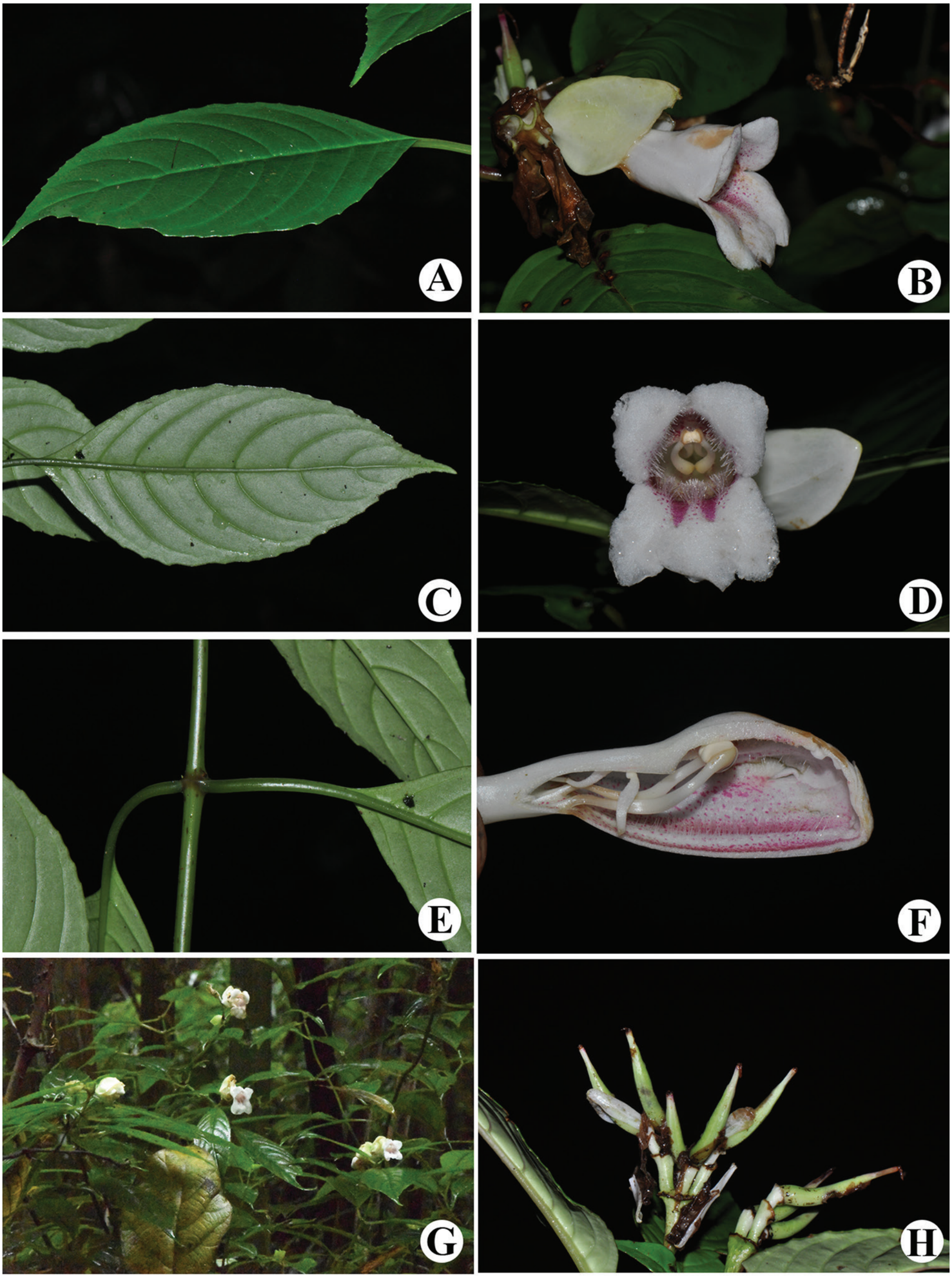

Figure 2. *Hemiboea albiflora.* **A** Adaxial leaf blade **B** flower side view **C** abaxial leaf blade **D** flower face view **E** stem and petioles **F** opened corolla showing stamens, staminodes and pistil **G** flowering habit **H** fruits. Photographs by Zhiyou Guo.

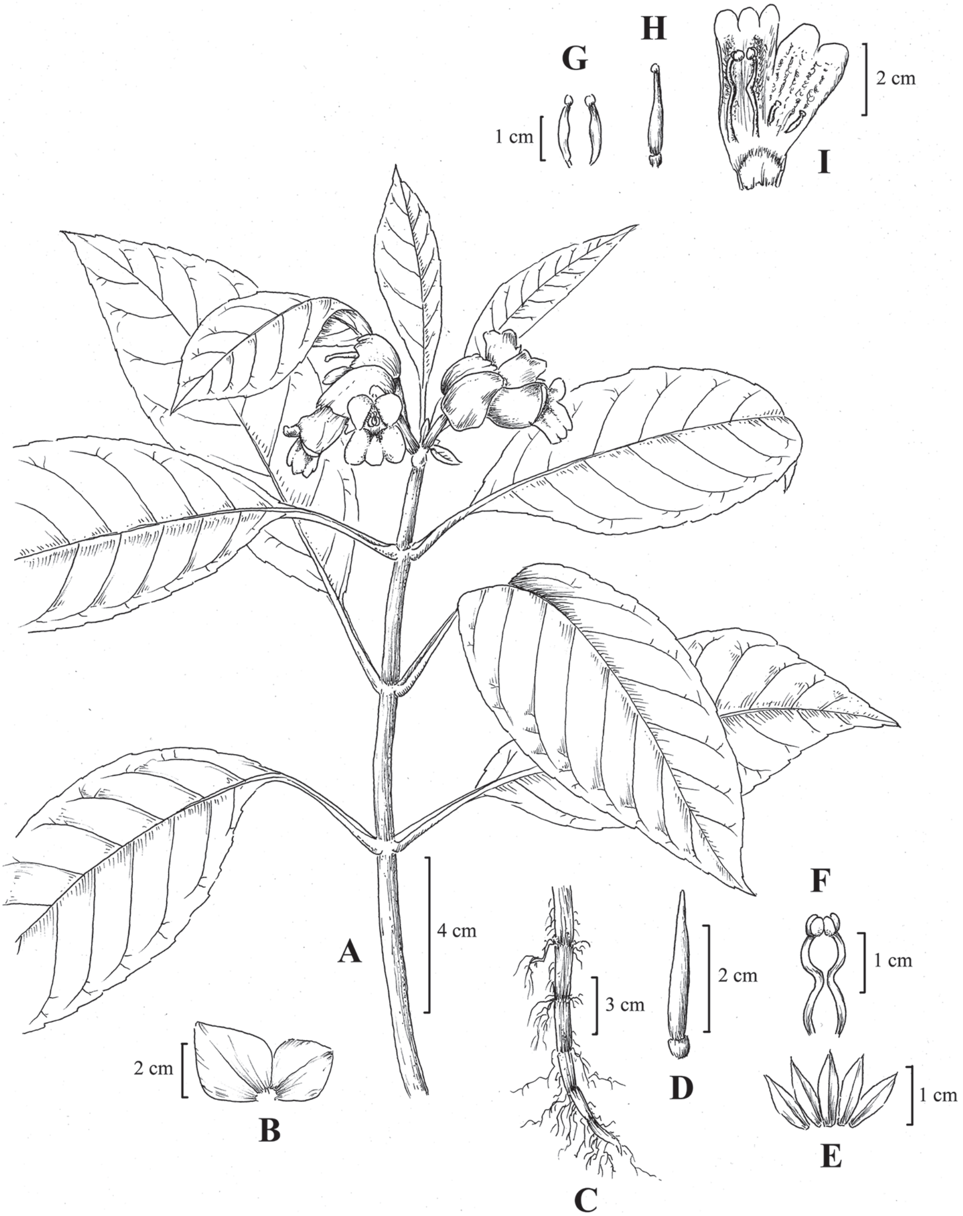

Figure 3. *Hemiboea albiflora.* **A** Flowering habit **B** involucre **C** root **D** capsule **E** calyx segments **F** stamens **G** staminodes **H** pistil **I** flower inside view. Drawn by Zhaowen Wu.

Distribution and habitat. *Hemiboea albiflora* is known from Maling River Valley and Pogang Nature Reserve, Xingyi City, Guizhou, China, growing on rock faces near Maling River and near streams in Pogang Nature Reserve, at an elevation of ca. 720–970 m.

Table 1. Morphological comparisons between *H. albiflora* and the similar species *H. gamosepala*, *H. cavaleriei* var. *paucinervis* and *H. subcapitata*.

	H. albiflora	***H. gamosepala***	***H. cavaleriei* var. *paucinervis***	***H. subcapitata***
Leaf				
Petiole	3–6 cm	0.6–6 cm	0.5–6.5 cm	0.5–5.5 cm
adaxial surface	green, sparsely pubescent	deep green, glabrous	green, glabrous	deep green, glabrous or sparsely pubescent
abaxial surface	pale green, glabrous	pale green or pale purple, glabrous	pale green or purple, glabrous	pale green, glabrous or sparsely pubescent
Veins on each side of midrib	5–9	4–10	4–8(-9)	5–6
Flower				
Peduncle	2–3 cm long	0.2–0.4 cm long	0.5–6.5 cm long	2–4(-13) cm long
Involucre	2–3 cm in diameter	1.8–2.3 cm in diameter	1–2.5 cm in diameter	1.5–2.2 cm in diameter
Corolla	4–5.5 cm long, outside white, glabrous	3.8–4 cm long; outside pink, sparsely glandular-puberulent	3.0–4.8 cm long, outside white, pale yellow or pink, sparsely glandular-puberulent	3.5–4.2 cm long, outside white, sparsely glandular-puberulent
Tube	3.5–4.5 cm long	3–3.1 cm long	2.3–3.3 cm long	2.8–3.5 cm long
Filaments	1.8–2 cm long	1.2–1.5 cm long	1.0–1.3 cm long	0.8–1.3 cm long
Anther	ovate-elliptic, 2–3 mm long	subovate, ca. 3 mm long	elliptic, 3–3.2 mm long	elliptic, 3–4 mm long
Staminodes	2	2	2	3
Pistil	2–2.5 cm long	ca. 1.5 cm long	1.7–2.5cm long	3.2–3.5 cm long
Capsule	2–3 cm long	1.8–2.4 cm long	1.5–2.5 cm long	1.5–2.2 cm long

Phenology. Flowering occurs in August to October and fruiting in October to November.

Etymology. The specific epithet refers to the corolla colour of this new species.

Additional collection. CHINA. Guizhou: Xingyi City, Maling River Valley, ca. 950 m alt., 12 October 2018, *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017060* (PE), *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017062* (PE); Xingyi City, Maling River Valley, ca. 720 m alt., 12 October 2018, *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017057* (PE); Xingyi City, Maling River Valley, *C.Y. Deng 3071* (XIN); Xingyi City, Pogang Nature Reserve, ca. 1000 m alt.,11 October 2018, *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017054* (PE), *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017055* (PE), *X.G. Xiang, Z.W. Wu & Z.Y. Guo 2017056* (PE).

Proposed IUCN conservation status

To date, *Hemiboea albiflora* has two known populations of more than 300 and less than 1000 mature individuals, according to field observations. Both populations are endemic in karst areas and grow on rock faces or under forests near streams. The population, which is distributed in scenic spots and habitats, is susceptible to human activities, e.g. road construction or deforestation. The species is considered to be "Vulnerable" (VU D1) according to the IUCN Red List Criteria (IUCN 2017), based on Criterion D1 and population size, estimated to be fewer than 1000 mature individuals.

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RESEARCH ARTICLE

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A new species of *Microlicia* (Melastomataceae): first record of the genus for Colombia

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Abstract

Microlicia (Melastomataceae) is a Neotropical genus nearly restricted to southeastern Brazil, and the Guiana Shield in Venezuela, with a few species in some places in the Andes of Bolivia and Peru. A new species of *Microlicia* endemic to the mountains of eastern Andes of Colombia is described and illustrated. Its affinities with other morphologically similar species from Venezuela are also documented. This novelty is the first record of the genus for Colombia and the northern Andes. It is argued that this disjunct distribution of the genus is attributable to the phenomenon of long-distance seed dispersal by wind.

Keywords

Northeastern Andes, endemism, long-distance seed dispersal, northern Andes, sub-páramo

Introduction

Microlicia D. Don is a genus of approximately 140 species, 135 of which occur in Brazil, two species grow in the Guaiana Shield of Venezuela, and two in the Andean mountains of Peru and Bolivia (Michelangeli and Cotton 2008, Romero 2013, Romero and Woodgyer 2015, Flora do Brasil 2019). The genus is extremely diverse in the campos rupestres and savannah vegetation of the states of Bahia, Minas Gerais and Goiás in Brazil (Romero 2003a, 2013).

The species of *Microlicia* are generally characterized by solitary flowers with five or occasionally six petals, a superior ovary with three or occasionally five locules, and capsules dehiscing longitudinally from the apex to the base (Almeda and Martins 2001, Romero 2003b). Difficulty in the delimitation of closely related species may explain the high number of names proposed for several species complexes in the genus (Romero and Woodgyer 2014).

This novelty represents the first record of the genus for Colombia and the northeastern Andes. The area from which this new taxon comes is poorly collected due to the difficult access and social conflict in the region. The current peace process in Colombia and the project Boyacá BIO developed by the Alexander von Humboldt Institute and the Government of the Department of Boyacá has allowed access to these new biologically unexplored areas.

Material and methods

This new species was found in the course of reviewing collections in regional herbaria of Colombia generated by the Boyacá BIO project. After several collections were located in the Federico Medem (FMB, Villa de Leyva) and Universidad Distrital (UDBC, Bogotá) herbaria, it was possible to visit the localities and collect new samples. Therefore new collections, field photographs and samples of flowers, fruits, and seeds stored in 70% alcohol were made.

Measurements of vegetative parts were made in the dry herbarium material with a digital caliper with a precision of 0.1 mm. The measurements of floral parts were based on fresh flowers preserved in alcohol from the type specimens. A Leica S8AP0 microscope was used. Photographs of leaves, flowers, fruits, and seeds were taken in the field and laboratory from fresh material using an MC190 HD camera.

The distribution of the *Microlocia* was associated with South America wind currents to evaluate the possible cause of the presence of the new taxon in the Andes of Colombia. For this, the map of winds patterns from the Earth Nullschool (https://earth.nullschool.net) was used, on which the distribution records of *Microlicia* from the electronic Tropicos database of the Missouri Botanical Garden (http://www.tropicos.org) were mapped using Arc-GIS version 10.2.1.

Results

Taxonomic treatment

Microlicia colombiana HumbertoMend. & R.Romero, sp. nov.

urn:lsid:ipni.org:names:60478838-2
Figs 1, 2, 3

Diagnosis. Related to *Microlicia benthamiana* Triana but differs in having larger internodes, strigose nodes, linear to obovate leaf blades, trichomes between sepals, petals

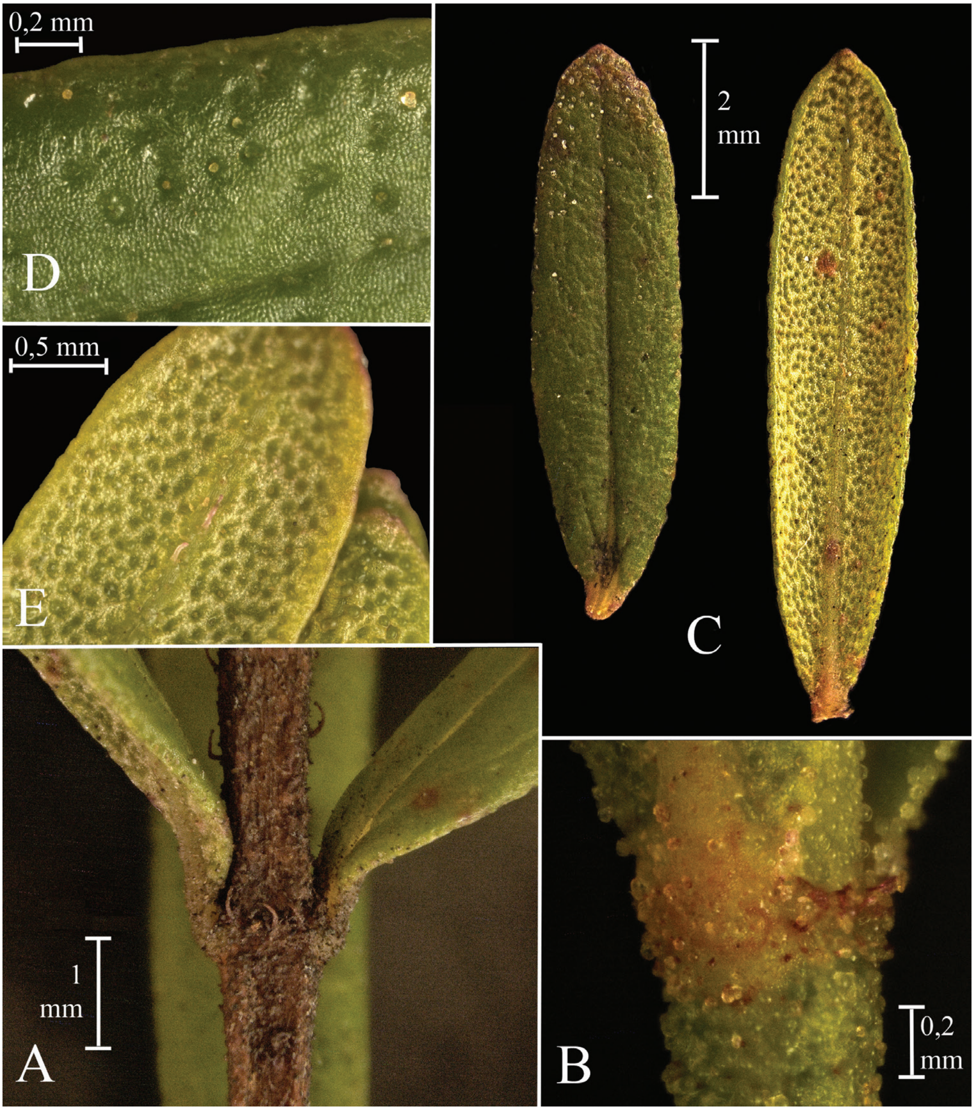

Figure 1. *Microlicia colombiana* HumbertoMendR.Romero. **A** Node at basal portion of a branch **B** Node with spherical golden glands at the distal part of a branch **C** Leaves, adaxial (left) and abaxial (right) surfaces **D** Leaf adaxial surface, with detail of indumentum **E** Leaf abaxial surface, with detail of indumentum (**A–E** from *H. Mendoza & D. Granados 22014* (FMB). All photos by Humberto Mendoza-Cifuentes).

and pedoconective of antesepalous stamens shorter. Also related to *Microlicia guanayana* Wurdack but differs in having non-strigose adaxial foliar surfaces, 3-nerved leaf blades, hypanthia 10-ribbed, petals < 8.5 mm long and with a rounded setose apex, and stamens with smaller dimensions.

TYPE: COLOMBIA. Boyacá: Municipio de Pisba, vereda Miraflores, Sabana de Nubacá, 2389 m elev., 5°44'7.10"N, 72°37'32.02"W, 19 Nov 2018 (fl, fr), *H. Men-*

Figure 2. *Microlicia colombiana* HumbertoMend.&R.Romero. **A** Floral bud **B** Lateral view of the calyx and hypanthium in open flower **C** Petal **D** Antepetalous stamen **E** Top view of ventral appendage of the connective **F** Lateral view of ventral appendage of the connective **G** Polysporangiate anther **H** Antesepalous stamen **I** Top view of ventral appendage of the connective **J** Anther **K** Gynoecium **L** Longitudinal section of the ovary **M** Horizontal section of the ovary **N** Capsule covered by hypanthium **O** Open capsule **P** Seeds (A–P from H. *Mendoza & D. Granados 22014* (FMB). All photos by Humberto Mendoza-Cifuentes).

doza & D. Granados 22014 (holotype: FMB!; isotypes: COL!, CUVC!, HUA!, FMB!, CUVC!, UDBC!).

Description. Denselly branched shrub 70–190 cm tall; internodes 2.4–8.1 mm long, 0.3–1.1 mm wide; young branches quadrangular becoming terete in old-basal parts, glabrous or puberulous with long-stalked glands 0.3–0.6 mm long, the stalk is curled, glands early caducous; nodes strigose, trichomes similar to the ones in the internodes;

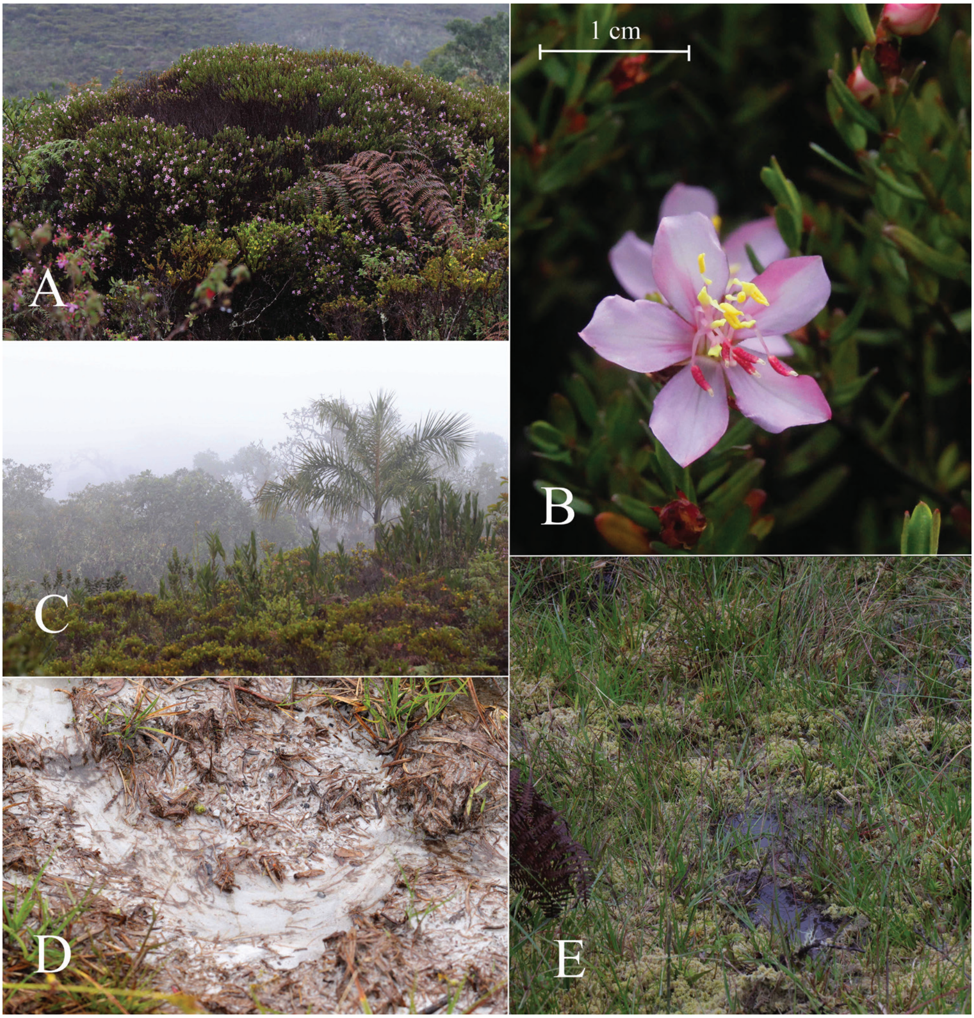

Figure 3. *Microlicia colombiana* HumbertoMend.&R.Romero. **A** Habit **B** Flowering branch **C** Sub-páramo habitat at te type locality **D, E** Sandy soils and substrate of the type lovality (all photos by David Granados).

distal internodes with sessile glands. Leaves decussate, isophyllous, ascending, adaxial surface green (fresh material), abaxial surface clear pale green (fresh material), subsessile; petiole 0.3–0.7 mm long and 0.2–0.5 mm wide; blade linear to oblong, 4.1–9.9 × 1.1–2 mm, apex rounded, mucronate, frequently with a terminal seta 0.2–0.4 mm long, margin entire, revolute, frequently with sparse trichomes ca. 0.3 mm long, adaxial surface with spherical, golden glands, 0.03–0.06 mm diameter, abaxial surface glabrous or impressed with spherical golden glands 0.03–0.04 mm diameter, central vein with pale trichomes 0.2–0.3 mm long; 3-nerved or slightly plienerved to 0.4 mm from the base (visible only on adaxial surface), middle vein impressed on adaxial surface. Flowers 5-merous, axillary, among the distal leaves, solitary, diplostemonous; pedicel 1.2–2 mm long. Hypanthium 3–3.7 × 2.2–2.5 mm, obconical or terete, externally 10–ribbed, with short-stalked glands,

glands 0.03–0.04 mm diameter; internally glabrous. Calyx lobed; undivided part of 0.2–0.3 mm long; lobes 2.1–2.7 × 0.9–1.4 mm (excluding seta), narrowly triangular, apex acute with a terminal seta 0.3–0.9 mm long, adaxial surface glabrous, abaxial surface towards the base with short-stalked glands similar to the hypanthium; pale trichomes 0.6–1 mm long intercalated with lobes. Petals 6.8–8.5 × 4.3–5 mm, obovate, pink, darker in the venation, glabrous, apex rounded. Stamens 10, strongly dimorphic, glabrous, anthers polysporangiate; small (antepetalous) stamens 5, filaments 2.6–5.3 × 0.2–0.4 mm, glabrous, light purple; pedoconnective 0.7–1.5 mm long, arcuate, yellow; ventral appendage 0.3–0.7 × 0.3–0.4 mm, globose or lobed, yellow; thecae 1.8–2 × 0.5–0.8 mm (including the rostrum), oblong, yellow, rostrum 0.3–0.4 mm long, with a ventrally oriented pore 0.1–0.3 mm diameter; large (antesepalous) stamens 5, filaments 3.2–4.9 × 0.2–0,4 mm, glabrous, light purple; pedoconnective 1.9–2.9 mm, ventrally arcuate, light purple; ventral appendage 1.1–2.2 × 0.9–1.1 mm, spatulate, light purple towards the base and yellow towards the apex; thecae 2.2–2.4 × 0.6–0.7 mm (including the rostrum), oblong, red, rostrum 0.3–0,5 mm long, with a ventrally oriented pore 0.1–0.2 mm diameter. Ovary 1.6–2.5 × 0.8–1.4 mm, oblate, superior, 3-locular, glabrous, apex rounded; style 3.3–5.2 mm long; stigma punctiform, 0.1–0.2 mm diameter. Capsule 3.2–3.4 × 2.1–2.3 mm, oblong, dehiscing into 3 valves from the apex, enveloping hypanthium early caducous. Seeds ca. 0.6 × 0.2–0.3 mm, ovoid to oblate, beige; testa lightly reticulate.

Phenology. Collected with flowers and fruits in July and November. In the area, there is only one rainy period with the highest levels of precipitation between the months of May to July and with less precipitation between December to February (Jaramillo and Chaves 2000). Flowering coincides with less rainy periods.

Habitat and distribution. *Microlicia colombiana* is endemic to northeastern Andes of Colombia towards the Orinoquian flank. This species is only known from the type locality in the department of Boyacá near the southern border of Pisba National Natural Park, and a nearby second locality in the department of Casanare, between 2000 to 2400 m elevation (Figure 4A). It grows in open areas of sub-páramo vegetation on white sandy soil covered with sphagnum (Figure 3).

Etymology. The specific epithet refers to the restricted occurrence of the new species to Colombia and for being the first record of the genus in this country.

Specimens examined (Paratypes). COLOMBIA. Boyacá: Municipio de Pisba, vereda Miraflores, Sabana de Nubacá, 2389 m elev., 5°44'7.10"N, 72°37'32.02"W, 1 nov 2017, fl, fr, *D. Granados 811* (CUVC, FMB); vereda Miraflores, Sabana de Nubacá, 2389 m elev., 5°44'7.10"N, 72°37'32.02"W, 19 nov 2018, fl, fr, *H. Mendoza & D. Granados 22015* (FMB, HUA, UPTC), 22016 (COL, FMB, HUA, UPTC, UIS). Casanare. Municipio de Yopal, corregimiento El Morro, vereda Perico, finca La Reserva, 1300–2000 m elev., 17 July 1993, fl, fr, *F. Castro 18718* (FMB, UDBC).

Discussion

Microlicia colombiana is recognized by its strigose nodes with long-stalked glands curled trichomes, and early caducous glands, leaves 3-nerved or 3-plinerved, hypanthium 10-costate, and pale trichomes between the calyx lobes. Other characters, although not unique within the genus but that together help to differentiate *M. colombiana*, are 5-mereous flowers, petals with rounded apex, without seta, glabrous stamens, and polysporangiate anthers. The anthers of species that are polysporangiate have both of their thecae divided into numerous small locules in a way that resembles the structure of a honeycomb (Almeda and Martins 2001), character that can be observed externally without dissecting the anther. The most morphologically similar species is *Microlicia benthamiana* that occurs in Cerro Roraima in Venezuela and Brazil. Both have glabrescent subssesile and 3-nerved leaves, and 10–ribbed hypanthia. In *M. benthamiana*, however, the internodes are shorter, branches and leaves do not have spherical glands and pale trichomes, and the flowers are larger (Table 1). *Microlicia colombiana* also bears some similarity to *M. guanayana*, which occurs on Cerro Guanay in the state of Amazonas, Venezuela. Both have leaves of similar shape and size; however, *Microlicia guanayana* has leaves 1-nerved (vs. 3-nerved in *M. colombiana*), internodes and leaves with strigose indumentum with trichomes > 1 mm long (vs. without setae or only over veins and 0.3 mm long), petals >10 mm long (vs. <8.5 mm long) and setulose and unribbed hypanthia (vs. 10-ribbeb) (Table 1).

Regarding the Andean species that grows in Peru and Bolivia, the most affine is *M. sphagnicola* Gleason, nevertheless the latter has flowers 4-merous and glandular marginate connective in outter (antesepalous) stamens.

Microlicia is a highly diversified genus in south-central Brazil, with a few disjunct species in the Andes of Bolivia and Peru and the Guiana Shield of Venezuela (Romero 2003a). The most morphologically similar species to *M. colombiana* grow in high areas (1000–2700 m elevation) of the Guiana Shield around 650 km (*M. guanayana*) and 750–1300 km (*M. benthamiana*) away from the northeastern Andes of Colombia (Figure 4A).

This distributional pattern could be explained by long-distance seed dispersal events from the East (southeastern Brazil or Guiana Shield) towards the West (central and northern Andes). In Melastomataceae, there are several different genera with disjunct distribution between the northern Andes and the Guiana Shield, such as in *Boyania* Wurdack (Mendoza 2010) and *Phainantha* Gleason (Ulloa and Neill 2009). Also, there are species with known disjunct distributions between the Guiana Shield and the Andes without records in the lowland of Amazonia and Orinoquia, such as *Marcetia taxifolia* (A. St.-Hil.) DC. (Martins 1989), *Graffenrieda intermedia* Triana and *G. weddelli* Naudin (Almeda et al. 2016), and *Monochaetum bonplandii* (Kunth) Naudin (Alvear and Almeda in press).

The majority of these groups with disjunct distributions have capsular fruits with seeds dispersed by wind. Renner et al. (2001) and Renner (2004) discussed the preponderant role of long-distance dispersal in the evolution of the distribution of Paleotropical Melastomataceae. The small seeds of some of the genera in the Melastomataceae are likely to travel great distances in air currents. The disjunctive distribution of *Microlicia* could possibly be associated with the wind currents in the north of South America that run from East to West (Figure 4B). However, it is possible that the distribution in the center of South America is a combination of stepping-stone route with consecutive short dispersal events.

Table 1. Morphological comparison between *M. colombiana* and related species. Differential characters highlighted in bold. Based in Wurdack (1958, 1973).

Character	*M. colombiana*	*M. guanayana*	*M. benthamiana*
Indumentum on the branch	Frequently puberulous	Strigose - setulose	**Glabrous**
Internode length (mm)	2.4–8.1	3–7	**1.3–2.2**
Petiole length (mm)	0.3–0.7	0.6–0.8	0.8
Leaf shape	Linear to oblong	Linear obovate	**Elliptic**
Leaf length (mm)	4.1–9.9	6–9	4–9
Leaf adaxial surface	Without setae	**Sparse strigose**	Without setae
Leaf abaxial surface	Setae on veins	Sparse strigose	**Without setae**
Venation	3–nerved	**1–nerved**	3–nerved
Pedicel length (mm)	1.2–2	0.5–1.5	**0.8**
Hypanthium length (mm)	3–3.7	3	2–3.5
Hypanthium	10-ribbed	**Smooth**	10-ribbed
Calyx lobe length (mm)	2.1–2.7	3	2–4.6
Indumentum between calyx lobes	Trichomes 0.6–1 mm	?	**Without trichomes**
Petal length (mm)	6.8–8.5	**10–10.5**	**6.8–12**

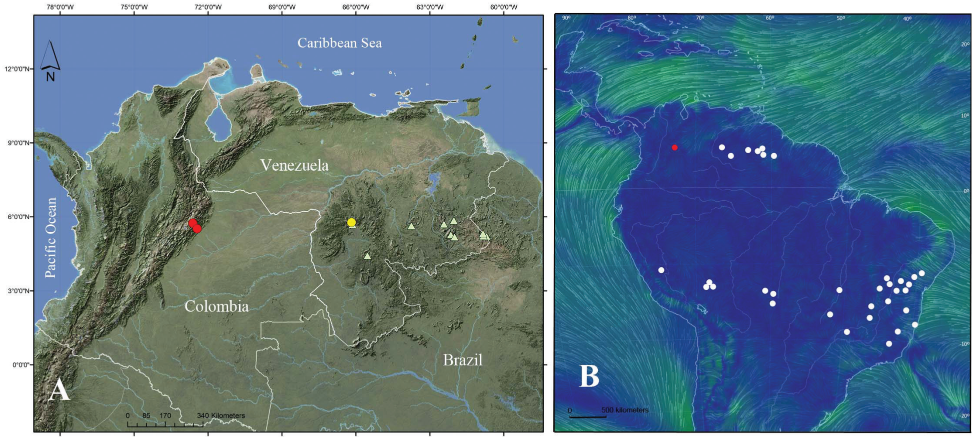

Figure 4. Distribution of *Microlicia*. **A** Distribution of *M. colombiana* and the most similar species in northern South America (Red dots: *M. colombiana*; Yellow point: *M. guanayana*; Green triangles: *M. benthamiana*) **B** Distribution of *Microlicia* in South America and wind currents (Red point depicts distribution of *M. colombiana*, white dots are other species of the genus).

Another condition is the type of ecosystem, like sandy enclaves in highlands Andes. Successful colonization and establishment are more likely in environments that approximately match the source environment (Cavendar-Bares et al. 2009). The most affine species to *M. colombiana*, grow in what is known as Pantepui (Wurdack 1973), which includes the characteristically flat topped mountain summits of the Guiana highlands, between 1500 and 3000 m a.s.l., encompassing a range of meso- to submicrothermic temperature regimes (MAT 18–8 °C), the extensive herbaceous ecosystems are developed on open sandstone surfaces (Huber 2006). These temperature conditions, herbaceous or shrub vegetation and sandy soils occur in some areas along the eastern slope of the eastern Andes in Colombia as the type locality of *M. colombiana*.

Dispersal by birds that transport seeds adhered in mud may also be a possibility to explain the disjunct distribution of *Microlicia* in the northern Andes. However, there is no greater evidence to document this. Bird migrations occur mostly from north-south and not from East to West (Gillespie et al. 2011), and the possibilities of transporting seeds in mud from areas where soils are sandy are unlikely.

Acknowledgments

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Typification of names in *Kaempferia* (Zingiberaceae) in the flora of Cambodia, Laos and Vietnam

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Abstract

Neotypes are designated for five names in *Kaempferia* (Zingiberaceae) from Lao PDR, namely *K. attapeuensis* Picheans. & Koonterm, *K. champasakensis* Picheans. & Koonterm, *K. gigantiphylla* Picheans. & Koonterm, *K. sawanensis* Picheans. & Koonterm and *K. xiengkhouangensis* Picheans. & Phokham.

Keywords

Kaempferia, nomenclature, Lao PDR, typification

Introduction

Kaempferia L. is a genus of ca. 40 species distributed in tropical Asia (Mabberley 2017). Gagnepain (1908: 45–54) recognised 13 species of *Kaempferia* in Cambodia, Laos and Vietnam, nine of which are still placed in this genus. The Thai Forest Bulletin (Botany) by Sirirugsa (1992: 1–15) recorded 15 species in Thailand and 10 species in Cambodia, Laos and Vietnam (Sirirugsa 1992).

Twelve names were coined by C. Picheansoonthon and his colleagues from 2008–2013, namely *Kaempferia attapeuensis* Picheans. & Koonterm (2009b: 221), *Kaempferia champasakensis* Picheans. & Koonterm (2008: 406), *Kaempferia gigantiphylla* Picheans.

& Koonterm (2009b: 219), *Kaempferia koratensis* Picheans. (2011: 4), *Kaempferia koontermii* Prasarn, Wongsuwan & Picheans. (Wongsuwan et al. 2015: 29), *Kaempferia lopburiensis* Picheans. (2010: 148), *Kaempferia picheansoonthonii* Wongsuwan & Phokham (Phokham et al. 2013: 302), *Kaempferia saraburiensis* Picheans. (2011: 1), *Kaempferia sawanensis* Picheans. & Koonterm (2009: 509), *Kaempferia sisaketensis* Picheans. & Koonterm (2009a: 52), *Kaempferia udonensis* Picheans. & Phokham (Phokham et al. 2013: 299) and *Kaempferia xiengkhouangensis* Picheans. & Phokham (Phokham et al. 2013: 305). Five of these species are based on type specimens collected in Laos and are being studied and cited in a revision of *Kaempferia* for the *Flora of Cambodia, Laos and Vietnam* currently in preparation.

The protologues of *Kaempferia attapeuensis*, *K. champasakensis*, *K. gigantiphylla*, *K. sawanensis* and *K. xiengkhouangensis* state that the type specimens were collected in Laos and deposited at BK, BKF and SING. Paratypes of *Kaempferia attapeuensis*, *K. gigantiphylla* and *K. xiengkhouangensis* were also cited at the same herbaria. In order to locate this material, the first author visited BK, BKF and SING but, at each of these herbaria, no type specimens or paratype specimens were found. Attempts were made to contact the authors of these names and to encourage them to deposit the specimens cited in their protologues. No reply was received, either to our enquiries or to those of the curator of BKF so we are obliged to review the original material of each name and, as necessary, to select neotypes to replace the missing holotypes and isotypes. If the holotypes and isotypes are found to exist in the future, then the neotypifications made below will be superseded (Turland et al. 2018, Art. 9.19).

Materials and methods

The type locality of each name was visited and a search was made for plants which matched the protologue. In some cases, the type locality was clearly indicated by GPS coordinates but we also found cases in which the GPS coordinates appear to be in error, as noted below.

Result

Neotypifications

Kaempferia attapeuensis Picheans. & Koonterm, Taiwania 54(3): 221. 2009.

Type. Lao PDR, Attapeu Province, Ban Oudomxay, 14°45.167'N, 106°60.415'E (*sic*), alt. 80 m, 5 Jul 2007, *C. Picheansoonthon & S. Koonterm 123* (holotype BKF; isotypes: BK, SING). Lao PDR, Attapeu Province, Xaysettha District, Ban Touy, 14°50.305'N, 106°57.51'E, 113 m alt., 20 Jun 2016, *O. Insisiengmay OI-141* (neotype: HNL, designated here; isoneotypes: E (with spirit collection), P (with spirit collection)).

Note. The original material comprises the type and one further collection, *Picheansoonthon & Koonterm 229* (BKF, *n.v.*), from Ban Kasome, Attapeu Province, 14°50.167'N, 106°57.515'E, alt. 88 m, 5 Jul 2008. The GPS coordinates of the holotype locality are in error (there are only 60 minutes in a degree so the longitude given is impossible) and, furthermore, Ban Oudomxay cannot be traced in Attapeu. The paratype locality, Ban Kasome, exists and a small collection (*OI-146*) matching the protologue was made there in June 2016. A larger, identical collection (*OI-141*) was made at a nearby locality and it is this which is designated here as neotype.

Kaempferia champasakensis Picheans. & Koonterm, Taiwania 53(4): 406. 2008.

Type. Lao PDR, Champasak Province, Xanasomboun District, Ban Lat Suea, 15°18.954'N, 105°38.654'E, alt. 109 m, 10 Jun 2007, *C. Picheansoonthon & S. Koonterm 52* (holotype: BKF; isotypes: BK, SING). Lao PDR, Champasak Province, Xanasomboun district, Boung Kha village, Ya Nang stream, 15°18.955'N, 105°38.5933'E, 105 m alt., 19 Jun 2016, *O. Insisiengmay OI-128* (neotype: HNL, designated here; isoneotypes: BKF, E (with spirit collection), P (with spirit collection), SING).

Note. This species is based on the type collection alone. No paratype material was cited in the protologue. The type locality was found using the GPS coordinates given in the protologue though the nearby village is called Ban Boung Kha, not Ban Lat Suea. A collection, *O. Insisiengmay OI-128*, was made at this location and it matches the description in the protologue exactly. This is designated here as the neotype of *Kaempferia champasakensis*.

Kaempferia gigantiphylla Picheans. & Koonterm, Taiwania 54(3): 219. 2009.

Type. Lao PDR, Salawan Province, Tad Loa Waterfalls, 15°27.363'N, 106°44.12'E, alt. 482 m, 4 Jul 2007, *C. Picheansoonthon & S. Koonterm 117* (holotype BKF; isotypes: BK, SING). Lao PDR, Salawan Province, Tad Lo Waterfalls, 15°31.6633'N, 106°16.535'E, 370 m alt., 21 Jun 2016, *O. Insisiengmay OI-149* (neotype: HNL, designated here; isoneotypes: E (with spirit collection), P (with spirit collection)).

Note. The original material comprises the type and two paratype collections, as follows: Champasak Province, Phou Savan, 15°23.355'N, 105°41.318'E, alt. 696 m, 14 Jun 2007, *Picheansoonthon & Koonterm 105* (BK, *n.v.*); Attapeu Province, Ban Kasome, 14°50.167'N, 106°57.515'E, alt. 88 m, 26 Apr 2008, *Picheansoonthon & Koonterm 219* (BK, *n.v.*). The type locality is a well-known place which is easy to find. The neotype collection was made at Tad Lo and matches the protologue exactly.

Kaempferia sawanensis Picheans. & Koonterm, Acta Bot. Yunnan. 31(6): 509. 2009

Type. Lao PDR, Sawanakhet province, Phin District, Dong Phou Vieng NPA, 16°30.457'N, 106°1.446'E, alt. 288 m, 26 Apr 2007, *C. Picheansoonthon & S. Koonterm 16* (holotype: BKF; isotypes: BK, SING). Lao PDR, Sawanakhet Province, Phin District, Dong Phou Vieng NBCA, 16°25.385'N, 105°58.6217'E, 289 m alt., 7 Jun 2016, *O. Insisiengmay OI-49* (neotype: HNL, designated here; isoneotypes: BKF, E (with spirit collection), FOF, P (with spirit collection), SING).

Note. The protologue cites only the type collection, comprising the holotype and two isotypes. No other collections were cited as paratypes so the existing original material consists of the published text and figures alone.

A search for *Kaempferia sawanensis* was made at the type locality, using the GPS coordinates given in the protologue. These coordinates lead to an area of rice fields with patches of heavily disturbed forest near human habitation just south of the district town of Phin. No plants which matched the protologue could be found in this area.

Proceeding southwards along the same road, Dong Phou Vieng NPA is reached as the land begins to rise. After a right turn, the road leads towards Ban Tad Hai through evergreen forest with clearings. *Kaempferia sawanensis* was found in one of these clearings.

In the protologue, the habitat is described as "sandy soil along dry evergreen forest and pine-deciduous dipterocarp forest". Along the road to Ban Tad Hai, a substantial population of *Kaempferia sawanensis* was found in deciduous forest with bamboo (*Vietnamosasa* sp.) but completely without pine. The collectors of the holotype may have misunderstood the name for *Vietnamosasa* bamboo, which is *kok phêk* or *ya phêk* in Laotian, very close to *kok pek* (*Pinus* sp.). In any case, this locality matches the habitat described in the protologue and our collection, *O. Insisiengmay OI-49* matches the description of *Kaempferia sawanensis*. We designate this collection as the neotype.

Kaempferia xiengkhouangensis Picheans. & Phokham, J. Jap. Bot. 88: 305. 2013.

Type. Lao PDR, Xiengkhouang District, Mueang Kham, 19°33.139'N, 103°44.384'E, alt. 600–720 m, 25 Mar 2011, *C. Picheansoonthon & S. Phokham 250311-1* (holotype: BKF; isotypes: BK, SING). Lao PDR, Xiengkhouang Province, Kham District, Houay Phad village, 19°32.6383'N, 103°45.1917'E, 700 m alt., 29 Apr 2016, *O. Insisiengmay OI-2* (neotype: P, designated here).

Note. The original material cited in the protologue comprises the type collection and a paratype, *Picheansoonthon & Phokham 150711-1* (BKF, *n.v.*), collected in the same place as the type, on 15 Jul 2011. The first author travelled towards the GPS coordinates given in the protologue, stopping at the nearest village to ask whether anyone remembered the Thai collectors who had visited the area in 2011. The villagers did remember and were able to give directions to the type locality. *O. Insisiengmay OI-2* was collected at the type locality and matches the description in the protologue. It is designated here as the neotype.

A note on *Kaempferia chayanii*

***Kaempferia chayanii* Koonterm, Folia Malaysiana 9(1): 19. 2008.**

Type. Lao PDR, Champasak Province, Xanasomboon Town, Baan Kamphaeng, 15°22.548'N, 105°45.577'E, alt. 610 m, 10 Jun 2007, *C. Picheansoonthon, & S. Koonterm 021* (holotype: BKF; isotypes: BK, SING).

Note. This species belongs in *Kaempferia* subgenus *Kaempferia*. As in the cases above, the type material cited in the protologue cannot be found at BK, BKF or SING so a search of the type locality in Champasak Province was made. No material was found to match the protologue, so this species remains to be neotypified.

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