

# *Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave, a new species of Vitaceae from Papua New Guinea

Jun Wen<sup>1</sup>, Robert Kiapranis<sup>2</sup>, Michael Lovave<sup>2</sup>

**1** Department of Botany, National Museum of Natural History, MRC 166, Smithsonian Institution, Washington, D.C. 20013-7012, USA **2** Forest Biology Program, PNG Forest Research Institute, P.O. Box 314, Lae 411, Morobe Province, Papua New Guinea

Corresponding author: Jun Wen (wenj@si.edu)

---

Academic editor: H. Schaefer | Received 16 December 2012 | Accepted 22 February 2013 | Published 15 March 2013

---

**Citation:** Wen J, Kiapranis R, Lovave M (2013) *Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave, a new species of Vitaceae from Papua New Guinea. PhytoKeys 21: 1–6. doi: 10.3897/phytokeys.21.4512

---

## Abstract

A new species *Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave of Vitaceae is described from Morobe Province of Papua New Guinea. It is a close relative of *A. muelleriana* Planch., another endemic of New Guinea and differs from the latter by its densely woolly tomentose lower leaflet surface and much thicker leaflets. The new species is from the mid montane forests, whereas *A. muelleriana* occurs in the lowland rain forests.

## Keywords

*Ampelocissus*, *Ampelocissus asekii*, Morobe Province, Papua New Guinea, Vitaceae

## Introduction

*Ampelocissus* Planch. (Vitaceae) consists of ca. 95 species from tropical Asia, Africa, Australia and Central America (Wen 2007). The genus was established by Planchon in 1884 and is characterized by the inflorescences subtended by a tendril, bisexual flowers, and a floral disc usually with ten linear marks on its side (Planchon 1887). Lauterbach (1925) recognized two species of the genus in New Guinea, including the simple-leaved *A. arachnoidea* Planch. and the trifoliate *A. muelleriana* Planch. A third species *A. acetosa* (F. Muell.) Planch. with pedate leaves has been recorded from Papua

New Guinea (Jackes 1984). Nevertheless no specimens of *A. arachnoidea* have been examined by the authors. Lauterbach's locality of the species “Key-Inseln: Doela” is probably either Kai (Kei) Dulah or Dulah Laut in the Kai (Kei) Islands of Indonesia, off the southwest coast of New Guinea. We herein report a new species from Morobe Province based on our herbarium studies.

## Methodology

Herbarium work was conducted in the Papua New Guinea National Herbarium in Lae (LAE). Micromorphological characters were documented with scanning electron microscopy (SEM). The SEM samples were coated with gold and palladium, and observed under a Zeiss EVO M15 electron microscope with LaB6 electron source at the SEM Lab of the National Museum of Natural History, the Smithsonian Institution.

## Results and discussion

***Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave, sp. nov.**

urn:lsid:ipni.org:names:77125856-1

[http://species-id.net/wiki/Ampelocissus\\_asekii](http://species-id.net/wiki/Ampelocissus_asekii)

Figs 1–3

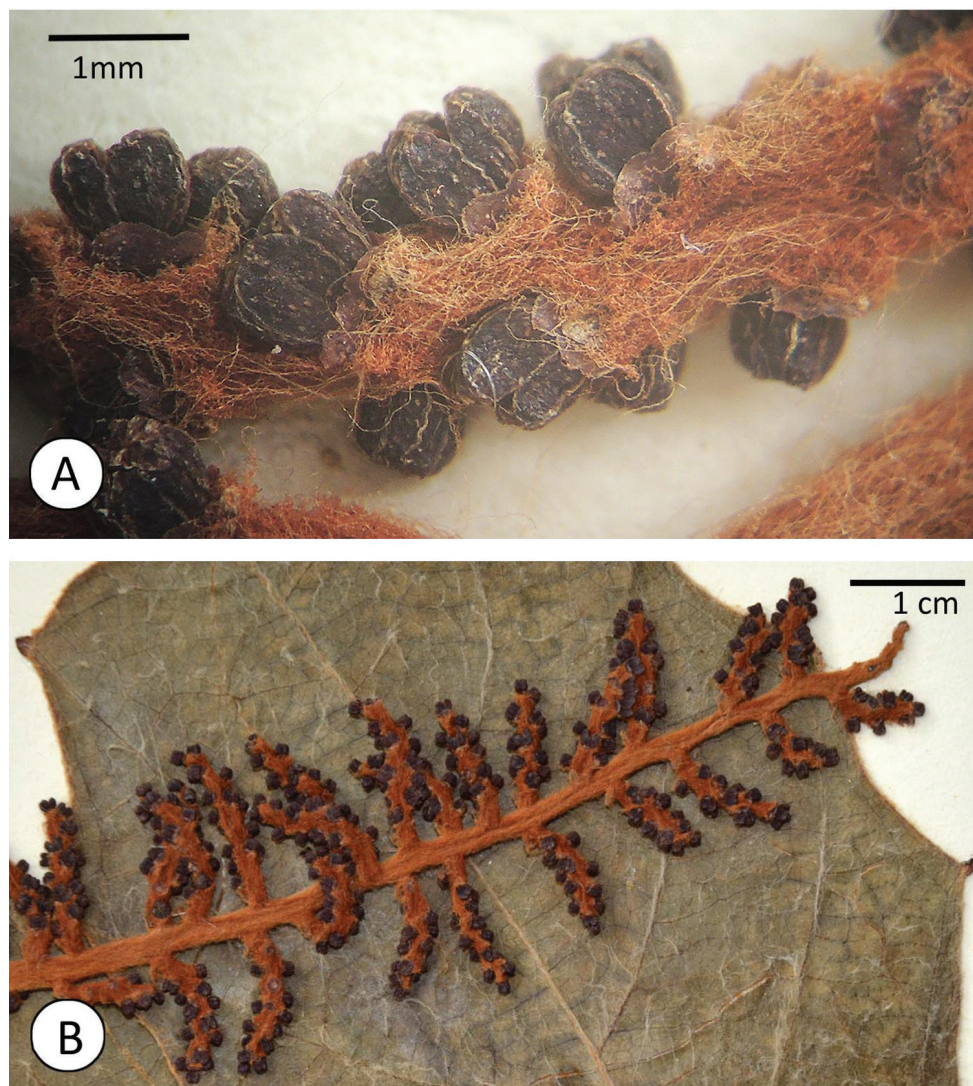
**Type.** Papua New Guinea. Morobe Province: near Haumga, Aseki Patrol area, steep gully in secondary lower montane forest, alt. 4600 ft, liana, leaves glossy mid green above, brownish below, buds dark brown, 6 Apr 1966, L. A. Craven & R. Schodde 1219 (holotype: LAE!, accession number 143956; isotypes: A, CANB, K, L).

**Description.** Liana. Young stems with dense light-brown woolly hairs. Leaves trifoliate; stipules narrowly triangular, 3–5 mm long, 2–3.5 mm wide; leaflets chartaceous, woolly pubescent with white hairs above, densely rusty woolly pubescent below, base of lateral leaflet strongly oblique, that of terminal leaflet acute, but slightly oblique, apex acute, margin sinuate-spinulose with 3–10 teeth on each side; petiole 9.5–10.5 cm long, densely woolly pubescent; blade of terminal leaflets obovate, blade of lateral leaflets unequally ovate, 13–15 cm long, 6–8 cm wide; lateral veins 5–7 on each side; petiolule 2–3 cm long, densely woolly pubescent. Tendril simple. Inflorescence ca. 35 cm long, a narrow panicle of spikes with all but one branch aggregated on the top 1/3 of the inflorescence primary axis, primary branches ca. 35, each 1–2.8 cm long, light rusty woolly pubescent, each with 6–25 flowers; peduncle ca. 10 cm long. Flowers sessile, 4 to rarely 5-merous; calyx saucer-shaped, glabrous, 0.2–0.3 mm long, 0.5–0.6 mm wide; petals oblong to ovate-oblong, glabrous, 1.0–1.3 mm long, 0.5–0.7 mm wide; floral disc adnate to ovary, grooved; stamens with filaments 0.5–0.6 mm long and ovate-oblong anthers; ovary 2-locular, styles short, 0.2–0.3 mm long. Fruits not seen.



**Figure 1.** Image of the holotype of *Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave.





**Figure 2.** *Ampelocissus aseki* J.Wen, R.Kiaprani & M.Lovave. **A** Close-up of an inflorescence branch showing trichomes and floral morphology **B** A portion of inflorescence laying on the adaxial leaflet surface.

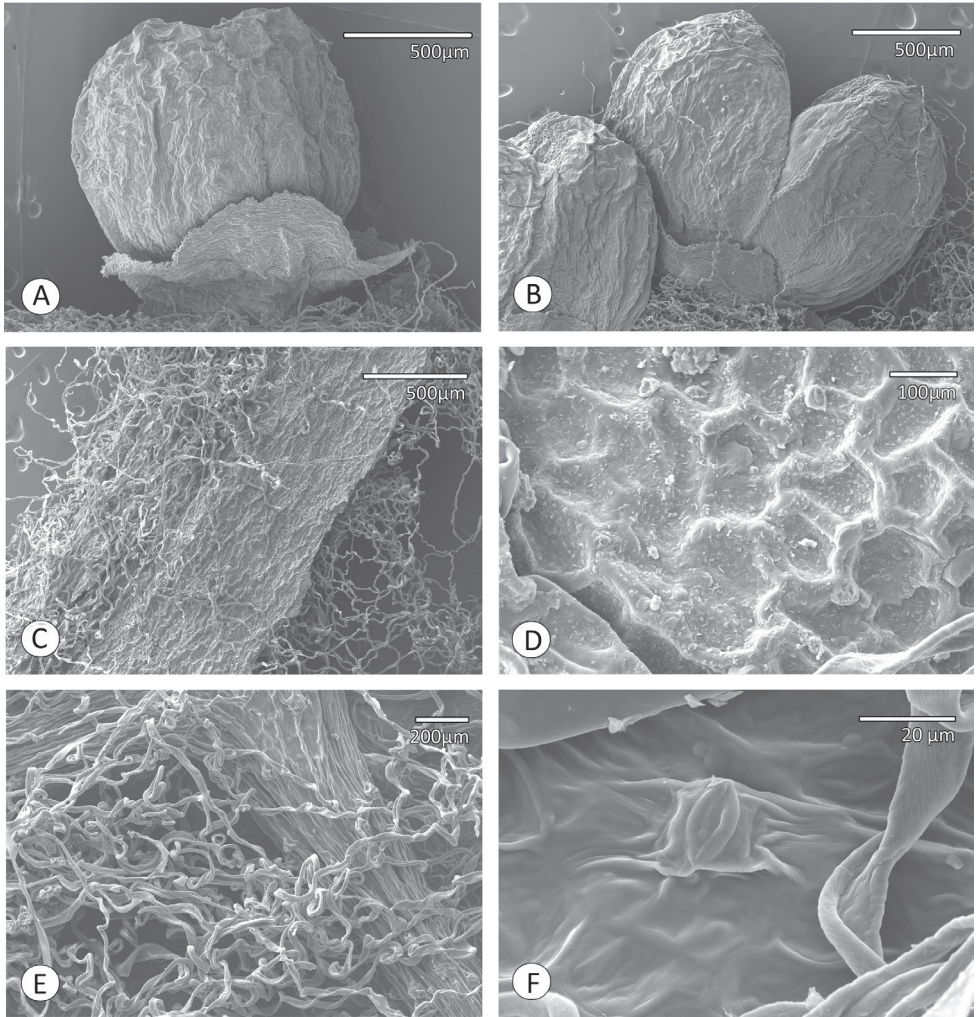
**Distribution.** The new species is only known from its type locality in Morobe Province, Papua New Guinea.

**Ecology.** Mid montane forests. Fl. Apr; elevation at ca. 1500 m.

**Etymology.** This species is named after the type locality, the Aseki Patrol area in Morobe Province.

The new species is closely related to *A. muelleriana*, another endemic from New Guinea. They differ in the highly distinctive brown woolly hairs on the lower leaflet surface, the acute leaflet apex and the chartaceous leaflet texture in the new species (vs. with tufts of rusty hairs in the axils of veins on the lower surface, acuminate leaflet apex, and thin





**Figure 3.** Micromorphology of *Ampelocissus asekii* J. Wen, R. Kiapranis & M. Lovave. **A** Floral bud showing sepals and petals **B** An opening floral bud **C** Trichomes on adaxial leaflet surface near a veinlet **D** Cuticle on adaxial leaflet surface **E** Trichomes on abaxial leaflet surface **F** Cuticle and a stoma on abaxial leaflet surface.

chartaceous to membranaceous leaflet texture in *A. muelleriana*). The new species occurs in the mid montane zone, whereas *A. muelleriana* grows in the lowland rain forests in East Sepik, Madang and Morobe of Papua New Guinea as well as in West Papua of Indonesia.

Below we provide a key to all four *Ampelocissus* species in New Guinea

- 1a        Leaves simple or pedately compound, inflorescence a thyrses with pedicellate flowers ..... **2**
- 2a        Leaves simple ..... *A. arachnoidea*

- 2b      Leaves pedate with (5-) 7-9 (-11) leaflets .....***A. acetosa***
- 1b      Leaves trifoliate, inflorescence a panicle with spicate inflorescence units (sessile or nearly sessile flowers) .....**3**
- 3a      Lower leaflet surface densely rusty woolly pubescent, leaflet chartaceous in texture, in mid montane habitat .....***A. asekii***
- 3b      Lower leaflet surface with rusty hairs at the leaflet vein axils, leaflet thin chartaceous or membranaceous; in lowland rain forest habitat.....***A. muelleriana***

*Ampelocissus arachnoidea* is tentatively included in the key.

## Acknowledgments

This study was supported by NSF Award number DEB 0743474, the Smithsonian Endowment Grant Program, and the Small Grants Program of the National Museum of Natural History of the Smithsonian Institution. We thank Marc Appelhans for photographing the specimens, Sue Lutz for preparing the figures, John Boggan for checking localities, Thomas Magun for herbarium assistance, and two anonymous reviewers for helpful comments.

## References

- Jacks BR (1984) Revision of the Australian Vitaceae, 1. *Ampelocissus* Planchon. *Austrobaileya* 2: 81–86.
- Lauterbach C (1925) Die Vitaceen Papuasians. *Botanischer Jahrbücher für Systematik* 59: 505–534.
- Planchon JE (1884) *Ampelocissus* Planch. In: *La Vigne Américaine (et la Viticulture en Europe)*, 8(1): 371–372.
- Planchon JE (1887) Monographie des Ampélidées vrais. In: De Candolle AFPP and De Candolle C, eds. *Monographiae Phanaerogamarum*, vol. 5(2). Sumptibus G. Masson, Paris, 305–654.
- Wen J (2007) Vitaceae. In: Kubitzki K, ed. *The families and genera of vascular plants*, vol. 9. Springer–Verlag, Berlin, 466–478.

# ***Axonopus graniticola*, a new species of *A. ser. Suffulti* (Poaceae, Panicoideae, Paspaleae) from Minas Gerais, Brazil**

Pedro Lage Viana<sup>1</sup>, Luiza Fonseca Amorim de Paula<sup>2</sup>

**1** Bicho do Mato Instituto de Pesquisa, Rua Perdigão Malheiros 222, 30380-234, Belo Horizonte, Minas Gerais, Brazil **2** Departamento de Botanica, Instituto de Ciencias Biológicas, Universidade Federal de Minas Gerais, 31270-901, Belo Horizonte, Minas Gerais, Brazil

Corresponding author: *Pedro Lage Viana* (vianapl@yahoo.com.br)

---

Academic editor: *L. Versieux* | Received 23 October 2012 | Accepted 25 February 2013 | Published 22 March 2013

---

**Citation:** Viana PL, de Paula LFA (2013) *Axonopus graniticola*, a new species of *A. ser. Suffulti* (Poaceae, Panicoideae, Paspaleae) from Minas Gerais, Brazil. *PhytoKeys* 21: 7–16. doi: 10.3897/phytokeys.21.4157

---

## **Abstract**

A new species of *Axonopus* ser. *Suffulti* from Minas Gerais, Brazil, is described and illustrated. Comparison with morphologically related species, as well as comments on the ecology and the conservation status are provided.

## **Resumo**

Uma nova espécie de *Axonopus* ser. *Suffulti* é descrita e ilustrada para o estado de Minas Gerais, Brasil. São fornecidas comparações com espécies morfologicamente relacionadas, assim como comentários sobre ecologia e estado de conservação.

## **Keywords**

Atlantic Forest, *inselbergs*, Grasses, new taxon, Gramineae



## Introduction

*Axonopus* P.Beauv. is an American genus of Poaceae comprising approximately 110 species (Black 1963, Clayton and Renvoize 1986, Cialdella et al. 2006). Most of its species occur in the tropics, where it is especially diverse in the Neotropical savannas, such as the Brazilian *cerrado* (Mendonça et al. 1998), the Espinhaço Range mountains (Viana and Filgueiras 2008), the Amazonian savannas and the Guayana Shield (Davidse et al. 2004). Traditionally, *Axonopus* was included in a wide circumscription of the tribe Paniceae, Panicoideae subfamily (e.g. Black 1963, GPWG 2001, Cialdella et al. 2006, Giraldo-Cañas 2007, 2008). However, the identity of Paniceae s.l. was challenged in the latest proposal of classification of this tribe (Morrone et al. 2012), based on an integrated analysis of *ndhF* plastid DNA and morphology. The authors split Paniceae s.l. into Paniceae s.s. (pantropical, basic chromosome number  $x = 10$ ) and Paspaleae (American,  $x = 9$ ), the latter encompassing *Axonopus* and other 38 genera.

Chase (1911) recognized three sections of *Axonopus*: *A. sect. Cabrera* (Lag.) Chase, *A. sect. Lappagopsis* (Steud.) Chase, and *A. sect. Axonopus*, a circumscription that was followed by Dedecca (1956) in his revision of the genus for Brazil. Thereafter, Black (1963), in his taxonomic study of the genus, divided *A. sect. Axonopus* into the series *Axonopus*, *Barbigeri*, *Cappilares*, *Fastigiati*, and *Suffulti*, based on such combination of characters as life span, indumentum, the number of nerves in the upper glume, trichomes in the rachis of racemes, and the color of fertile florets. The only attempt to assess the monophyly of Black's *Axonopus* infrageneric groups using a combined analysis of morphological and molecular data (López and Morrone 2012) do not support Black's classification. Some groups, however, appear to be monophyletic, like serie *Suffulti*. Nonetheless, a comprehensive phylogeny including a broader sampling within *Axonopus* is necessary to support a robust infrageneric classification of the genus.

Species of the *Axonopus* ser. *Suffulti* are perennial plants, with the upper glume and lower lemma lacking a central nerve, and fertile florets characteristically shiny brown to dark brown (Black 1963, Cialdella et al. 2006). Cialdella et al. (2006) published a comprehensive revision of the taxon, providing detailed descriptions of the 16 accepted names, ornamentation of the upper floret on SEM, illustrations, a key for identification of the species, and nomenclatural updates. Fifty five species of *Axonopus* are currently indicated to Brazil (Filgueiras and Rodrigues 2012), and seven of them are placed in the *Axonopus* ser. *Suffulti*.

A floristic survey in an overlooked granitic outcrop, or *inselberg*, in northeastern Minas Gerais, Brazil (de Paula et al. in prep.), revealed at least five new species of flowering plants. One of those, belonging to the *Axonopus* ser. *Suffulti*, is herein presented, illustrated and compared with putatively related species. SEM images of the fertile floret, as well as comments on its ecology and the conservation status are provided. For SEM images, samples were mounted on stubs, coated with gold palladium in a Hummer 6.2 (Anatech, Union City, CA, USA) sputtering system and viewed with a JSM-541OLV (JEOL, Tokyo, Japan) at 10kV.

## Taxonomic treatment

### *Axonopus graniticola* P.L.Viana, sp. nov.

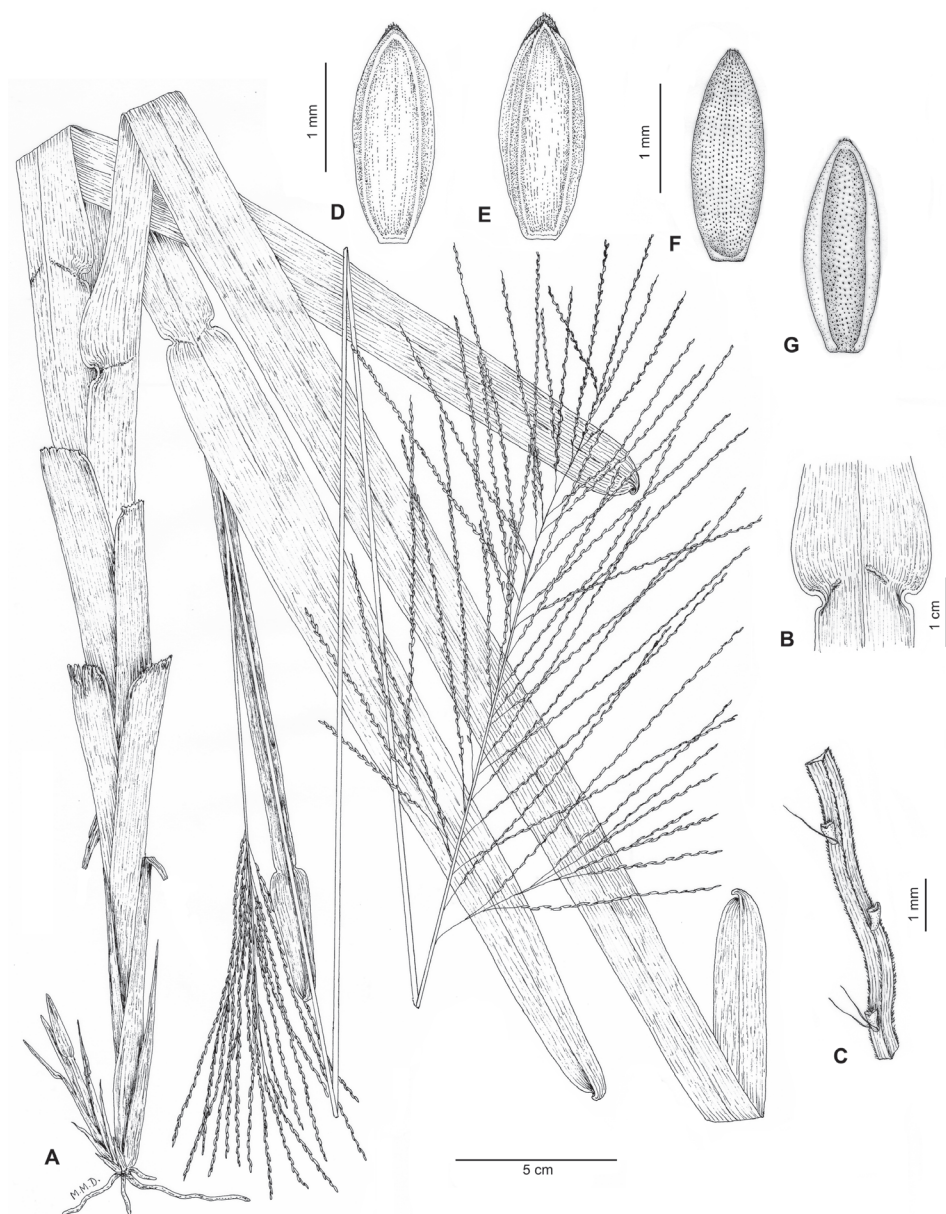
urn:lsid:ipni.org:names:77126079-1

[http://species-id.net/wiki/Axonopus\\_graniticola](http://species-id.net/wiki/Axonopus_graniticola)

**Diagnosis.** *Axonopus graniticola* is distinguished from all other species of the *Axonopus* ser. *Suffulti* by its mostly caulinar leaves, distichous laterally compressed leaf sheaths, 1.5–2.5 cm wide leaf blades, deciduous with a subcordate base, and multi-racemose inflorescences of 26–75 racemes, with the basal ones re-branched.

**Type. BRAZIL:** Minas Gerais: Município Teófilo Otoni, Afloramento rochoso ao lado esquerdo da MG 418, cerca de 30 km norte de Teófilo Otoni, 17°51'21.5"S, 41°15'39.4"W, 560 m alt., 8 Jan 2011, L.F.A. de Paula, N.F.O. Mota, P.L. Viana, T.B. Jorge, P.M. Burkowski 145 (Holotype: BHCB! Isotypes: RB! NY!) (Figures 1–3).

**Description.** Plants perennial, densely caespitose, with very short falciform rhizomes. Culms 95–125 cm long, erect to decumbent, slightly curved at the base, not geniculate, unbranched; nodes various, hidden by leaf sheaths, glabrous; internodes 5–8.5 mm wide, cylindrical to slightly flattened, glabrous, stramineous. Leaves distichous, mostly caulinar; leaf sheaths 5.5–32 cm long, larger than the internodes, conduplicate, strongly keeled, striate, scabrous, glabrescent, persistent; ligule 0.15–0.20 mm long or absent, ciliate, apparently deciduous, because it is usually absent in older leaves; collar prominent, glabrous; leaf blades (4.5)12–32 × 1.5–2.5 cm, oblong to linear, lanceolate, flat, retorsely scabrous abaxially, antrorsely scabrous adaxially, eventually with sparse hairs on abaxial or adaxial surfaces, deciduous, nerves prominent, margins scabrous, base rounded, subcordate, arising from a constriction of 1–2 mm long in each margin of the ligular region, apex obtuse, asymmetrical, emarginate, slightly folding, reflexed, scabrous. Inflorescences 2 per flowering culm, terminal and axillary; peduncle up to 55 cm long, partially included in the leaf sheaths, cylindrical to angulose, striate, scabrous; pulvinulus pubescent; main axis 8–16.5 × 0.05–0.14 cm, angulose, striate, scabrous; panicles 12–26 cm long, in dense clusters of alternate to verticillate racemes, the lower branches re-branching in 5–18 racemes; racemes (4–)9–16.5 cm long, the apical ones slightly shorter than the basal, 26–75 per panicle; rachis of racemes triquetous, fertile all along, except for the 1–4.5 mm basal portion length, ending in a fertile spikelet, (5)10–15 spikelets per portion of 25 mm long, pubescent, scabrous in the angles; pedicels 0.25–0.5 mm long, scaberulous, sometimes with a few hyaline tuberculate trichomes to 0.8–1.5 mm long. Spikelets 1.8–2.0 × 0.6–0.8 mm, oblong-ellipsoid, dorsiventrally compressed, apex acute; upper glume as long as the spikelet, elliptical, membranous, glabrous or with sparse trichomes, hyaline to stramineous, 2–4(–5)-nerved, nerves prominent, scaberulous in the apex, mid-nerve occasionally present; lower lemma glumiform, 2(–3)-nerved, nerves glabrous; upper lemma 1.8–2.0 × 0.8–0.9 mm, elliptical, stiff, glabrous, except for a discrete tuft of short white hairs at the apex, densely ornamented by diminute papillae, fading in den-



**Figure 1.** *Axonopus graniticola* P.L. Viana **A** Habit **B** Ligular region, adaxial side **C** Rachis of culm **D** Spikelet, upper glume view **E** Spikelet, lower lemma view **F** Upper floret, lemma view **G** Upper floret, palea view. Drawn from the holotype (de Paula et al. 145).

sity toward the margins, shiny brown to dark brown, apex acute, brown to pale, base brown to pale; upper palea similar to the upper lemma but slightly shorter, 1.7–1.9 × 0.6–0.8 mm, glabrous. Lodicules 0.2–0.3 mm long, 2, oblong, erose; stamens 3, anthers ca. 0.8 mm, dorsifixed, purplish; stigmas plumose, whitish. Caryopsis not seen.



**Etymology.** The epithet refers to the occurrence of the plants of this species on exposed granite rock outcrops.

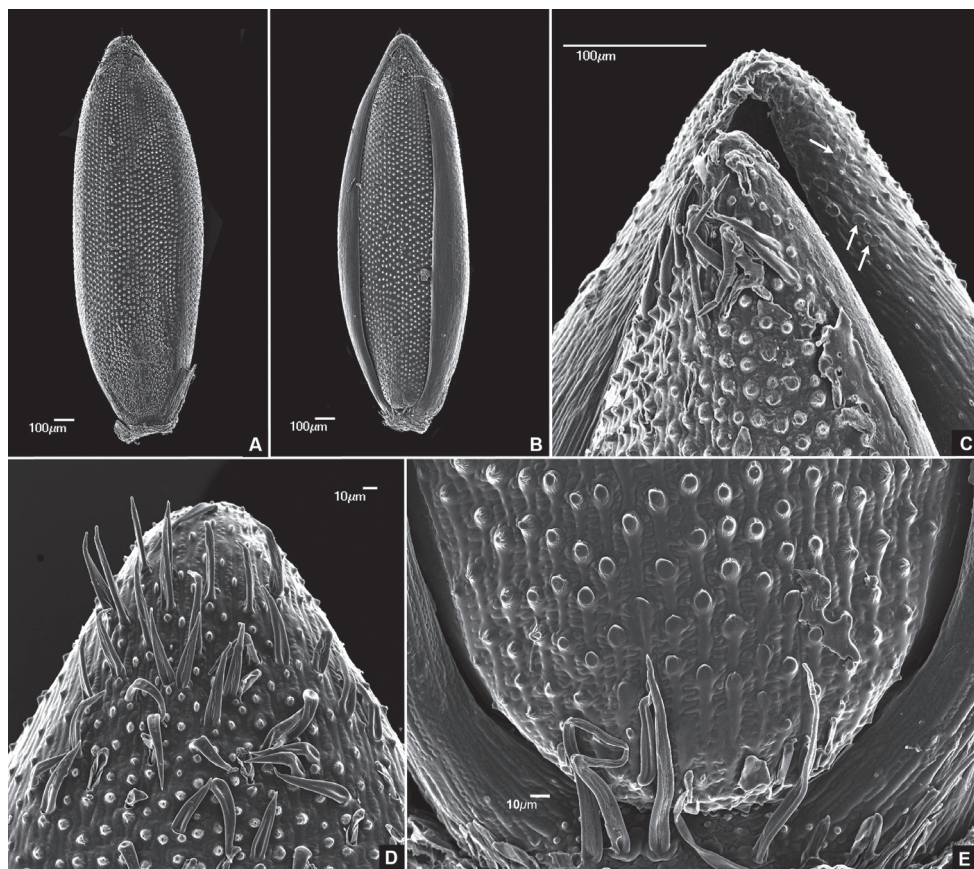
**Morphological comments.** The new species has perennial habit, scabrous pubescent rachis, with few scattered trichomes 0.8–1.5 mm long associated with the region of the pedicel insertion, the 2–4(–5)-nerved upper glume and 2(–3)-nerved lower lemma, and typically shiny brown and stiff fertile florets. In accordance with Black's (1963) infrageneric circumscription of *Axonopus*, accepted by Cialdella et al. (2006) and Giraldo-Cañas (2007, 2008), and the combination of the above features, *Axonopus graniticola* should be placed into the *Axonopus* subg. *Axonopus* ser. *Suffulti*.

A mid-nerve in the upper glume and lower lemma is found in some spikelets of the specimen *de Paula* 237. Although this feature is uncommon in *Axonopus* ser. *Suffulti* (Cialdella et al. 2006), some species included in this group can bear a discrete mid-nerve in these bracts in some spikelets. For example, in the delicate Peruvian *Axonopus elegantulus* (J. Presl) Hitchc. and in *A. flabeliformis* Swallen, from northern South America, some spikelets can have the upper glume with a visible mid-nerve; in the Venezuelan *Axonopus magallanesiae* Giraldo-Cañas, both upper glume and lower lemma can be 4-5-nerved, with a noticeable mid-nerve on the bracts (Cialdella et al. 2006), as recorded in some spikelets of the new species.

*Axonopus flabeliformis* shares with *A. graniticola* the characteristically equitant base, with distichous, laterally compressed and persistent leaf sheaths, disposed along the culm. The compound panicle, occasionally occurring in *A. flabeliformis*, and spikelets 1.6–2.2 mm long, also suggest affinity, even though superficial, to the new species. *Axonopus graniticola* can be easily distinguished from *A. flabeliformis* by its wider leaf blades (1.5–2.5 cm vs. 0.5–0.9 cm in *A. flabeliformis*), the rounded and subcordate base of the blade arising from a constriction in the ligular region (against blade bases straight and following the sheath apex width in *A. flabeliformis*), and its multi-flowered panicles (26–75 racemes vs. 6–20(–30) racemes in *A. flabeliformis*).

The new species also bears slight resemblance to *Axonopus pressus* (Nees ex Steud.) Parodi, from the Brazilian *cerrado*, Bolivia and Paraguay, by its strongly conduplicate and keeled leaf sheaths, giving the typical laterally compressed aspect to the plant. However, the leaves of *A. pressus* are predominantly basal, contrasting with mostly caulinar leaves of *A. graniticola*, with shorter spikelets (1.8–2 mm long, vs. 2.2–3 mm in *A. pressus*), wider leaf blades (1.5–2.5 cm, vs. 0.8–1.2 cm in *A. pressus*) and inflorescences with 26–75 racemes (against less than 35 racemes in *A. pressus*). Moreover, the panicles of the new species are compound, with the lower branches re-branching in 5–18 racemes, a feature absent in *A. pressus*, with its panicles with unbranched racemes.

The flat and characteristically wide leaf blades and the compound panicles of the new species bear a slight resemblance to the widely distributed *Axonopus scoparius* (Flüggé) Kuhlm. However, the latter species is placed in the *Axonopus* sect. *Axonopus* ser. *Barbigeri* Black (Black 1963, Giraldo-Cañas 2007, 2008), and is characterized, among others, by spikelets with the upper glume and lower lemma with a central nerve, and pale brown upper florets. *Axonopus graniticola* plainly fits the circumscription of the *Axonopus* sect. *Axonopus* ser. *Suffulti*, as discussed above.



**Figure 2.** SEM micrographs of upper floret **A** Lemma view **B** Palea view **C** Apical portion of floret showing silica bodies (arrows) **D** Upper lemma apex, showing conspicuous macrohairs and papillae **E** Basal portion of floret. Images taken from the holotype (de Paula et al. 145).

**Ornamentation of fertile floret on SEM.** (Figure 2). Abaxial surface of palea and lemma ornamented with papillae, silica bodies, macro-hairs and micro-hairs. Papillae simple, conical, apex acute, one per cell, evenly distributed in longitudinal rows on the floret surface, except in the margins of the lemma, which lack papillae. Silica bodies equidimensional, dumbbell shaped, visible on the apical portion of lemma margins. Macro-hairs unicellular, simple, located in the apex of lemma and palea and in the basal portion of the lemma (Figure 2 E). Micro-hairs collapsed in the studied material, probably due to samples preparation process, distributed in the apex of lemma and palea and in the basal portion of the lemma.

The presence of numerous papillae, dumbbell shaped equidimensional silica bodies on the apex of fertile floret and macro- and micro-hairs on the base and apex of floret are typical features of species included in *Axonopus* ser. *Suffulti* (Cialdella et al. 2006). Although no unique diagnostic feature was recorded in *Axonopus graniticola*, papillae

with acute apex seems to be uncommon among species of *A. ser. Suffulti*, being only recorded in the new species and in *A. polydactylus* (Steud.) Dedecca, *A. ramosus* Swallen and *A. suffultus* (Mikan ex Trin.) Parodi (Cialdella et al. 2006).

**Additional specimen examined (Paratype).** **BRAZIL: Minas Gerais:** Município Teófilo Otoni, Afloramento rochoso ao lado esquerdo da MG 418, cerca de 30 km norte de Teófilo Otoni, em inselbergue, 17°51'11"S, 41°15'44"W, 650 m alt., 16 Apr 2011, L.F.A. de Paula, M. Augsten 237 (BHCB, RB).

**Distribution and ecology.** The new species is known only from its type locality, an *inselberg* in the municipality of Teófilo Otoni, eastern Minas Gerais, Brazil. It occurs on granitic and gneissic rock outcrops, surrounded by the Atlantic Forest matrix (Veloso et al. 1991), at elevations around 600 m.

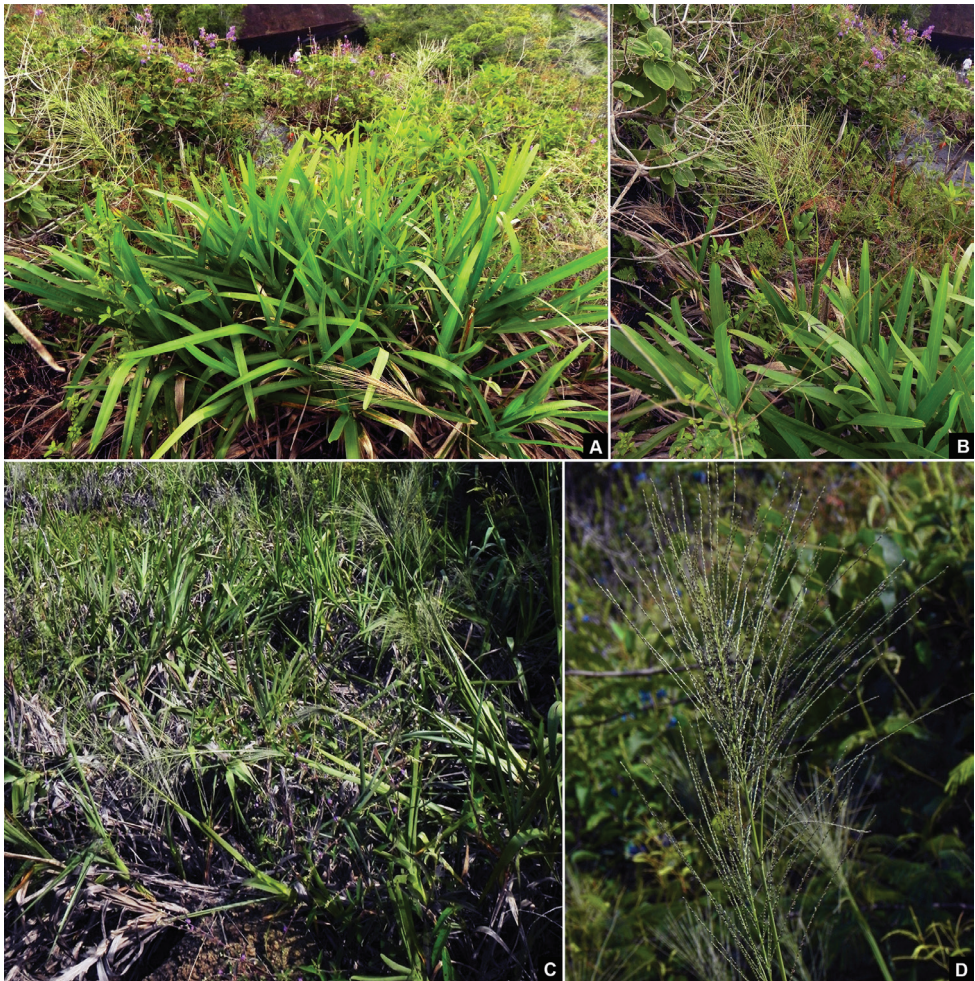
The species is found in depressions filled with thin soil, forming dense clumps, surrounded by rocky surface. During the rainy season, the profuse growth of new leaves with conspicuous flat and wide blades gives a vivid green color to the clumps (Figure 3A), in contrast with the pale brown, almost bladeless, clumps observed during the dry season (Figure 3C). The persistent leaf sheaths covering the culms and the readily deciduous leaf blades may be adaptations to avoid desiccation during the dry season and serve as protection against high temperatures of this extremely seasonal environment. These features are described for other species among monocots families, like Velloziaceae and Cyperaceae, which are usually known as desiccation-tolerant plants (Porembski 2007, Porembski and Barthlott 2000).

The vegetation of the *inselberg* is influenced by the soil (Porembski et al. 1998, Porembski 2007), and its flora is predominantly xeromorphic. Adaptations to drought and high insolation are common for the species from the type locality of *Axonopus graniticola*. Desiccation tolerance is found in other plant groups that occur in this area, as in some ferns and allies (*Sellaginella convoluta* (Arn.) Spring, *S. sellowii* Hieron., *Cheilanthes geraniifolia* (Weath.) R.M.Tryon & A.F.Tryon) and in Angiosperms, such as Cyperaceae (*Trilepis lhotzkiana* (Nees) ex Arn.), and Velloziaceae (*Barbacenia* spp., *Vellozia* spp.). Succulence occurs in Cactaceae (*Coleocephalocerus buxbaumianus* Buining, *Pilosocereus brasiliensis* (Britton & Rose) Backeb.), Bromeliaceae (*Encholirium gracile* L.B.Sm.), Orchidaceae (*Cyrtopodium glutiniferum* Raddi, *Encyclia spiritusanc-tensis* L.C.Menezes), and in some Piperaceae (*Peperomia* spp.). Leaf deciduousness is also an adaptation in *Wunderlichia azulensis* Maguire & G.M.Barroso (Asteraceae) and *Tabebuia reticulata* A.H.Gentry (Bignoniaceae).

**Conservation.** The species is known so far from a single granite-gneiss outcrop in the Teófilo Otoni region, Minas Gerais, Brazil. Due to the poor state of knowledge of the flora from that region (Martinelli 2007), more field efforts are required to clarify the distributional range of this species. In accordance with the IUCN (2001) guidelines, the species should be evaluated as Data Deficient.

Although it was not possible to assess the precise conservation status of the species, it is important to note that the vegetation of the *inselbergs* are under threat due to the ever increasing granite and gem exploration, road-building, grazing and illegal plant collection in southeastern Brazil's *inselbergs* (Safford and Martinelli 2000). To fill





**Figure 3.** In situ photographs of *Axonopus graniticola* P.L. Viana **A** Dense clump of *A. graniticola* during the rainy season **B** Flowering culm **C** Clumps, in the beginning of the dry season **D** Detail of panicle. Photographs by L.F.A. de Paula.

the gap of information in this diverse and poorly studied area, and therefore provide guidelines for the conservation of the flora in the region, taking into account that rock outcrops support a large number of endemics (Porembski 2007), a broader study of the flora of the Teófilo Otoni *inselbergs* is urgently needed.

### Acknowledgements

We thank Marcelo de Paula, Ana Lúcia de Paula, Nara F.O. Mota, Felipe Leite, Pablo Burkowski, Mariana Augsten, Tulio Jorge, Creuzo and Cerva Jonka for help in building our foothold lodging on the *inselberg*. We also want to express our gratitude to

Cássio Addiny for kindly providing permission to collect botanical samples on his property. Special thanks go to Nara F.O. Mota and Poliana Cardoso, for providing the SEM images of fertile florets, to Myrian M. Duarte for line drawings, and to Alex Popovkin who improved the English of this article. We are also thankful for Tarciso S. Filgueiras for encouraging us to publish this article and for clarifying questions on the etymology of the new species epithet. Leonardo Versieux and two anonymous reviewers provided crucial suggestions on the final text.

## References

- Black GA (1963) Grasses of the genus *Axonopus* (a taxonomic treatment). *Advancing Frontiers of Plant Science* 5: 1–186.
- Chase A (1911) Notes on genera of Paniceae. IV. *Proceedings of the Biological Society of Washington* 24: 103–160.
- Cialdella AM, Morrone O, Zuloaga FO (2006) Revisión de las Especies de *Axonopus* (Poaceae, Panicoideae, Paniceae), Serie *Suffulti*. *Annals of the Missouri Botanical Garden* 93: 592–633. doi: 10.3417/0026-6493(2006)93[592:RDLEDA]2.0.CO;2
- Clayton WD, Renvoize SA (1986) *Genera Graminum*. Her Majesty's Stationery Office, London.
- Davidse G, Judziewicz EJ, Zuloaga FO (2004) Poaceae in Steyermark, J.A et. al, *Flora of the Venezuelan Guyana*, Vol. 8. Poaceae-Rubiaceae. Missouri Botanical Garden Press, St. Louis.
- Dedecca DM (1956) As espécies brasileiras do gênero *Axonopus* (Gramineae). *Bragantia* 15: 251–296. doi: 10.1590/S0006-87051956000100019
- Filgueiras TS, Rodrigues RS (2012) *Axonopus*. In: Forzza RC, *Lista de Espécies da Flora do Brasil*. Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil. <http://floradobrasil.jbrj.gov.br/2012/FB013032/> [Accessed 24 July 2012].
- IUCN (2001) IUCN Red list categories and criteria: version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, United Kingdom.
- Giraldo-Cañas D (2007) Análisis filogenético del género neotropical *Axonopus* (Poaceae: Panicoideae: Paniceae) con base en caracteres morfológicos y anatómicos. *Revista Institucional Universidad Tecnológica del Chocó* 29: 9–27.
- Giraldo-Cañas D (2008) Sistemática del género *Axonopus* (Poaceae: Panicoideae: Paniceae) y revisión de las especies de la serie *Barbigeri*. *Serie Biblioteca José Jerónimo Triana* 17: 1–211. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C.
- GPWG (Grass Phylogeny Working Group) (2001) Phylogeny and subfamilial classification of the grasses (Poaceae). *Annals of the Missouri Botanical Garden*, 88: 373–457. doi: 10.2307/3298585
- López A, Morrone O (2012) Phylogenetic studies in *Axonopus* (Poaceae, Panicoideae, Paniceae) and related genera: morphology and molecular (nuclear and plastid) combined analyses. *Systematic Botany* 37: 671–676. doi: 10.1600/036364412X648625
- Martinelli G (2007) Mountain Biodiversity. *Revista Brasileira de Botânica* 30: 587–597. doi: 10.1590/S0100-84042007000400005

- Mendonça RC, Felfili JM, Walter BMT, Silva-Júnior MC, Rezende AV, Filgueiras TS, Nogueira PE (1998) Flora Vascular do Cerrado. In: Sano SM, Almeida SP (Eds) Cerrado: Ambiente e Flora, 289–556. EMBRAPA-CPAC, Planaltina, Brazil.
- Morrone O, Aagesen L, Scataglini MA, Diego LS, Denham SS, Chemisquy MA, Sede SM, Liliana MG, Kellogg EA, Zuloaga FO (2012) Phylogeny of the Paniceae (Poaceae: Panicoideae): integrating plastid DNA sequences and morphology into a new classification. *Cladistics* 28: 333–356. doi: 10.1111/j.1096-0031.2011.00384.x
- Porembski S (2007) Tropical inselbergs: habitat types, adaptative strategies and diversity patterns. *Revista Brasileira de Botânica* 30: 579–586. doi: 10.1590/S0100-84042007000400004
- Porembski S, Barthlott W (2000) Granitic and gneissic outcrops (inselbergs) as centers of diversity for desiccation-tolerant vascular plants. *Plant Ecology* 151: 19–28. doi: 10.1023/A:1026565817218
- Porembski S, Martinelli G, Ohlemuller R, Barthlott W (1998) Diversity and ecology of saxicolous vegetation mats on inselbergs in Brazilian Atlantic Forest. *Diversity and Distributions* 4: 101–119. doi: 10.1046/j.1365-2699.1998.00013.x
- Safford HD, Martinelli G (2000) Southeast Brazil. In: Barthlott W, Porembski S (Eds) *Inselbergs: biotic diversity of isolated rock outcrops in the tropics*, 339–389. *Ecological Studies*. Springer-Verlag, Berlin.
- Veloso HP, Rangel Filho ALR, Lima Veloso HP, Rangel Filho ALR, Lima JCA (1991) *Classificação da vegetação brasileira, adaptada a um sistema universal*. IBGE, Rio de Janeiro.
- Viana P, Filgueiras TS (2008) Inventário e distribuição geográfica das gramíneas (Poaceae) na Cadeia do Espinhaço, Brasil. *Megadiversidade* 4: 71–88.



# *Pyropia plicata* sp. nov. (Bangiales, Rhodophyta): naming a common intertidal alga from New Zealand

Wendy A. Nelson<sup>1,2</sup>

**1** National Institute of Water and Atmospheric Research, Private Bag 14-901, Wellington 6241, New Zealand

**2** School of Biological Science, University of Auckland, PO Box 92-019, Auckland 1142, New Zealand

Corresponding author: Wendy A. Nelson (wendy.nelson@niwa.co.nz)

Academic editor: J. Brodie | Received 2 January 2013 | Accepted 25 February 2013 | Published 22 March 2013

**Citation:** Nelson WA (2013) *Pyropia plicata* sp. nov. (Bangiales, Rhodophyta): naming a common intertidal alga from New Zealand. PhytoKeys 21: 17–28. doi: 10.3897/phytokeys.21.4614

## Abstract

A commonly found red alga of the upper intertidal zone of New Zealand rocky coasts is described for the first time as *Pyropia plicata* sp. nov. This species has been incorrectly known as *Porphyra columbina* Mont. (now *Pyropia columbina* (Mont.) W.A.Nelson) for many years. *Pyropia plicata* is widespread and common, and it is readily distinguished from other species of bladed Bangiales in New Zealand by its distinctive morphology, with pleated blades attached by a central rhizoidal holdfast.

## Keywords

Bangiales, New Zealand, *Porphyra*, *Pyropia columbina*, *Pyropia plicata* sp. nov.

## Introduction

For many years the most commonly found and widespread species of bladed Bangiales in New Zealand has been incorrectly known as *Porphyra columbina* Mont. Based on material collected from the New Zealand subantarctic Auckland Islands (Montagne 1842, 1845), *Porphyra columbina* was the first species in the order described from the New Zealand region. The name *P. columbina* has been applied to specimens with widely ranging growth forms and colour states found in diverse habitats from subantarctic to warm temperate areas of New Zealand, Australia, and South America (e.g. Howe 1914, Taylor 1947, Levring 1953, 1955, 1960, Chapman 1969, Womersley and Conway 1975, Acleto and Endo 1977, Ricker 1987, Ramírez and Santelices 1991, Adams 1994, Womersley 1994). Although there have been significantly different inter-

pretations of the species concept in New Zealand (e.g. Laing 1928, Levring 1955, Chapman 1969), the name *P. columbina* in New Zealand has been generally applied to a common species with a very distinctive rosette-like morphology and deeply folded or pleated blades, found in the upper intertidal zone of mainland shores, as treated and illustrated in Nelson and Conroy (1989) and Adams (1994: p. 143). This species was assigned the code “ROS54” by Broom et al. (1999) and has been referred to by this code in a number of subsequent publications (e.g. Hemmingson and Nelson 2002, Jones et al. 2004, Nelson et al. 2006, Sutherland et al. 2011).

The combination of targeted collections of members of the Bangiales from throughout the New Zealand region, and analyses of sequence data coupled with morphological and anatomical investigations, has revealed many undescribed species around the archipelago (e.g. Broom et al. 1999, Nelson et al. 2001, Broom et al. 2004, Nelson and Broom 2005, Nelson et al. 2006). Recent collections of bladed Bangiales from subantarctic regions revealed at least four distinct species present on the Auckland Islands. With these data and specimens, Nelson and Broom (2010) were able to re-examine the original concept of *P. columbina* and the subsequent interpretations and applications of this name. They concluded that *P. columbina* is not conspecific with the mainland rosette-forming species referred to as ROS54, but rather it is primarily distributed in cold temperate areas of the southern hemisphere. They confirmed its presence on Auckland, Campbell, Antipodes, Chatham and Falkland Islands, and established that it is rarely present on mainland New Zealand (i.e. only one collection from the southern coast of the South Island from more than 700 samples of bladed Bangiales sequenced from the New Zealand region).

Although the monophyly of the Bangiales had been shown to be well supported by a number of studies (e.g. Oliveira and Bhattacharya 2000, Müller et al. 2001, Saunders and Hommersand 2004), Oliveira et al. (1995) demonstrated that neither of the two genera traditionally recognised in the order on the basis of gametophyte morphology (*Bangia* for filaments, *Porphyra* for foliose species) were monophyletic. A series of subsequent studies (e.g. Müller et al. 1998, Broom et al. 1999, 2004, Oliveira and Bhattacharya 2000, Lindstrom and Fredericq 2003, Nelson et al. 2006, Lindstrom 2008) provided further evidence of the diversity within the order and the need for segregate genera. Sutherland et al. (2011) revised the order Bangiales, recognising 15 genera of which eight are foliose. *Porphyra columbina* is now placed in the genus *Pyropia* (*Py. columbina* (Mont.) W.A.Nelson).

The rosette-forming species of *Pyropia*, previously referred to as ROS54, is formally described here.

## Materials and methods

This study is based on specimens of foliose Bangiales collected from throughout the New Zealand region, particularly from the North, South and Chatham Islands from 1987 to 2012, as part of diversity surveys. Voucher material is deposited in the her-

barium of the National Museum of New Zealand Te Papa Tongarewa (WELT, Thiers 2012). Selected examples have been used for molecular sequence analyses (e.g. Broom et al. 1999, Nelson et al. 2006, Sutherland et al. 2011) as well as cell wall polysaccharide investigations (Hemmingson and Nelson 2002). Terminology for packets of reproductive cells follows Nelson et al. (1999).

## Taxonomy

### *Pyropia plicata* W.A.Nelson, sp. nov.

[http://species-id.net/wiki/Pyropia\\_plicata](http://species-id.net/wiki/Pyropia_plicata)

Figures 1–7

**Diagnosis.** Blades circular to folded rosettes, strongly attached centrally by rhizoidal holdfast. Blades (1.5) 4–12 (42) cm in diameter. Colour purple to grey, bleaching to khaki-green on upper edges. Blades monostromatic, margin irregular bordered by pale cells. Monoecious, fertile regions marginal with intermixed sterile cells; zygotosporangia large, deep red to maroon, lozenge-shaped ( $a/4-8 \times b/4-8 \times c/4-8$ ), spermatangia golden ( $a/2, b/2, c/8$ ). Found in the upper to mid intertidal zone on open coasts.

**Holotype.** WELT A032582 (Figure 1).

**Type locality.** North Island, Wellington, Island Bay, W. Nelson, 22 Aug 1990.

**Distribution.** New Zealand - North I., South I., Chatham Is.

**Sequence data.** GenBank - nSSU – AF136426, *rbcL* – GU046410, voucher specimen = WELT A024408.

**Etymology.** *plicata* – folded or pleated.

**Description.** The blades of *Pyropia plicata* are deeply folded and when fully extended are seen to have a circular to oval shape. The blades are very variable in size, generally in the range of 4–12 cm in diameter although reproductively mature thalli have been found to range from 1.5 cm through to 42 cm in diameter. The thalli are attached to rock substrata by a centrally located holdfast, made up of rhizoids extending from cells in the lower (central) area of the blade. The thalli are robust and very strongly attached to rock substrata in the upper intertidal zone of rocky open coasts (Figure 2). Thalli are primarily purple to grey in colour, but they become bleached particularly in summer and autumn and become khaki to yellow-green particularly on the upper edges.

Thalli are monostromatic and monoecious. Sterile regions of the blades are ca. 50–55  $\mu\text{m}$  thick and the margin of the blade has a ragged or irregular appearance bordered by several layers of small pale cells (Figure 3). Fertile regions of the blade develop around the margins with sterile cells intermixed with patches of spermatangia and presumed zygotosporangia (Figure 4).

In the early stages of development spindle-shaped carpogonia form trichogynes on both sides of the blade, in marked contrast to the box-like shape of the neighbouring sterile cells (Figure 5). Blades increase in thickness to ca. 85–110  $\mu\text{m}$  in zygotosporangial regions (Figure 6) and ca. 60–70  $\mu\text{m}$  in mature spermatangial regions

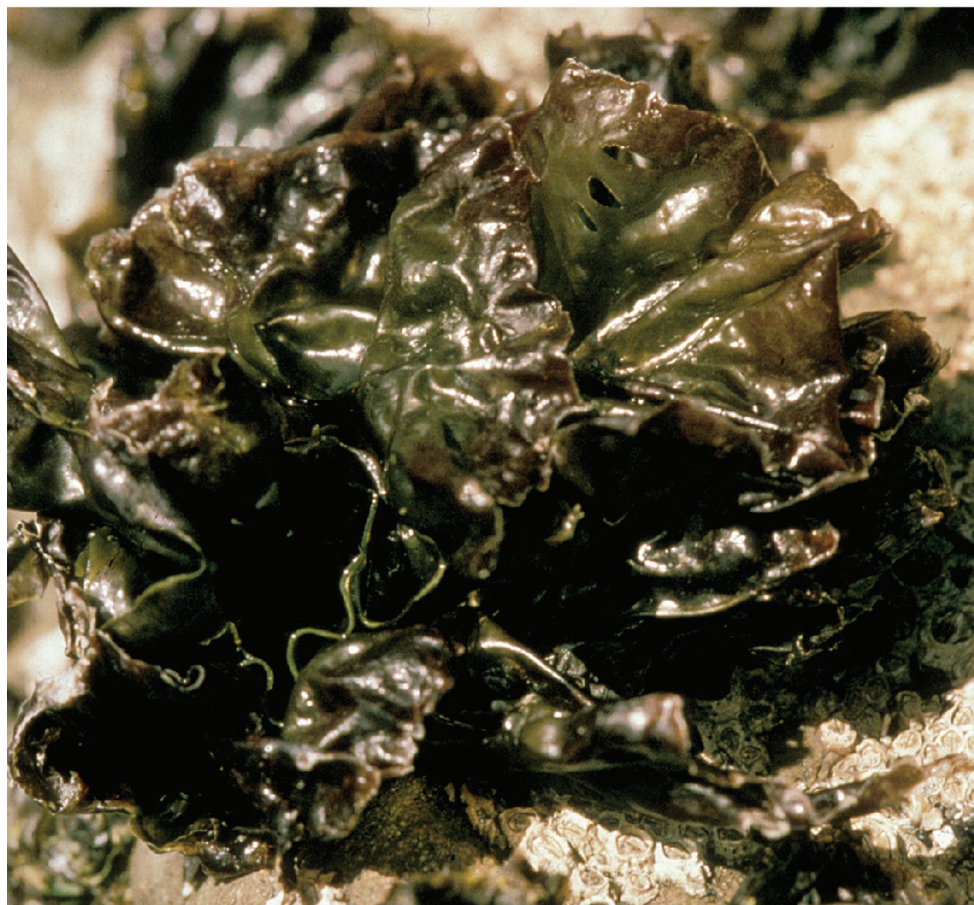


**Figure 1.** Holotype of *Pyropia plicata* sp. nov. (WELT A A032582). Scale bar = 5 cm.

(Figure 7). The zygotosporangia when mature are deep red and the packets vary in size, becoming lozenge shaped at maturity with divisions up to  $a/8$ ,  $b/8$ ,  $c/8$  (Figure 6). The spermatangial patches become golden as they develop and when mature are divided into packets ca.  $a/2$ ,  $b/2$ ,  $c/8$  (Figure 7). Spermatia and zygotospores are usually released before reaching the maximum division formulae.

Typically *Pyropia plicata* is found on the upper intertidal shores of open coasts on rocky substrata. It has not been found growing epiphytically and is uncommon in sheltered areas. The deep pleats and central attachment of *P. plicata* enable the retention of moisture between the folds in the blade. This morphology would appear



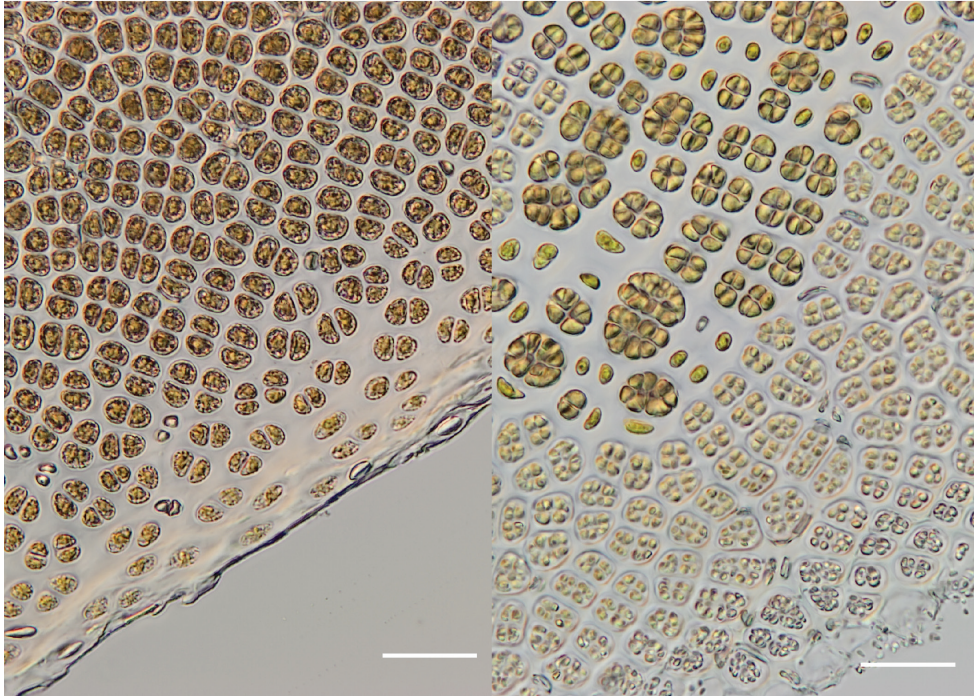


**Figure 2.** *Pyropia plicata* exposed at low tide on upper intertidal rocks (ca 5 cm high).

to be advantageous in the upper intertidal habitats where it is found, as this species can be out of water for periods of up to eight hours between tidal cycles. The outer part of a clump of *P. plicata* may be dried with a cellophane-like appearance yet within the folds, parts of the blade remain wet.

*Pyropia plicata* shows no particular seasonal trends in its distribution, with reproductively mature specimens collected throughout the year. Collections of this species have been made from the northern tip of the North Island, through to areas on the south western and south eastern South Island, as well as on the Chatham Islands. It has not been found on the Three Kings Islands, Stewart Island, or any of the New Zealand subantarctic islands.

Distinctive features: *Pyropia plicata* can be distinguished from other New Zealand species of bladed Bangiales by a number of distinctive features. It is the only species of *Pyropia* present on mainland shores with a marked rosette-like growth form. Although the ribbon-like blades of *P. cinnamomea* may become eroded with age, the basal position of the holdfast in this species differs from *P. plicata*. In addition, these two species can

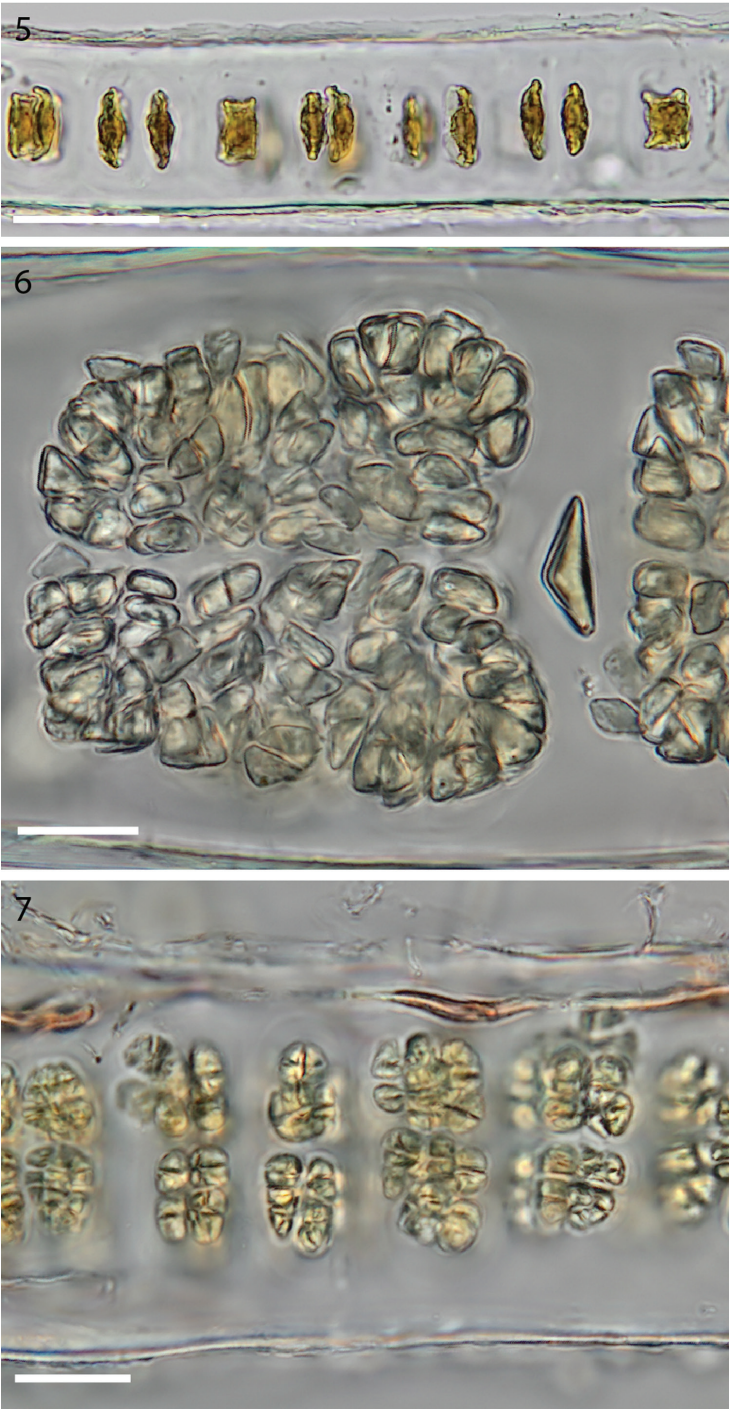


**Figure 3–4. 3** (left): Vegetative region of the blade showing the margin with small pale cells. (WELT A032593) **4** (right): Fertile region of the blade with packets of developing zygotosporangia (larger, darker-coloured clusters), single sterile cells (between zygotosporangia) and packets of spermatangia (smaller, paler-coloured clusters) releasing at the blade margin. (WELT A032593). Scale bar = 50  $\mu\text{m}$ .

be distinguished by colour, and also by the division formulae of zygotosporangia. On intertidal shores *P. plicata* is characteristically found in the high intertidal but below the position occupied by *Cllymene coleana* (W.A.Nelson) W.A.Nelson from which it can be easily distinguished. *Cllymene coleana* has finely divided finger-like lobes rather than the continuous circular to oval deeply pleated blade of *P. plicata*. Although both of these species have a predominantly grey colour in winter months, they bleach to different colours in bright light, with *C. coleana* becoming golden compared with the khaki colour of *P. plicata*. In addition the zygotosporangia and spermatangia are arranged in separate areas of the blade in *C. coleana* rather than being intermixed in *P. plicata*.

**Selected specimens examined: NEW ZEALAND. North Island. North Auckland:** Far North, east Tapotupotu Bay, 13 Nov 2001, R. Dunmore, WELT A030179 (34°26.1080'S, 172°43.0050'E); Muriwai Beach, Maori Bay (Maukatia), 04 Apr 2000, W. Nelson, T. Farr & G. Williams, WELT A024784 (36°50.30'S, 174°25.90'E). **Bay of Plenty:** Tauranga, Mount Maunganui main beach, 05 May 2000, G. Williams & T. Farr, WELT A024775 (37°38.00'S, 176°11.00'E); Maketu, Okurei Point East, 05 May 2000, T. Farr & G. Williams, WELT A024772 (37°44.95'S, 176°28.37'E). **Wellington:** Wellington City Harbour, Frank Kitts Lagoon reclamation, 12 Feb 2001, W. Nelson & T. Farr, WELT A030170 (41°17.20'S, 174°46.90'E); Lyall Bay,





**Figure 5–7.** **5** Cross section of monostromatic blade showing square sterile cells and spindle-shaped developing carpogonia. (WELT A032593) **6** Cross section view of mature zygotosporengia. (WELT A032593) **7** Cross section view of mature spermatangia. (WELT A032593). Scale bar **5**: 50  $\mu\text{m}$ , **6–7**: 20  $\mu\text{m}$ .

5 Nov 2012, W. Nelson, WELT A032593 (41°21.0'S, 174°48.00'E; Southern Wairarapa, Ngawihi, 26 Oct 2000, W. Nelson, T. Farr & G. Williams, WELT A024816 (41°36.00'S, 175°14.00'E).

**Chatham Islands.** Reef at Owenga wharf, 10 Mar 2001, W. Nelson, J. Broom, W. Jones, T. Farr & M. Clayton, WELT A030169 (44°01.50'S, 176°22'W).

**South Island. Marlborough:** D'Urville Island, Bonne Point, 20 Sep 1999, W. Nelson & G. Williams, WELT A031087 (40°52.00'S, 173°55.00'E).

Kaikoura, Ocean View, 18 Oct 1997, W. Nelson, WELT A024408 (42°31'S, 173°30'E). **Westland:** West coast, Charleston, Constant Bay, 10 Mar 2000, W. Nelson & T. Farr, WELT A024727 (41°54.20'S, 171°26.00'E); Punakaiki, 12 Mar 2000, W. Nelson & T. Farr, WELT A024793 (42°06.70'S, 171°20.00'E). **Canterbury:** Banks Peninsula, Avon Heathcote estuary, 20 Mar 2000, J. Broom, WELT A023952 (43°33.00'S, 172°44.00'E); Christchurch, Sumner, Cave Rock, 20 Mar 2000, J. Broom, WELT A023953, also, 26 Jun 2005, J. Broom & S. Heesch, WELT A023946 (43°33.9370'S, 172°45.5190'E); Lyttelton Harbour, Corsair Bay, 17 Sep 2001, M. Parsons, W. Jones & K. Neill, WELT A030172 (43°37.00'S, 172°42.00'E). **Otago:** Purakanui, 19 Apr 2000, K. Neill, WELT A023949 (45°45.00'S, 170°38.00'E); Dunedin, Brighton, 22 Oct 1999, J. Broom & W. Nelson, WELT A023956 (45° 57.05' S 170°20.00'E). **Southland:** Catlins, Kaka Point, 28 Apr 2005, S. Heesch & J. Broom, WELT A031597 (46°23.010'S, 169°47.140'E); Fiordland, Edwardson Sound, Chalky Inlet, 23 Feb 2000, G. Williams, WELT A024786 (45°55.983'S, 166°38.067'E).

## Discussion

A major problem in Bangiales taxonomy has been the incorrect application of names, making studies of the ecology and comparative physiology of species exceedingly difficult. The need for molecular sequence data in Bangiales taxonomic studies has been emphasised by many authors over the past decade in order to clarify species concepts as well as the phylogenetic relationships amongst taxa (e.g. Lindstrom and Fredericq 2003, Nelson et al. 2006). Such data have led to the discovery of cryptic taxa amongst species with very similar morphologies (e.g. Brodie and Irvine 1997, Broom et al. 2002, 2004, Neefus et al. 2002, Lindstrom and Fredericq 2003, Brodie et al. 2007, Lindstrom 2008). Descriptions of foliose members of the Bangiales have traditionally emphasised features such as blade shape and size, colour, and texture, in addition to division formulae for spermatangia and phyllosporangia, number of cell layers, number of plastids (e.g. summarised in Lindstrom and Cole 1993). In addition to external morphology (including marginal structure) and reproductive features, Miyata and Kikuchi (1997) also found seasonality and habitat (whether species are epiphytic or epilithic) to be of value taxonomically when distinguishing species of bladed Bangiales in Japan.

As circumscribed by Sutherland et al. (2011), the genus *Pyropia* encompasses species displaying a wide range of morphological forms, a wide colour spectrum and at least four different types of arrangements of reproductive regions on sexual thalli. This



genus is the most speciose of the Bangiales, and it also has the widest geographic distribution, with species occurring from tropical to cold temperate waters. *Pyropia plicata* has been recognised in the flora of mainland New Zealand for a long time, but has remained without a formal name as a result of confusion over the application of the name *P. columbina*. This situation was able to be clarified only after material collected in the subantarctic islands became available for study (Nelson and Broom 2010). Although mature thalli of *Pyropia plicata* range widely in size and also in colour, the fundamental shape of the blade, and the arrangement of reproductive regions are consistent, and enable this species to be readily distinguished. Within the genus *Pyropia*, *P. plicata* is grouped within a clade of at least 15 southern hemisphere species. The majority of these species are currently undescribed but the clade includes *P. virididentata*, *P. cinnomomea* and *P. columbina* (Broom et al. 2010, Sutherland et al. 2011).

## Acknowledgements

I would like to thank Jenn Dalen for assistance with access to the herbarium and the registration of voucher material at Te Papa, and the many people who have assisted with field work and collections, particularly Judy Sutherland (Broom), Tracy Farr, and Kate Neill, as well as Margaret Clayton, Anne Conroy, Robyn Dunmore, Svenja Heesch, Wyn Jones, Glenys Knight, Peter de Lange, Murray Parsons, Louise Phillips, and Gina Williams. Erika Mackay is thanked for assistance with the figures. Funding for this research has been from the New Zealand Foundation for Research Science Technology, now MBIE Core Funding to NIWA (COBR1301).

## References

- Acleto C, Endo J (1977) Las especies peruanas de *Porphyra* (Rhodophyta, Bangiales). I. Taxonomía y distribución geográfica. Publicaciones del Museo de Historia Natural 'Javier Prado', Serie B, Botánica 29: 1–19.
- Adams NM (1994) Seaweeds of New Zealand. Canterbury University Press, Christchurch, 360 pp.
- Brodie J, Irvine LM (1997) A comparison of *Porphyra dioica* sp. nov. and *P. purpurea* (Roth) C. Ag. (Rhodophyta: Bangiophycidae) in Europe. Cryptogamie, Algologie 18: 283–97.
- Brodie J, Bartsch I, Neefus C, Orfanidis S, Bray T, Mathieson AC (2007) New insights into the cryptic diversity of the North Atlantic-Mediterranean '*Porphyra leucosticta*' complex: *P. olivii* sp. nov. and *P. rosenburgtii* (Bangiales, Rhodophyta). European Journal of Phycology 42: 3–28. doi: 10.1080/09670260601043946
- Broom JE, Jones WA, Hill DF, Knight GA, Nelson WA (1999) Species recognition in New Zealand *Porphyra* using 18S rDNA sequencing. Journal of Applied Phycology 11: 421–428. doi:10.1023/A:1008162825908
- Broom JE, Nelson WA, Yarish C, Jones WA, Aguilar Rosas R, Aguilar Rosas LE (2002) A reassessment of the taxonomic status of *Porphyra suborbiculata*, *Porphyra carolinensis* and

- Porphyra lilliputiana* (Bangiales, Rhodophyta) based on molecular and morphological data. *European Journal of Phycology* 37, 227–35. doi: 10.1017/S0967026202003566
- Broom JES, Farr TJ, Nelson WA (2004) Phylogeny of the *Bangia* (Rhodophyta) flora of New Zealand suggests a southern origin for *Porphyra* and *Bangia*. *Molecular Phylogenetics and Evolution* 31: 1197–1207. doi: 10.1016/j.ympev.2003.10.015
- Broom JES, Nelson WA, Farr TJ, Phillips LE, Clayton MN (2010) A molecular survey of the summer *Porphyra* (Bangiales, Rhodophyta) flora of the Falkland Islands using *rbcL* and *nSSU* sequence data. *Australian Systematic Botany* 23: 27–37. doi: 10.1071/SB09033
- Chapman VJ (1969) The marine algae of New Zealand. Part III: Rhodophyceae. Issue 1: Bangiophycidae and Florideophycidae (Nemalionales, Bonnemaisoniales, Gelidiales). Cramer, 1–113, figs 1–35, pls 1–38.
- Hemmingson JA, Nelson WA (2002) Cell wall polysaccharides are informative in *Porphyra* species taxonomy. *Journal of Applied Phycology* 14: 357–364. doi:10.1023/A:1022110722705
- Howe MA (1914) The marine algae of Peru. *Memoirs of the Torrey Botanical Club* 15: 1–185.
- Jones WA, Griffin NJ, Jones DT, Nelson WA, Farr TJ, Broom JE (2004) Phylogenetic diversity in South African *Porphyra* (Bangiales, Rhodophyta) determined by nuclear SSU sequence analysis. *European Journal of Phycology* 39: 197–211. doi:10.1080/0967026042000202145
- Laing RM (1928) New Zealand Bangiales (*Bangia*, *Porphyra*, *Erythrotrichia* and (?) *Erythrocladia*). *Transactions and Proceedings of the New Zealand Institute* 59: 33–59.
- Levring T (1953) The marine algae of Australia. I. Rhodophyta: Goniotrichales, Bangiales and Nemalionales. *Arkiv för Botanik Series* 2(2): 457–530.
- Levring T (1955) Contributions to the marine algae of New Zealand. I. Rhodophyta: Goniotrichales, Bangiales, Nemalionales and Bonnemaisoniales. *Arkiv för Botanik Series* 2(3): 407–432.
- Levring T (1960) Contributions to the marine algal flora of Chile. *Lunds Universitets Årsskrift, Ny Följd, Andra Afdelningen II* 56(10): 1–85.
- Lindstrom SC (2008) Cryptic diversity, biogeography and genetic variation in northeast Pacific species of *Porphyra* sensu lato (Bangiales, Rhodophyta). *Journal of Applied Phycology* 20: 951–62. doi: 10.1007/s10811-008-9313-9
- Lindstrom SC, Cole KM (1993) The systematics of *Porphyra*: character evolution in closely related species. *Hydrobiologia* 260/261: 151–157. doi: 10.1007/BF00049014
- Lindstrom SC, Fredericq S (2003) *rbcL* gene sequences reveal relationships among north-east Pacific species of *Porphyra* (Bangiales, Rhodophyta) and a new species, *P. aestivalis*. *Phycological Research* 51: 211–24. doi: 10.1111/j.1440-1835.2003.tb00189.x
- Miyata M, Kikuchi N (1997) Taxonomic study of *Bangia* and *Porphyra* (Bangiaceae, Rhodophyta) from Boso Peninsula, Japan. *Natural History Research, Special Issue* 3: 19–46.
- Montagne C (1842) *Prodromus generum specierumque phycearum novarum*. In 'Itinere ad polum antarcticum...ab illustri Dumont d'Urville peracto collectarum, notis diagnosticis tantum huc evulgatarum, descriptionibus verò fusioribus nec no iconibus analyticis jam jamque illustrandarum'. Paris, [1–]16.
- Montagne C (1845) *Plantes cellulaires*. In: Hombron JB, Jacquinot H. (Eds) *Voyage au Pôle Sud et dans l'Océanie sur les corvettes l'Astrolabe et la Zélée...pendant les années 1837–*

- 1838–1839–1840, sous le commandement de M. J. Dumontd'Urville. Botanique. Vol. 1. Paris, i–xiv, 1–349.
- Müller KM, Oliveira MC, Sheath RG, Bhattacharya D (2001) Ribosomal DNA phylogeny of the Bangiophycidae (Rhodophyta) and the origin of secondary plastids. *American Journal of Botany* 88: 1390–400. doi: 10.2307/3558445
- Müller KM, Sheath RG, Vis ML, Crease TJ, Cole KM (1998) Biogeography and systematics of *Bangia* (Bangiales, Rhodophyta) based on the Rubisco spacer, *rbcL* gene and 18S rRNA gene sequences and morphometric analyses. *Phycologia* 37: 195–207. doi: 10.2216/i0031-8884-37-3-195.1
- Neefus CD, Mathieson AC, Klein AS, Teasdale B, Gray T, Yarish C (2002) *Porphyra birdiae* sp. nov. (Bangiales, Rhodophyta): a new species from the northwest Atlantic. *Algae* 17: 203–16. doi: 10.4490/ALGAE.2002.17.4.203
- Nelson WA, Brodie J, Guiry MD (1999) Terminology used to describe reproduction and life history stages in the genus *Porphyra* (Bangiales, Rhodophyta). *Journal of Applied Phycology* 11: 407–410. doi:10.1023/A:1008174307352
- Nelson WA, Broom JES (2005) Contributions of molecular biology to understanding systematics and phylogeny in the order Bangiales. *Natural History Research Special Issue* 8: 1–12.
- Nelson WA, Broom JES (2010) The identity of *Porphyra columbina* (Bangiales, Rhodophyta) originally described from the New Zealand subantarctic islands. *Australian Systematic Botany* 23: 16–26. doi: 10.1071/SB09032
- Nelson WA, Broom JE, Farr TJ (2001) Four new species of *Porphyra* (Bangiales, Rhodophyta) from the New Zealand region. *Cryptogamie, Algologie* 22: 263–284. doi: 10.1016/S0181-1568(01)01060-1
- Nelson WA, Conroy AM (1989) Effect of harvest method and timing on yield and regeneration of Karengo (*Porphyra* spp.) Bangiales, Rhodophyta) in New Zealand. *Journal of Applied Phycology* 1: 277–283. doi: 10.1007/BF00003654
- Nelson WA, Farr TJ, Broom JES (2006) Phylogenetic relationships and generic concepts in the red order Bangiales: challenges ahead. *Phycologia* 45: 249–259. doi:10.2216/05-26.1
- Oliveira MC, Bhattacharya D (2000) Phylogeny of the Bangiophycidae (Rhodophyta) and the secondary endosymbiotic origin of algal plastids. *American Journal of Botany* 87: 482–92. doi: 10.2307/2656591
- Oliveira MC, Kurniawan J, Bird CJ, Rice EL, Murphy CA, Singh RK, Gutell RR, Ragan MA (1995) A preliminary investigation of the order Bangiales (Bangiophycidae, Rhodophyta) based on sequences of nuclear small-subunit ribosomal RNA genes. *Phycological Research* 43: 71–9. doi: 10.1111/j.1440-1835.1995.tb00007.x
- Ramírez ME, Santelices B (1991) Catálogo de las algas marinas bentónicas de la costa temperada del Pacífico de Sudamérica. *Monografías Biológicas* 5: 1–437.
- Ricker RW (1987) Taxonomy and biogeography of Macquarie Island seaweeds. *British Museum (Natural History)*, London, 344 pp.
- Saunders GW, Hommersand MH (2004) Assessing red algal supraordinal diversity and taxonomy in the context of contemporary systematic data. *American Journal of Botany* 91: 1494–1507. doi: 10.3732/ajb.91.10.1494

- Sutherland J, Lindstrom S, Nelson W, Brodie J, Lynch M, Hwang MS, Choi HG, Miyata M, Kikuchi N, Oliveira M, Farr T, Neefus C, Mols-Mortensen A, Milstein D, Müller K (2011) A new look at an ancient order: generic revision of the Bangiales. *Journal of Phycology* 47: 1131–1151. doi: 10.1111/j.1529-8817.2011.01052.x
- Taylor WR (1947) Algae collected by the ‘Hassler’, ‘Albatross’ and Schmitt Expeditions. II. Marine algae from Peru and Chile. *Papers of the Michigan Academy of Sciences. Arts and Letters* 1: 57–90.
- Thiers B (2012 – continuously updated) ‘Index herbariorum: a global directory of public herbaria and associated staff.’ New York Botanical Garden’s Virtual Herbarium. Available at <http://sweetgum.nybg.org/ih/>
- Womersley HBS (1994) The marine benthic flora of southern Australia. Rhodophyta – part IIIA. Australian Biological Resources Study. Canberra, 508 pp.
- Womersley HBS, Conway E (1975) *Porphyra* and *Porphyropsis* (Rhodophyta) in southern Australia. *Transactions of the Royal Society of South Australia* 99: 59–70.



# *Allium formosum* Sennikov & Lazkov (Amaryllidaceae), a new species from Kyrgyzstan

Alexander N. Sennikov<sup>1</sup>, Georgy A. Lazkov<sup>2</sup>

**1** Botanical Museum, Finnish Museum of Natural History, P.O. Box 7, 00014 University of Helsinki, Finland; & Herbarium, Komarov Botanical Institute of Russian Academy of Sciences, Prof. Popov str. 2, 197376 St. Petersburg, Russia **2** Laboratory of Flora, Institute of Biology and Soil Science, Kyrgyz Academy of Sciences, 720071 Bishkek, Kyrgyzstan

Corresponding author: Alexander N. Sennikov (alexander.sennikov@helsinki.fi)

Academic editor: L. Peruzzi | Received 16 November 2012 | Accepted 8 March 2013 | Published 2 April 2013

**Citation:** Sennikov AN, Lazkov GA (2013) *Allium formosum* Sennikov & Lazkov (Amaryllidaceae), a new species from Kyrgyzstan. PhytoKeys 21: 29–36. doi: 10.3897/phytokeys.21.4130

## Abstract

*Allium formosum* Sennikov & Lazkov **sp. nov.** is described as new to science and illustrated. This species is the second member of *A.* sect. *Spathulata* F.O.Khass. & R.M.Fritsch, being different from *A. spathulatum* F.O.Khass. & R.M.Fritsch in larger, broader, obtuse and more intensely purple-coloured tepals, and in a more robust habit. It is a local endemic of Babash-Ata Mt. Range situated east of Fergana Valley in Kyrgyzstan, recommended for legal protection as Endangered because of the very small population size in its only locality.

## Keywords

Central Asia, conservation, endemism, hotspot, new species, plant protection, Western Tian-Shan

## Introduction

The genus *Allium* L. is highly speciose in the former Soviet part of Central Asia. The latest synopsis (Khassanov 2008) lists nearly 250 species and subspecies, and this number is constantly growing with descriptions of new species from nearly all mountainous areas of this region.

Kyrgyzstan is a Central Asian country with a rich native flora, assessed at nearly 3800 native species of vascular plants (Lazkov and Sultanova 2011) and still remaining seriously underexplored (Kamelin 2002). The old *Flora of Kirghiz SSR* (Nikitina and Kaschenko 1951) listed 67 species of *Allium*; this number has been significantly increased with a further exploration of the country by local botanists and *Allium* taxono-

mists. The current inventory is being performed after publication of the new checklist of vascular plants of Kyrgyzstan (Lazkov and Sultanova 2011) that counted 85 species of *Allium*, making an increase of 25% for the last 60 years.

During the years 2009–2011 botanists of the Botanical Museum of the University of Helsinki, in collaboration with the Institute of Biology and Soil Science of the Kyrgyz Academy of Sciences, made expeditions to collect plants in Kyrgyzstan. The expeditions focused on the most difficult and diverse taxonomic groups, with emphasis on local endemics. Several taxonomic novelties and new records resulted from these travels (Sennikov 2010, 2011; Sennikov et al. 2011). One of the new species belongs to *Allium* sect. *Spathulata* F.O.Khass. & R.M.Fritsch, and its description is presented here.

*Allium* sect. *Spathulata* was established (Khassanov 2000) for the single species *A. spathulatum* F.O.Khass. & R.M.Fritsch that was discovered only recently (Fritsch et al. 1998). This miniature plant has a very limited local occurrence and remained undetected in spite of its location within the limits of the famous Sary-Chelek Nature Reserve (Kyrgyzstan), where its type locality is situated nearby the headquarters of the Nature Reserve. These plants are so rare and minute that they were unnoticed for 100 years of botanical studies in the Nature Reserve.

When originally described, *A. spathulatum* was considered unique in *A.* subgen. *Allium* because of the presence of spathules and papyraceous tunics, ovoid bulbs, and the absence of bulblets (Khassanov 2000). Although this species was not included in the molecular phylogeny of *Allium* (Friesen et al. 2006) yet, which still embraces selected sections only, it was speculated to be less specialised in the subgenus from the primitive state of its several characters, e.g. an inflorescence with numerous long bracteoles (“spathules”), papery-like bulb tunics, and a symmetric karyotype with small satellites (Fritsch et al. 1998; Friesen et al. 2006).

## Materials and methods

A description of the new taxon and its relative is based on herbarium vouchers and field observations, following the standard used in the taxonomy of *Allium*. One population per species is used. Measures are taken from dried plants.

Distribution maps are compiled using R software environment for statistical computing and graphics (R Development Core Team 2008). The base maps are taken from the Digital Chart of the World, Arc/INFO resource provided by the Environmental Systems Research Institute, Inc., the Pennsylvania State University Libraries.

## Data resources

Specimen information is deposited in the database of records in vascular plants of Kyrgyzstan (Sennikov and Lazkov 2012) that is published also through the Global Biodiversity Information Facility (GBIF) and in the Dryad Data Repository at doi: 10.5061/dryad.pq87t

## Taxonomic treatment

***Allium formosum* Sennikov & Lazkov, sp. nov. (*Allium* sect. *Spathulata* F.O.Khass. & R.M.Fritsch)**

urn:lsid:ipni.org:names:77126319-1

[http://species-id.net/wiki/Allium\\_formosum](http://species-id.net/wiki/Allium_formosum)

Fig. 1

*Ab Allio spathulato statura majore (caulibus ad 30 cm, nec ad 20 cm altis), spathulis brevioribus paucioribus, floribus pluris (ad 30, nec ad 20), tepalis obscuriore roseolo-purpureis, longioribus (6–7.5 mm, nec 4–5.5 mm longis) latioribusque (2–2.5 mm, nec 2 mm latis), apice obtusioribus (nec acutis) basi subrotundis (nec distincte angustatis) differt.*

**Type.** Kyrgyzstan. Babash-Ata Range: Kara-Köl River valley, left riverside, alt. 1650 m, 41.53°N, 72.68°E, 14.07.2010, *A. Sennikov & G. Lazkov* 132 (H 1750496, holotype; isotypes FRU, H 1750497).

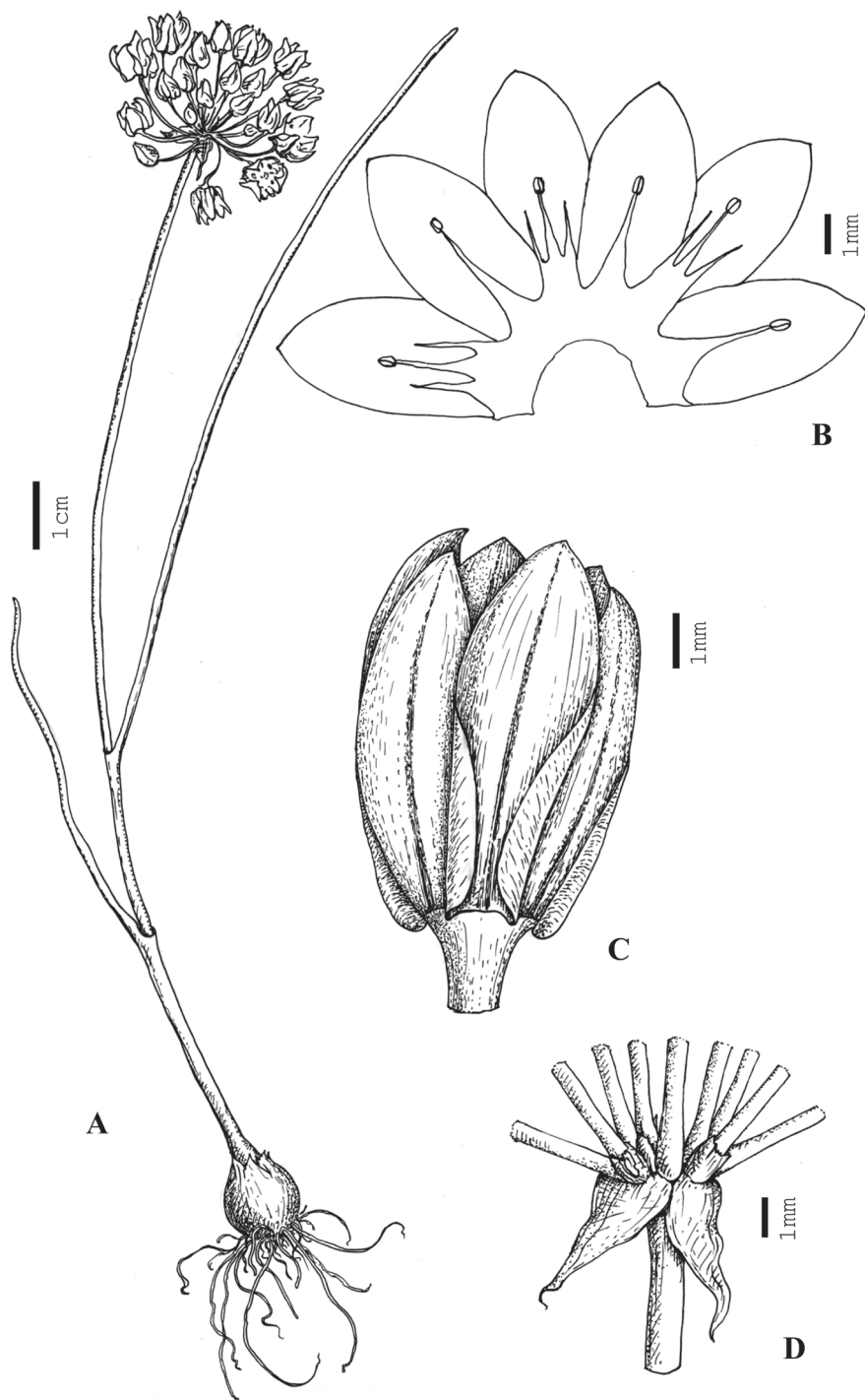
**Description.** Bulbs subglobose, 7–8 mm in diameter, ca. 8 mm long, inner tunics slightly violaceous, very thin, transparent, papyraceous, with several longitudinal nerves, outer ones light-grey, decomposing. Bulblets missing. Scape single, 20–25 (30) cm long, up to 1.5 mm in diameter, solid, dark green with a slight purple tint at the base. Leaves 2(3), linear, not exceeding the stems, upright, with the blade up to 20 cm long, ca. 1.5 mm wide, round-appressed and fistulose in the section, dark green, glabrous, with sheaths up to 10 cm long. Spathe membranous, completely divided into two elongate valves 4–6 mm long, reflexed. Inflorescence hemispherical, rather lax, with 7–30 developed flowers and ca. 5 abortive buds; pedicels thin, basally thickened, straight, dark-green, of the same length, ca. 1.5 cm long, some of them being embraced in narrow spathules ca. 1 mm long. Perianth cupuliform, intensively pinkish-purpureous in the upper two thirds, basally whitish, with dark-purpureous median veins. Tepals 6–7.5 mm long, 2–2.5 mm wide, oblong, obtuse at the apex, subrotund and only very slightly narrowed to the base. Filaments shorter than tepals, 2.5–3 mm long, white, connected and fused with sepals at the base, outer ones with the triangular base, inner ones broader, tricuspidate. Anthers ca. 0.4 mm long, yellow. Ovary ca. 2 mm long, 2–2.5 mm in diameter, subglobular. Style slightly over 1 mm long, white. Capsule and seeds not known.

**Phenology.** Flowering in July, fruiting unknown.

**Ecology.** The species occurs in the low-altitude forest zone (altitudes of ca. 1600–1700 m) in river valleys, on open sunny slopes with sparse savannoid vegetation, sheltered by stones. The plants grow clustered in small patches, suggesting the most successful establishment nearby mature plants (vegetative reproduction is not known in this section).

**Distribution.** Possibly a narrow endemic of Babash-Ata Mt. Range, Kyrgyzstan (Fig. 3), so far known from the type locality only.

**Proposed conservation status.** The distribution area of this species is like those of other local endemics of the mountains east of Fergana Valley. A single locality is known, where ca. 10 clusters of flowering plants were noticed. Even though no imme-



**Figure 1.** *Allium formosum*. **A** habit. **B** inner side of the perianth with stamens. **C** flower. **D** basal part of the umbel. Drawn from the type (H 1750496).



diate threat was observed, the area is in active use, first of all for grazing and mining. For this reason and because of the very limited distribution area and a small size of the only population known to date (criterion D: population size estimated to number fewer than 250 mature individuals), this taxon may be recommended for protection as Endangered (IUCN 2001).

**Etymology.** The new species is named because of its elegant habit and beautiful colouration of the perianth, transitional between deeply pink and purple; Lat. *formosum* = beautiful.

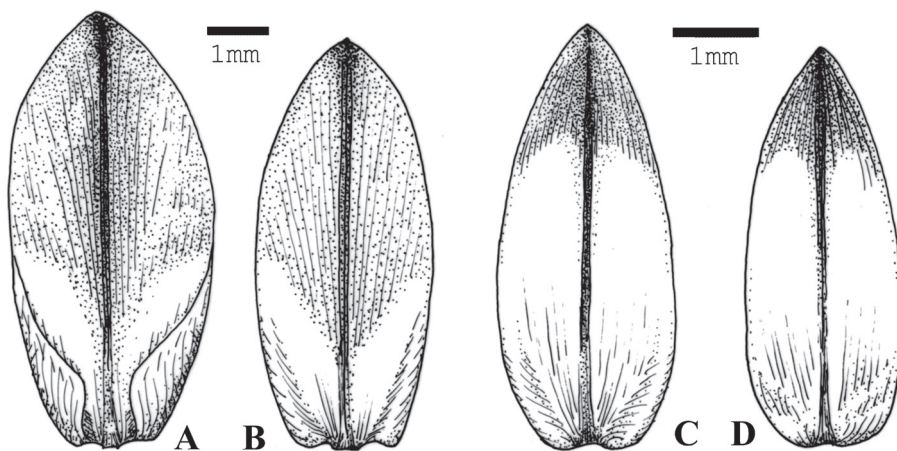
## Discussion

*Allium spathulatum* F.O.Khass. & R.M.Fritsch has been recently described from Chatkal Range, Sary-Chelek Nature Reserve, vicinities of Arkyt village (Fritsch et al. 1998). This species was recollected on 10.06.2010 by G. Lazkov from the slopes on the left side of Kojo-Ata River valley, situated immediately outside the entrance to Sary-Chelek Nature Reserve, in ca. 1 km from the original locality. The plants collected at that site (FRU, H 1750495, 1750506) were in a complete agreement with the protologue.

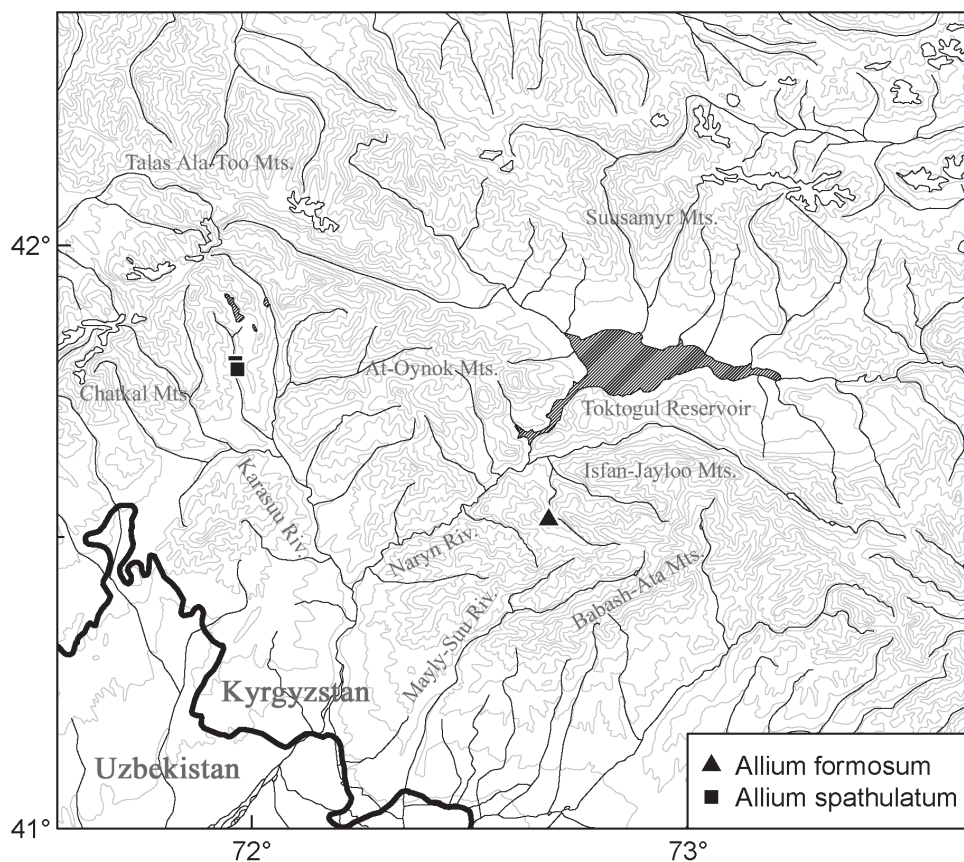
The plants from Babash-Ata Mts., Kara-Köl River differ from *A. spathulatum* mostly in having longer and broader tepals, which are obtuse at the apex and less narrowed to the base (Fig. 2), and in a larger size of the whole plant. The flowers seem to be more numerous. Some pedicels are embraced by spathules which are generally less developed (shorter and less numerous) than in *A. spathulatum*. These differences warrant the segregation of these plants into a separate taxon; the rank of species is preferred here because the differences are complex and constant. Another example of a similar distinction in the floral characters is the Central Asian pair *A. tianschanicum* Rupr. – *A. kokanicum* Regel, where major differences are also in the size and shape of tepals.

Another difference is observed in the shape of flowers which open less widely and thus look cupuliform in *A. formosum* (campanulate in *A. spathulatum*). However, this difference may appear dependent on weather conditions and needs to be proven by further observations.

The distance between the localities of *A. spathulatum* and *A. formosum*, both narrow endemics of mountains surrounding the eastern end of Fergana valley, is about 60 km (Fig. 3). The area of the eastern part of Chatkal Range and the northern outliers of Fergana Range (Babash-Ata and neighbouring mountains) is well known for the concentration of many narrow endemics, being a hotspot of plant diversity in Western Tian-Shan (Lazkov et al. 2002). The territories surrounding the eastern end of Fergana valley harbour many narrow endemics of *Allium* as well (see a brief review in Fritsch et al. 1998), and our discovery stresses the need of further explorations and plant protection in this area. Because of vulnerability of the species, we anticipate its inclusion in the forthcoming Red Data Book of Central Asia and the next edition of the Red Data Book of Kyrgyzstan.



**Figure 2.** *Allium formosum*. **A** outer tepal **B** inner tepal. Drawn from the type (H 1750496). *Allium spathulatum* **C** outer tepal **D** inner tepal. Drawn from Lazkov s.n. (H 1750506).



**Figure 3.** Distribution areas of *Allium formosum* and *Allium spathulatum*.

The present state of the *Allium* research in Central Asia, especially descriptions of new species that are still regularly published, clearly show that the species inventory in this speciose and difficult genus is far from complete. In the absence of elaborated molecular phylogenies we feel premature to speculate on the origin and age of our newly discovered species.

The members of *A. sect. Spathulata* may be keyed out as follows

- 1 Plants up to 20 cm tall. Tepals narrowly oblong, 4–5.5 mm long, 2 mm wide, acute at the apex and narrowed to the base, pinkish in the upper third ..... *A. spathulatum*
- Plants up to 30 cm tall. Tepals oblong, 6–7.5 mm long, 2–2.5 mm wide, obtuse at the apex, subrotund and very slightly narrowed to the base, intensely pinkish-purple in the upper two thirds..... *A. formosum*

#### Other specimens examined

*Allium spathulatum* F.O.Khass. & R.M.Fritsch

Kyrgyzstan. Chatkal Range (S side): immediately S of Sary-Chelek Nature Reserve, left side of Kojo-Ata River valley, on rocks, 41.7° N, 71.9° E, 10.06.2010, *G. Lazkov* (FRU, H 1750495, 1750506).

#### Acknowledgements

We are grateful to Sampsa Lommi (Helsinki) for the distribution map. Nijolė Kalinauskaitė (Helsinki) performed the drawing of the plant habit and Mikhail Kozhin (Moscow) has skilfully drawn the tepals. The field trip to Kyrgyzstan in 2010 was supported by Millennium Seed Bank (to G.L.) and Botanical Museum of the University of Helsinki (to A.S.). The text benefited from critical comments of two anonymous reviewers and the editors.

#### References

- Friesen N, Fritsch RM, Blattner FR (2006) Phylogeny and new intrageneric classification of *Allium* (Alliaceae) based on nuclear ribosomal DNA ITS sequences. *Aliso* 22: 372–395.
- Fritsch RM, Khassanov FO, Friesen NW (1998) New taxa, new combinations, and taxonomic remarks on *Allium* L. from Fergan depression, Middle Asia. *Linzer Biologische Beiträge* 30: 281–292.

- IUCN Species Survival Commission (2001) IUCN Red List Categories: Version 3.1. IUCN, Gland and Cambridge.
- Kamelin RV (2002) Brief survey of the vegetation of Kirghizia. Phytogeographical regions of Kirghizia. In: Pimenov MG, Kluykov EV, The Umbelliferae of Kirghizia. KMK Scientific Press, Moscow, 3–18.
- Khassanov FO (2000) Subinfrageneric grouping in genus *Allium* subgenus *Allium*. In: Ashurmetov O, Khassanov F, Salieva Y (Eds) Plant life in South-West and Central Asia (5th International symposium, Tashkent '98). Chinor ENK, Tashkent, 107–112.
- Khassanov FO (2008) The genus *Allium* L. in the flora of Central Asia. Abstract of Thesis for the Degree of Dr. Sci. in Biology. Scientific-Applied Research Centre “Botany”, Uzbek Academy of Sciences, Tashkent.
- Lazkov GA, Sultanova BA (2011) Checklist of vascular plants of Kyrgyzstan. *Norrinia* 24: 1–166.
- Lazkov GA, Sultanova BA, Kenjebaeva NV (2002) The level of studies on the flora of the Western Tian-Shan within Kyrgyzstan and the centres of its local endemism. In: Shukurov EJ (Ed.) Biodiversity of Western Tian-Shan: Achievements and prospects. Proceedings of the scientific conference, Bishkek, 26 Dec 2001. Central Asia Transboundary Biodiversity Project, Bishkek, 172–175.
- Nikitina EV, Kaschenko LI (1951) *Allium* L. In: Vvedensky AI (Ed.), Flora of Kirghiz SSR. Academy of Sciences of the Kirghiz SSR, Frunze, 3: 50–96.
- R Development Core Team (2008) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna.
- Sennikov AN (2010) A revision of *Cousinia* sections *Alpinae* (syn. *Carduncellus*), *Subappendiculatae* and *Tianschanicae* (Asteraceae) in the Kirghizian Tian-Shan and the neighbouring territories. *Phytotaxa* 5: 1–30.
- Sennikov AN (2011) *Cousinia hystricocephala* (section *Tianschanicae*, Asteraceae), a new species from Central Asia. *Phytotaxa* 25: 23–30.
- Sennikov AN, Lazkov GA (2012–, continuously updated) Distribution records in vascular plants of Kyrgyzstan (according to herbarium specimens kept at the Botanical Museum, University of Helsinki). <http://archive.org/details/DistributionRecordsOfVascularPlant-sInKyrgyzstan> (accessed 13.11.2012)
- Sennikov AN, Lazkov GA, Uotila P, Weber H (2011) Taxonomic corrections and new records in vascular plants of Kyrgyzstan. *Memoranda Societatis pro Fauna et Flora Fennica* 87: 41–64.

# A synopsis of *Harperocallis* (Tofieldiaceae, Alismatales) with ten new combinations

Lisa M. Campbell<sup>1</sup>, Laurence J. Dorr<sup>2</sup>

**1** The New York Botanical Garden, Bronx, New York 10458, USA **2** Department of Botany, National Museum of Natural History, MRC-166, Smithsonian Institution, P.O. Box 37012, Washington, D.C. 20013–7012, USA

Corresponding author: Lisa M. Campbell (lcampbell@nybg.org)

Academic editor: W. John Kress | Received 12 February 2013 | Accepted 28 April 2013 | Published 9 May 2013

**Citation:** Campbell LM, Dorr LJ (2013) A synopsis of *Harperocallis* (Tofieldiaceae, Alismatales) with ten new combinations. *PhytoKeys* 21: 37–52. doi: 10.3897/phytokeys.21.4859

## Abstract

Ten new combinations from *Asagraea*, *Isidrogaliva*, and *Tofieldia* are proposed in the previously monospecific genus *Harperocallis* (Tofieldiaceae, Alismatales). As circumscribed here, the genus is restricted to the Americas. The majority of species occur in the Andes or the Guayana region of northern South America; more than half have restricted distributions, and *H. flava* is narrowly endemic in the Coastal Plain of the southeastern United States. A key to species, synonymies, distributions, representative specimens, and salient notes are presented. Populations of the species are mapped and *H. robustior* is illustrated. A neotype is selected for *Tofieldia frigida*, here considered a synonym of *H. falcata*. Several recent records of *H. longiflora*, previously known only from the type collected in 1902, are reported.

## Resúmen

Se proponen diez nuevas combinaciones de *Asagraea*, *Isidrogaliva*, and *Tofieldia* en *Harperocallis* (Tofieldiaceae, Alismatales), un género previamente monoespecífico. Como se circunscribe aquí, el género se restringe a las Américas. La mayoría de las especies se encuentran en los Andes o en la región de Guayana, en el norte de América del Sur. Más de la mitad tienen distribuciones restringidas, y *H. flava* es estrictamente endémica en la llanura costera del sudeste de los Estados Unidos. Se presenta una clave para distinguir las especies, sinonimias, distribuciones, muestras representativas y notas salientes. Se mapearon poblaciones de las especies y se ilustra *H. robustior*. Se seleccionó un neotipo para *Tofieldia falcata*, considerado aquí como un sinónimo de *H. falcata*. Se reportan algunos registros adicionales de *H. longiflora*, especie anteriormente conocida sólo con el tipo colectado en 1902.

## Keywords

Andes, Coastal Plain, Florida, Guayana region, *Isidrogalvia*, monocot, nomenclature, *Tofieldia*



## Introduction

When Ruiz and Pavon (1802) established the genus *Isidrogalvia* Ruiz & Pav. they described and illustrated a single species, *I. falcata* Ruiz & Pav. This species was collected in Peru, but it is clear from their protologue that they did not intend to recognize a genus restricted to South America as they stated that the European species *Anthericum calyculatum* L. should be referred to their new genus (“Ad hoc Genus referendum est *Anthericum calyculatum* Linn.”). This European species is the type of the generic name *Tofieldia* Huds., which when published by Hudson (1787) included only one named species, *T. palustris* Huds., a name superfluous for, and homotypic with, *A. calyculatum* (McNeill et al. 2012; Arts 7.5 & 52). Thus, Ruiz and Pavon (1802) inadvertently created a generic synonym of *Tofieldia*.

The nomenclatural implications of this synonymy were overlooked when the South American taxa were revised by Cruden (1991) and when additional South American taxa were transferred to or described in *Isidrogalvia* (Cruden and Dorr 1992, Remizowa 2007, Campbell 2010). Concurrently, recognition of a distinct South American genus was reinforced as palynological (Mosyakin et al. 2009, Campbell 2010), morphological (Remizowa et al. 2010, 2011), and molecular data (Azuma and Tobe 2011) revealed that these South American taxa were distinct from *Tofieldia*. Phylogenetic analyses of molecular (Azuma and Tobe 2011) and morphological data (Remizowa et al. 2011) resolved the monospecific North American *Harperocallis* McDaniel (1968) as sister to the South American taxa (Azuma and Tobe 2011), or as derived with that lineage, and *H. flava* McDaniel was transferred to *Isidrogalvia* (Remizowa et al. 2011). Long known from only three populations, recent field surveys revealed additional populations (Leonard and Baker 1983, Walker and Silletti 2005, Keppner and Anderson 2008) of this endangered species (US Fish and Wildlife Service 1991, see also Pitts-Singer et al. 2002). *Harperocallis flava*, nonetheless, remains narrowly endemic and has low infraspecific genetic diversity (Godt et al. 1997).

Due to the nomenclatural consequences of Ruiz and Pavon’s synonymy (1802), Sokoloff et al. (2011) proposed conservation of the genus *Isidrogalvia* with a conserved type, *I. falcata*, a reasonable solution given that all recent literature treating the South American taxa (see Sokoloff et al. 2011) had employed the generic name *Isidrogalvia*. This proposal, however, was rejected (Applequist 2012) as the Nomenclature Committee for Vascular Plants indicated that they preferred to follow the rule of priority (McNeill et al. 2012; Art. 11.4). Consequently, we propose the following ten transfers of names first published in *Asagraea* Lindl., *Isidrogalvia*, or *Tofieldia* to *Harperocallis*.

## Methods

Herbarium specimens or their images (indicated by an identifier in brackets) were examined from the following herbaria (herbarium abbreviations follow Index Herbariorum, <http://sweetgum.nybg.org/ih>): A, B-W (Röpert 2000), BC (Courtesy of JSTOR

2012), BM (Courtesy of JSTOR 2012), BRIT (BRIT Virtual Herbarium), F (The Field Museum 2013), FLAS (Florida Museum of Natural History 2013), FSU (Mast et al. 2004), FTG, GH, K (Courtesy of JSTOR 2012), MA (Courtesy of JSTOR 2012), MO, NY, P (Muséum National d'Histoire Naturelle 2012), PH (Courtesy of JSTOR 2012), PORT, US, and VEN. Measurements were obtained visually and augmented from literature (*Asagraea* and *Harperocallis flava*).

## Nomenclatural synopsis

***Harperocallis* McDaniel, J. Arnold Arbor. 49(1): 36. 1968.**

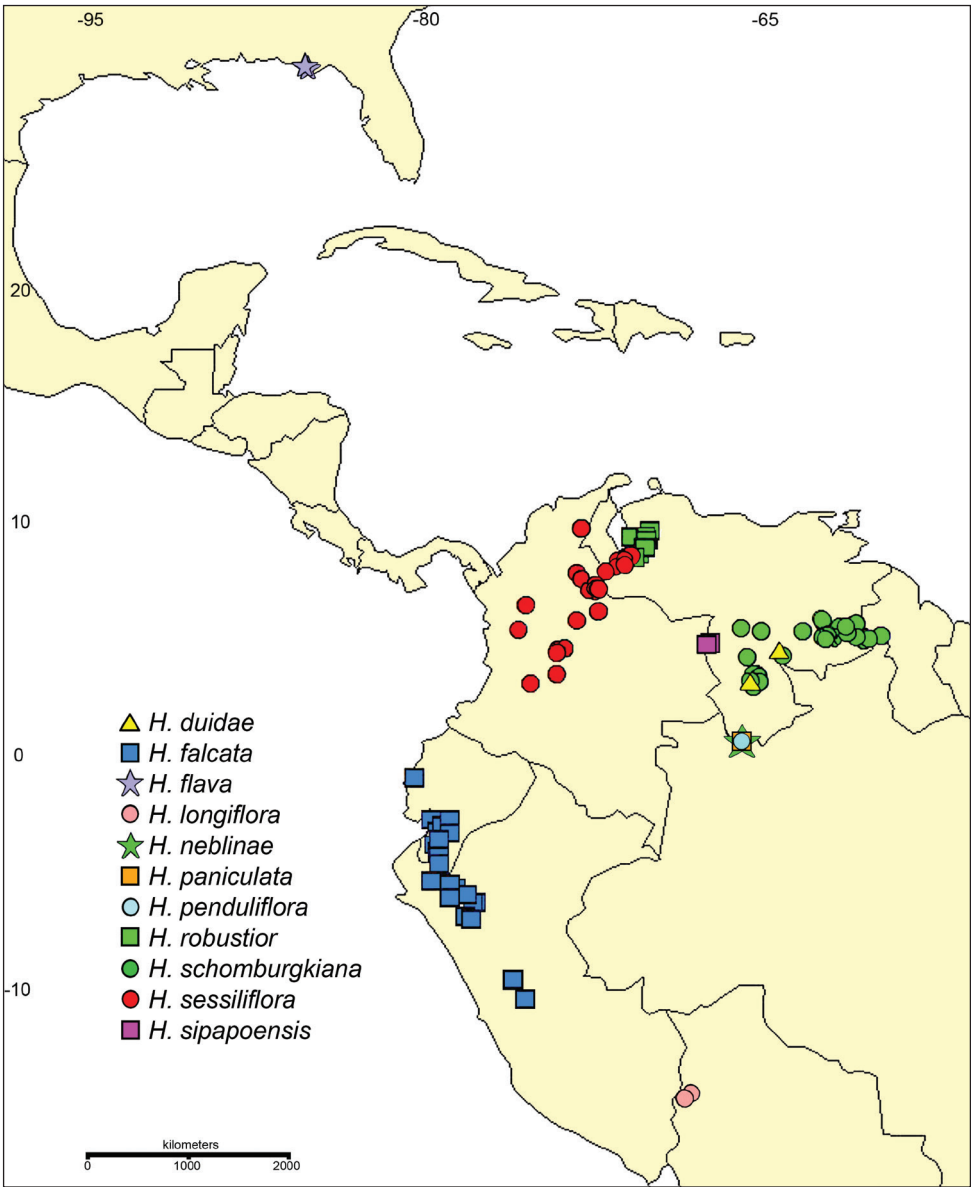
<http://species-id.net/wiki/Harperocallis>

Figs 1–3

**Type.** *Harperocallis flava* McDaniel.

**Key to the Species of *Harperocallis*** (modified from: Cruden 1991, and Campbell 2010)

- 1 Capsules ribbed or unribbed, well-developed lateral veins never extending to the style base..... **6**
- Capsules 9-ribbed, well-developed lateral veins extending to the style base... **2**
- 2 Inflorescence compound, the branches subtended by chlorophyllous cataphylls..... *H. paniculata*
- Inflorescence a simple raceme; peduncular bracts scarious..... **3**
- 3 Flowers pendant ..... *H. penduliflora*
- Flowers erect..... **4**
- 4 Leaves 2.0–4.0 mm wide, usually glabrous, occasionally ciliate at the sheath apex; peduncles < 1.5 mm wide; calycular bracts longer than wide; tepals 6.0–9.0 × 1.5–2.0 mm; anthers 0.9–1.1 mm long ..... *H. duida*
- Leaves 3.0–7.0 mm wide, margin ciliolate to hirsutulous; peduncles > 1.5 mm wide; calycular bracts usually wider than long, sometimes equal; tepals 11–14 × 2–4 mm; anthers > 1.1 mm long ..... **5**
- 5 Leaves 3.0–6.5 mm wide; peduncular bracts 3–8(–10); inflorescence ca. 9–30-flowered; tepals enclosing the rest of the flower; anthers 1.2–1.8 mm long ..... *H. schomburgkiana*
- Leaves 6.0–7.0 mm wide; peduncular bracts 3 or 4; inflorescence ca. 25–40-flowered; tepals open; anthers 2.0–2.5 mm long..... *H. neblinae*
- 6 Capsule incompletely 9-ribbed, well-developed lateral veins never extending to the style base..... **7**
- Capsule 3-ribbed or unribbed..... **8**
- 7 Inflorescence with eglandular hairs; peduncular bracts (3–)4–11(–15); flowers (4–)8–28; styles recurved, apices oblique; stigmas facing outward; capsule etuberculate ..... *H. sessiliflora*



**Figure 1.** Distribution of *Harperocallis*.

- Inflorescence glabrous; peduncular bracts 7–17; flowers 23–35; styles straight; stigmas capitate; capsule tuberculate ..... ***H. robustior***
- 8    Leaves glabrous, veins not prominent; inflorescence 1-flowered; flower erect; ovary densely tuberculate; capsule unribbed..... ***H. flava***
- Leaf margin tomentose, ciliate or glabrous, veins prominent; inflorescence > 1-flowered, or if 1-flowered, the flower pendant; ovary not tuberculate; capsule 3-ribbed..... **9**

- 9 Peduncular bract solitary, chlorophyllous; inflorescence 1–4-flowered; flowers pendant ..... *H. sipapoensis*
- Peduncular bracts (1)2–8, scarious; inflorescence > 10-flowered; flowers erect ..... **10**
- 10 Calycular bracts usually longer than wide (1.8–3.0 × 1.7–2.5 mm); styles 0.3–0.8(–0.9) mm long, straight; stigmas capitate ..... *H. falcata*
- Calycular bracts usually wider than long (1.5–2 × 1.8–2.3 mm); styles 0.9–1.1 mm long, recurved, apices oblique; stigmas facing outward ..... *H. longiflora*

***Harperocallis duidae* (Steyserm.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128356-1

[http://species-id.net/wiki/Harperocallis\\_duidae](http://species-id.net/wiki/Harperocallis_duidae)

*Tofieldia duidae* Steyserm., Fieldiana, Bot. 28(1): 156. 1951.

Type: Venezuela. Amazonas: stream bank above Vegas Falls, Brocchinia Hills, summit of Cerro Duida, 1700–1980 m, 1 Sep 1944, *J.A. Steyermark* 58176 (holotype: F [F0046065F!]; isotypes: MO!, NY!, US!, VEN).

*Isidrogalvia duidae* (Steyserm.) Cruden, Syst. Bot. 16(2): 278. 1991.

Type: Based on *Tofieldia duidae* Steyserm.

**Type.** Based on *Tofieldia duidae* Steyserm.

**Distribution** (Fig. 1). Endemic to the Guayana Highlands of Venezuela (Amazonas and Bolívar states) where it is known only from two tepuis (Cerro Duida and Jáua); 1000–2100 m.

**Representative specimens. VENEZUELA. Amazonas:** Mpio. Atabapo, Parque Nacional Duida-Marahuaka, Macizo del Duida, 2100 m, Apr 1991, *A. Fernández et al.* 8094 (US); Cerro Duida, río Cunucunuma, 1000–1100 m, 18 Nov 1950, *B. Maguire et al.* 29515 (NY); along upper Caño Culebra, 1500–1600 m, 21 Nov 1950, *B. Maguire et al.* 29616 (NY, US). **Bolívar:** Meseta de Jáua, Cerro Jáua, cumbre de la porción Central-Occidental de la Meseta, 1922–2100 m, 22–27 Mar 1967, *J.A. Steyermark* 97899 (NY).

***Harperocallis falcata* (Ruiz & Pav.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128358-1

[http://species-id.net/wiki/Harperocallis\\_falcata](http://species-id.net/wiki/Harperocallis_falcata)

*Isidrogalvia falcata* Ruiz & Pav., Fl. Peruv. 3: 69, t. 302b. 1802.

Type: Peru. de Pillao [sic], *H. Ruiz & J.A. Pavon s.n.* (lectotype: MA [MA810531!], F-negative no. 29435 (F!, MO!), selected by Cruden, 1991; possible isoelectotypes: BC [BC872749!], BM [BM000938089!], MA [MA810498!], MA [MA810530!]).

*Tofieldia falcata* (Ruiz & Pav.) Pers., Syn. Pl. 1: 399. 1805.

Type: Based on *Isidrogalvia falcata* Ruiz & Pav.

*Tofieldia falcata* (Ruiz & Pav.) Willd., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 2: 29. 1808, comb. illeg.

Type: Based on *Isidrogalvia falcata* Ruiz & Pav.

*Narthecium falcatum* (Ruiz & Pav.) Poir., Encycl., Suppl. 4: 61. 1816.

Type: Based on *Isidrogalvia falcata* Ruiz & Pav.

*Asphodeleris falcata* (Ruiz & Pav.) Kuntze, Revis. Gen. Pl. 2: 706. 1891.

Type: Based on *Isidrogalvia falcata* Ruiz & Pav.

*Tofieldia flexuosa* Willd., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 2: 28. 1808.

Type: Peru [Ecuador?]. *F.W.H.A. von Humboldt & A.J.A. Bonpland* 3383 (holotype: B-W [B-W-07103-01 0!]; isotypes: GH-fragm., P [P02137266!]).

*Tofieldia frigida* Kunth in H.B.K., Nov. Gen. Sp. [quarto ed.] 1: 267. 1815 [1816]; Ibid. [folio ed.] 1: 213. 1815 [1816]. Type: Peru [Ecuador?]. *F.W.H.A. von Humboldt & A.J.A. Bonpland* 3383 (neotype, here designated: B-W [B-W-07103-01 0!]; isoneotypes: GH-fragm., P [P02137266!]).

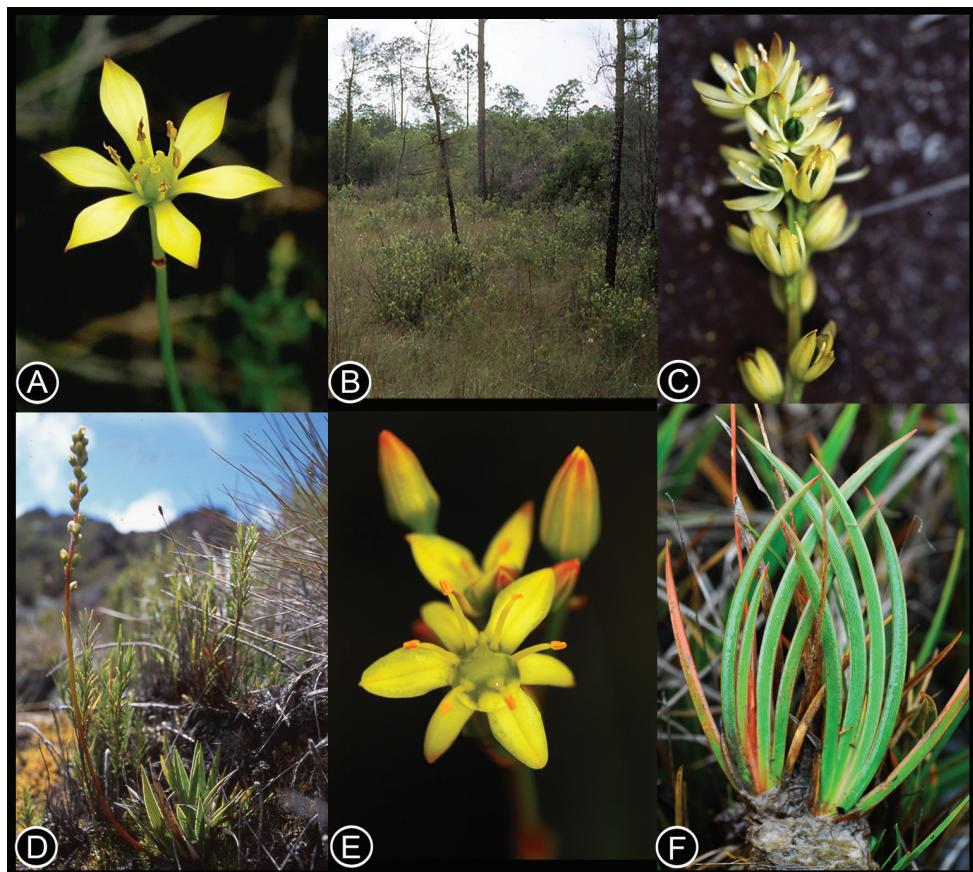
**Type.** Based on *Isidrogalvia falcata* Ruiz & Pav.

**Distribution** (Fig 1). The Andes of Ecuador (Azuay, Cañar, Loja, Morona-Santiago, and Zamora-Chinchipe provinces) and Peru (Amazonas, Cajamarca, Cusco, Huánuco, Junín, and Pasco regions); 2300–3860 m.

**Representative specimens.** **ECUADOR.** **Azuay:** Cordillera Oriental, alrededores del Páramo de Patococha entre Gualaceo y Limon, 3400–3450 m, 6–7 Aug 1959, *H.G. Barclay & P. Juaquibioy* 8632 (MO, NY); Km 85 on Pan American Highway N of Loja, 2850–2950 m, 3 May 1973, *L. Holm-Nielsen et al.* 4815 (MO, NY); Hac. Horta-Naque, 3100 m, 11 Jun 1946, *H.N. Moldenke* 869 (NY). **Cañar:** Cerro Yanguán NE of Pindilig, 3100 m, 13 Dec 1980, *L.B. Holm-Nielsen et al.* 29300 (MO, NY). **Loja:** Loma de Oro at Panamerican Highway, 3300 m, 2 Jan 1981, *H. Balslev* 1382 (MO, NY, US); Yangana–Zumba road Km 15–20, N slopes of Cordillera de Sabanilla, 2550 m, 31 Dec 1980, *H. Balslev* 1298 (NY). **Loja/Zamora-Chinchipe:** Parque Nacional Podocarpus, crest of the Cordillera de los Andes E and SE of Nudo de Cajanuma, s.d., *B. Øllgaard* 90768 (NY). **Morona/Santiago:** Gualaceo–Sigisig–Gualaquiza road, SSE of Sigisig, 03°11'S, 78°40'W, ca. 2900–3090 m, 3 Dec 1990, *J.L. Luteyn et al.* 14287 (NY). **PERU.** **Amazonas:** Prov. Chachapoyas: Cerca a Calla-Calla, siguiendo la ruta a Leymebamba–Balsas, 3860 m, 18 Dec 1992, *I. Sanchez Vega & J. Tanta* 6481 (US); Cerros [de] Calla Calla, east side, 19 km above Leimebamba [sic] on the road to Balsas, 3100 m, 4 Jun 1964, *P.C. Hutchinson & J.K. Wright* 5510 (NY, US). **Cajamarca:** Prov. Cutervo: 2350 m, 22 Jun 1992, *I. Sanchez Vega & A. Miranda* 6265 (NY).

**Notes.** When compared to its present on-line image (<http://plants.jstor.org/specimen/ma810531>), a photograph (F-negative no. 29435) of the lectotype of *Isidrogalvia falcata* taken by J. Francis Macbride of the Field Museum before World War II shows





**Figure 2.** Habit and habitats of *Harperocallis*. *H. flava*. **A** Flower (note the peduncular bract, pronounced connective, and tuberculate ovary) **B** Habitat. *H. robustior*. **C** Inflorescence **D** Habit and habitat. *H. schomburgkiana*. **E** Flower **F** Leaves. (A, unvouchered, photograph A.R. Schotz; B, photograph G. Anglin, C, D B. Stergios *et al.* 20368 (PORT), photograph K.J. Wurdack; E, F K.J. Wurdack *et al.* 5636 (US), photograph K.J. Wurdack).

that the original label (“*Isidrogalvia falcata* Sp. Pl. Fl. Per. de Pillao”) was moved from the center of the specimen to the lower left-hand corner.

*Tofieldia frigida* was based on a collection or collections made by F.W.H.A. von Humboldt & A.J.A. Bonpland in Ecuador (“Crescit in frigidis regni Quitensis inter Loxam et pagum Ona, in summis montibus Saraguri, et Alpachacae, alt. 1200–1400 hexap, ... Floret Decembri.”). While no material with this name was found in Paris (P-Bonpl.) (Stauffer *et al.* 2012), the type specimen of *T. flexuosa* in B-W is annotated as *Isidrogalvis* [sic] *frigida* Klotzsch, nom. nud. This strongly supports that the names *T. frigida* and *T. flexuosa* are based on the same gathering (i.e., F.W.H.A. von Humboldt & A.J.A. Bonpland 3383) and we have selected this collection to neotypify the name *T. frigida*.

***Harperocallis flava* McDaniel, J. Arnold Arbor. 49(1): 38, figs 1, 2. 1968.**

[http://species-id.net/wiki/Harperocallis\\_flava](http://species-id.net/wiki/Harperocallis_flava)

Fig. 2 A, B

*Isidrogalvia flava* (McDaniel) Remizowa et al., *Taxon* 60(4): 1092. 2011.

Type: Based on *Harperocallis flava* McDaniel

**Type.** U.S.A. Florida: Franklin Co: 2.2 miles south of Sumatra, 11 May 1965, *S. McDaniel* 6205 (holotype: A; isotypes: BM, DUKE, FLAS [FLAS-97596!], FSU [000004217!], GA, M!, MO!, NCU, NY!, PH [00013616!], SMU [BRIT 23682], US-not found).

**Distribution** (Fig. 1). Endemic to the southeastern U.S.A. where it is known only from the Apalachicola River lowlands on the Coastal Plain of the Florida panhandle (Bay, Franklin, and Liberty counties).

**Representative specimens. U.S.A. Florida:** Bay Co.: North of highway 22 and east of Star Avenue, 16 May 2003, *L. Keppner* 37 (FSU [000081383]). Franklin Co.: 15 May 1978, *A.F. Clewell s.n.* (FSU [000004215]; 25 May 1979, *L.C. Anderson* 4875 (FSU [000004220]). Liberty Co.: North side of turn in Route 65, 1.8 miles southwest of Wilma, 8 air miles north of Sumatra, 1 May 1986, *L.C. Anderson* 9287 (FSU [000004223], NY); 12 May 1982, *A. Gholson, Jr. et al.* 9699 (FLAS [FLAS-168245], FSU [000001249]); 19 Oct 2005, *L.C. Anderson et al.* 23047 (FSU [000037492]).

**District of Columbia:** U.S. Botanic Garden, Washington, cultivated from Florida, 7 Jul 2007, *L.M. Campbell* 1045 (NY).

**Note.** Zomlefer (1997) provides a complete description and detailed illustration of *Harperocallis flava*.

A search of the collection and accession records of the U.S. National Herbarium (US) indicates that not all of the herbaria McDaniel (1968) listed in his protologue have isotypes accessioned.

***Harperocallis longiflora* (Rusby) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128360-1

[http://species-id.net/wiki/Harperocallis\\_longiflora](http://species-id.net/wiki/Harperocallis_longiflora)

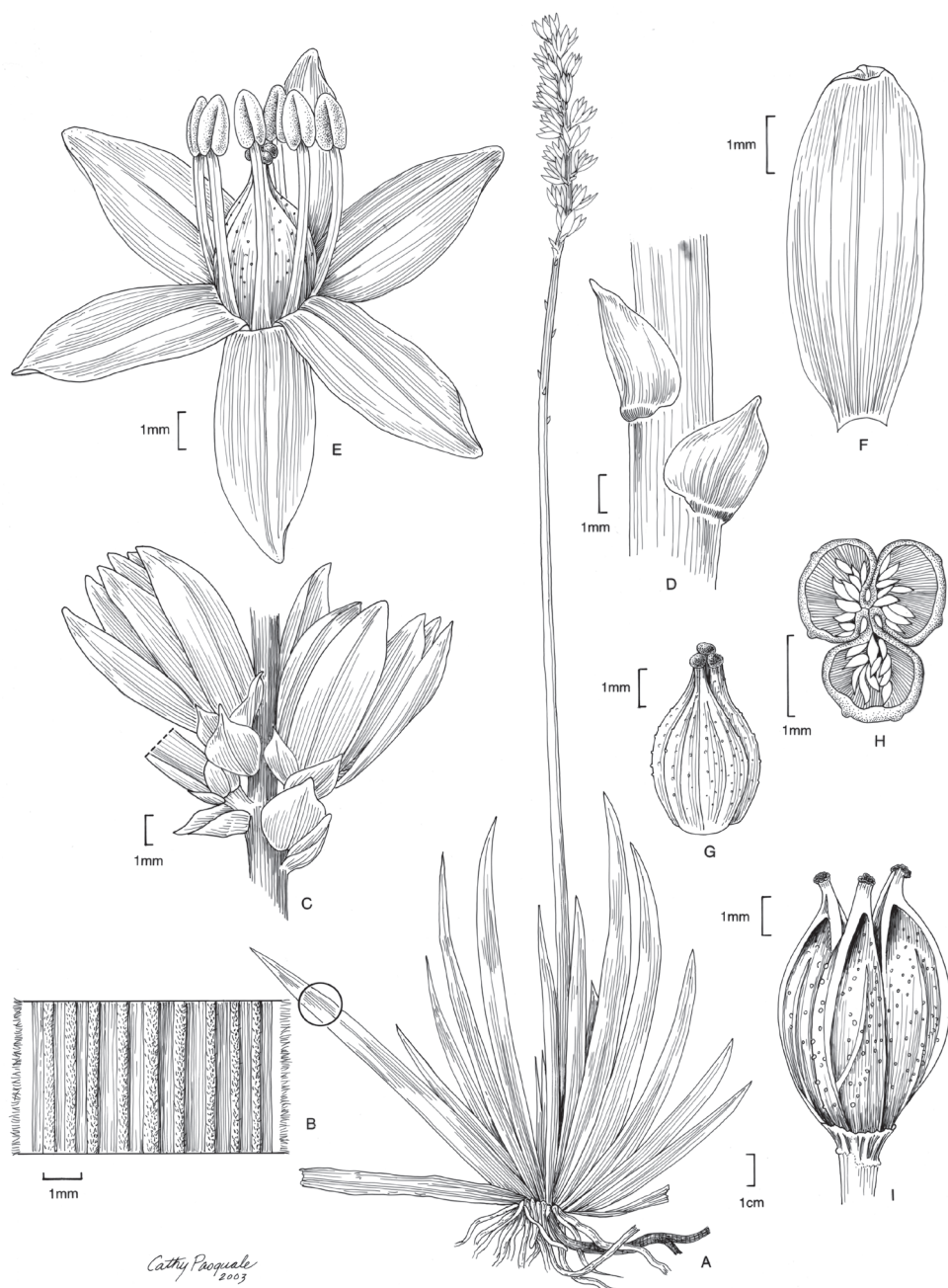
*Asagraea longiflora* Rusby, Bull. New York Bot. Gard. 6(22): 491. 1910.

Type: Bolivia. La Paz: Franz Tamayo: Near Apolo, ca. 1785 m, 24 Jul 1902, *R.S. Williams* 1471 (holotype: NY!).

*Isidrogalvia longiflora* (Rusby) Cruden & Dorr, *Brittonia* 44(3): 368. 1992.

**Type.** Based on *Asagraea longiflora* Rusby

**Distribution** (Fig. 1). Known only from the type locality and vicinity in Bolivia (La Paz department); 1785–2000 m.



**Figure 3.** *Harperocallis robustior*. **A** Habit **B** Leaf (detail of parallel veins and tomentose margins) **C** In-florescence (detail showing peduncular and calycular bracts subtending flowers) **D** Peduncular bracts (detail) **E** Flower **F** Tepal (adaxial view) **G** Ovary (note the tuberculae) **H** Ovary (cross-section showing axile placentation and ovules) **I** Capsule (carpels separating distally). (A, I from *L.J. Dorr et al.* 4967 (US); B–H from *B. Stergios et al.* 17327 (PORT)).

**Representative specimen. Bolivia. La Paz:** Franz Tamayo: Senda Apolo–San José de Uchupiamonas, último arroyo antes de río Huacataya, 1958 m, 8 Oct 2002, *C. Maldonado et al.* 3138 (MO).

**Note.** Another recent collection, *C. Maldonado et al.* 3121, from the same locality at a slightly higher elevation (2000 m) is reported to be at LPB (see Missouri Botanical Garden 2013).

***Harperocallis neblinae* (Steyserm. ex L.M. Campb.) L.M. Campb. & Dorr, comb. nov.**  
urn:lsid:ipni.org:names:77128371-1  
[http://species-id.net/wiki/Harperocallis\\_neblinae](http://species-id.net/wiki/Harperocallis_neblinae)

*Isidrogalvia neblinae* Steyserm. ex L.M. Campb., Harvard Pap. Bot. 15(1): 52, fig. 1. 2010.  
Type: Venezuela. Amazonas: Cerro de la Neblina, altiplanicie en la cumbre del brazo noroccidental, al norte del campamento base a lo largo del Río Mawarinuma, afluente del Río Baria, 1880 m, 7–8 Feb 1984, *J.A. Steyermark & J.L. Luteyn* 129828 (holotype: VEN!; isotype: MO!).

**Type.** Based on *Isidrogalvia neblinae* Steyserm. ex L.M. Campb.

**Distribution** (Fig. 1). Known only from Cerro de la Neblina in the Guayana Highlands of Venezuela (Amazonas state); 1700–2100 m. This species is expected to occur also in the Brazilian part of the massif (Amazonas state).

**Representative specimens. VENEZUELA. Amazonas:** Mpio. Río Negro, Cerro de la Neblina, altiplanicie en la cumbre del brazo noroccidental, al norte del campamento base a lo largo del Río Mawarinuma, afluente del Río Baria, aprox. 0°52–53'N; 66°05'W, 1880 m, 7–8 Feb 1984, *J.A. Steyermark & J.L. Luteyn* 129828-A (VEN-unicate); 4–6 km northeast of Cumbre Camp, 2100 m, 20 Nov 1957, *B. Maguire et al.* 42154 (NY); Ridge at divide between Brazil and Venezuela, 26 km east-northeast of Neblina base camp, ca. 0°53'N; 65°56'W, 2000 m, 15 Apr 1984, *T. Plowman & W.W. Thomas* 13594 (F).

***Harperocallis paniculata* (L.M. Campb.) L.M. Campb. & Dorr, comb. nov.**  
urn:lsid:ipni.org:names:77128372-1  
[http://species-id.net/wiki/Harperocallis\\_paniculata](http://species-id.net/wiki/Harperocallis_paniculata)

*Isidrogalvia paniculata* L.M. Campb., Harvard Pap. Bot. 15(1): 52, fig. 2. 2010.  
Type: Brazil. Amazonas: Serra da Neblina, open slopes to base of cliffs, Pico Phelps, 2600–2700 m, 2 Dec 1965, *B. Maguire, J.M. Pires & C.K. Maguire* 60463 *p.p.* (holotype: NY!).

**Type.** Based on *Isidrogalvia paniculata* L.M. Campb.

**Distribution** (Fig. 1). Known only from Serra da Neblina in Brazil (Amazonas state); 2600–2700 m. This species may occur also in the Venezuelan part of the massif (Amazonas state).



***Harperocallis penduliflora* (L.M. Campb.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128373-1

[http://species-id.net/wiki/Harperocallis\\_penduliflora](http://species-id.net/wiki/Harperocallis_penduliflora)*Isidrogalvia penduliflora* L.M. Campb., Harvard Pap. Bot. 15(1): 54, fig. 3. 2010.

Type: Venezuela. Amazonas: Mpio. Río Negro, Cerro de la Neblina camp 2, Neblina massif, 2.8 km NE of Pico Phelps, 2100 m, 15 Apr 1984, *B.A. Stein & A.H. Gentry* 1559 (holotype: VEN!; isotypes: K [K000400739!] US!).

*Isidrogalvia schomburgkiana* var. *patula* Remizowa, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 112(4): 74. 2007.

Type: Venezuela. Amazonas: Mpio. Río Negro, Neblina Massif, Camp II, 2.8 km NE of Pico Phelps (= Neblina), 2085–2100 m, 16 Mar 1984, *B.L. Stannard* 137 (holotype: K [K000400738!]; isotype: VEN!).

**Type.** Based on *Isidrogalvia penduliflora* L.M. Campb.

**Distribution** (Fig. 1). Known only from the vicinity of the type locality in the Guayana Highlands of Venezuela (Amazonas state); 1800–2100 m. This species likely occurs also in the Brazilian part of the massif (Amazonas state).

**Representative specimens. VENEZUELA. Amazonas:** Mpio. Río Negro, Neblina massif, camp II, 2.8 km NE of Pico Phelps (= Neblina), on plateau, 0°49'40"N; 65°59'W, 2085–2100 m, 17 Mar 1984, *B.L. Stannard* 166 (VEN); *S.S. Renner* 2026 pro parte (MO [1434169]).

***Harperocallis robustior* (Steyserm.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128374-1

[http://species-id.net/wiki/Harperocallis\\_robustior](http://species-id.net/wiki/Harperocallis_robustior)

Figs 2 C, D, 3

*Tofieldia sessiliflora* var. *robustior* Steyserm., Fieldiana, Bot. 28(1): 157. 1951.

Type: Venezuela. Lara: Wet meadow at Las Sabanetas, above Los Aposentos, west of Humocaro Bajo, 2530 m, 5 Feb 1944, *J.A. Steyermark* 55291 (holotype: F [F0046066F!]; isotype: NY!).

*Isidrogalvia robustior* (Steyserm.) Cruden, Syst. Bot. 16(2): 278. 1991.

Type: Based on *Tofieldia sessiliflora* var. *robustior* Steyserm.

**Type.** Based on *Tofieldia sessiliflora* var. *robustior* Steyserm.

**Distribution** (Fig. 1). Andes of Venezuela (Lara, Mérida, and Trujillo states); 2200–3700 m.

**Representative specimens. VENEZUELA. Lara:** Mpio. Moran, below Páramo Las Rosas, 2285–3290 m, 25 Jun 1979, *R. Liesner et al.* 7965 (MO, NY). **Mérida:** Mpio. Rangel, Cerro el Guamo, 3100–3200 m, 19 Jun 1988, *L.J. Dorr & L.C. Barnett* 5627 (NY). **Trujillo:** Páramo de Cachaco, 3400–3700 m, 7 Nov 1927, *P. Christ* 84 (NY); Mpio. Boconó, Páramo de Guaramacal, ca. 3080 m, ca.



9°14'N, 70°11'W, 28 Apr 1988, *L.J. Dorr et al.* 4967 (NY, PORT); Páramo de Guirigay, 3000 m, 22 Apr 2002, *L.J. Dorr et al.* 9200 (NY, PORT, US); Parque Nacional Guaramacal, vertiente norte, ca. 1977–2350 m, 28 Apr 1998, *B. Stergios et al.* 17327 (PORT-unicate); Laguna Larga via Laguna Las Parias to Laguna Eco, Páramo de Motumbo, 2400–2600 m, 15 Sep 2003, *B. Stergios et al.* 20368 (F, MO, NY, PORT, US).

***Harperocallis schomburgkiana* (Oliv.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128375-1

[http://species-id.net/wiki/Harperocallis\\_schomburgkiana](http://species-id.net/wiki/Harperocallis_schomburgkiana)

Fig. 2 E, F

*Tofieldia schomburgkiana* Oliv. in Thurn, *Timehri* 5: 206. 1886; [Trans. Linn. Soc., ser. 2, 2: 206, t. 49, fig. A 1–6. 1887].

Type: Venezuela. Roraima, summit, ca. 1845 m, Oct, *M.R. Schomburgk s.n.* (lectotype: K [K000099720!], MO [F negative 10002!], selected by Cruden 1991).

*Isidrogavia schomburgkiana* (Oliv.) Cruden, *Syst. Bot.* 16(2): 276. 1991.

Type: Based on *Tofieldia schomburgkiana* Oliv.

*Isidrogavia guianensis* Klotzsch in Ri. Schomburgk, *Reis. Br.-Guiana* 3: 1065. 1848 [1849], nom. nud.

*Tofieldia guianensis* (Klotzsch) R. Schulze, *Bot. Jahrb. Syst.* 17(3–4): 330. 1893, comb. illeg.

**Type.** Based on *Tofieldia schomburgkiana* Oliv.

**Distribution** (Fig. 1). Guayana Highlands of Venezuela (Amazonas and Bolívar states) and adjacent Guyana; 1430–2800 m.

**Representative specimens.** **GUYANA. Cuyuni-Mazaruni Region:** Mt. Maringma, summit, 2110 m, 15 Jun 2004, *H.D. Clarke et al.* 11717 (MO, NY, US); Paruima, 20 km W, Waukauyengtipu, 1430 m, 18 Jul 1997, *H.D. Clarke et al.* 5855 (NY); Below 1st escarpment (of four) of Kamakusa Mt., 0–1 mi. SW of Ducking (1st) Camp [heading] to savanna, 5°45'58.9"N, 60°15'57.6"W, 637m, 15 May 2012, *K.J. Wurdack et al.* 5636 (US). **Upper Takutu-Upper Essequibo:** Mount Roraima, summit, Autumn 1898, *J.J. Quelch & F. McConnell* 657 (NY). **VENEZUELA. Amazonas:** Mpio. Atabapo, Cerro Marahuaca-Atuhua-Shiho, cumbre, parte aislada al Sur-Oeste del Cerro, 2450–2480 m, 9–10 Feb 1982, *J.A. Steyermark et al.* 124367 (MO, NY), cumbre, sección noroccidental, 2500 m, 16 Feb 1981, *J.A. Steyermark et al.* 124393 (MO, NY); Caño Sapo, summit of Mount Duida, 1920 m, Aug 1928 to Apr 1929, *J.A. Steyermark* 690 (NY). **Bolívar:** Cerro Guaiquinima, Río Paragua, 1800 m, 29 Dec 1951, *J.J. Wurdack* 32817 (MO, NY); North Valley, 1600–1700 m, 10–12 Jan 1952, *J.J. Wurdack* 33039 (NY); macizo del Chimantá, sección nor-oriental del Acopan-tepui, 1950 m, 8–11 Feb 1985, *J.J. Pipoly et al.* 7207 (NY).

***Harperocallis sessiliflora* (Hook.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128376-1

[http://species-id.net/wiki/Harperocallis\\_sessiliflora](http://species-id.net/wiki/Harperocallis_sessiliflora)*Tofieldia sessiliflora* Hook., Icones Pl., ser. 2, 7: t. 691. 1844.Type: Colombia. "Andes of New Grenada," 1842–3, *J.J. Linden 410* pro parte (lectotype: K, selected by Cruden, 1991; isoelectotype: BM [BM000938091!]).*Asphodeleris sessiliflora* (Hook.) Kuntze, Revis. Gen. Pl. 2: 706. 1891. Type: Based on *Tofieldia sessiliflora* Hook.*Isidrogalvia sessiliflora* (Hook.) Cruden, Syst. Bot. 16(2): 279. 1991.Type: Based on *Tofieldia sessiliflora* Hook.*Isidrogalvia moritziana* Klotzsch ex Baker, J. Linn. Soc., Bot. 17(103): 489. 1879, nom. nud., pro syn.*Tofieldia moritziana* (Klotzsch ex Baker) R. Schultze, Bot. Jahrb. Syst. 17(3–4): 330. 1893, comb. illeg.**Type.** Based on *Tofieldia sessiliflora* Hook.**Distribution** (Fig. 1). Andes of Venezuela (Mérida and Táchira states) and Colombia (Antioquia, Boyacá, César, Cundinamarca, Huila, Magdalena, and Norte de Santander departments); 2500–3200 m. Cruden (1991) also cites a dubious record (*J.A. Steyermark 54804*) from Ecuador (Loja), which we have not mapped.**Representative specimens. VENEZUELA. Mérida:** Páramo de los Conejos, 3300 m, 24 Jun 1953, *L. Bernardi 685* (NY); Mpio. Rivas Dávila, 25 km NE of La Grita, 2830 m, 15 Apr 1984, *J.L. Luteyn & M. Lebrón-Luteyn 9928* (NY). **Táchira:** NE side of Páramo de Táma, 2900–3200 m, 18 Oct 1978, *J.L. Luteyn et al. 5906* (MO, NY, US). **COLOMBIA. Boyacá:** Cordillera Oriental, Páramo de Belén, 3150 m, 6 May 1959, *H.G. Barclay & P. Juaquibioy 7564* (MO, NY). **Cundinamarca:** Chapinero, near Bogotá, 3000–3100 m, 18–23 Sep 1917, *F.W. Pennell 2013* (NY, US). **Huila:** Río Balsillas, 2100–2200 m, 3–5 Aug 1917, *H.H. Rusby & F.W. Pennell 756* (MO, NY-2 sheets, US). **Magdalena:** Sierra de Perijá, east of Manaure, Sabana Rubia, 3000–3100 m, 6 Nov 1959, *J. Cuatrecasas & R. Romero Castaneda 25040* (US). **Norte de Santander/César:** Cerro de Oroque, 3700–3960 m, 19–21 May 1969, *H. García-Barriga & R.J. Mejía 19740* (NY, US).***Harperocallis sipapoensis* (L.M. Campb.) L.M. Campb. & Dorr, comb. nov.**

urn:lsid:ipni.org:names:77128377-1

[http://species-id.net/wiki/Harperocallis\\_sipapoensis](http://species-id.net/wiki/Harperocallis_sipapoensis)*Isidrogalvia sipapoensis* L.M. Campb., Harvard Pap. Bot. 15(1): 57, figs 4, 5. 2010.Type: Venezuela. Amazonas: Mpio. Autana, Cerro Cuao–Sipapo, canyon on northeastern end of massif, ca. 1700 m, 14 Sep 2001, *L.M. Campbell, G.A. Romero-González & C. Gómez 798* (holotype: VEN!; isotypes: GH!, MO!, NY!, TFAV!).

**Type.** Based on *Isidrogalvia sipapoensis* L.M. Campb.

**Distribution** (Fig. 1). Known only from Cerro Sipapo in the Guayana Highlands of Venezuela (Amazonas state); 1500–1700 m. This species likely occurs also on the geologically and floristically similar Cerro Autana, which is near the type locality.

**Representative specimens. VENEZUELA. Amazonas:** Mpio. Atures, areniscas del Cerro Cuao, Caño Cabeza de Manteco, 73 km SE de Pto. Ayacucho, 5°06'N; 67°24'W, 1580 m, Sep 1989, *A. Fernández et al.* 6207 (MO, NY, PORT); Serranía Sipapo, cumbre, 5°N; 67°30'O, 1500 m, 17 Feb 1981, *J.A. Steyermark et al.* 124556 (VEN).

**Excluded name.** *Isidrogalvia borealis* Ruiz & Pav. ex Steud., Nomencl. Bot. 839. 1821., nom. nud., pro syn. = *Tofieldia palustris* Huds.

## Acknowledgements

We especially appreciate the assistance of Rose Gullledge (US) who prepared the map and arranged the figures. We thank Cathy Pasquale for preparing the illustration of *Harperocallis robustior*; Donald Wheeler (Mertz Library, NY) for providing critical literature; Andres Botero (NY) for technical assistance; Brett Jestrow (FTG) for providing a specimen image; Kenneth Wurdack (US) for sharing photographs; the curators and staff at A, B, BC, BM, BRIT, F, FLAS, FSU, GH, K, MA, MO, NY, P, PH, PORT, US, and VEN for access to their specimens; and Wendy Zomlefer (GA) for a critical review of the manuscript.

## References

- Appelquist WL (2012) Report of the Nomenclature Committee for Vascular Plants: 64. *Taxon* 61(5): 1108–1117.
- Azuma H, Tobe H (2011) Molecular phylogenetic analyses of Tofieldiaceae (Alismatales): Family circumscription and intergeneric relationships. *Journal of Plant Research* 124(3): 349–357. doi: 10.1007/s10265-010-0387-5
- BRIT Virtual Herbarium. Atrium Biodiversity Information System for the Botanical Research Institute of Texas. <http://atrium.brit.org> [accessed on 16 April 2013]
- Campbell LM (2010) Four new species of *Isidrogalvia* (Tofieldiaceae) from the Guayana Highlands. *Harvard Papers in Botany* 15(1): 51–62. doi: 10.3100/025.015.0119
- Cruden RW (1991) A revision of *Isidrogalvia* (Liliaceae): Recognition for Ruiz & Pavón's genus. *Systematic Botany* 16(2): 270–282. <http://www.jstor.org/stable/2419279>
- Cruden RW, Dorr LJ (1992) A previously unrecognized *Isidrogalvia* (Liliaceae) from Bolivia. *Brittonia* 44(3): 368–369. doi: 10.2307/2806941
- The Field Museum (2013) <http://emuweb.fieldmuseum.org/botany/taxResultsList.php> [accessed on 6 February 2013]
- Florida Museum of Natural History (1995–2013) University of Florida Herbarium. <http://www.flmnh.ufl.edu/herbarium/cat/imagesearch.asp> [accessed 6 February 2013]

- Godt, MJ, Walker WJ, Hamrick JL (1997) Genetic diversity in the endangered lily *Harperocal-  
lis flava* and a close relative, *Tofieldia racemosa*. *Conservation Biology* 11(2): 361–366. doi:  
10.1046/j.1523-1739.1997.95439.x
- Hudson WH (1787) *Flora Anglica: exhibens Plantas per Regnum Angliae Sponte Crescentes,  
Distributas Secundum Systema Sexuale*. 2 ed. Vol. 1. Impensis auctoris, London.
- JSTOR (2012) Trademark of ITHAKA. <http://plants.jstor.org/> [accessed on 6 February 2013]
- Keppner LA, Anderson LC (2008) Notes on Harper's Beauty, *Harperocallis flava* (To-  
fieldiaceae), in Bay County, Florida. *Southeastern Naturalist* 7(1): 180–184. doi:  
10.1656/1528-7092(2008)7[180:NOHBHF]2.0.CO;2
- Leonard SW, Baker WW (1983) Additional populations of *Harperocallis flava* McDaniel (Lili-  
aceae). *Castanea* 48(2): 151–152. <http://www.jstor.org/stable/4033078>
- McDaniel S (1968) *Harperocallis*, a new genus of the Liliaceae from Florida. *Journal of the  
Arnold Arboretum* 49(1): 35–40.
- McNeill J, Barrie FR, Buck WR, Demoulin V, Greuter W, Hawksworth DL, Herendeen PS,  
Knapp S, Marhold K, Prado J, Prud'homme van Reine WF, Smith GF, Wiersema JH,  
Turland NJ (Eds) (2012) *International Code of Nomenclature for algae, fungi, and plants  
(Melbourne Code): Adopted by the Eighteenth International Botanical Congress Mel-  
bourne, Australia, July 2011*. Regnum Vegetabile 154. Koeltz Scientific Books, Königstein.
- Mast AR, Stuy A, Nelson G, Bugher A, Weddington N, Vega J, Weismantel K, Feller DS, Paul  
D (2004 onward [continuously updated]) *Database of Florida State University's Robert K.  
Godfrey Herbarium*. <http://herbarium.bio.fsu.edu/> [accessed on 6 February 2013]
- Missouri Botanical Garden (2013) Tropicos.org. Missouri Botanical Garden. <http://www.tropicos.org> [accessed 6 February 2013]
- Mosyakin AS, Bezusko AG, Tsymbalyuk ZM (2009) Palynomorphological peculiarities of rep-  
resentatives of the family Tofieldiaceae (Liliopsida) and *Isidrogalvia*: Evolutionary aspects.  
*Naukovy Zapiski, Biologiya ta Ekologiya* 93: 16–22.
- Muséum National d'Histoire Naturelle (2013) <http://coldb.mnhn.fr/Consultation?catalogue=1>  
[accessed 6 February 2013]
- Pitts-Singer TL, Hanula JL, Walker JL (2002) Insect pollinators of three rare plants  
in a Florida longleaf pine forest. *Florida Entomologist* 85(2): 308–316. doi:  
10.1653/0015-4040(2002)085[0308:IPOTRP]2.0.CO;2
- Remizowa MV (2007) A new variety of *Isidrogalvia schomburgkiana* (Oliver) Cruden (Tofiel-  
diaceae) from Venezuela. *Byulleten' Moskovskogo Obshchestva Ispytatelei Prirody. Ot-  
del Biologicheskii. Moscow [Bulletin of Moscow Society of Naturalists, Biological Series]*  
112(4): 73–75. [In Russian, with English summary].
- Remizowa MV, Sokoloff DD, Campbell LM, Stevenson DW, Rudall PJ (2011) *Harperocallis*  
is congeneric with *Isidrogalvia* (Tofieldiaceae, Alismatales): Evidence from comparative floral  
morphology. *Taxon* 60(4): 1076–1094.
- Remizowa MV, Sokoloff DD, Rudall PJ (2010) Evolutionary history of the monocot flower.  
*Annals of the Missouri Botanical Garden* 97(4): 617–645. doi: 10.3417/2009142
- Röpert D (2000) [continuously updated] Digital specimen images at the Herbarium Bero-  
linense. Botanischer Garten und Botanisches Museum Berlin-Dahlem, Freie Universität  
Berlin. <http://ww2.bgbm.org/Herbarium/default.cfm> [accessed 6 February 2013]



- Ruiz H, Pavon JA (1802) *Flora Peruviana, et Chilensis*. Vol. 3. Typis Gabrielis de Sancha, Madrid.
- Sokoloff DD, Remizowa MV, Campbell LM, Stevenson DW, Rudall PJ, Gandhi KN (2011) (2020) Proposal to conserve the name *Isidrogalvia* (Tofieldiaceae) with a conserved type. *Taxon* 60(3): 909.
- Stauffer FW, Stauffer J, Dorr LJ (2012) Bonpland and Humboldt specimens, field notes, and herbaria; new insights from a study of the monocotyledons collected in Venezuela. *Candollea* 67(1): 75–130.
- US Fish and Wildlife Service, Region 4 (1991) *Endangered & threatened species of the southeastern United States*. USFWS, Atlanta, Georgia.
- Walker JL, Silletti, AM (2005) A three-year demographic study of Harper's beauty (*Harperocallis flava* McDaniel), an endangered Florida endemic. *Journal of the Torrey Botanical Society* 132(4): 551–560. doi: 10.3159/1095-5674(2005)132[551:ATDSOH]2.0.CO;2
- Zomlefer WB (1997) The genera of Tofieldiaceae in the southeastern United States. *Harvard Papers in Botany* 2(2): 179–194.

# Reinterpretation of the nomenclatural type of *Pseudobombax heteromorphum* (Malvaceae, Bombacoideae) reveals an overlooked new species from Bolivia

Jefferson G. de Carvalho-Sobrinho<sup>1</sup>, Luciano P. de Queiroz<sup>1</sup>, William S. Alverson<sup>2</sup>

**1** *Herbário HUEFS, Universidade Estadual de Feira de Santana, Avenida Transnordestina s/n, Novo Horizonte, 44036-900, Feira de Santana, Bahia, Brazil* **2** *Department of Botany, Birge Hall, University of Wisconsin-Madison, 53706, Madison, WI, U.S.A.*

Corresponding author: Jefferson G. de Carvalho-Sobrinho (jef.sobrinho@gmail.com)

Academic editor: Laurence J. Dorr | Received 26 March 2013 | Accepted 7 May 2013 | Published 9 May 2013

**Citation:** de Carvalho-Sobrinho JG, de Queiroz LP, Alverson WS (2013) Reinterpretation of the nomenclatural type of *Pseudobombax heteromorphum* (Malvaceae, Bombacoideae) reveals an overlooked new species from Bolivia. *PhytoKeys* 21: 53–61. doi: 10.3897/phytokeys.21.5213

## Abstract

In the course of a taxonomic revision of *Pseudobombax* Dugand, one of us (JGCS) frequently has observed herbarium specimens of Bombacoideae that comprise a mixture of different Angiosperm families. In particular, *P. heteromorphum* (Kuntze) A. Robyns, a frequent name in checklists of the Bolivian flora, is based on type material of *Bombax heteromorphum* Kuntze that is clearly a mixture of *Pseudobombax* flowers and *Tabebuia* Gomes ex DC. (Bignoniaceae) leaves. We herein designate as the lectotype of *B. heteromorphum* the flowers of an herbarium sheet deposited in NY and as epitype a complete specimen (leaves, flowers, and fruit) in HUEFS. We consider *Bombax heteromorphum* to be a synonym of *P. longiflorum* (Mart.) A. Robyns, a species widespread in Neotropical seasonally dry forest of Bolivia, Brazil, Paraguay, and Peru. Furthermore, we describe a new species, *P. pulchellum* Carv.-Sobr., apparently endemic to seasonally dry tropical forest (SDTF) in Bolivia (Chiquitano dry forest), based on specimens commonly but incorrectly identified as *P. heteromorphum*. We also comment on the morphology, distribution, and conservation status of this new species.

## Resumen

En el curso de una revisión taxonómica de *Pseudobombax* Dugand, uno de nosotros (JGCS) con frecuencia se ha observado especímenes de herbario de Bombacoideae que comprenden una mezcla de diferentes familias de angiospermas. En particular, *P. heteromorphum* (Kuntze) A. Robyns, un nombre frecuente en las listas de la flora boliviana, se basa en el material tipo de *Bombax heteromorphum* Kuntze que es claramente una mezcla de flores de *Pseudobombax* y hojas de *Tabebuia* Gomes ex DC. (Bignoniaceae). Aquí se designa como el lectotipo de *B. heteromorphum* las flores de uno espécimen de el herbario NY y como epitipo uno

especimen completo (hojas, flores y frutos) de el herbario HUEFS. Consideramos *Bombax heteromorphum* como sinónimo de *P. longiflorum* (Mart.) A. Robyns, una especie ampliamente distribuida en los bosques neotropicales estacionalmente seco de Bolivia, Brasil, Paraguay y Perú. Por otra parte, se describe una especie nueva, *P. pulchellum* Carv.-Sobr., aparentemente endémica de los Bosques secos Chiquitanos en Bolivia, con base en colecciones comúnmente, pero incorrectamente identificado, como *P. heteromorphum*, con comentarios sobre su morfología, distribución y estado de conservación.

## Keywords

*Bombax*, Chiquitano dry forest, new species, seasonally dry neotropical forest, *Tabebuia*, typification

## Palabras clave

*Bombax*, Bosque seco Chiquitano, Bosques secos neotropicales, especie nueva, *Tabebuia*, tipificación

## Introduction

In his revision of *Bombax* L. s.l., Robyns (1963) transferred *B. heteromorphum* Kuntze to *Pseudobombax* Dugand and considered *P. heteromorphum* (Kuntze) A. Robyns to be endemic to Bolivia. Based solely on the holotype of *B. heteromorphum* (Kuntze s.n., Fig. 1), Robyns described *P. heteromorphum* as having long petiolules and scarcely expanded petiole apices. In his key to the species of *Pseudobombax*, he used these two characters to separate this species from morphologically closely related congeners. According to Robyns's description, *P. heteromorphum* also has grooved (canaliculate) petiolules, which if true would represent a unique character in the genus *Pseudobombax*.

In the course of a taxonomic revision of *Pseudobombax* (Carvalho-Sobrinho, in prep.), mixed collections of Bombacoideae, including type specimens based on mixtures, often have been observed. This is especially common for collections from seasonally dry Neotropical forest habitats where species often are leafless during the flowering period. In the present case, a careful examination of the morphology of the leaves and flowers of the holotype of *Bombax heteromorphum* revealed that the specimen is a mixture of reproductive and vegetative elements from two different Angiosperm families. Robyns (1963) failed to note that his type specimen has leaflets that are articulated with the petiole, a character state unknown in *Pseudobombax*; the genus is separated from all other Bombacoideae by the synapomorphy of non-articulated leaflets, which lack an abscission zone between the apex of the petiole and the base of the petiolules (Robyns 1963, Carvalho-Sobrinho and Queiroz 2011).

The holotype of *Bombax heteromorphum* (NY) and an image of an isotype (B as F negative 9535; Field Museum 2012) show floral material matching that of *Pseudobombax longiflorum* (Mart.) A. Robyns, including an androecium with a glabrous, relatively long staminal tube, filaments freely originating from the apex of the tube (i.e., without phalanges), and typical hippocrepiform anthers. However, the vegetative material of these two type specimens matches the leaves of *Tabebuia aurea* (Silva Manso) Benth. & Hook. f. ex S. Moore (Bignoniaceae), with suberous branches, opposite leaves (inferred from leaf scars), longer and grooved petiolules, leaflets with a clear abscission zone, and a clearly different venation pattern (Fig. 1). *Pseudobombax longiflorum*, a



Figure 1. Photograph of the holotype of *Bombax heteromorphum* Kuntze (NY 133522).



species widespread in Neotropical seasonally dry forest of Bolivia, Brazil, Paraguay, and Peru, and *T. aurea* are sympatric in the Bolivian Chiquitano dry forest and the latter species has been collected several times in the type locality of *B. heteromorphum* (municipality of Velasco, Santa Cruz, Bolivia) according to Tropicos (2012) and specimen labels from herbaria (F, US, and WIS).

### Lectotypification of *Bombax heteromorphum*

Having demonstrated above that the holotype of *Bombax heteromorphum* represents a mixture of leaves belonging to *Tabebuia aurea* and detached flowers belonging to a species of *Pseudobombax* it becomes necessary to select a lectotype from these two elements in order to fix the application of the name (McNeill et al. 2012, Art. 9.14). We choose to lectotypify the name on the flowers only because the name *B. heteromorphum* always has been associated with Malvaceae.

*Pseudobombax longiflorum* (Mart.) A. Robyns, Bull. Jard. Bot. État Bruxelles 33: 57. 1963.

= *Bombax heteromorphum* Kuntze, Revis. Gen. Pl. 3(3): 18. 1898. *Pseudobombax heteromorphum* (Kuntze) A. Robyns, Bull. Jard. Bot. État Bruxelles 33: 80. 1963. **Lectotype (designated here):** BOLIVIA. Velasco, O. Kuntze s.n. (NY flowers only!). **Epitype (designated here):** BRAZIL. Bahia, Inhaúmas, ca. 10 km de Inhaúmas na estrada para Santa Maria da Vitória, Cerrado, 13°13'47"S, 44°33'09"W, 600 m alt., 15 Aug 2005, Carvalho-Sobrinho & Queiroz 577 (HUEFS 100549!, lf, fl, fr, in two sheets).

### A new species of *Pseudobombax* long confused with *P. heteromorphum*

Robyns (1963) and subsequent authors (Killeen et al. 1993, Jardim et al. 2003) assigned specimens of a distinctive Bolivian species of *Pseudobombax* to *P. heteromorphum* in error. These collections in fact represent a new species, which we describe here.

#### *Pseudobombax pulchellum* Carv.–Sobr., sp. nov.

urn:lsid:ipni.org:names:77128380-1

[http://species-id.net/wiki/Pseudobombax\\_pulchellum](http://species-id.net/wiki/Pseudobombax_pulchellum)

Figs 2, 3

**Diagnosis.** Similar to *Pseudobombax longiflorum* (Mart.) A. Robyns by its long petiolules, obovate to suborbicular leaflets, and maculate seeds, but differing by the smaller leaves, flowers and fruits, slender branches, petioles 4 times the length of the petiolules

(vs. a petiole/petiolule ratio of 6–12 in *P. longiflorum*), and fruits acuminate for the distal 20% of their length (vs. 3%–5% in *P. longiflorum*).

**Type.** BOLIVIA. Santa Cruz: 42 km E of Curuyuqui, 18°45'56"S, 62°13'59"W, 350 m, 25 October 1991 (lf, fr), A. Gentry, R. Foster & M. Peña 75227 (holotype: MO!; isotypes: F!, LPB!, USZ!, WIS!).

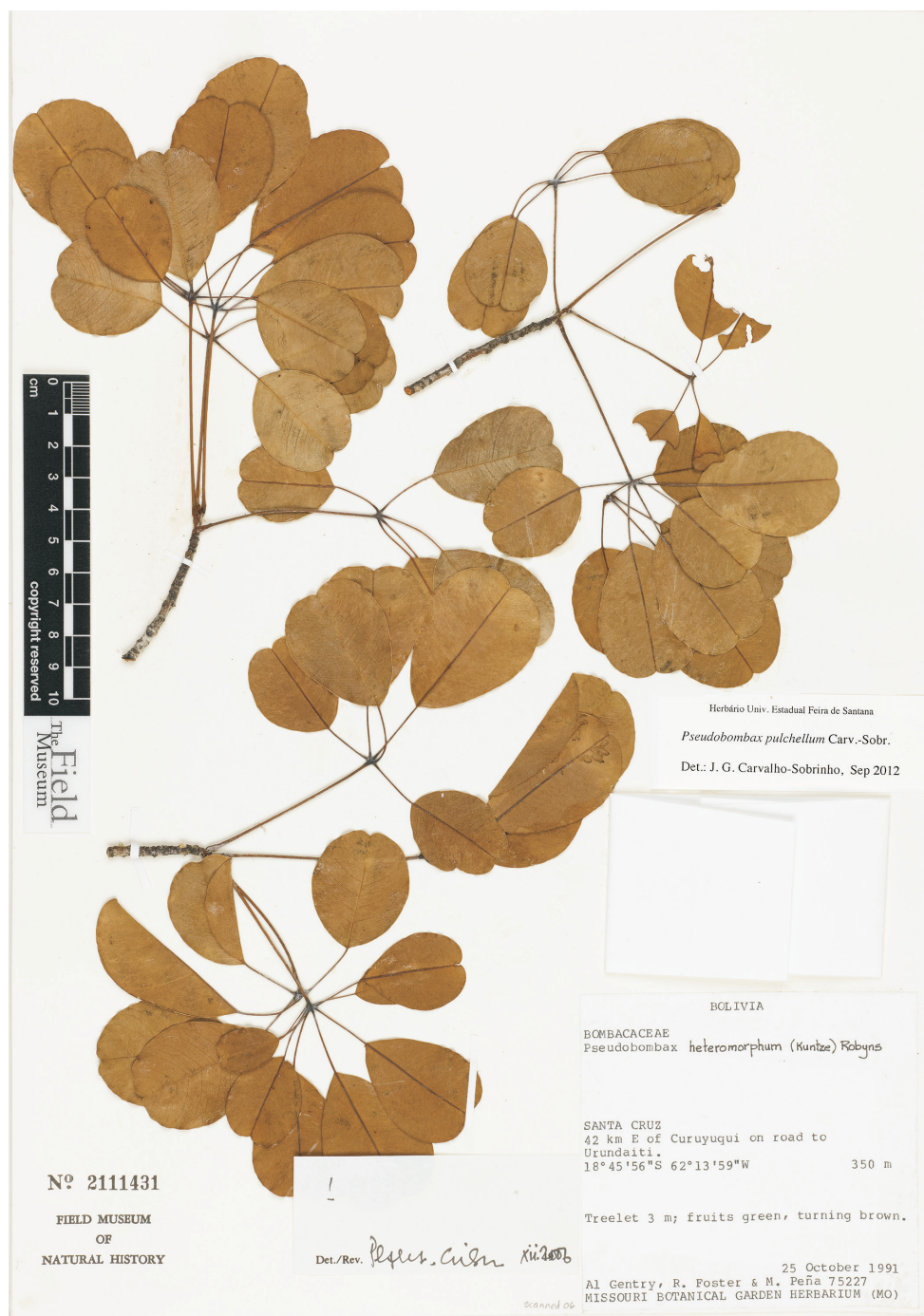
**Description.** Treelets 3–8 m, deciduous; branches glabrous, relatively slender, often covered with pale wax; brachyblasts absent. Stipules not seen. Leaves palmately compound, clustered at apex of the branches; petioles (17–)34–87 mm long, flattened, slender, glabrous, usually glaucous with pale wax at the ends, bases slightly thickened, apices slightly thickened to 3–4 mm diam.; petiolules 14–22 mm long; leaflets (4) 5 (7), chartaceous, proximal leaflets 17–38 × 9–30 mm, distal leaflets 45–57(–75) × 29–51 mm, obovate, broadly elliptic to suborbicular, apices retuse, rarely acuminate, bases obtuse, rounded, truncate to slightly cordate, margins entire, glabrous on both surfaces, except for sparse, peltate microtrichomes, abaxial surface dull-brown in dried state, midrib prominent abaxially, 8–12 secondary veins inconspicuous, intersecondary veins present, tertiary veins reticulate. Complete inflorescences not seen; pedicels 19 mm long (–26 mm when in fruit). Flowers c. 65 mm long; receptacle with single whorl of c. 5 glands; calyces 8–9 × 11–15 mm, cupular to campanulate, truncate, outwardly glabrous except for peltate microtrichomes, internally sericeous; petals (50–)61–70 × 6–8 mm, linear to lanceolate, apex acute, dark-brown externally, covered with tufted, rigid hairs, inwardly pilose to glabrescent towards the base, covered mainly by verrucose microtrichomes; stamens c. 150–200, staminal tube 9–10 × 4 mm, pubescent, phalanges absent, filaments free for 40–58 mm, anthers hippocrepiform c. 2 mm long; ovary 5 × 2 mm, oblong-obovoid, glabrous except for peltate microtrichomes, style c. 70 mm long, glabrous, stigma inconspicuously 5-lobed. Capsules c. 90 mm long, woody, oblong-obovoid, conspicuously acuminate for distal 15 mm or so, valves coriaceous, glabrous, kapok abundant, golden brown. Seeds c. 5 mm diam., subglobose to pyriform, maculate, glabrous.

**Distribution.** *Pseudobombax pulchellum* is known from only four sites in the Department of Santa Cruz, Bolivia, and appears to be endemic to Chiquitano dry forest at elevations of 230 to 520 m.

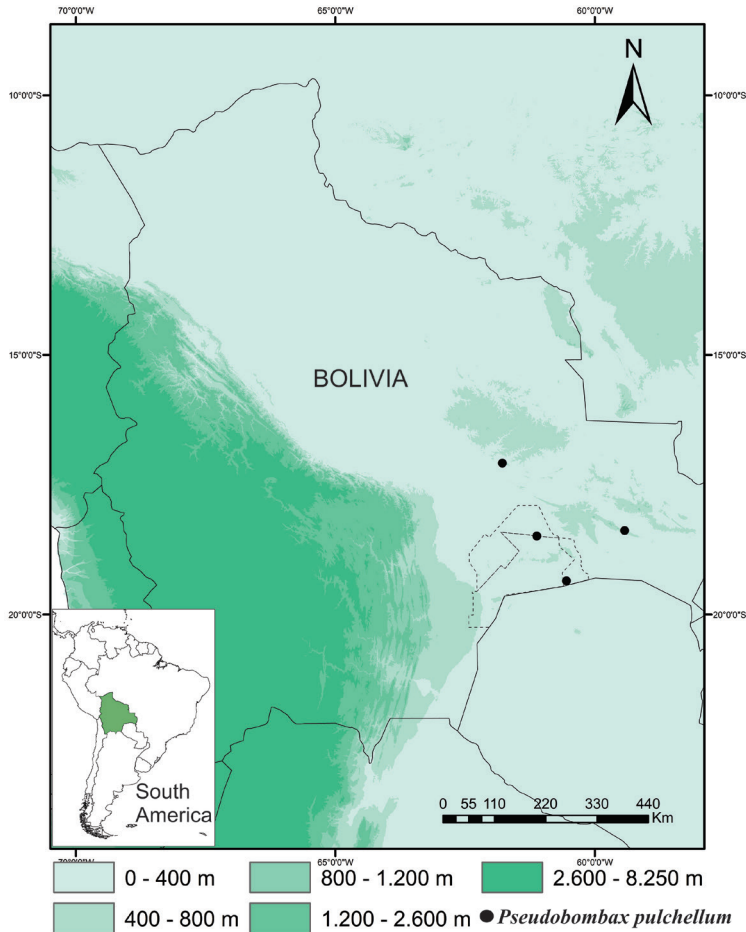
**Phenology.** Flowers of this new species are known from a single collection made in June; fruiting material was collected in October.

**Etymology.** The specific epithet refers to the small, delicate leaflets and long, slender petiolules of this species, diagnostic even in sterile specimens. The epithet also honors the Brazilian botanist Aline Costa da Mota for her important insights and collaboration on the systematics of Bombacoideae.

**Conservation status.** Although *Pseudobombax pulchellum* occurs in the Kaa-Iya del Gran Chaco National Park, it must be considered Near Threatened because it is known from only four sites and “there are plausible events that may cause the species to decline, but these are unlikely to make the species Extinct or Critically Endangered in a short time” (IUCN 2010). Extensive fieldwork in other areas of dry forests in Bolivia is necessary to properly survey and to assess the status of this species.



**Figure 2.** Photograph of an isotype of *Pseudobombax pulchellum* Carv.-Sobr. (Gentry et al. 75227, F 2111431).



**Figure 3.** Distribution of *Pseudobombax pulchellum* Carv.-Sobr. in Santa Cruz, Bolivia. Dashed lines indicate the boundaries of the Kaa-Iya del Gran Chaco National Park.

**Specimens examined. BOLIVIA. Santa Cruz:** Chiquitos, 19–23 Dec 1993 (fr), *G. Navarro Sanchez* 2192 (LPB!); Cordillera, 09 January 1993 (lf), *G. Navarro Sanchez* 1713 (MO!, USZ!); *ibidem*, 18°29'20"S, 61°07'06"W, 230 m, 17 June 1998 (fl), *Alfredo F. Fuentes & G. Navarro Sanchez* 2436 (MO!); Ñuflo de Chavez, 17°05'00"S, 61°47'00"W, 400 m, 24 October 1995 (lf), *Alfredo F. Fuentes* 1132 (LPB!, USZ, WIS!).

**Discussion.** *Pseudobombax pulchellum* is a remarkable species by its diminutive aspect, especially the relatively small, retuse, obovate to suborbicular leaflets, and the flowers; the petiolules are markedly long in relation to the petiole, and fruits are conspicuously acuminate. It seems to be closely related to *P. longiflorum* (Mart.) A. Robyns, a sympatric congener in Bolivian Chiquitano dry forest. The two are similar because of their glabrous aspect, long petiolules, leaflets with retuse apices, truncate to cordate bases, and maculate seeds.



The new species is also similar to *Pseudobombax croizatii* A. Robyns and *P. minimum* Carv.-Sobr. & L.P. Queiroz; both of these species share small flowers (60–65 mm long), glabrous staminal tubes, androecia with relatively few stamens (c. 150–200), and glabrous fruits. The following key can be used to separate these four species of *Pseudobombax*.

- 1      Petiolules 14–75 mm long. Petals externally blackish, staminal tube lacking phalanges (filaments freely originating from the apex of the tube). Seeds bi-colored, maculate..... **2**
- Petiolules to 5 mm long. Petals externally cream-colored, staminal tube originating phalanges 3–5 mm long. Seeds uniformly colored..... **3**
- 2      Petioles 4 times the length of the petiolules. Flowers c. 65 mm long, calyx 8–9 mm long, staminal tube c. 10 mm long. Capsules c. 90 mm long, acuminate for the distal 20% of their length ..... ***P. pulchellum* (Bolivia)**
- Petioles 6–12 times the length of the petiolules. Flowers 15–22 mm long, calyx 15–25 mm long, staminal tube 35–60 mm long. Capsules 14–24 mm long, acuminate for the distal 3%–5% of their length..... ***P. longiflorum* (Bolivia, Brazil, Paraguay, Peru)**
- 3      Leaflets 7–9, obovate, cuneate, margins revolute. Flowers to 60 mm long, staminal tube glabrous. Capsules 55 mm long, not acuminate ..... ***P. minimum* (Central Brazil)**
- Leaflets 5, elliptic to broad-elliptic, acute, margins plane. Flowers 85–100 mm long, staminal tube with bands of simple trichomes. Capsules c. 70 mm long, acuminate ..... ***P. croizatii* (Colombia, Venezuela)**

## Acknowledgements

Thanks are due Hibert Huaylla for photographs of Bombacoideae specimens from Bolivia; the staff and curators of F (especially Nancy Hensold and Robin Foster), LPB, MO, NY, and WIS for scanned images; the reviewers and the subject editor for their suggestions to the manuscript; the Fundação de Amparo à Pesquisa do Estado da Bahia (process APP0006/2011) and the Conselho Nacional de Desenvolvimento Científico e Tecnológico–CNPq (processes 300811/2010-1 and 563546/2010-7-REFLORA) for financial support. This paper is part of the PhD thesis of JGCS prepared in the Programa de Pós-Graduação em Botânica (PPGBot-UEFS) and supported by a grant from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior–CAPES.

## References

- Carvalho-Sobrinho JG, Queiroz LP (2011) Morphological cladistic analysis of *Pseudobombax* Dugand (Malvaceae, Bombacoideae) and allied genera. *Revista Brasileira de Botânica* 34(2): 197–209. doi: 10.1590/S0100-84042011000200007

- Field Museum (2012) Image of isotype *Bombax heteromorphum*, photographed by F. MacBride at the Berlin Herbarium. Berlin Negatives, Botany Collections Database. [http://emuweb.fieldmuseum.org/botany/berDisplay.php?irn=243333&QueryPage=%2Fbotany%2Fsearch\\_berlin.php](http://emuweb.fieldmuseum.org/botany/berDisplay.php?irn=243333&QueryPage=%2Fbotany%2Fsearch_berlin.php) The Field Museum, Chicago, IL. [accessed 31.12.2012]
- IUCN Standards and Petitions Subcommittee (2010) Guidelines for Using the IUCN Red List Categories and Criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee in March 2010. <http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf> [accessed 09.10.2011]
- Jardim A, Killeen TJ, Fuentes A (2003) Guía de los Árboles y Arbustos del Bosque Seco Chiquitano, Bolivia. Missouri Botanical Garden Press. 324p.
- Killeen TJ, García E, Beck S (1993) Guía de árboles de Bolivia. Missouri Botanical Garden and Herbario Nacional de Bolivia, St. Louis, MO and La Paz. 958p.
- McNeill J, Barrie FR, Buck WR, Demoulin V, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Marhold K, Prado J, Prud'Homme van Reine WF, Smith JF, Wiersema JH, Turland NJ (Eds) (2012) International Code of Nomenclature for Algae, Fungi, and Plants (Melbourne Code): adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile 154. Koeltz Scientific Books. <http://www.iapt-taxon.org/nomen/main.php> [accessed 03.05.2013]
- Robyns A (1963) Essai de monographie du genre *Bombax* s.l. (Bombacaceae). Bulletin du Jardin Botanique de l'État à Bruxelles 33(1–2): 1–315.
- Tropicos (2012) Tropicos.org. Missouri Botanical Garden. <http://www.tropicos.org/Name/3701652> [accessed 18.10.2012]

