

A brief botanical survey into Kumbira forest, an isolated patch of Guineo-Congolian biome

Francisco M. P. Gonçalves^{1,2}, David J. Goyder³

1 *Herbarium of Lubango, ISCED-Huila, Sarmento Rodrigues, S/N Lubango, Angola* **2** *University of Hamburg, Biocentre Klein Flottbek, Ohnhorststr.18, 22609 Hamburg, Germany* **3** *Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK*

Corresponding author: *Francisco Maiato Pedro Gonçalves* (francisco.maiato@gmail.com)

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Abstract

Kumbira forest is a discrete patch of moist forest of Guineo-Congolian biome in Western Angola central scarp and runs through Cuanza Norte and Cuanza Sul province. The project aimed to document the floristic diversity of the Angolan escarpment, a combination of general walk-over survey, plant specimen collection and sight observation was used to aid the characterization of the vegetation. Over 100 plant specimens in flower or fruit were collected within four identified vegetation types. The list of species includes two new records of Guineo-Congolian species in Angola, one new record for the country and one potential new species.

Keywords

Kumbira forest, Guineo-Congolian, floristic diversity

Introduction

Angola lies almost wholly within the southern zone of tropical grassland, bounded by tropical rain forest of the Congo in the north and by the Kalahari Desert in the south (Shaw 1947). In general the country comprises four main physiographic components: a coastal plain from the Atlantic seaboard of approximately 200 m above sea level, and from 12 to 200 km wide; a narrow steep escarpment, from 200 to 1000 m altitude;

an interior plateau, occupying nearly 80% of the country lying between 1000 and 1600 m, and a mountain belt rising above the escarpment and plateau of about 2620 m in central plateau (Huntley and Matos 1994).

Between the Karoo-Namib phytochorion of the coastal belt and the *Brachystegia* dominated Zambesian phytochorion of the interior plateau, a discontinuous series of moister vegetation type extends southwards from the Guinea forest and Congo savanna systems following the escarpment (Huntley 1974, White 1983). The Angolan escarpment is dominated by semi-deciduous forest and a mosaic of forest-savanna and gallery forest of Guineo-Congolian affinity, which is restricted to the interior of Cabinda province and large but discontinuous patches of forest in Zaire, Uíge, Cuanza Norte and Cuanza Sul provinces (Barbosa 1970, Huntley 1974).

These vegetation formations, as referred above, cover large areas of Cabinda with a tree strata of about 30 to 40 m height, while in the south are restricted to extensive “Coffee forests” in Dembos, Cazengo and Gabela regions (Huntley 1974). In this latter Kumbira forest, located in Conda, Cuanza Sul province is no doubt the most important and, probably the most southerly and most isolated patch of this biome, with various elements of Congo basin and West African affinities, dominated by genera *Celtis*, *Morus*, *Albizia*, *Bombax* and *Pterocarpus* (Barbosa 1970).

To these formations can be added the afro-montane forests, also of great biogeographic interest (Hall 1960a), restricted to small and isolated patches of forest in Benguela, Huambo and Huíla provinces. The total area of these forest patches was estimated to be approximately 200 ha, the best known of which is Mount Moco in Huambo province which provides habitat for its flora and avifauna (Huntley 1974, Olmos 2008 unpub., Maiato 2009, Mills 2010). The Angolan escarpment with approximately 1000 km of extent is unique, beautiful and constitutes the section of the Great Escarpment of Southern Africa poorly known in terms of its biodiversity, but high level of endemism (Huntley and Matos 1994, Figueiredo 2008, Clark 2011).

Despite the recent published checklist of Angolan vascular plants (Figueiredo and Smith 2008), data on the Angolan flora is mostly limited to the literature of pre-independence era, and current knowledge on Angolan plants is poor and restricted to isolated and focused studies carried out by individuals or institutions. Increasing interest and efforts are being made in order to document and obtain baseline data of areas with high socio-ecological importance (for example The Future Okavango Project – <http://www.future-okavango.org> and the Okavango Wilderness Project – <http://www.wildbirdtrust.com/portfolio/okavango-wilderness-project>) which focus on the Cubango and Cuito river catchments respectively). However large parts of the country, such as the Angolan escarpment, remain to be studied biologically.

In terms of biodiversity, only the avifauna has been investigated in any detail (Hall 1960a, Cagan and Riley 2005, Mills 2010, Cáceres et al. 2015). Recommendations have been made to undertake botanical surveys in the Kumbira area (Barbosa 1970, Huntley 1974). The ecological importance of Kumbira forest in maintaining the highest number of Angolan endemic avifauna highlighted the area as important for conservation of biodiversity. But at the same time concerned due to the increasing human pressure

(Huntley 2011 unpub.). To fill in the gap in terms of botanical diversity, we undertook a botanical survey into Kumbira forest. Here we document our current knowledge of the plant diversity and phytogeographical affinities of Kumbira Forest, the findings are based primarily on a rapid botanical assessment conducted between 10th and 18th June 2014.

Methods

Study area

The central escarpment of western Angola on which Kumbira forest is part of, runs through Cuanza Norte and Cuanza Sul provinces. Barbosa (1970) recognized three types of moist high forest along this escarpment occurring in discrete geographic and climatic zones. North to south, these are:

- i. forests of subtype Cazengo to the north of the Cuanza River;
- ii. forests of subtype Amboim, between the Cuanza and Keve (Queve) Rivers, of which the most significant is the area of forest around Gabela;
- iii. forests of subtype Uku (Vila Nova do Seles) to the south of the Keve River;

Kumbira forest (11°07.00'S; 014°17.00'E) is a discrete patch of moist forest vegetation in this third zone, SW of Conda (Figure 1), where cloud gathers under the knife-edge ridge of the Njelo mountain which reaches around 1500 m in elevation and prevents the cloud from moving further inland. The forest forms part of about 200 000 ha of semi-deciduous moist forest (Cagan and Riley 2005) and occurs on middle altitude slopes at around 700–900 m. Below this altitude dry open vegetation predominates, and at higher elevation the forest gives way to woodland and ultimately open rocky mountain slopes into rocky gorges in Njelo mountain.

Kumbira forest is considered to be part of Gabela Important Bird Area (Dean 2001), and holds unique and threatened bird community (Cagan and Riley 2005). Although its ornithological importance the area is not protected by law, the proposed implementation of Gabela Natural Reserve, recently reinforced (Huntley 1974; Huntley 2011 unpub.) is unfortunately far from being achieved.

Sampling strategy

The botanical team consisted of staff from the Royal Botanic Gardens Kew, UK and from the Herbarium of Lubango, Angola. The team used a combination of general walk-over survey (Filgueiras et al. 1994), plant specimen collection and sight observations to aid the characterization of the vegetation and the compiling of an inventory of the plant species present. Over 100 herbarium specimens were collected, mostly of flowering and fruiting plants, but some sterile collections (lacking flowers or fruits)

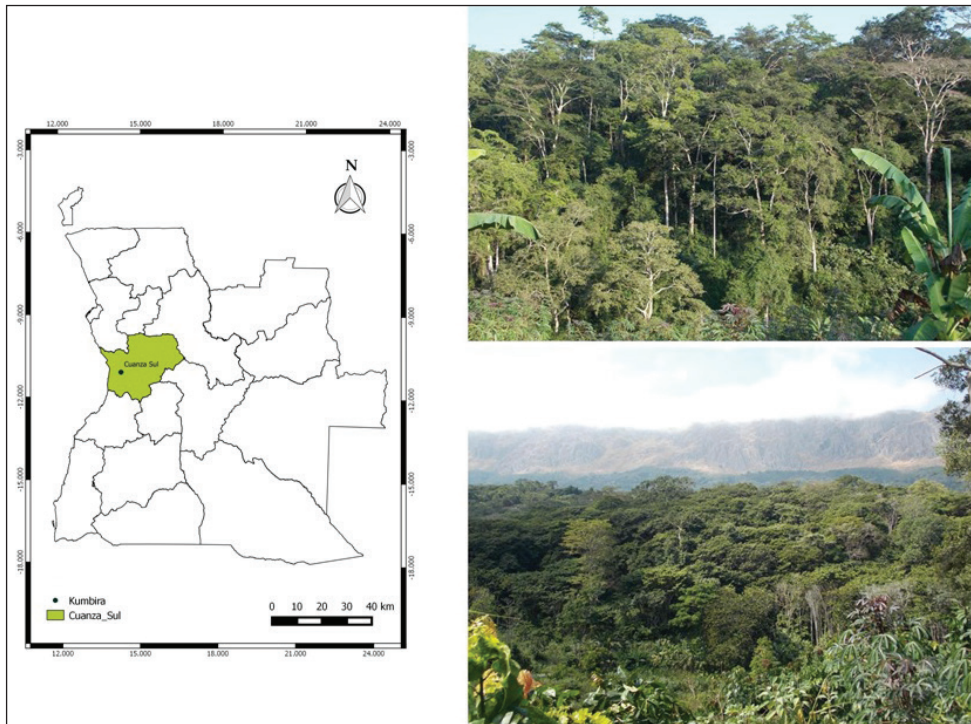


Figure 1. Map of Angola and its provinces, Cuanza Sul province highlighted and Kumbira in Conda municipality (black dot). Kumbira forest (top), the forest with Njelo mountain in the background (bottom).

were made of the more common or important species which were not flowering or fruiting at the time of our visit.

Due to the limited time available, no plot-based surveys to quantify the composition of the different vegetation types were conducted. Plant specimens were collected in duplicate or triplicate, with one set deposited in Lubango for incorporation into the main collection, the remaining set(s) being taken back to the UK where they were identified by comparison with material housed in the Kew herbarium. A range of botanical specialists were consulted to help in the identification of difficult plant groups.

Due to the paucity of useful literature on Angolan plants, and to the limited previous botanical work in the region, it was not possible to name all collections made, particularly sterile material, but we were able to name the large majority. Those named only to genus are nevertheless included within the checklist in Appendix 1. We have not included the additional species listed by Gossweiler and Mendonça (1939) and Barbosa (1970) from this forest subtype in the Appendix 1, as it is not possible to say which forest patch they are from.

The recent Angolan plant checklist by Figueiredo and Smith (2008) was used as the baseline for assessing species records and distributions in the country. The African Plants Database (<http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php>) and the World Checklist series (<http://apps.kew.org/wcsp/home.do>) for a number of plant families were used as the standards for up-to-date taxonomy of African plant species.

Results

From the vegetation survey carried out in Kumbira forest, four main vegetation types were identified. Here we provide a very brief overview of the forest types and their dominant species as recorded by the rapid botanical survey. The habitat types outlined here are also assigned to each of the species listed in (Appendix 1).

- **Moist high forest (F)**

Surveyed at former coffee plantation at foot of Serra Njelo, c.7 km SW of Conda [centred on 11°09.26'S, 014°17.56'E]. The canopy trees in this part of the forest were retained as shade for the coffee grown underneath (*Coffea canephora*, *C. robusta*), and there has been considerable regrowth of forest understorey since the plantations were abandoned. The canopy is c. 25-30 m high, and the commonest tree is the seasonally deciduous *Albizia adianthifolia*, *Trema orientalis*, *Markhamia zanzibarica*, *Antidesma venosum* and several species of *Ficus* are common elements. We also encountered *Anthocleista schweinfurthii*, *Cola welwitschii*, *Pteleopsis diptera*, *Synsepalum cerasiferum*, *Turraea vogelii* and *Vitex welwitschii* in some areas. An arborescent *Dracaena* and a species of *Erythrina* were also noted (sight records only). The understorey was rich in Rubiaceae, and the herbaceous flora included many ferns and occasional epiphytes, *Justicia paxiana* is recorded from Angola for the first time.

- **Submontane forest/woodland (W)**

(Upper margins of Moist High Forest). The moist high forest gives way to deciduous woodland at higher elevations (above c. 900 m). Characteristic trees and shrubs include *Harungana madagascariensis*, *Dombeya rotundifolia*, *Cochlospermum angolense*, *Grewia flavescens*, *Pittosporum viridiflorum* and *Hymenocardia acida*. We also encountered *Podocarpus milanjanus*, an afromontane element, in the gullies at high altitude.

- ***Inga*-dominated former coffee plantation (*Inga*)**

(Surveyed at: mostly at Monte Belo estate, former coffee plantation at foot of Serra Njelo, c. 11 km SW of Conda [centred on 11°10.68'S, 014°16.36'E]). The exotic, evergreen *Inga* trees (*Inga vera* from northern South America) planted initially as shade for the coffee are now overgrown and let little light through the canopy, seriously reducing the development of a shrub or herb layer except in gaps. *Inga vera* was recently referred as one of the most impressive and worrying invasive species of western Angola, forming dense stands in localized sites as observed in Kumbira forest (Rajmánek et al. 2016). Nevertheless, we did record a variety of ferns and other herbaceous plants in this area, in addition to the very large fig *Ficus saussureana*, the first record of this Guineo-Congolian species from Angola. We observed some regeneration of *Inga* from

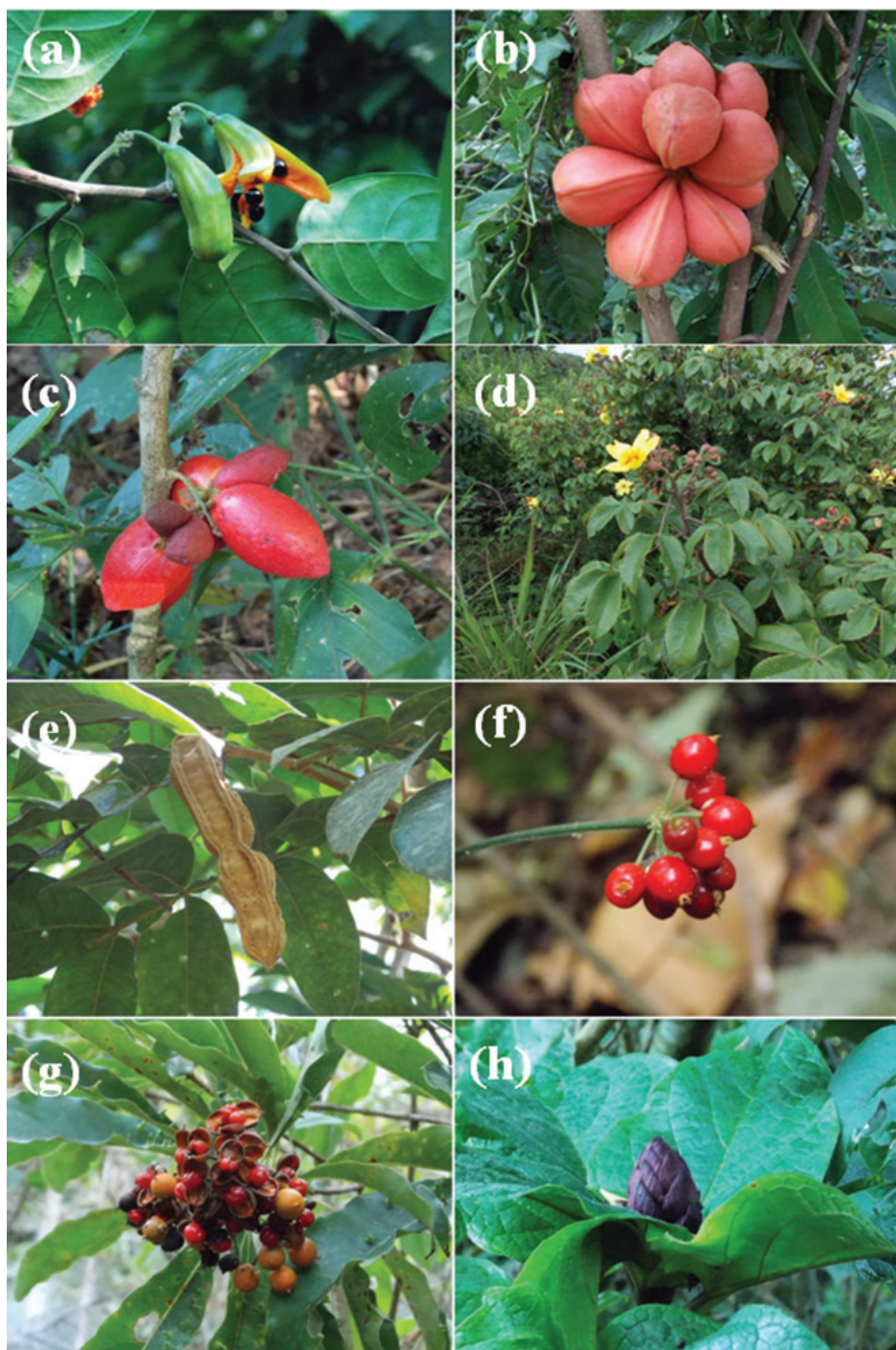


Figure 2. *Turraea vogelii* Hook.f. ex Benth, *Cola welwitschii* Exell & Mendonça ex R. Germ., *Pancovia golungensis* (Hiern) Exell & Mendonça, *Cochlospermum angolense* Welw. ex Oliv., *Inga vera* Willd. subsp. *vera*, *Pavetta gossweileri* Bremek, *Pittosporum viridiflorum* Sims, *Clerodendrum poggei* Gürke

seed, demonstrating its potential as an invasive species. A second exotic mimosoid legume tree was encountered in this area – *Leucaena leucocephala* – also native to the New World.

- **Ruderal and secondary habitats (Sec)**

There is extensive encroachment of agriculture in the vicinity of villages, roads and tracks, and extraction of timber trees in some areas of forest. We did not survey this beyond making occasional observations. The commonest subsistence crops grown in the region are manioc (cassava) and plantain. The oil palm *Elaeis guineensis* is widely planted. We also encountered dense stands of the pigeon pea *Cajanus cajan* in one area. Disturbed areas of forest, recently cleared, had large patches of the invasive shrub *Solanum mauritianum*.

- **Plant diversity**

Our records are a brief snapshot, based on a visit of just six collecting days, at just one time of the year (June). They are by no means comprehensive. Nevertheless, we recorded 92 species from the forest.

- **New plant records for Angola**

We report two new records of Guineo-Congolian forest species for Angola – the tree *Ficus saussureana* and the herb *Justicia paxiana*. In addition, *Tarenna pavettoides* is newly recorded for the country, and may represent an undescribed subspecies. We also report a potential new species in *Rytigynia* sp. nov. (Appendix 2).

Discussion

Phytogeographical context

Coastal regions of Angola are strongly influenced by the Benguela cold-water current which reduces surface evaporation and rainfall. Although the current moves off-shore north of Namibe, corresponding with the northern limit of the Namib Desert, coastal vegetation north of the desert remains dry, and is dominated by dry scrub woodland and succulents such as aloes, euphorbias and baobabs.

Kumbira Forest is a very localized patch of forest between this dry coastal vegetation and the moist savannas of the plateau. Barbosa (1970) regarded the forest as typically Zambezian, the canopy dominated by *Albizia* species that lose their leaves in the dry season. Barbosa also quoted from Gossweiler and Mendonça (1939) who commented on the high percentage of *Ficus* species. However, we found that most of the species within the forest are Guineo-Congolian rather than Zambezian in

floristic affinity *sensu* White (1983) - the species recorded are generally widespread within the Guineo-Congolian phytogeographical region but often rare or previously unrecorded in Angola.

And it must be noted that *Albizia adianthifolia* which we encountered in the forest, is distributed widely across tropical Africa, and not just in the Zambezian region. Kumbira Forest must be one of the most southerly areas in western Angola with significant Guineo-Congolian vegetation. The upper limits of the forest contain occasional afro-montane elements, and the forest merges into moist woodland characterized by widespread species.

Conclusions

We surveyed key sites in a small portion of Kumbira Forest in Cuanza Sul Province, reporting on diversity and floristic affinities of the flora. The vegetation types were identified: moist high forest, submontane forest & woodland, and *Inga*-dominated former coffee plantation. In addition, ruderal or disturbed areas also occur.

Species composition is overwhelmingly Guineo-Congolian, and this forest represents one of the most southerly areas of such vegetation along the Angolan escarpment. Most species have a wide geographic distribution, but some such as *Pavetta gossweileri* are more restricted, and are reported from just Cuanza Sul and Cuanza Norte. *Deinbollia laurifolia* is restricted to riverine lowland habitats from Cuanza Sul to Cameroon.

Much of the area surveyed had good regeneration of the understorey since coffee cultivation ceased, but we observed large trees being taken out of the forest, and evidence of village agriculture encroaching in a number of places. Areas formerly planted with New World legume species, particularly *Inga vera*, were in less favourable condition as the overgrown *Inga* shades out the understorey. There is some evidence of this species reproducing and spreading naturally, and we observed other potentially invasive species such as *Solanum mauritianum*. In addition, some coffee estates are being reestablished, which will reduce the extent of undisturbed or recovering forest further. Three species are newly recorded for Angola, *Ficus saussureana*, *Justicia paxiana* and *Tarenna pavettoides*. We also report a potential new species of *Rytigynia*.

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Appendix I

List of the vascular plants collected and observed in Kumbira Forest, Cuanza Sul, Angola. Habitat types in Kumbira forest relate to the phytochoria recognised by White (1983) as follows: Forest = I. Guineo-Congolian; Woodland = VIII. Afriomontane. Most species found in secondary forest and *Inga*-dominated forest are also Guineo-Congolian in distribution and affinity.

Family	Species	Habitat type	Collectors	Voucher number(s)
PTERIDOPHYTA				
Dennstaedtiaceae	<i>Blotiella currorii</i> (Hook.) R.M.Tryon	Forest	Goyder & Maiato	7701, 7719, 7720, 7722
Dryopteridaceae	<i>Bolbitis gemmifera</i> (Hieron.) C.Chr.	Forest	Goyder & Maiato	7702, 7726
Lomariopsidaceae	cf. <i>Lomariopsis</i>	Forest	Goyder & Maiato	7718
Polypodiaceae	<i>Platyserium</i> sp.	Forest	Sight record	
Pteridaceae	<i>Pteris catoptera</i> Kunze var. <i>catoptera</i>	Inga	Goyder & Maiato	7783
Thelypteridaceae	<i>Christella dentata</i> (Forssk.) Brownsey & Jermy	Forest	Goyder & Maiato	7721, 7727
GYMNOSPERMAE				
Podocarpaceae	<i>Podocarpus milanjianus</i> Rendle	Woodland	Goyder & Maiato	77800
ANGIOSPERMAE				
Araceae	<i>Culcasia angolensis</i> Welw. ex Scott	Forest	Goyder & Maiato	7802
Asparagaceae	<i>Asparagus africanus</i> Lam. var. <i>puberulus</i> (Baker) Sebseb	Forest	Goyder & Maiato	7751
	<i>Dracaena</i> sp.	Forest	Sight record	
Commelinaceae	<i>Aneilema beniniense</i> (P.Beauv.) Kunth	Forest	Goyder & Maiato	7741
	<i>Palisota</i> cf. <i>schweinfurthii</i> C.B.Clarke	Forest	Goyder & Maiato	7715
Dioscoreaceae	<i>Dioscorea puehensis</i> Benth.	Forest	Goyder & Maiato	7758
Marantaceae	<i>Marantochloa leucantha</i> (K.Schum.) Milne-Redh.	Forest	Goyder & Maiato	7778
	<i>Acanthus montanus</i> (Nees) T.Anderson	Forest	Goyder & Maiato	7707
Acanthaceae	<i>Justicia flava</i> (Vahl) Vahl	Secondary forest	Sight record	
	<i>Justicia paxiana</i> Lindau	Forest	Goyder & Maiato	7717
Apocynaceae	<i>Motandra guineensis</i> (Thonn.) A.DC.	Forest	Goyder & Maiato	7804
	<i>Oncinotis</i> sp.	Forest	Goyder & Maiato	7777
Bignoniaceae	<i>Markhamia zanzibarica</i> (Bojer ex DC.) K.Schum.	Forest	Goyder & Maiato	7710

Family	Species	Habitat type	Collectors	Voucher number(s)
Bixaceae	<i>Cochlospermum angolense</i> Welw. ex Oliv.	Woodland	Goyder & Maiato	7796
Cactaceae	<i>Rhipsalis baccifera</i> (J.S.Muell.) Stearn	Forest/Inga	Sight record	
Cannabaceae	<i>Trema orientalis</i> (L.) Blume	Forest	Goyder & Maiato	7765
Cleomaceae	<i>Cleome</i> sp.	Forest	Goyder & Maiato	7713
	<i>Combretum angolense</i> Welw. ex M.A.Lawson	Forest	Goyder & Maiato	7712
Combretaceae	<i>Combretum collinum</i> Fresen.	Woodland	Goyder & Maiato	7792
	<i>Combretum platypetalum</i> Welw. ex M.A.Lawson	Forest	Goyder & Maiato	7757, 7766
	<i>Pteleopsis dipetala</i> Engl. & Diels	Forest/woodland	Goyder & Maiato	7725, 7793
Connaraceae	<i>Rourea thomsonii</i> (Baker) Jongkind	Forest	Goyder & Maiato	7703
Dichapetalaceae	<i>Dichapetalum crassifolium</i> Chodat	Forest	Goyder & Maiato	7704
Ebenaceae	<i>Diospyros heterotricha</i> (Welw. ex Hiern) F.White	Forest	Goyder & Maiato	7704
	<i>Acadypha paniculata</i> Miq.	Forest	Goyder & Maiato	7762
Euphorbiaceae	<i>Antidesma venosum</i> E.Mey. ex Tul	Forest	Goyder & Maiato	7768
	<i>Croton gratissimus</i> Burch.	Forest	Goyder & Maiato	7801
	<i>Mallotus oppositifolius</i> (Geiseler) Müll. Arg.	Forest	Goyder & Maiato	7734
Gentianaceae	<i>Anthocleista schweinfurthii</i> Gilg.	Forest	Goyder & Maiato	7774
Hypericaceae	<i>Harungania madagascariensis</i> Lam. ex Poir.	Woodland	Goyder & Maiato	7791
	<i>Clerodendrum poggei</i> Gürke	Forest	Goyder & Maiato	7736
Lamiaceae	<i>Clerodendrum volubile</i> P.Beauv.	Forest	Goyder & Maiato	7714
	<i>Vitex welwitschii</i> Gürke	Forest	Goyder & Maiato	7770
Leguminosae:	<i>Acacia pentagona</i> (Schumach. & Thonn.) Hook.f.	Forest	Goyder & Maiato	7748
Mimosoideae	<i>Albizia adianthifolia</i> (Schumach.) W.Wight	Forest	Goyder & Maiato	7740, 7764
	<i>Inga vera</i> Willd. subsp. <i>vera</i>	Inga	Goyder & Maiato	7759, 7764
	<i>Leucaena leucocephala</i> (Lam.) de Wit	Inga	Goyder & Maiato	7780
	<i>Cajanus cajan</i> (L.) Millsp.	Secondary forest	Goyder & Maiato	7784
Leguminosae:	<i>Dalbergia saxatilis</i> Hook.f.var. <i>saxatilis</i>	Forest	Goyder & Maiato	7769
Papilionoideae	<i>Desmodium repandum</i> (Vahl) DC	Forest	Goyder & Maiato	7742
	<i>Erythrina</i> sp.	Forest	Sight record	
	<i>Millettia drastica</i> Welw. ex Baker	Forest	Goyder & Maiato	7787

Family	Species	Habitat type	Collectors	Voucher number(s)
Loranthaceae	<i>Neonotonia wightii</i> (Widht & Arn.) J.A.Lackey	Forest	Goyder & Maiato	7723
	<i>Psophocarpus scandens</i> (Engl.) Verdc.	Secondary forest	Goyder & Maiato	7785
	<i>Tapinanthus constrictiflorus</i> (Engl.) Danser	Forest	Goyder & Maiato	7789
	<i>Cola welwitschii</i> Exell & Mendonça ex R. Germ.	Forest	Goyder & Maiato	7730, 7747
	<i>Dombeya rotundifolia</i> (Hochst.) Planch. var. <i>rotundifolia</i>	Woodland	Goyder & Maiato	7795
Malvaceae	<i>Grewia flavescens</i> Juss.	Woodland	Goyder & Maiato	7794
	<i>Grewia floribunda</i> Mast.	Forest	Goyder & Maiato	7744
	<i>Urena lobata</i> L.	Secondary forest	Goyder & Maiato	7776
Meliaceae	<i>Turnaea vogelii</i> Hook.f.ex Benth	Forest	Goyder & Maiato	7728, 7756
	<i>Ficus conraui</i> Warb.	Inga	Goyder & Maiato	7761
Moraceae	<i>Ficus saussureana</i> DC.	Inga	Goyder & Maiato	7782
	<i>Ficus</i> sp.	Forest	Goyder & Maiato	7739
	<i>Trilepium madagascariense</i> DC.	Forest	Goyder & Maiato	7733
Passifloraceae	<i>Adenia lobata</i> (Jacq.) Engl. subsp. <i>lobata</i>	Forest	Goyder & Maiato	7752
Phyllanthaceae	<i>Hymenocardia acida</i> Tul.	Woodland	Goyder & Maiato	7798
	<i>Thecacoris trichogyne</i> Müll. Arg.	Forest	Goyder & Maiato	7716
Pittosporaceae	<i>Pittosporum viridiflorum</i> Sims	Woodland	Goyder & Maiato	7797
Primulaceae	<i>Mesa welwitschii</i> Gilg.	Forest	Goyder & Maiato	7709
Rhamnaceae	<i>Gouania longipetala</i> Hemsl.	Forest	Goyder & Maiato	7724
	<i>Bertera orthopetala</i> (Hiern) N.Hallé	Forest	Goyder & Maiato	7771
	<i>Coffea canephora</i> Pierre ex A.Froehner	Forest/Inga	Goyder & Maiato	7786
	<i>Empogona glabra</i> (K.Schum.) Tosh & Robbr.	Forest/Inga	Goyder & Maiato	7755
	<i>Mussaenda erythrophylla</i> Schumach. & Thonn.	Forest	Goyder & Maiato	7803
Rubiaceae	<i>Pavetta gossweileri</i> Bremek	Forest/Inga	Goyder & Maiato	7760
	<i>Psychotria nigropunctata</i> Hiern	Woodland	Goyder & Maiato	7799
	<i>Rothmannia longiflora</i> Salisb.	Forest	Goyder & Maiato	7745
	<i>Rothmannia whitfieldii</i> (Lindl.) Dandy	Forest	Goyder & Maiato	7746
	<i>Sherbournia bignoniiflora</i> (Welw.) Hua	Forest	Goyder & Maiato	7705

Family	Species	Habitat type	Collectors	Voucher number(s)
	<i>Tarenna pavettoides</i> (Harv.) Sim?subsp. nov.	Forest/Inga	Goyder & Maiato	7775
	<i>Rytigynia?</i> sp. nov.	Forest	Goyder & Maiato	7788
	<i>Deinbollia laurifolia</i> Baker	Forest	Goyder & Maiato	7743
Sapindaceae	<i>Pancovia golungensis</i> (Hiern) Exell & Mendonça	Forest	Goyder & Maiato	7772
	<i>Paullinia pinnata</i> L.	Forest	Goyder & Maiato	7767
Sapotaceae	<i>Synsepalum cerasiferum</i> (Welw.) T.D.Penn.	Forest	Goyder & Maiato	7754
	<i>Solanum anomalum</i> Thonn.	Forest	Goyder & Maiato	7711
Solanaceae	<i>Solanum mauritianum</i> Scop.	Secondary forest	Goyder & Maiato	7738
	<i>Solanum terminale</i> Forssk.	Forest	Goyder & Maiato	7749
	<i>Steganotaenia araliacea</i> Hochst.	Inga	Goyder & Maiato	7779
Umbelliferae	<i>Urena trinervis</i> (Hochst.) Friis & Immelman	Forest	Goyder & Maiato	7773
Urticaceae	<i>Rinorea ilicifolia</i> (Welw. ex Oliv.) Kuntze	Forest	Goyder & Maiato	7750
Violaceae	<i>Cissus aralioides</i> (Welw. ex Baker) Planch.	Forest	Goyder & Maiato	7790
	<i>Leea guineensis</i> G.Don	Secondary forest	Goyder & Maiato	7708

Appendix 2

List of species collected in Kumbira forest which represent new records for Angola.

Family	Species	Notes
Acanthaceae	<i>Justicia paxiana</i> Lindau	Widely distributed in West Africa and the Congo Basin, but not recorded before from Angola
Moraceae	<i>Ficus saussureana</i> DC.	Widely distributed in West Africa and eastern and western margins of the Congo Basin, but not recorded before in Angola.
Rubiaceae	<i>Rytigynia</i> ?sp. nov.	We were unable to match this to any known species of the genus.
Rubiaceae	<i>Tarenna pavettoides</i> (Harv.) Sim	This species has one subspecies distributed across West Africa and northern limits of the Congo Basin, and other subspecies in Eastern and Southern Africa. It has not been reported from Angola before, and our collection may represent a new subspecies.

A new species of *Amphitecna* (Bignoniaceae) endemic to Chiapas, Mexico

Andres Ernesto Ortiz-Rodriguez¹, Carlos Manuel Burelo Ramos²,
Héctor Gomez-Dominguez³

1 Instituto de Ecología, A.C., Departamento de Biología Evolutiva, Xalapa, Veracruz, México **2** Herbario UJAT, División Académica de Ciencias Biológicas, Universidad Juárez, Autónoma de Tabasco, Villahermosa Tabasco, México **3** Herbario Eizi Matuda (HEM) Facultad de Ciencias Biológicas, Universidad de Ciencias y Artes de Chiapas, Tuxtla Gutiérrez, Chiapas, México

Corresponding author: Andres Ernesto Ortiz-Rodriguez (ortizrodriguez.ae@gmail.com)

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Abstract

Amphitecna loreae Ortiz-Rodr. & Burelo, **sp. nov.** (Bignoniaceae), a new species endemic to the karst rainforest in southern Mexico, is described and illustrated. The new species differs from the other species of *Amphitecna* by the combination of cauliflorous inflorescences, larger flowers, buds rounded at apex, and globose-ellipsoid rather than acuminate fruits. A key to the Mexican species of *Amphitecna* is presented.

Keywords

Crescentieae, karst forest, zona sujeta a protección ecológica “La Pera”

Introduction

Bignoniaceae (calabash tree family) includes about 82 genera and approximately 900 species of trees, shrubs and woody vines distributed mainly in tropical areas around the world (Lohmann and Ulloa 2006). The most recent tribal classification of Bignoniaceae (Fischer et al. 2004), recognizes seven tribes: Bignonieae, Coleeae, Crescentieae, Eccremocarpeae, Oroxyleae, Tecomeae, and Tourrettieae. However, phylogenetic analysis based on molecular characters (Olmstead et al. 2009) shows that many of

the above tribes, as traditionally had been recognized, do not represent monophyletic groups. Based on this phylogenetic hypothesis (Olmstead et al. 2009), the 82 genera of Bignoniaceae can be organized in the tribes Bignonieae, Catalpeae, Jacarandae, Oroxyleae, Tecomeae, and Tourrettieae. In addition, a strongly supported clade informally named *Crescentiina* is recognized (Olmstead et al. 2009, Collevatti and Dornelas 2016).

The *Crescentiina* clade contains approximately 34 genera and 300 species, and it is formed by two subclades corresponding to the *Tabebuia* alliance and the Paleotropical clade (a group of genera traditionally assigned to Tecomeae and Coleae) (Olmstead et al. 2009). The *Tabebuia* alliance, is a lineage endemic to the Neotropics and consists of 14 genera and 147 species of trees and shrubs, from which stands a small clade of three genera traditionally assigned to the tribe Crescentieae, *Amphitecna*, *Crecentia*, and *Parmentiera*, which together comprise nearly 36 species of trees distributed in Central America, northern Colombia and the Greater Antilles (Gentry 1980, Grose and Olmstead 2007a).

The genus *Amphitecna* is easily differentiated from *Crecentia* and *Parmentiera* by the combination of simple, alternate leaves and the greenish flowers with the lobes of the petals fused (Gentry 1980). The genus comprises about 20 species (Grose and Olmstead 2007b), most of them known to be restricted to a few localities. In Mexico, the genus *Amphitecna* is particularly diverse and consists of roughly 10 species, all of them having their southernmost distribution in Guatemala and Belize.

During the course of several botanical explorations in southern Mexico, a species of *Amphitecna* with a unique combination of features differing from all other members of the genus was collected in a karst forest of Chiapas. In this paper, this interesting species is described and illustrated and its affinities with other species of *Amphitecna* are discussed. Furthermore a key to Mexican species of *Amphitecna* is presented.

Materials and methods

In order to confirm the status of this new species we visited and reviewed the specimens of *Amphitecna* deposited in herbaria XAL, HEM and CHIP (Thiers 2016). Also, we consulted the digitized type specimens available at JSTOR Global Plants (<http://plants.jstor.org/>). The putative new species was recognized using the unique combination of features criteria (Donoghue 1985) through comparisons with morphologically similar species and literature review (Gentry 1980). Finally, description of the species was elaborated following terminology presented in Hickey (1973).

We assessed the conservation status by calculating the extent of occurrence (EOO) and the area of occupancy (AOO) using the GeoCAT tool (Bachman et al. 2011) and applying the IUCN Red List Categories and criteria (IUCN 2001).

Additionally, coordinates of occurrence data were assembled for the new species herein described and for the morphologically similar species, which were obtained from the Global Biodiversity Information Facility (GBIF; <http://www.gbif.org/species>).

cies/4003073), supplemented with records from field collection and with information available in the herbarium specimens. Then climate layers were obtained at a 30 arc-sec (c. 1 km²) resolution from the WorldClim database (Hijmans et al. 2005) and for all occurrence records, we extracted data from 19 climatic variables using ArcView v3.2 (ESRI, Redlands, CA, USA). Using these data, we performed a principal components analysis (PCA) using a correlation matrix with PAST ver. 3.06 (Hammer et al. 2001) to explore patterns of climatic differentiation between species.

Taxonomic treatment

Amphitecna loreae Ortiz-Rodr. & Burelo, sp. nov.

urn:lsid:ipni.org:names:77155494-1

Figures 1, 3

Type. Mexico. Chiapas, Municipio de Berriozábal, zona sujeta a protección ecológica “La Pera”, predio “Peña Flor” camino Berriozábal- Vista Hermosa-El Cairo, km. 12 desvío al Pozo Turipache, 1068 m, 16°51'50.6"N, 93°19'51.7"W, 05 March 2012 (fl, fr) *Ortiz-Rodríguez A. E 0178* (holotype HEM; isotypes: UJAT, XAL).

Diagnosis. *Amphitecna loreae* is distinguishable from the other species of *Amphitecna* by a combination of its cauliflorous inflorescences, large flowers, buds rounded at apex, and broadly elliptical to spherical rather than acuminate fruits. *Amphitecna tuxtensis*, *A. montana* and *A. latifolia*, also distributed in Mexico, have affinities with *A. loreae* and share the cauliflorous inflorescences and leaves less than 50 cm long. However, *A. tuxtensis* differs in having the flower buds pointed at the apex and fruits elliptic, acute to acuminate at apex, and *A. montana* differs in having larger leaves, long pedicellate flowers and elliptical fruits shortly pointed at the tip, while *A. latifolia* differs in having obovate to widely elliptic leaves, rounded to mucronate at apex with poorly defined petioles (Figure 1).

Description. Trees, 15–25 m and 15–50 cm DBH, the secondary branches terete. *Leaves*, alternate-verticillate, clustered near the apex of the branches, olive-green when dry, glabrous, 10–20 cm long, 2–5 cm wide, oblanceolate to narrowly elliptic, acuminate, subcoriaceous, acute to attenuate basis, midrib slightly raised on the upper surface, prominent on the lower surface; secondary veins 11–14 on a side, slightly raised above, prominent below; petiole short, to 2 cm long, merging with attenuate leaf base. *Inflorescences*, groups of two or three flowers, with an unpleasant odor, which are borne on leafless portions of old branches and along the main trunk (cauliflory). Flower buds, rounded at apex. *Flowers* pendant, pedicel 35–60 mm long; calyx campanulate, 28–38 mm long, more or less coriaceous, evenly 2 to 3-labiate to below the middle, circumscissile; corolla radially symmetric, pale green, tubular-infundibuliform, 48–60 mm long, 30–40 mm wide at the mouth of the tube, the basal part of the corolla a straight tube, 15–25 mm long, the lobes fused in to frilly-margined rim; stamens included, inserted 18–28 mm from base of the tube, the anther thecae divergent, 4–7

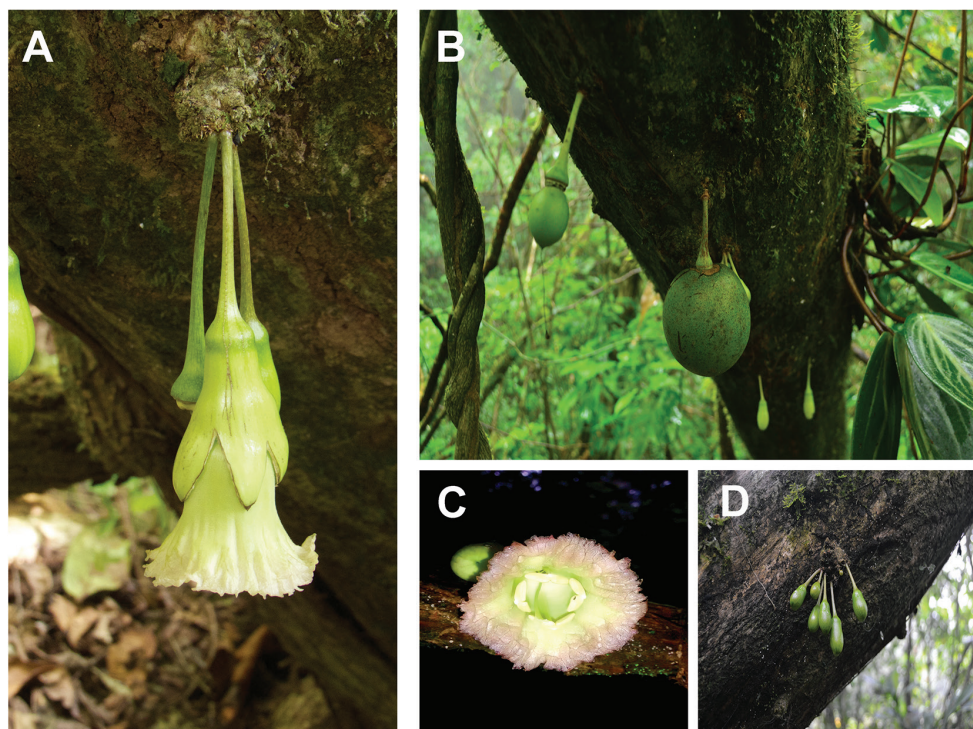


Figure 1. *Amphitecna loreae* sp. nov. **A** cauliflorous flowers with trilobate calyx. **B** broadly elliptical to spherical fruits **C** corolla **D** buds rounded at apex. Photographs by Andres E. Ortiz-Rodriguez (**A** and **C**) and Marcos Escobar (**B** and **D**).

mm long, the filaments 18–30 mm long; the staminode, when present, less than 20 mm long, inserted 10–20 mm from base of the tube, sometimes well developed (with one or two small thecae) to give the impression of being a fifth stamen; ovary, up to 3 mm long and 2.5 mm wide, broadly elliptical, glandular-papillose; pistil 40–60 mm long with the stigma bifurcate; disc annular-pulvinate, about 6 mm in diameter; flowers are often found with signs of herbivory, in which the ovule and disc are not present. *Fruits* broadly elliptical to spherical, 70–100 mm long, 60–80 mm wide.

Habitat and ecology. The species is only known from Chiapas, Mexico. It is a rare species at the type locality in the ecological reserve La Pera. The species inhabits the karst areas, mainly in the tropical rainforest. It is a canopy tree and coexists with species of *Quercus lancifolia* Schltdl. & Cham., *Q. corrugata* Hook., *Calatola costaricensis* Standl., *Spathacanthus hahnianus* Baill. and *Quararibea funebris* (La Llave) Vischer.

Phenology. Mature flowers and fruits were collected in March and April; buds, ripe and immature fruits were observed in the same months.

Etymology. The specific epithet honors Francisco Lorea Hernández, in recognition of his many important contributions to our knowledge of the Mexican flora.

Conservation status. Currently we lack the necessary information to objectively define the conservation status of *Amphitecna loreae*. However, according to the criteria

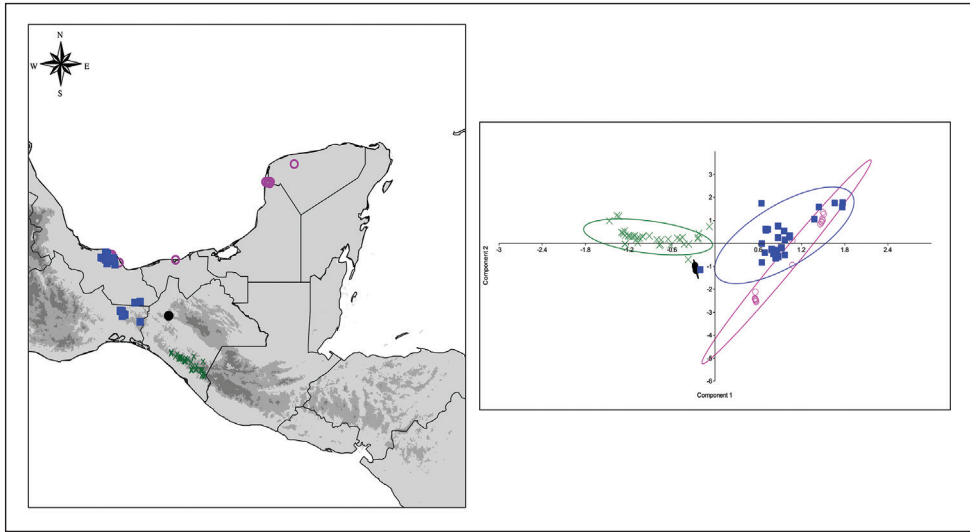


Figure 2. Distribution range and climatic preferences of *Amphitecna loreae* and related species. *Amphitecna latifolia* (purple circles) *Amphitecna montana* (green cross), *Amphitecna loreae* (black dots) and *Amphitecna tuxtensis* (blue squares). In colours similar to those of the species the 95% confidence ellipses produced by PCA analysis.

established by the IUCN, it is possible to tentatively determine that the species is Critically Endangered [CR B1ab (iii)]. Although the only known population of the species is located within a protected natural area, *A. loreae* appears to be rare ecologically and only eight individuals in one hectare of sampling were recorded (Escobar-Castellanos 2016). The Area of occupancy (AOO) is 12,000 km² and the Extent of occurrence (EOO) is 0.763 km², suggesting a very restricted overall distribution. Furthermore, the tropical rain forest in this region of Chiapas is seriously fragmented and only small remnants persist.

Additional specimens examined. Mexico. Chiapas, Berriozabal: Rancho “El Retiro”, atrás de el rancho “El Zapote”. 13 km al N de Berriozábal camino a Joaquín Miguel Gutiérrez, 16°52'09.2"N, 93°19'26.4"W, 1114 m., 04 May 2014, *M. A. Escobar Castellanos* 586 (HEM); same locality, *M. A. Escobar Castellanos* 675 (HEM); zona sujeta a protección ecológica “La Pera”, predio “Peña Flor” camino Berriozábal- Vista Hermosa-El Cairo, km. 12 desvío al Pozo Turipache, 16°51'50.6"N, 93°19'51.7"W, 1100 m, 16 May 2015, *Y. Licona-Vera* 190 (XAL).

Discussion. *Amphitecna loreae* sp. nov. has a combination of characters that clearly separate it from other species of *Amphitecna*: its strictly cauliflorous inflorescences distinguish it from those species with terminal inflorescences (*Amphitecna apiculata* A.H. Gentry, *Amphitecna breedlovei* A.H. Gentry, *Amphitecna donnell-smithii* (Sprague) L.O. Williams, *Amphitecna isthmica* (A.H. Gentry) A.H. Gentry, *Amphitecna molinae* L.O. Williams and *Amphitecna steyermarkii* (A.H. Gentry) A.H. Gentry).

The four cauliferous species discussed in the diagnoses have different distribution ranges with different climatic preferences (Figure 2). *Amphitecna tuxtensis* has two

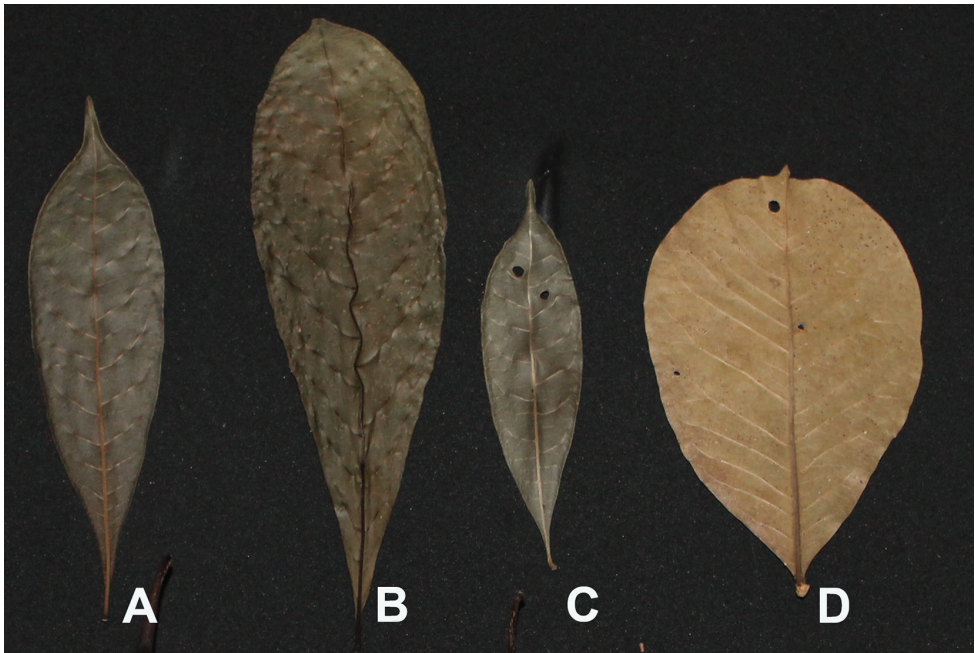


Figure 3. Leaf variation in *Amphitecna loreae* and related species. **A** *Amphitecna tuxtlensis* (H. Gomez 3710 HEM) **B** *Amphitecna montana* (N. Martinez 927 HEM) **C** *Amphitecna loreae* (M. Escobar 586 HEM) and **D** *Amphitecna latifolia* (E. Ucan E 251 XAL).

disjunct populations in Veracruz, one in the area of the Los Tuxtlas and another in the Uxpanapa-Chimalpas region, where it inhabits the tropical rainforest. *Amphitecna montana* is distributed along the Sierra Madre de Chiapas and inhabits the cloud forest above 1200 m. *Amphitecna latifolia* is distributed intermittently in areas near to the Atlantic coast of Mexico, where it inhabits mainly in riparian vegetation and mangrove associations. In contrast, *A. loreae* is endemic to Chiapas and it is known only from a single locality at the municipality of Berriozabal, Chiapas. The species grows on a karstic zone at approximately 900–1,150 m and it inhabits the tropical rainforest (Table 1).

Key to the Mexican species of *Amphitecna* (modified from Gentry 1980)

- 1 Terminal inflorescences2
- Cauliflorous inflorescences (borne on leafless portions of old branches and along the main trunk)5
- 2 Calyx spathaceous with a sharp acumen..... *A. steyermarkii*
- Calyx bilabiate or trilabiate3
- 3 Corolla tubular less than 1 cm wide at the mouth of tube..... *A. apiculata*
- Corolla campanulate more than 1 cm wide at the mouth of tube.....4

Table 1. Comparison of diagnostic morphological characters of *Amphitecna loreae* with its close relatives.

Characters	<i>Amphitecna latifolia</i>	<i>Amphitecna montana</i>	<i>A. tuxtlensis</i>	<i>Amphitecna loreae</i>
Habit	Tree to 10 m tall	Large tree, 10-20 m tall	Tree, 5-15 m tall	Large tree, 10-25 m tall
Leaf length	to 19 cm	to 34 cm	to 18 cm	to 20 cm
Leaf width	to 11 cm	to 11 cm	to 5 cm	to 5 cm
Petiole	poorly defined	clearly differentiated	defined	defined
Leaf shape	Broadly obovate	Oblanceolate to narrowly obovate	Oblanceolate	Oblanceolate
Leaf apex	rounded to acute, usually apiculate	acute to short-acuminate	acuminate	acuminate
Length of the flower pedicel	to 36 mm	to 100 mm	to 26 mm	to 60 mm
Tip of flower buds	rounded	rounded	Pointed	rounded
Fruit shape	broadly elliptical to spherical	Oblong-ovoid or ellipsoid	ellipsoid	broadly elliptical to spherical
Fruit apex	rounded (rare shortly pointed)	shortly pointed to acute	acute to acuminate	rounded
Habitat	always near sea level, mostly in mangrove associations and flooded vegetation	Mountain cloud forest	Tropical rain forest	Tropical rain forest
Distribution	Mexico (Campeche, Tabasco, Veracruz and Yucatan); Central America, West Indies to Venezuela and Ecuador	Mexico (Chiapas); Guatemala	Mexico (Veracruz and Oaxaca)	Mexico (Chiapas)

- 4 Leaves membranaceous; corolla less than 3 cm long.....*A. donnell-smithii*
- Leaves chartaceous to coriaceous; corolla more than 3 cm long...*A. breedlovei*
- 5 Leaves mostly 50–100 cm long, clustered near tip of twigs; small trees, 2–7 m, simple or few branched stem..... **6**
- Leaves less than 40 cm long, alternate; medium and large sized trees, 10–25 m, branched..... **7**
- 6 Corolla less than 2 cm wide at the mouth of tube; pedicels to 4 cm long
..... *A. macrophylla*
- Corolla more than 2 cm wide at the mouth of tube; pedicels to 1 cm long ...
..... *A. regalis*
- 7 Fruits ovoid to narrowly oblong-ellipsoid, apiculate at apex..... **8**
- Fruits ellipsoid to spherical, rounded at apex or very inconspicuously apiculate..... **9**
- 8 Secondary venation impressed below leaves and conspicuously whitish-margined; petiole poorly demarcated, to 1 cm long; flower buds rounded to shortly pointed *A. silvicola*
- Secondary venation prominent below leaves; and not whitish-margined; petiole 1–2 cm long; flower buds pointed *A. tuxtlensis*

- 9 Trees to 10 m tall; leaves obovate to wide elliptic, rounded to mucronate at apex with poorly defined petioles; restricted to coastal ecosystems.....***A. latifolia***
- Large trees, to 25 m tall; leaves oblanceolate to narrowly obovate, acute to acuminate at apex with defined petioles; tropical rain forest or cloud forest **10**
- 10 Leaves, 34 × 11 cm; petiole to 4 cm long; pedicels to 10 cm long; forests above 1200 m.....***A. montana***
- Leaves, 20 × 5 cm; petiole short, less than 2 cm; pedicels to 6 cm long; forests below 1000 m.....***A. loreae***

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Cephalaria anamurensis (Caprifoliaceae), a new species from south Anatolia, Turkey

Ramazan Süleyman Göktürk¹, Hüseyin Sümbül¹

¹ Department of Biology, Faculty of Science, Akdeniz University, 07058, Antalya, Turkey

Corresponding author: Ramazan Süleyman Göktürk (gokturk@akdeniz.edu.tr)

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Abstract

A new species, *Cephalaria anamurensis* (Caprifoliaceae) is described and illustrated from south Anatolia, Turkey. The species grows on steppe and stony places in Anamur (C4 Mersin province) in south Anatolia. Diagnostic morphological characters from closely similar taxa are discussed. The geographical distribution of the new species and two closely related species in Turkey are mapped.

Keywords

Cephalaria, New species, Taxonomy, Turkey

Introduction

The genus *Cephalaria* Schrad. ex Roem. & Schult. was first described by J.J. Roemer and J.A. Schultes (Roemer and Schultes 1818). It is distributed from Mediterranean area to west China, and some of the species are also found in southern Africa (Szabó 1940). The genus *Cephalaria* has long been regarded as belonging to the Dipsacaceae, whereas according to APG III it is included within the larger family Caprifoliaceae (Dipsacales) and consist of 100 species (Reveal and Chase 2011). In Turkey, the family Caprifoliaceae is represented by 12 genera, namely *Centranthus* DC. (3 spp.), *Cephalaria* (39 spp.), *Dipsacus* L. (5 spp.), *Knautia* L. (9 spp.), *Lonicera* L. (11 spp.), *Morina* L. (2 spp.), *Pterocaphalus* Adans. (9 spp.), *Scabiosa* L. (32 spp.), *Succisa* Haller (1 sp.), *Tremastelma* Rafin. (1 sp.), *Valeriana* L. (14 spp.) and *Valerianella* Mill. (31 spp.) (Güner et al. 2012).

In July 2015, the authors collected a specimen of *Cephalaria* from the Taurus Mountains (Mersin province) during fieldwork for Expo Antalya 2016 natural plant supply project. Fruiting material was gathered in the same area in September 2015 by the authors. This specimen has been compared to many specimens including two supposedly closely related species in the Herbaria of Akdeniz University Herbarium, ANK, GAZI and HUB, records in the literature (Szabó 1940, Göktürk et al. 2012, Göktürk and Sümbül 2014) and consulting floras of Turkey and neighboring countries (Bobrov 1957, Matthews 1972, Ferguson 1976, Feinbrun-Dothan 1978, Matthews 1988, Lack 1991). Successful efforts have also been made to find additional locations in this vicinity where this novel plant may be located. After comparison with material of morphologically similar taxa, we concluded that these specimens represent a species new to science.

Materials and methods

In a total, five specimens (23 individuals) of the new species were collected from three adjacent localities. The illustrations of the species were made from dry materials by using Adobe Photoshop CS4. Herbarium studies were made in Akdeniz University Herbarium, which has the richest *Cephalaria* collections in Turkey, and ANK, GAZI and HUB.

Taxonomic treatment

Cephalaria anamurensis Göktürk & Sümbül, sp. nov.

urn:lsid:ipni.org:names:77155495-1

Figs 1, 2

Diagnosis. *Cephalaria anamurensis* is similar to *C. elmaliensis* Hub.-Mor. & V. A. Matthews and *C. speciosa* Boiss. & Kotschy. It can be distinguished from them by its rhizomatous growth, the lower stem leaves 35–55 × 3.5–4.5 cm, a globose capitula, involuclral bracts that are ovate-orbicular to triangular-ovate, 3–7 × 2.5–6 mm, and completely blackish or blackish on the dorsal side and at the acute or subobtusate apex, receptacular bracts that are oblanceolate and blackish at an acuminate apex, and the involucler with long teeth 3–4 mm long and short teeth 1–1.5 mm long.

Type. TURKEY, Mersin, Anamur, Anamur to Kazancı, Kırkkuyu, Bıçkıcı boğazı, 36°28'35"N; 032°44'11"E, 1784 m, steppe and stony places, 24 July 2015 *Göktürk 8018, Sümbül & Çingay* (holotype: Akdeniz University Herbarium 3446!; isotypes: ANK!, GAZI!, HUB!, NGBB!).

Description. Plant stout, erect, perennial, rhizomatous herbs, up to 1.5 m, simple, striate, covered with densely stellate hairy and retrorse hairy in lower part. Leaves coriaceous, densely stellate hairy; lower stem leaves simple, lanceolate, 35–55 × 3.5–4.5

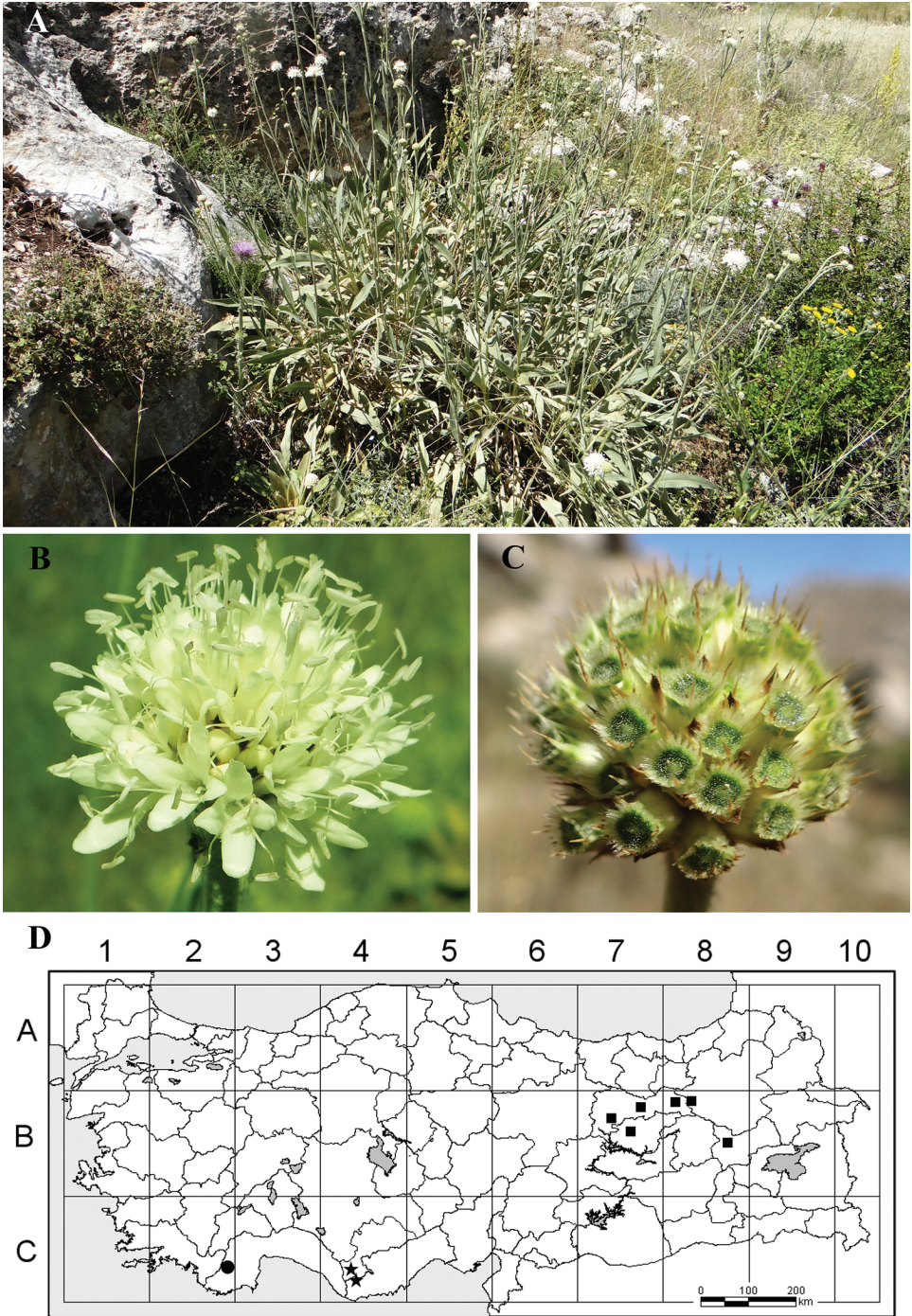


Figure 1. Photographs and distribution map of *Cephalaria anamurensis*. **A** habit and habitat of the type plant **B** Close-up of flowering capitula **C** Close-up of fruiting capitula **D** Distribution of *Cephalaria anamurensis* (★), *C. elmaliensis* (●) and *C. speciosa* (■) in Turkey. Photos: Ramazan Süleyman Göktürk.



Figure 2. **A** Holotype specimen of *Cephalaria anamurensis* Göktürk & Sümbül **B** Reproductive parts of *Cephalaria anamurensis* (Göktürk 8018) (1), *C. elmaliensis* (Göktürk 3532) (2) and *C. speciosa* (Göktürk 4727) (3): **a** corolla **b** involucre bract **c** receptacular bract **d** involucre **e** calyx.

cm, crenate-serrate, acuminate; cauline leaves simple or lyrate; simple leaves lanceolate or broadly lanceolate, $10\text{--}30 \times 1.5\text{--}5.5$ cm, entire, acuminate; lyrate leaves lanceolate or broadly lanceolate in outline, $10\text{--}25 \times 2\text{--}5$ cm, with 2–3 segments, lateral segments lanceolate, $0.3\text{--}1.5 \times 0.1\text{--}0.4$ cm, entire, acute, terminal segment larger than lateral ones, lanceolate or broadly lanceolate, $8\text{--}22 \times 2\text{--}5$ cm, margins entire or crenate-serrate, acute; upper stem leaves simple, sessile, linear or linear-lanceolate, $0.5\text{--}6 \times 0.2\text{--}0.8$ cm, entire, acuminate. Capitula globose, 25–50-flowered, 2–4 cm in diameter in flower, 2–3 cm in diameter in fruit. Involucre bracts ovate-orbicular to triangular-ovate, $3\text{--}7 \times 2.5\text{--}6$ mm, completely blackish or blackish in dorsal side and at apex, pubescent or adpressed pilose, margins ciliate, acute or subobtusate at apex; receptacular bracts oblanceolate, $8\text{--}13 \times 2\text{--}4$ mm, straw-coloured on dorsal side and base, blackish at apex, pubescent and adpressed pilose in dorsal side and apex, margins ciliate, acuminate at apex. Calyx cupuliform, 1–2 mm in diameter, with irregular teeth. Corolla cream or pale yellow, 8–15 mm long, densely adpressed hairy outside. Involucre 4-angled, 7–13 mm long in fruit, pilose, 4 long and 4 short teeth at apex; long teeth 3–4 mm long, short teeth 1–1.5 mm long. Flowering from July to August, fruiting from August to September.

Distribution and ecology. This species is endemic to South Anatolia, Turkey, and east Mediterranean (mountain) element (Fig. 1D). According to EUNIS (2007),

habitat type of this new species is E2.5 (Meadows of the steppe zone). *Cephalaria anamurensis* grows in steppe and stony places at an elevation of 1784–1800 m. It is associated with endemics such as *Marrubium lutescens* Boiss. & Heldr. subsp. *micranthum* (Boiss. & Heldr.) P. H. Davis, *Nepeta nuda* L. subsp. *glandulifera* Hub.-Mor. & P. H. Davis, *Papaver pilosum* Sibth. & Sm. subsp. *pilosum*, *Sideritis libanotica* Labill. subsp. *violascens* (P. H. Davis) P. H. Davis, *Verbascum cucullatibracteum* Hub.-Mor. and non-endemic plants such as *Digitalis ferruginea* L. subsp. *ferruginea*, *Euphorbia kotschyana* Fenzl, *Berberis crataegina* DC., *Genista albida* Willd., *Hordeum bulbosum* L., *Onopordum sibthorpiatum* Boiss. & Heldr., *Phlomis armeniaca* Willd., *Scutellaria orientalis* L. subsp. *pinnatifida* J. R. Edm. and *Thymus sipyleus* Boiss.

Conservation status. This species is known only from three adjacent localities with small populations in Kırkkuyu collected by the authors. It is suggested that this new species should be placed under the IUCN threat category “Critically Endangered (CR)” (IUCN 2014) because the estimated area of occupancy is less than 10 km², the population size of the new species is estimated to be less than 50 mature individuals, and the population size of the new species could be reduced in the near future based on heavily grazing pressure [CR B2; C2a(i)].

Etymology. The specific epithet is derived from the name of Anamur district in Mersin province, where the holotype of *C. anamurensis* was collected.

Results

The new species is included in a group of *Cephalaria* species that are covered with stellate hairs. There are nine species in this group in Turkey, and eight of them are endemic to the country. Only *Cephalaria stellipilis* Boiss. has a distribution extending out of Turkey to Lebanon. *Cephalaria anamurensis* is morphologically closest to *C. elmaliensis* and *C. speciosa*. *Cephalaria elmaliensis* is endemic to Çıglikara nature protection area and grows on stony ground and in openings in cedar forests (*Cedrus libani* A. Rich. var. *libani*) in the Elmalı district/Antalya. *Cephalaria speciosa* is endemic to east Anatolia and grows in rocky places and roadsides (Fig. 1D). A comparison of *Cephalaria anamurensis*, *C. elmaliensis* and *C. speciosa* is given in Table 1.

The genus *Cephalaria* was represented by 29 species in the *Flora of Turkey and the East Aegean Islands* (Matthews 1972). Since then, 11 new species, one new subspecies and one variety have been described from Turkey (Matthews 1988, Sümbül 1991, Göktürk and Sümbül 1997, Göktürk et al. 2003, Göktürk and Sümbül 2003, Kuş and Göktürk 2005, Aksoy et al. 2007, Parolly and Eren 2007, Göktürk et al. 2012). Göktürk and Sümbül (2014) placed *C. amana* Rech. f. as a synonym of *C. taurica* Szabó. According to Göktürk and Sümbül (2014), the total number of species of *Cephalaria* reported from Turkey is 39 and the total number of taxa of *Cephalaria* is 41 in Turkey. With the description here of *C. anamurensis* the number of species in Turkey is now 40 and the total number of taxa of *Cephalaria* is also 42 in Turkey.

Table 1. Morphological comparison of *Cephalaria anamurensis*, *C. elmaliensis* and *C. speciosa*.

Characters	<i>C. anamurensis</i>	<i>C. elmaliensis</i>	<i>C. speciosa</i>
Stem	rhizomatous, up to 1.5 m, retrorse hairy in lower part	not rhizomatous, up to 1 m, antrorse hairy in lower part	not rhizomatous, up to 1.5 m, retrorse hairy in lower part
Lower stem leaves	lanceolate, 35–55 × 3.5–4.5 cm, crenate-serrate, acuminate	lanceolate, 10–26 × 1.3–4 cm, entire or crenate-serrate, acute	oblong-lanceolate, 10–40 × 2.5–6.5 cm, entire or crenate-serrate, acute or acuminate
Lyrate cauline leaves	lanceolate or broadly lanceolate in outline, 10–25 × 2–5 cm, with 2–3 segments	narrowly ovate-lanceolate in outline, 6–15.5 × 0.8–1.6 cm, with 2–6 segments	lanceolate or oblong-lanceolate in outline, 8–20 × 3–6 cm, with 2–6 segments
Capitula	globose, 2–4 cm in diameter in flower	subglobose, 1–2 cm in diameter in flower	ovate to globose, 2.5–4.5 cm in diameter in flower
Involucral bracts	ovate-orbicular to triangular-ovate, 3–7 × 2.5–6 mm, completely blackish or blackish in dorsal side and at apex, acute or subobtuse	ovate, 4–6 × 2.5–3 mm, completely straw-coloured or only brown at apex, acute	ovate to triangular-lanceolate, 7–15 × 3–7 mm, completely straw-coloured, acuminate or subacuminate
Receptacular bracts	oblanceolate, 8–13 × 2–4 mm, blackish at apex, acuminate	ovate or lanceolate, 8–12 × 2–3 mm, completely straw-coloured, acute	triangular-lanceolate, 12–20 × 3.5–6 mm, brown at apex, pungent
Involucel	long teeth 3–4 mm long, short teeth 1–1.5 mm long	long teeth 3 mm long, short teeth 1 mm long	long teeth 4 mm long, short teeth 2 mm long

A morphological key of *Cephalaria* species in Turkey with stellate hairs.

- 1 Lower stem leaves lyrate.....2
- Lower stem leaves simple4
- 2 Lower stem leaves only with sparsely stellate hairs, stem hollow ... *C. demirizii*
- Lower stem and cauline leaves with dense stellate hairs, stem not hollow3
- 3 Bracts blackish at apex; involucral bracts acute or subacute; receptacular bracts ovate-oblong..... *C. davisiana*
- Bracts straw-coloured at apex; involucral bracts obtuse; receptacular bracts oblong or narrowly oblanceolate *C. sumbuliana*
- 4 Petiole of lower stem leaves deflexed.....*C. duzceensis*
- Petiole of lower stem leaves not deflexed5
- 5 Capitula ovoid; involucel sericeous *C. elazigensis*
- Capitula not ovoid; involucel pilose.....6
- 6 Plant stout, greater than 1 m high.....7
- Plant slender, up to 1 m high.....8
- 7 Capitula ovate-globose; involucral bracts ovate to triangular-lanceolate.....
..... *C. speciosa*
- Capitula globose; involucral bracts ovate-orbicular to triangular-ovate.....
..... *C. anamurensis*
- 8 Lower and cauline stem leaves lanceolate*C. elmaliensis*
- Lower and cauline stem leaves oblong-spathulate.....*C. stellipilis*

Specimens examined

Cephalaria anamurensis (Paratypes), TURKEY- C4 Konya: Ermenek, Kazancı district plateau, Kırkkuyu, 1800 m, 19.07.1984, *Sümbül 3217* (HUB!, ANK!); C4 Mersin: Anamur, Anamur to Kazancı, Kırkkuyu, Bıçkıcı boğazı, 36°28'31"N; 032°44'53"E, 1800 m, steppe and stony places, 24.07.2015, *Göktürk 8020, Sümbül & Çingay* (Akdeniz University Herbarium!); C4 Mersin: Anamur, Anamur to Kazancı, Kırkkuyu, Bıçkıcı boğazı, 36°28'20"N; 032°45'05"E, 1800 m, steppe and stony places, 24.07.2015, *Göktürk 8024, Sümbül & Çingay* (Akdeniz University Herbarium!); C4 Mersin: Anamur, Anamur to Kazancı, Kırkkuyu, Bıçkıcı boğazı, 36°28'20"N; 032°45'05"E, 1800 m, steppe and stony places, 29.09.2015, *Göktürk 8066 & Sümbül* (fruiting) (Akdeniz University Herbarium!).

Cephalaria elmaliensis TURKEY- C2 Antalya: Elmalı, Çıglıkara, near security building, in openings in *Cedrus libani* var. *libani*, 1700–1900 m, 25.08.1993, *H. Duman et al. 5345* (GAZI!, Akdeniz University Herbarium!); C2 Antalya: Elmalı, Çıglıkara, near security building, in openings in *Cedrus libani* var. *libani*, 1700–1900 m, 12.08.1995, *Göktürk 3532* (Akdeniz University Herbarium!); Elmalı, Çıglıkara, between Ayıngediği-Kaş gediği, in openings in *Cedrus libani* var. *libani*, stony ground, 1750 m, 17.08.2007, *Göktürk 6111* (Akdeniz University Herbarium!).

Cephalaria speciosa TURKEY- B7 Erzincan: Keşiş mountain, Cimin, rocky slopes, c. 2300 m, 28.08.1957, *P. H. Davis 31828* (ANK!); Kemah, above Kömürköy, steppe, 1850 m, 31.07.1996, *Dönmez 5367* (HUB!); Tunceli: Ovacık, Munzur Mountain, Aksu stream, c. 1700 m, 21.07.1957, *P. H. Davis 31462 & I. C. Hedge* (ANK!); B8 Erzincan: Aşkale to Tercan, dry rocky places, c. 1700 m, 25.08.1957, *P. H. Davis 32657 & I. C. Hedge* (ANK!); between Tercan-Aşkale, slopes, 1765 m, 17.08.2000, *Göktürk 4528 & F. Göktürk* (Akdeniz University Herbarium!); B8 Muş: Varto, Muş to Varto, rocky slopes, 1350 m, 02.08.2001, *Göktürk 4727 & M. Göktürk* (Akdeniz University Herbarium!).

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Flora of Bokor National Park V: Two new species of *Machilus* (Lauraceae), *M. bokorensis* and *M. brevipaniculata*

Tetsukazu Yahara¹, Shuichiro Tagane¹, Keiko Mase¹,
Phourin Chhang², Hironori Toyama¹

1 Center for Asian Conservation Ecology, Kyushu University, 744 Motoooka, Fukuoka, 819-0395, Japan

2 Institute of Forest and Wildlife Research and Development, Forestry Administration, 40 Preah Norodom Blvd, Phnom Penh, Cambodia

Corresponding author: Shuichiro Tagane (stagane29@gmail.com)

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Abstract

Two new species, *Machilus bokorensis* Yahara & Tagane and *M. brevipaniculata* Yahara & Tagane (Lauraceae) are described from Bokor National Park, Cambodia with their illustrations and DNA barcodes of the two plastid regions of *rbcL* and *matK* and the nuclear region of ITS.

Keywords

Bokor National Park, Cambodia, Lauraceae, *Machilus*, new species

Introduction

Lauraceae is a large family containing 54 genera and 2500–3500 species distributed from tropical to temperate areas in the world (Rohwer 1993). In Southeast Asia, species of Lauraceae are found from lowlands to high elevations, and are often dominant components of tropical and subtropical evergreen forests. Thus, some efforts have been made to elucidate species taxonomy of Lauraceae in Southeast Asia (e.g., Lecomte

1914; Liou 1934; Kostermans 1974, 1988; Kochummen 1989), including regional revisions for *Beilschmiedia* of Borneo (Nishida 2008), *Cinnamomum* of Borneo (Wuu-Kuang et al. 2011), *Cryptocarya* of Thailand and Indochina (de Kok et al. 2015) and *Litsea* of Thailand (Ngernsaengsuruay et al. 2011). However, no volumes on Lauraceae have been published in Flore du Cambodge du Laos et du Vietnam, Flora Malesiana, or Flora of Thailand. Thus, species of Lauraceae still remain difficult to identify in many areas of Southeast Asia.

The genus *Machilus* Nees is a member of the monophyletic *Persea* group consisting of *Alseodaphne* Nees, *Apollonias* Nees, *Dehaasia* Blume, *Machilus*, *Nothaphoebe* Blume, *Persea* Mill., and *Phoebe* Nees (Rohwer et al. 2009; Li et al. 2011). Although Kostermans (1990) merged *Machilus* into *Persea*, recent molecular evidence showed that *Persea* of the New World may be polyphyletic and *Machilus* of Asia is well differentiated from the two clades including the majority of the Neotropical *Persea* species (Rohwer et al. 2009; Li et al. 2011). *Machilus* comprises about 100 species in tropical and subtropical S and SE Asia (Wei and van der Werff 2008). Twelve *Machilus* species (including *M. balansae* (Airy Shaw) F.N.Wei & S.C.Tang, *M. cochinchinensis* Lecomte, and *M. velutina* Champ. ex Benth., all treated as *Persea*) are recorded from Vietnam (Hô 1999), three species from Laos (Newman et al. 2007), eight species from Malaysia (treated as *Persea*, Kochummen 1989), and 82 species from China (Wei and van der Werff 2008). In Cambodia, only one species, *Machilus odoratissima* Nees, has been reported based on specimens (Lecomte 1914; Liou 1934; Phon 2000); three additional species, *M. gamblei* King ex Hook.f., *M. salicina* Hance, and *M. velutina*, were recorded from Cambodia in Flora of China (Wei and van der Werff 2008), but we could not find any specimens supporting those records.

During our field surveys of vascular plants in Bokor National Park, Kampot Province, Southern Cambodia conducted from 2011 to 2013, we collected five species of the genus *Machilus* among which two fertile species which differ from all known congeners. Here we describe them as new, *M. bokorensis* Yahara & Tagane and *M. brevipaniculata* Yahara & Tagane, with illustrations and DNA barcodes of the two plastid regions of *rbcL* and *matK* (CBOL Plant Working Group 2009), and the nuclear ITS region.

The specimens examined are deposited in the herbarium of Forest Administration of Cambodia, Phnom Penh (not in Index Herbariorum, abbreviated ‘PNP’ here), the Herbarium of the Museum of Kyushu University (FU) and partly in the Herbarium of the Kyoto University Museum (KYO) and the Forest Herbarium, Bangkok (BKF).

Materials and methods

Morphological observations

We have made morphological observations on the specimens that we had collected in Bokor National Park, Cambodia. We have surveyed the diagnostic features of all the known species in Cambodia and its neighboring regions by the means of a thorough

literature review and by morphological observations of the dry specimens, kept in the herbaria BKF, BO, FU, HN, K, KYO, L, MBK, P, RAF, SAR and VNM and specimen images available on the web [e.g. JSTOR Global Plants (<https://plants.jstor.org/>)].

DNA barcoding

Pieces of leaves were collected and desiccated with silica gel in the field. DNA was extracted from these samples using a modified CTAB method. Before DNA extraction, we ground silica gel-dried leaves with a TissueLyser (QIAGEN) into the powder that were subsequently washed at least four times with 1 mL buffer (0.1 M HEPES, pH 8.0; 2% mercaptoethanol; 1% PVP; 0.05 M ascorbic acid). We determined the partial sequences of DNA regions encoding the large subunit of ribulose-1,5-bisphosphate carboxylase oxygenase (*rbcL*) and maturase K (*matK*), following the published protocols (Kress et al. 2009; Dunning and Savolainen 2010). Additionally, we determined the sequences of the internal transcribed spacer (ITS) region using the primers of ITS18-F (5'-GTC-CACTGAACCTTATCATTTAGAGG-3') and ITS26-R (5'-GCCGTTACTAAGG-GAATCCTTGTTAG-3') according to the published protocol (Rohwer et al. 2009) with slight modification using Tks Gflex™ DNA Polymerase (TAKARA, Japan).

Taxonomic treatments

Machilus bokorensis Yahara & Tagane, sp. nov.

urn:lsid:ipni.org:names:77155497-1

Figs 1, 2

Machilus odoratissima (non Nees) sensu H.Liou, Laurac. Chine & Indochine: 53 (1932), for the specimen collected from Nord de Kampot (P, no. 14625).

Diagnosis. Similar to *M. odoratissima* Nees in elliptic-lanceolate or oblanceolate, glabrous leaves and subterminal inflorescences, but differing in having sericeous inflorescence rachis (Fig. 2c; vs. glabrous in *M. odoratissima*), perianth lobes pubescent on both surfaces (Fig. 2c; vs. outside almost glabrous), ca. 1 mm long staminodes (vs. ca. 2 mm long), and twigs drying blackish grey (vs. reddish). Similar to *M. parviflora* Meisn. among Indochinese species in having large terminal buds, but differing in bud scales densely puberulent outside (vs. densely golden hairy outside in *M. parviflora*).

Type. CAMBODIA. Kampot Province, Bokor National Park, dense evergreen forest on the plateau of Mt. Bokor, 10°39'19.5"N, 104°03'36.6"E, alt. 933 m, 16 Feb. 2013, with flowers, Tagane S., Toyama H., Wachi N., Ichihashi R., Mase K., Zhu M., Chhnang P. 5475 (holotype KYO!, isotypes BKF!, FU!, K, P, PNP!).

Description. Small tree, 10 m tall. Branchlets glabrous, blackish when dry, sparsely lenticellate, old branches blackish grey or blackish grey brown. Terminal buds 3–7

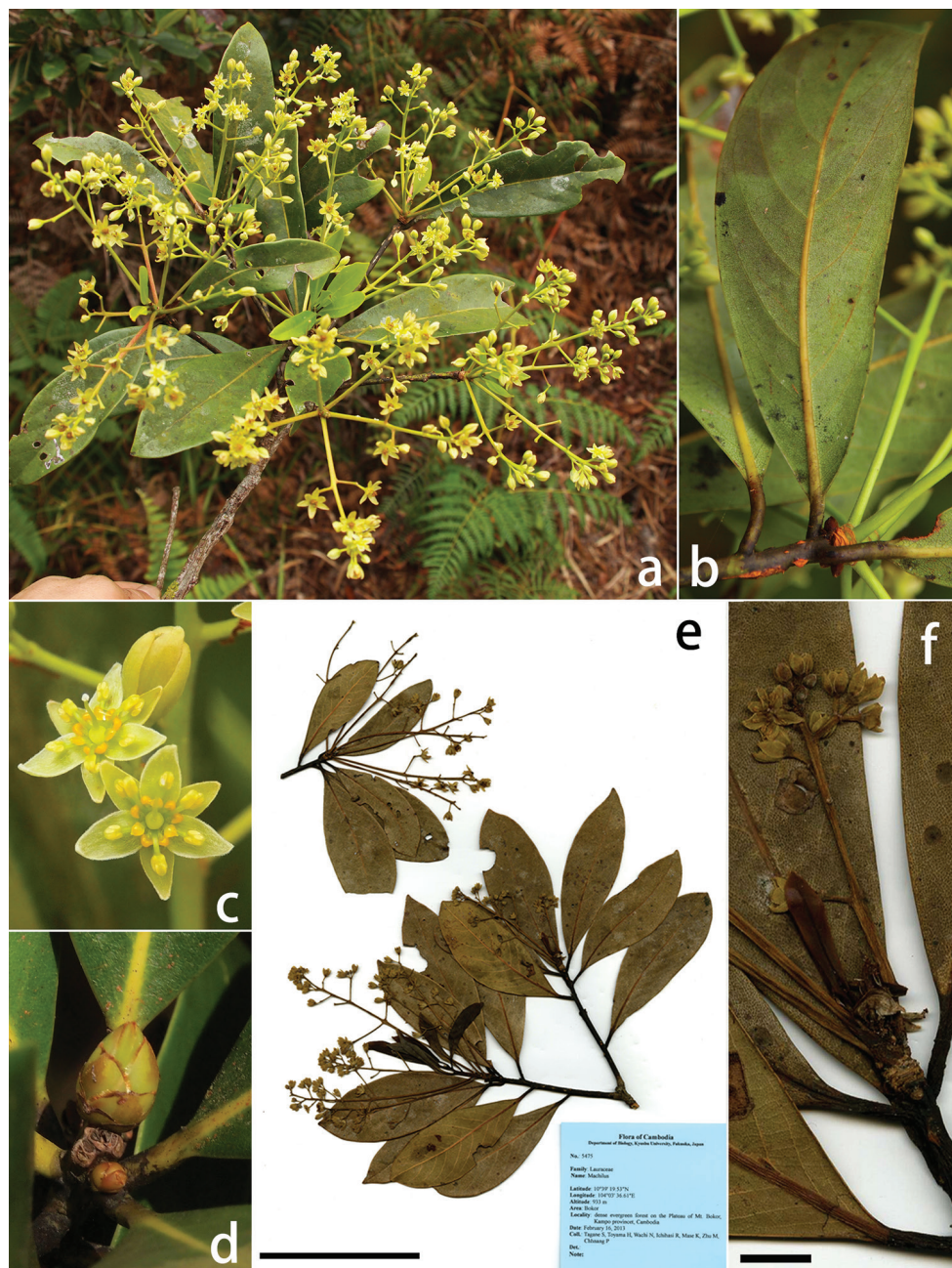


Figure 1. *Machilus bokorensis* Yahara & Tagane. **a** flowering branch, **b** abaxial lower surface of lamina **c** flowers **d** buds **e** holotype: Tagane et al. 5475 (KYO), scale bar = 10 cm **f** inflorescence, scale bar = 1 cm. Photographs: **a–c** by S. Tagane, **d** by K. Fuse.

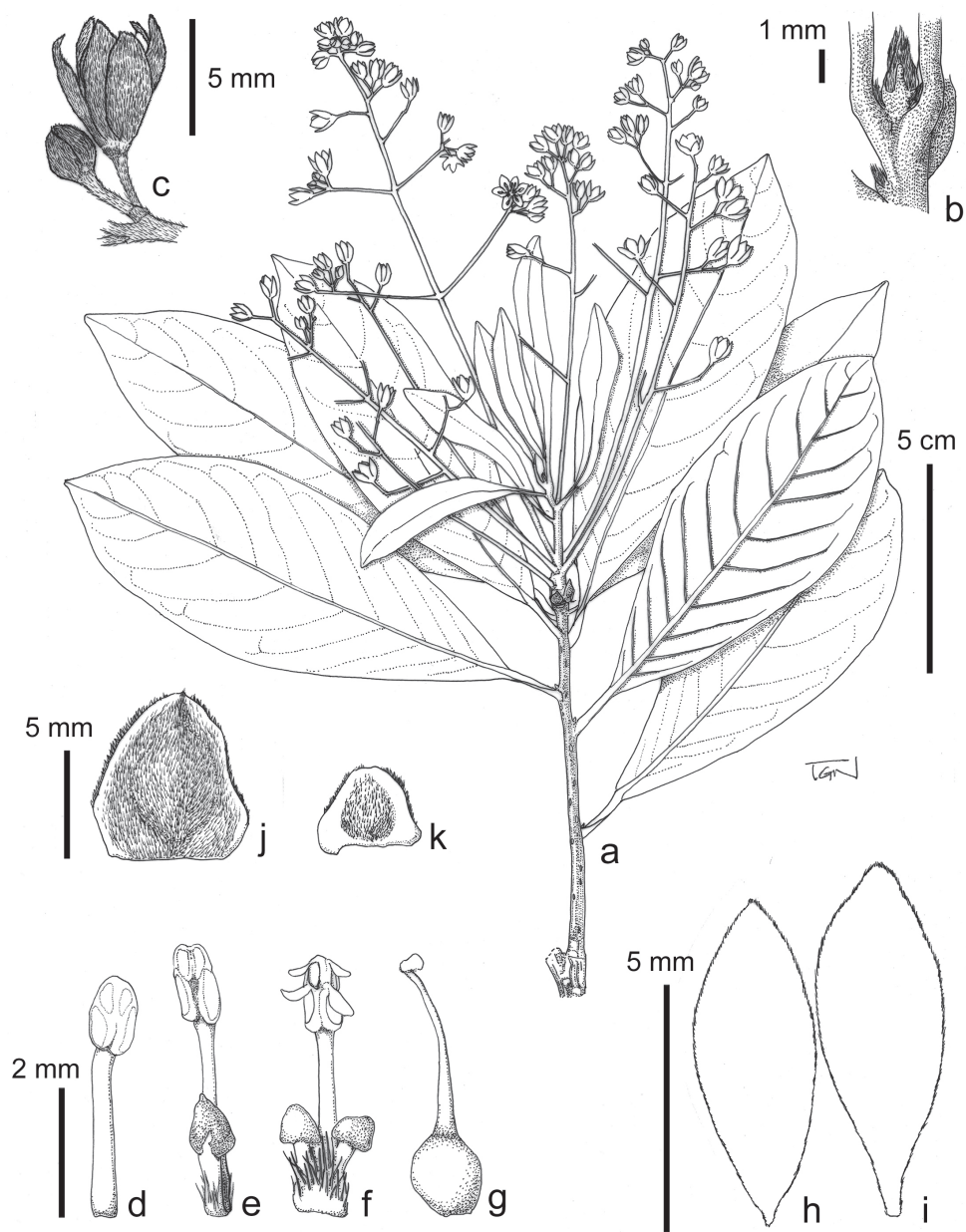


Figure 2. *Machilus bokorensis* Yahara & Tagane. **a** flowering branch **b** top of branch **c** flowers **d** stamen in 1st whorl **e** stamen in 2nd whorl with staminode **f** stamen in 3rd whorl with glands **g** pistil **h** outer perianth lobes **i** inner perianth lobe **j, k** bud scales. Materials from Tagane *et al.* 5475 (KYO). Drawn by S. Tagane.

mm long, bud scales broadly ovate to oblanceolate, densely puberulent outside, glabrous or very sparsely pubescent inside. Leaves alternate, blades elliptic-lanceolate, oblanceolate, (3–)7.5–11.5(–18.5) × (1.2–)2.5–4.0(–5.4) cm, thickly leathery, base cuneate, margin entire, slightly revolute, apex usually acute to obtuse, occasionally acuminate or rotund, developing leaves glabrous adaxially, sericeous abaxially, glabrous and densely foveolate on both sides when old, midrib concave adaxially, elevated abaxially, lateral veins 9–12 pairs, flat adaxially, slightly prominent abaxially, tertiary veins reticulate to scalariform-reticulate; petioles (0.5–)0.8–1.3(–2.5) cm long, glabrous. Inflorescences paniculate, subterminal, usually arising from near base of newly sprouted branchlets, (4.0–)6.0–13.0 cm long, sericeous, with 5–8 lateral branches. Pedicels 3–5 mm long, sericeous, bracts linear, 1–4 mm long, abaxially yellowish brown pubescent, adaxially glabrous, caducous. Flowers yellowish green; perianth lobes 6, oblong-elliptic, slightly unequal, outer ones, ca. 6.8 × 2.4 mm, inner ones ca. 7 × 2.5 mm, minutely pubescent on both surfaces. Stamens 9, subequal, 3.5–4 mm long, hairy at base, glands of 3rd series stipitate, ca. 0.4 mm long; staminodes 3, ca. 1 mm long, stipitate, glabrous. Ovary subglobose ca. 1.5 mm in diam., glabrous. Style 2.5–3 mm long, glabrous. Fruits subglobose, 7–8 mm in diam., glabrous, blackish when dry, perianth lobes spreading.

Other specimens examined. Cambodia, Bokor National Park [alt. 1043 m, 10°37'16.8"N, 104°01'52.3"E, 10 Dec. 2013, *Toyama et al.* 6258 (BKF, FU, PNP); alt. 1042 m, 10°38"N, 104°01.4'E, 9 Mar. 2001, with fruits, *Middleton & Monyrak* 643 (P); alt. 1014 m, 10°38'12.6"N, 104°02'06.4"E, 4 Dec. 2011, *Toyama et al.* 1556 (FU, PNP); ibidem, *Toyama et al.* 1575 (FU, PNP); alt. 1011 m, 10°38'11.2"N, 104°02'09.0"E, *Toyama et al.* 1725 (FU, PNP); alt. 928 m, 10°39'19.5"N, 104°03'36.6"E, *Toyama et al.* 2754 (FU, PNP); alt. 903 m, 10°39'35.4"N, 104°03'03.1"E, *Toyama et al.* 3167 (FU, PNP); alt. 871 m, 10°39'48.8"N, 104°02'53.3"E, 17 Dec. 2013, with flowers, *Fuse et al.* 6227 (BKF, FU, PNP)].

Distribution. Cambodia (endemic to Mt. Bokor).

Habitat and ecology. *Machilus bokorensis* is commonly found in moist evergreen forest on the top plateau of Mt. Bokor. Flowering specimens were collected in December and February and fruiting specimens in March.

GenBank accession No. *Toyama et al.* 1575: AB987667 (*rbcl*), AB987666 (*matK*), AB987665 (ITS).

Preliminary conservation assessment. *Machilus bokorensis* is commonly found in higher elevations in Mt. Bokor. Since many mature individuals were found in the protected areas, we suggest the status for this species as Least Concern (LC) according to IUCN Red List criteria (IUCN 2012).

Note. Among five species we collected in Mt. Bokor, this species is most common and agrees with the description of “*M. odoratissima*” in the key of Liou (1934) who recorded “*M. odoratissima*” from Nord de Kampot, corresponding to Mt. Bokor. Thus, we consider that this species is “*M. odoratissima*” recorded by Liou (1934), although we could not examine the specimen of *Poilane* 14625 (P) cited by Liou (1934) because it is currently on loan. In Indo-china, *Machilus* plants similar to this

species have been identified as *M. odoratissima* for a long time (Lecomte 1914; Liou 1934; Phon 2000). However, *M. bokorensis* is distinct from *M. odoratissima* distributed in Nepal, E Himalaya, Assam-Burma in sericeous inflorescence rachis (vs. glabrous in *M. odoratissima*; Pendry 2012), perianth lobes pubescent on both surfaces (vs. outside almost glabrous), ca. 1 mm staminodes (vs. ca. 2 mm), and blackish grey twigs (vs. reddish). In Cambodia, we collected sterile specimens of *Machilus* spp. morphologically similar to *M. bokorensis* in Central Cardamon and Seima protection forests but those are morphologically distinguishable and not sister to *M. bokorensis* in our unpublished phylogenetic tree constructed by *rbcL*, *matK* and ITS sequences. “*M. odoratissima*” is recorded from Mulu-prey, Preah Vihear (Lecomte 1914). The specimens from Mulu-prey (*Harmand s.n.*, P) are, however, different from *M. bokorensis* in having naked terminal buds and scalariform tertiary veins. Lecomte (1914) and Liou (1934) recorded “*M. odoratissima*” also from Laos and Vietnam, but we have not found specimens from Laos and Vietnam identical with *M. odoratissima*. As far as we know, *M. odoratissima* is not distributed in Cambodia, Laos, Thailand and Vietnam. The relationship between *M. bokorensis* and the specimens of Mulu-prey, Laos and Vietnam remains to be further examined. At present, we consider that *M. bokorensis* is endemic to Bokor, Cambodia. According to our unpublished ITS tree, this species is sister to *Machilus rimosa* (Blume) Blume distributed in Indonesia, but distinct from *M. rimosa* in thickly leathery leaves densely foveolate on both sides (vs. thinner leaves not densely foveolate in *M. rimosa*) and perianths larger (6.8–7 mm long vs. ca. 3.5 mm long).

***Machilus brevipaniculata* Yahara & Tagane, sp. nov.**

urn:lsid:ipni.org:names:77155498-1

Figs 3, 4

Diagnosis. Similar to *M. kingii* Hook.f. in leaf shape and size, and short panicles less than 5.5 cm long, but distinct from *M. kingii* by its naked bud (vs. bud covered with scales in *M. kingii*), lamina foveolate on both surfaces (vs. obscure on lower surface), fewer flowers per panicle (3–5 vs. 4–9), and smaller perianth lobes (2 mm vs. 3–3.5 mm long).

Type. CAMBODIA. Kampot Province, semi-evergreen secondary forest at the bottom of Mt. Bokor, 10°35'35.6"N, 103°58'43.1"E, alt. 65 m, 7 Dec. 2013, *Tagane S., Toyama H., Fuse K., Iwanaga F., Rueangruea S., Suddee S., Kanemitsu H., Zhang M., Kim W., Loth M.* 6011 (holotype KYO!, isotypes BKF!, FU!, PNP!).

Description. Small tree, 8 m tall. Branchlets sericeous near the tip, soon glabrous, brownish when dry, old branches greyish brown to reddish brown, without lenticels; terminal buds naked. Leaves alternate; blades lanceolate to oblanceolate, 5.0–8.3 × 1.4–3.1 cm, leathery, reddish brown when dried, glabrous and foveolate on both sides, lustrous adaxially when dry, base cuneate, margin slightly revolute when dry, apex acute to obtuse, midrib concave adaxially, elevated abaxially, lateral veins 8–10 pairs;

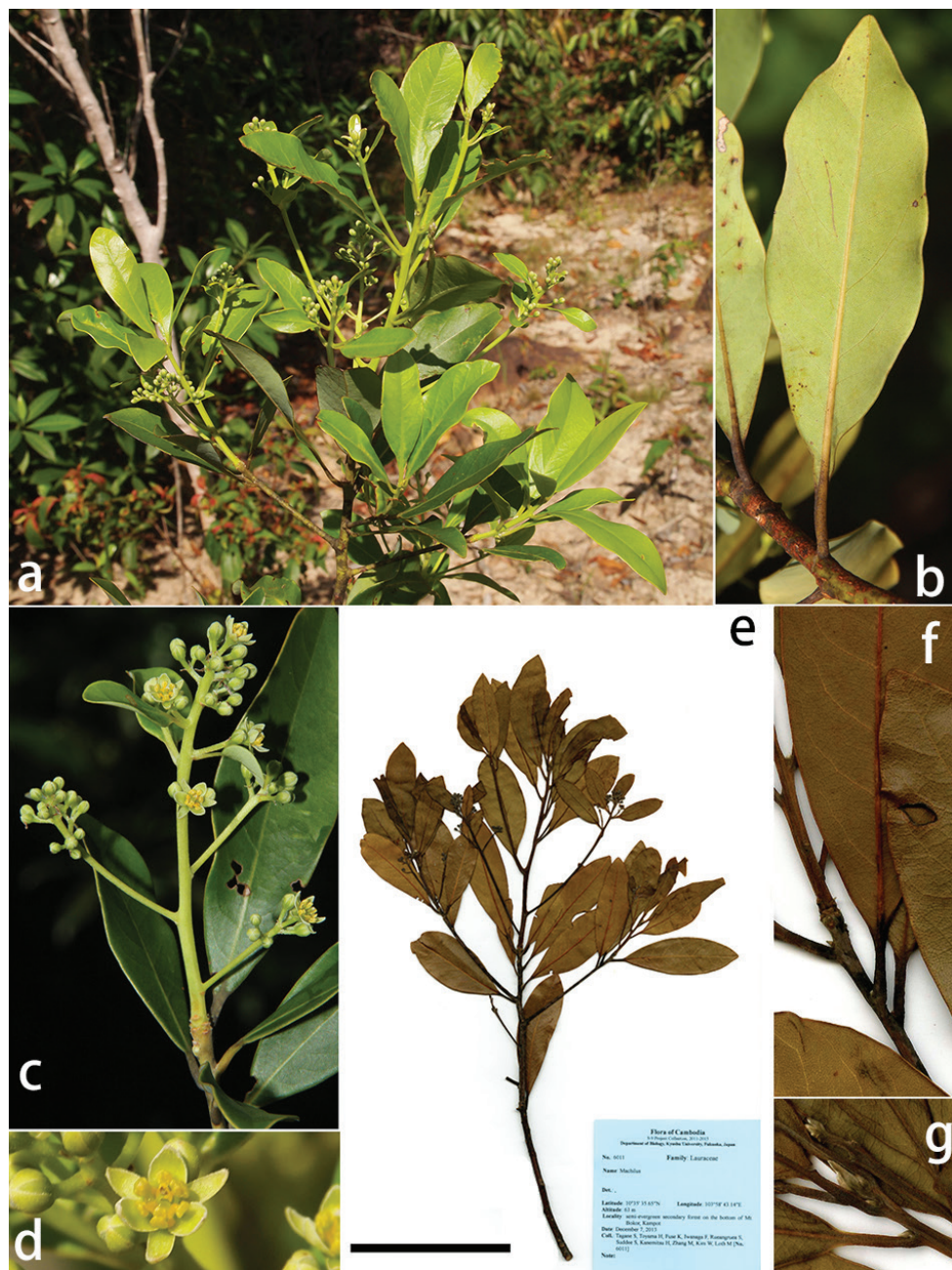


Figure 3. *Machilus brevipaniculata* Yahara & Tagane. **a** flowering branch **b** flowers **c** abaxial lower surface of lamina **d** flower **e** holotype: Tagane et al. 6011 (KYO), scale bar = 10 cm, **f** portion of leaves **g** apical bud. Photographs: **a**, **b**, **d** by S. Tagane and **c** by S. Rueangrua.

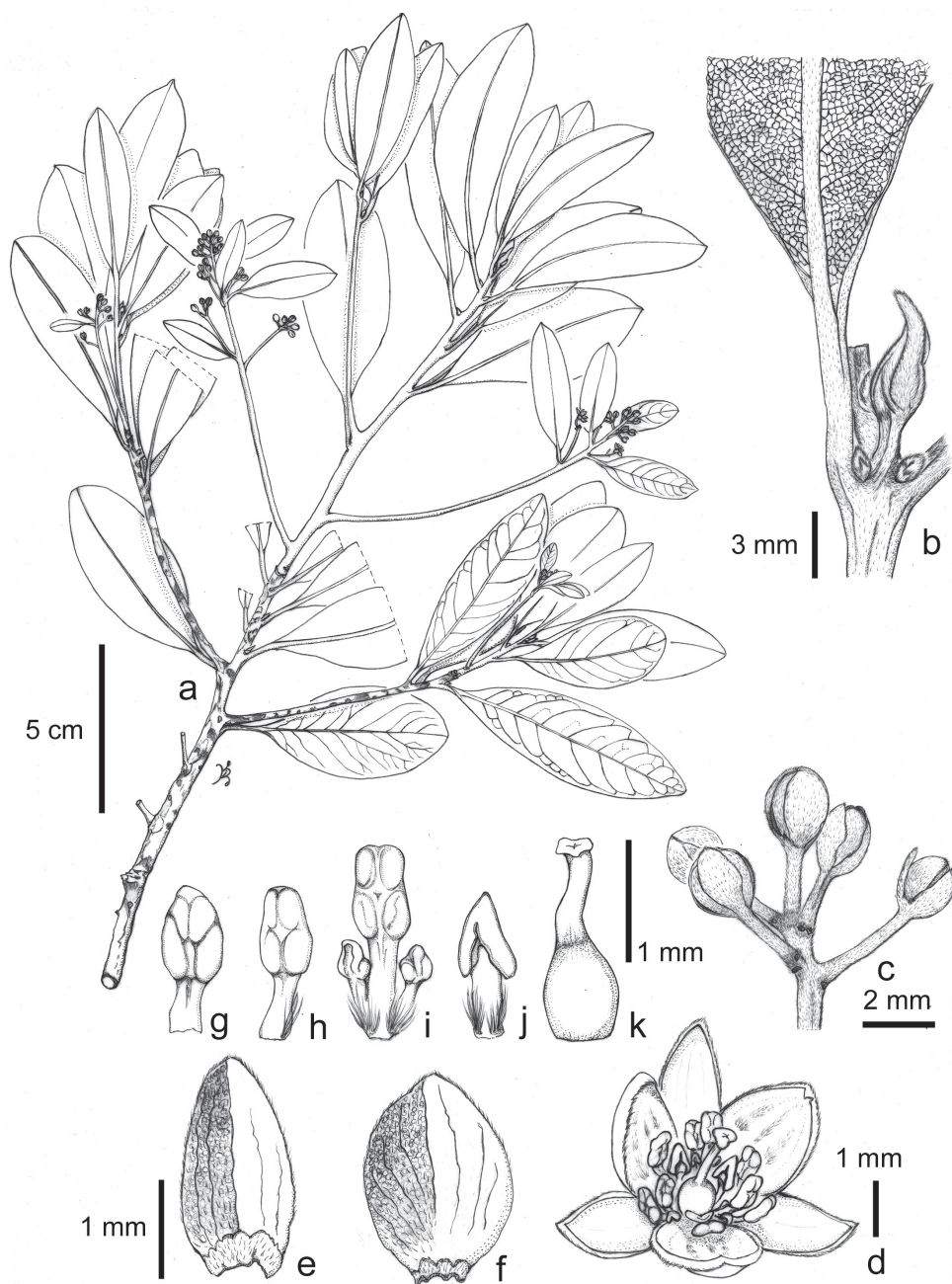


Figure 4. *Machilus brevipaniculata* Yahara & Tagane, **a** flowering branch **b** top of branch **c** flower buds **d** flower **e** outer perianth lobe **f** inner perianth lobe **g–i** stamens in 1st, 2nd and 3rd whorl from left **j** staminode **k** pistil. Materials from Tagane *et al.* 6011 (KYO). Drawn by K. Mase.

petioles 0.5–1.4 cm, glabrous. Inflorescences paniculate, terminal or arising as lateral branches of newly sprouted shoots, 4–11 cm long, usually with frondose bracts subtending secondary paniculate axes, secondary axes 0.8–1.3 cm long with 3–15 flowers. Pedicels ca. 2 mm long. Flowers yellowish green. Outer perianth lobes ovate, ca. 2×1 mm, inner ones broadly ovate, ca. 2×1.3 mm, pubescent on both surfaces, with many gland dots. Stamens 9, subequal, ca. 1.5 mm long, hairy at base, anthers 4-celled, ca. 1 mm long; glands of 3rd series stipitate, ca. 0.3 mm diam. Staminodes 3, ca. 0.6–1 mm long, glabrous. Ovary ellipsoidal, ca. 0.8 mm in diam., glabrous. Style ca. 0.8 mm long, glabrous. Fruits not seen.

Distribution. Cambodia. Known only from the lowland of Bokor National Park.

Habitat and ecology. This species was found in evergreen forest at the foot of Mt. Bokor. Flowering specimens were collected in December.

GenBank accession No. *Tagane et al.* 6011: AB987676 (*rbcL*), AB987675 (*matK*), AB987674 (ITS).

Preliminary conservation assessment. Critically endangered (CR) (IUCN 2012). We collected only one flowering individual of this species at alt. 65 m during 7 field surveys on the southern slope and top plateau of Mt. Bokor (Tagane et al. 2015). Further botanical inventories might enable us to find more individuals, but it seems to be a rare species. Considering the fact that the forest is almost cleared in the foot of Mt. Bokor (below 100 m in particular), we believe that this species should be considered critically endangered.

Note. This species is distinct in having naked terminal buds and panicles having frondose bracts subtending secondary paniculate axes, while most of *Machilus* species have scaly terminal buds and panicles without frondose bracts. According to our unpublished ITS tree, this species is sister to *Machilus coriacea* A.Chev. endemic to southern Vietnam, but can be readily distinguished from the latter by the two above mentioned traits and also in having glabrous leaves (vs. densely hairy beneath when young in *M. coriacea*).

Acknowledgement

We thank the Cambodian Ministries of the Environment and Forest Administration for the permission for our field works, and particularly the staffs and rangers of the Bokor National Park for their kind help. We are grateful to the curators and the staffs of the herbaria BKF, BO, FU, HN, K, KYO, L, MBK, P, RAF, SAR and VNM for providing us the opportunities to examine the collections. This study was supported by the Environment Research and Technology Development Fund (S9) of the Ministry of the Environment, Japan and also by a JSPS grant for Global Center of Excellence Program ‘Asian Conservation Ecology as a basis of human-nature mutualism’.

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A new species of *Eustigma* (Hamamelidaceae) from Hon Ba Nature Reserve, Vietnam

Hironori Toyama¹, Shuichiro Tagane¹, Van Son Dang², Hop Tran³,
Hidetoshi Nagamasu⁴, Akiyo Naiki⁵, Tetsukazu Yahara¹

1 Center for Asian Conservation Ecology, Kyushu University, 744 Motooka, Fukuoka, 819-0395, Japan
2 National Herbarium of Vietnam (VNM), Institute of Tropical Biology, Vietnam Academy of Sciences and Technology, 85. Tran Quoc Toan Str, Dist 3, Ho Chi Minh City, Vietnam
3 University of Science Ho Chi Minh City, 227 Nguyen Van Cu Street, District 5, Ho Chi Minh City, Vietnam
4 The Kyoto University Museum, Kyoto University, Yoshida Honmachi, Sakyo-ku, Kyoto, 606-8501, Japan
5 Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus, 870 Uehara, Taketomi-cho, Yaeyama-gun, Okinawa, 907-1541, Japan

Corresponding author: Hironori Toyama (htohyscb@kyushu-u.org)

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Abstract

A new species of Hamamelidaceae, *Eustigma honbaense* H. Toyama, Tagane & V.S. Dang, **sp. nov.**, is described from Hon Ba Nature Reserve, Vietnam. This species is similar to *Eustigma oblongifolium* Gardner & Champ., but differs from it in having entire leaves, longer infructescences, capsules with a longer apical part and seeds with a larger hilum. A description, preliminary conservation assessment, illustration and photographs of the new species are provided, as well as an updated key to the genus *Eustigma*.

Keywords

DNA barcoding, flora, Indochina, *matK*, *rbcL*, taxonomy

Introduction

Eustigma Gardner & Champ. (Gardner 1849) is a small genus of the Hamamelidaceae, distinguished from other genera by small auriculate petals and the greatly enlarged stigma (Harms 1930; Zhang et al. 2003). Currently, three species are known in the genus: *E. balansae* Oliv., *E. lenticellatum* C.Y. Wu and *E. oblongifolium* Gardner &

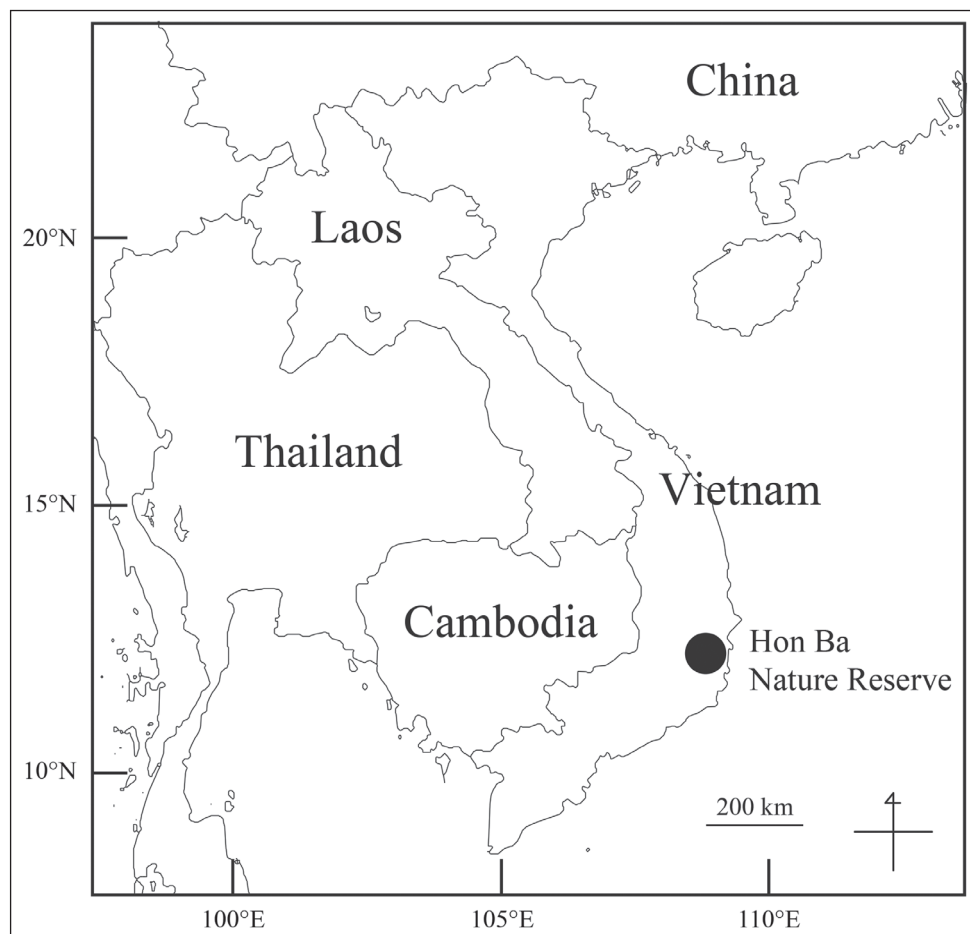


Figure 1. Location of Hon Ba Nature Reserve in Vietnam.

Champ., distributed in mainland China, Laos, Taiwan and Vietnam, among which *E. balansae* is the only species recorded in Vietnam (Tardieu 1965; Hsieh 1993; Hô 2003; Zhang et al. 2003; Newman et al. 2007).

From 2013 to 2014, as part of a collaborative programme to document the biodiversity and ecology of Southeast Asia, Kyushu University (FU) together with Institute of Tropical Biology, Vietnam (VNM) carried out botanical field surveys in Hon Ba Nature Reserve, in South Vietnam (Figure 1) and found a species of *Eustigma* that was distinct from any of the three known species. Here, we describe this plant as a new species, *Eustigma honbaense* H.Toyama, Tagane & V.S.Dang, and place the species within the wider generic context by providing an updated identification key to all known species of *Eustigma*. Our conclusion is based on observations of specimens in the herbaria, BKF, E, HN, K, KAG, KYO, L, P, TI, and VNM, and specimen images on the website of JSTOR Global Plants (<https://plants.jstor.org/>). We also provide

DNA sequences of two DNA barcode regions; the partial genes for the large subunit ribulose-1,5-bisphosphate carboxylase oxygenase (*rbcL*) and maturase K (*matK*) (CBOL Plant Working Group 2009); established protocols were used to determine the sequences of these regions (Kress et al. 2009; Dunning and Savolainen 2010).

Taxonomy

***Eustigma honbaense* H.Toyama, Tagane & V.S.Dang, sp. nov.**

urn:lsid:ipni.org:names:77155501-1

Figs 2–4

Diagnosis. This species is similar to *Eustigma oblongifolium* Gardner & Champ., but distinguished from that species by having entire elliptic to oblong leaves (vs. partly dentate oblong-lanceolate leaves), infructescences 5–10.3 cm long (vs. 3–5 cm long), apical part (above tepal scar) of capsules 6.5–9 mm long (vs. 3–5 mm long) and seed hilum 4 mm long and 3 mm wide for bigger side (vs. 2–3 mm long and 1–1.5 mm wide).

Type. VIETNAM. Khanh Hoa Province, Hon Ba Nature Reserve, evergreen forest margin along streamside, 401 m alt., 12°06.57'N, 108°59.21'E (DDM), 14 July 2014, S. Tagane, H. Kanemitsu, V.S. Dang, H. Tran, X.N. Loi, N.D. Thach, N. Dinh & H.N.P. Hieu V1586 (holotype: KYO!; isotypes: FU!, VNM!, the herbarium of Hon Ba Nature Reserve!).

Description. Trees 8–10 m tall. Branches yellow-green when young, turning brown when mature; indumentum sparsely to densely brown stellate hairy when young (denser on the uppermost branch), glabrescent; lenticels more distinct on young branches when dry. Terminal buds naked, narrowly ovoid, ca. 5 mm long, ca. 2 mm wide, having 2 opposite stipules incompletely covering young leaves, linear, ca. 4.5 mm long, ca. 0.5 mm wide, brown stellate hairy. Axillary buds scaled, narrowly ovoid, ca. 3.5 mm long, ca. 1.2 mm wide; bud scales 2, opposite, incompletely covering young leaves, narrowly ovate-oblong, 3–4 mm long, 0.5–1 mm wide, densely brown stellate hairy. Leaf blades elliptic to oblong, 6.5–21.5 cm long, 2.2–8.5 cm wide, coriaceous, lustrous and glabrous on both surfaces except veins below, base obtuse to cuneate, apex acuminate to rounded, margin entire; midribs sunken and glabrous above, prominent and sparsely brown stellate hairy below; secondary veins 5–9 pairs, slightly sunken and glabrous above, prominent and sparsely brown stellate hairy below; tertiary veins reticulate, slightly sunken and glabrous above, prominent and sparsely brown stellate hairy below; petiole 9–14 mm long, sparsely brown stellate hairy; stipules 2, opposite, caducous, linear, 5–8 mm long, 0.5–1 mm wide, brown stellate hairy. Flowers not seen. Infructescences terminal and axillary, racemose, 5–10.3 cm long; peduncles 1.2–4.5 cm long, brown stellate hairy, with 0–2 basal leaves; basal bracts not seen; bracts and bracteoles caducous, narrowly ovate, 1.8–3 mm long, 0.5–1 mm wide (but see note), densely brown stellate hairy; fruiting pedicels 5–8 mm long, densely brown stellate hairy. Floral cups in young fruits, turbinate, 2–3 mm in diameter, densely

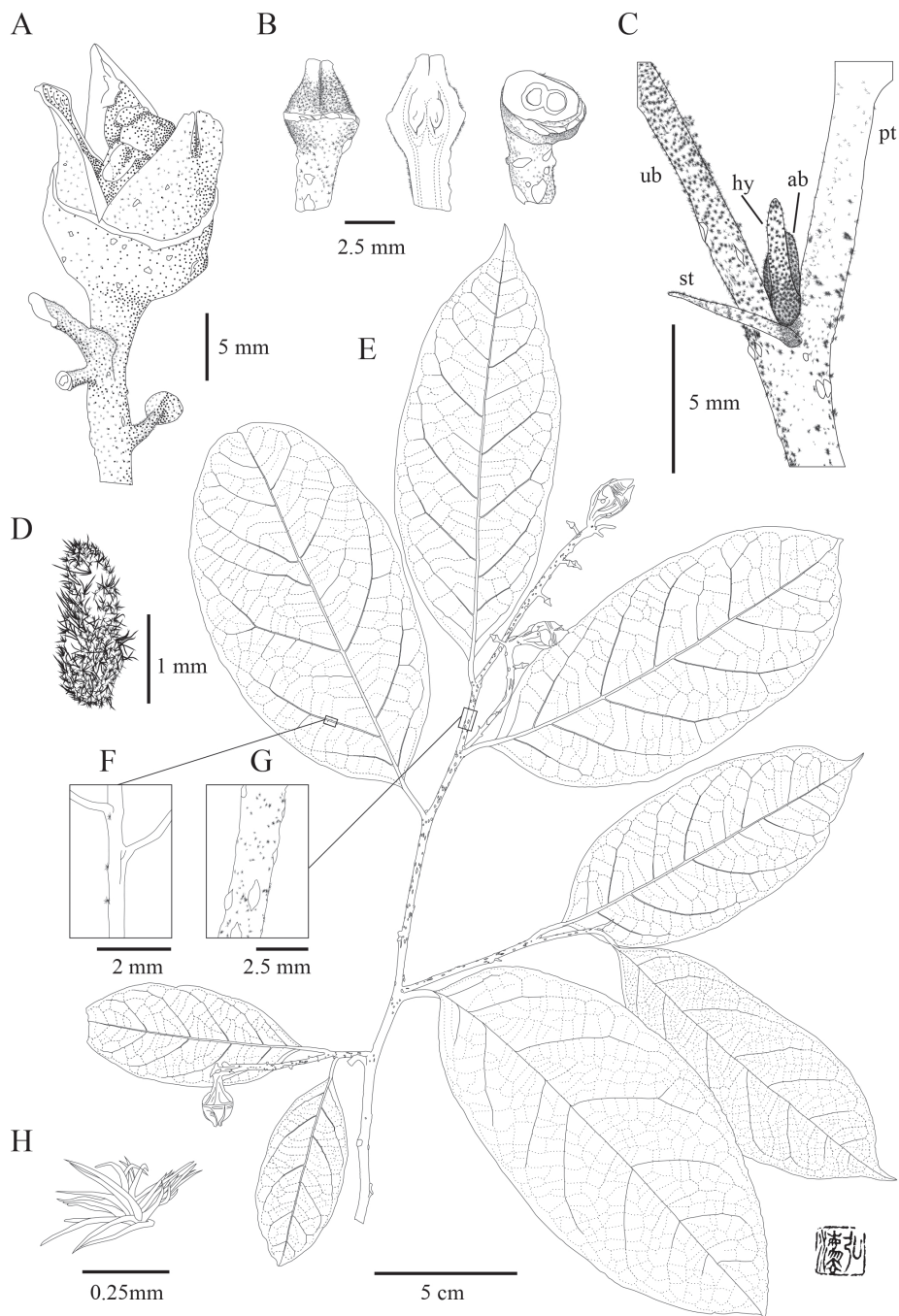


Figure 2. *Eustigma honbaense* H.Toyama, Tagane & V.S.Dang, sp. nov. **A** capsule; **B** immature fruits (lateral view, longitudinal and transverse sections from left) **C**, axillary bud (ab), bud scale (bs), petiole (pt) and stipule (st) and uppermost branch (ub) **D** bracteole **E** fruiting branch **F** vein with stellate hair **G** young branch **H** stellate hair on bud. [A–H from Tagane et al. VI586, KYO. Drawn by H. Toyama.]

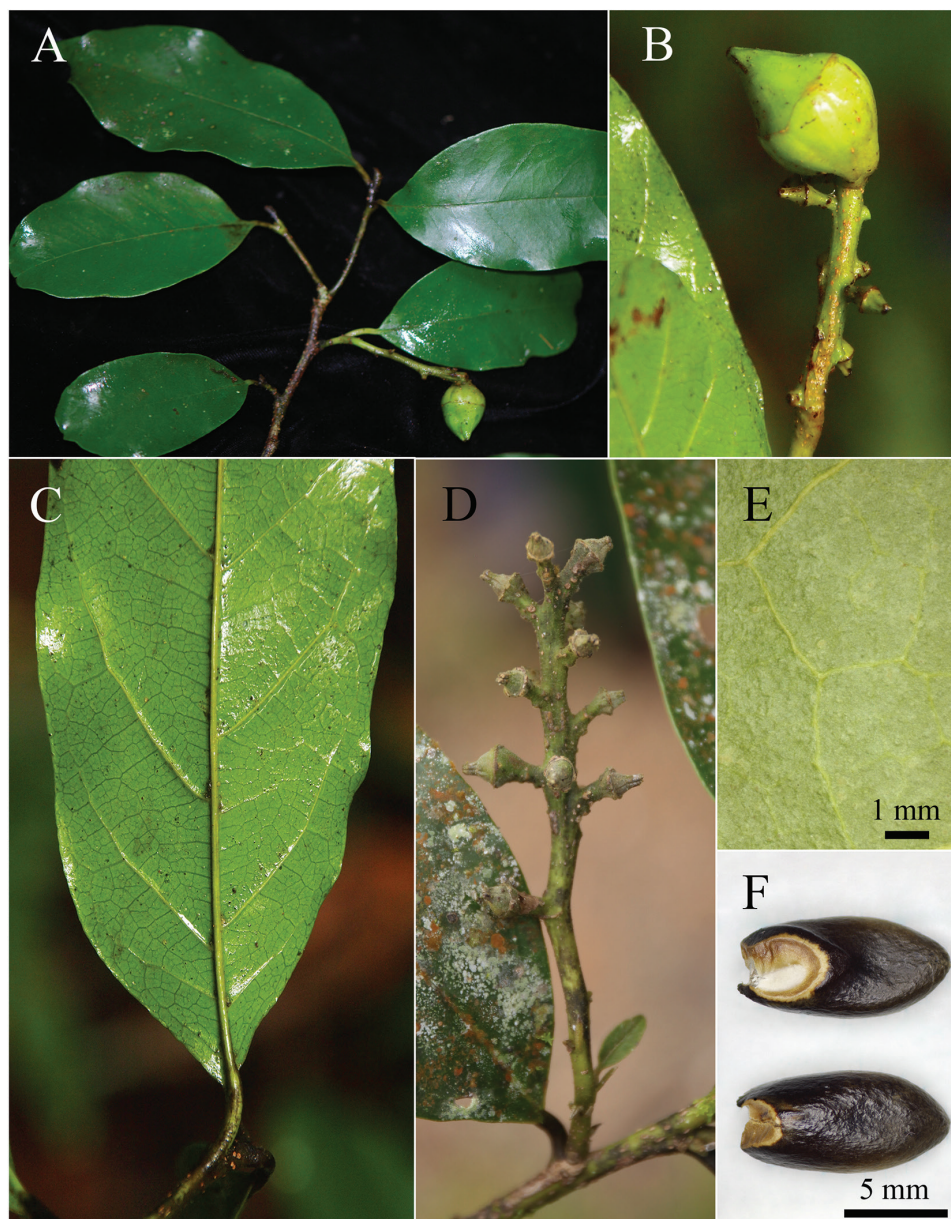


Figure 3. *Eustigma honbaense* H.Toyama, Tagane & V.S.Dang, sp. nov. **A** branch with infructescence **B** fruits; **C** abaxial surface of leaf **D** young infructescence **E** lamina showing glabrous abaxial surface **F** seeds with a large hilum showing basal side on the placenta (upper), and apical side (lower). [**A–D** photographed on 14 July 2014, **E** & **F** from Tagane *et al.* V1586, KYO.]

brown stellate hairy; ovary 2-locular; ovules 1 per locule. Capsules ovoid-globular, 12–16 mm long, 9–10 mm in diameter, woody, dehiscing loculicidally by two 2-lobed valves, sparsely lenticellate, sparsely brown stellate hairy, the length above tepal scar

6.5–9 mm; endocarp loose from woody exocarp. Seeds 2 per capsule, narrowly ovoid, ca. 10 mm long, ca. 4.5 mm wide, ca. 3 mm thick, brownish black, smooth, hilum ca. 4 mm long, ca. 3 mm wide for bigger side (the basal side on the placenta).

Other specimen examined. VIETNAM. Khanh Hoa Province, Hon Ba Nature Reserve, evergreen forest margin along streamside, 393 m alt., 12°06.51'N, 108°59.26'E (DDM), 22 November 2014, *H. Toyama, S. Tagane, V.S. Dang, H. Nagamasu, A. Naiki, H. Tran, C.J. Yang, H.Q. Cuong & H.N.P. Hieu* V1975 (FUI, VNM!, the herbarium of Hon Ba Nature Reserve!).

Distribution and habit. This species is only known from Hon Ba Nature Reserve of southern Vietnam. We found only three individuals in the evergreen forest along a stream at ca. 400 m alt. The flora of this area is reported in Choudhary et al. (2012), Schuitman et al. (2013) and Tagane et al. (2015a, b).

Phenology. Flowering season is unknown. Immature fruits and capsules were observed in July and November.

Etymology. *Eustigma honbaense* is named after the type locality, Hon Ba Nature Reserve.

Preliminary conservation status. *Eustigma honbaense* was collected from a single locality in the Hon Ba Nature Reserve, where only three individuals (one reproductive tree and two young trees) were found in evergreen forest along a streamside. The forest around the habitat was frequently logged and disturbed. Therefore, this species is assessed as Critically Endangered (CR) using the criterion D of the Red List Categories (IUCN 2012), although more individuals could be discovered by more thorough surveys.

Note. *Eustigma honbaense* has terminal naked buds and axillary scaled buds that are in contrast with the description of *Eustigma* having naked-buds as given in the Flora of China (Zhang et al. 2003). The naked bud is covered either with immature leaves that develop to foliage leaves or with their stipules, while the scaled bud is covered with cataphylls or stipules that are highly modified to protect the shoot tip (Nitta and Ohsawa 1998). The terminal buds of *E. honbaense* are classified as naked buds because they are incompletely covered by 2 stipules (Fig. 4A, B, E & F), while the axillary buds are classified as scaled buds because they are covered by 2 cataphylls that are subsequently shed or remained at the tip of previous shoot without further growth (Fig. 4C, D, E & F). The terminal bud of Fig. 4B shows alternate leaf arrangement from the axillary bud, but same direction is also observed.

The description of bracts and bracteoles is insufficient because most of the bracts and bracteoles had been shed. *Eustigma oblongifolium* and *E. lenticellatum* have 3-bracteate flowers (Gardner 1849; Hsieh 1993; Wu 1977), while *E. balansae* has 2-bracteate flowers (Oliver 1891; Tardieu 1965). This could be a key trait to distinguish between species. Further collections of *E. honbaense* are needed.

The *matK* sequences between *E. honbaense* and *E. oblongifolium* (AF013043) differ in 6 bases of the 781 total. The *rbcL* and *matK* sequences between *E. honbaense* and *E. balansae* (*rbcL*: HQ415214, *matK*: HQ415379) differ in 1 base of the 517 total and 5 bases of the 761 total, respectively.

Genebank accession No. *Tagane et al.* V1586: LC005200 (*rbcL*), LC005201 (*matK*).

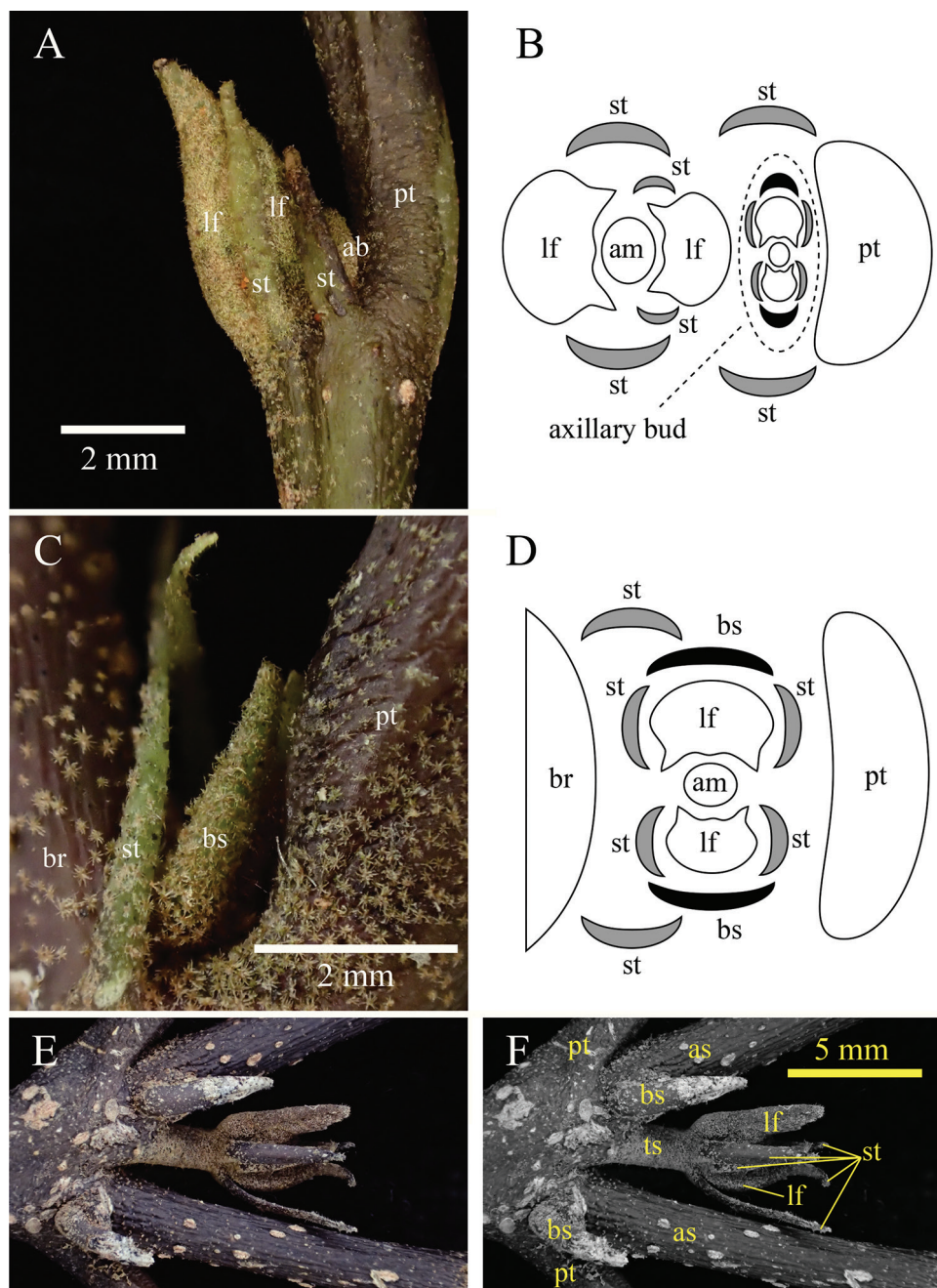


Figure 4. Terminal and axillary bud of *Eustigma honbaense* H.Toyama, Tagane & V.S.Dang, sp. nov. **A** terminal and axillary bud **B** schematic diagram of transverse section of Fig. 4A **C** axillary bud **D** schematic diagram of transverse section of Fig. 4C **E** elongated terminal and axillary shoot **F** grayscale image of Fig 4E. Abbreviations are as follows: axillary bud (ab), apical meristem (am), axillary shoot (as), bud scale (bs), branch (br), leaf (lf), petiole (pt), stipule (st), terminal shoot (ts). [**A** & **C** photographed on 22 November 2014, **E** & **F** from Toyama *et al.* V1975, FU.]

An updated key to the species of *Eustigma*

- 1 Leaf lamina brown tomentose with stellate hairs on abaxial surface..... *E. balansae*
- Leaf lamina glabrescent except along veins on abaxial surface..... 2
- 2 Capsules densely lenticellate..... *E. lenticellatum*
- Capsules smooth or sparsely lenticellate..... 3
- 3 Leaves oblong-lanceolate, margin sometimes dentate towards the apex; infructescences 3–5 cm long, capsule glabrous *E. oblongifolium*
- Leaves elliptic to oblong, margin entire, infructescences 5–10.3 cm long, capsule sparsely brown stellate hairy..... *E. honbaense*

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An updated checklist and key to the open-panicled species of *Poa* L. (Poaceae) in Peru including three new species, *Poa ramoniana*, *Poa tayacajaensis*, and *Poa urubambensis*

Steven P. Sylvester^{1,2,*}, Robert J. Soreng^{3,*}, Paul M. Peterson³,
Mitsy D.P.V. Sylvester^{1,4}

1 Institute of Systematic and Evolutionary Botany, University of Zurich, Zollikerstrasse 107, 8008 Zürich, Switzerland **2** Department of Geography, Philipps-Universität Marburg, Deutschhausstraße 10, D-35032 Marburg, Germany **3** Department of Botany, National Museum of Natural History, Smithsonian Institution Washington, DC, 20013–7012, USA **4** Universidad Nacional de San Antonio Abad del Cusco, Avenida de la Cultura 733, Cusco, Perú

Corresponding author: Steven P. Sylvester (steven_sylvester@hotmail.com)

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Abstract

We provide an updated checklist and key to the 30 *Poa* species with open panicles from Peru which includes previously circumscribed *Dissanthelium* and *Aphanelytrum* species, new taxon records, and three undescribed species. *Poa compressa*, *P. grisebachii*, and *P. leioclada* are recorded from Peru for the first time. A number of species are placed in synonymy: *Poa carazensis*, *P. ferreyrae* and *P. tovarii* are synonymized under the name *P. fibrifera*; *Poa adusta* (tentatively) and *P. pilgeri* are synonymized under *P. candamoana*; *Poa superata* is synonymized under *P. grisebachii*; and *Poa paramoensis* is synonymized under *P. huancavelicae*. Included within this treatment are three new species, *Poa ramoniana*, *P. tayacajaensis* and *P. urubambensis*, which are described and illustrated. *Poa ramoniana*, found growing near lakes in high elevation Puna grasslands of Junín, is similar to a small form of *P. glaberrima*, but differs in having rhizomes and growing to only 5 cm tall. *Poa tayacajaensis*, found from shrublands on Andean slopes of Huancavelica and Huánuco, bears similarities to *Poa aequatoriensis* but differs in having shorter lemmas which are pubescent between the veins, densely scabrous sheaths with smooth, glabrous throats, and shorter ligules. *Poa urubambensis*, a common element of the undisturbed *Polylepis* forest understory of the Cordillera

* Authors contributed equally to this work

Urubamba, Cusco, is distinct from all other members of open-panicled *Poa*s by having glabrous lemmas with a smooth and glabrous callus, and notably small anthers. The type material for the name *Poa adusta* is discussed and a lectotype is selected.

Resúmen

Aportamos una lista actualizada y una clave para las 30 especies de *Poa* con panículas abiertas de Perú que incluye las especies de *Dissanthelium* y *Aphanelytrum* anteriormente circunscritas, nuevos registros de taxones y tres especies no descritas. *Poa compressa*, *P. grisebachii*, y *P. leioclada* se registran para Perú por primera vez. Un número de especies son sinonimizadas: *Poa carazensis*, *P. ferreyrae* y *P. tovarii* son sinonimizadas bajo el nombre de *P. fibrifera*; *Poa adusta* (tentativamente) y *P. pilgeri* son sinonimizadas bajo el nombre de *P. candamoana*; *Poa superata* es sinonimizada bajo *P. grisebachii*; y *Poa paramoensis* es sinonimizada bajo *P. huancavelicae*. Dentro de este tratamiento se incluyen dos especies nuevas, *Poa ramoniana*, *P. tayacajaensis* y *P. urubambensis* que a continuación se describen e ilustran. *Poa ramoniana*, que se encuentra creciendo en pastizales de alta elevación cercanos a lagos en la Puna de Junín, es similar a la forma pequeña de *P. glaberrima*, pero se diferencia por tener rizomas y crecer hasta sólo 5 cm de altura. *Poa tayacajaensis*, que se encuentra en matorrales de las laderas andinas de Huancavelica y Huánuco, tiene un parecido a *Poa aequatoriensis*, pero se diferencia por tener lemas cortas que son pubescentes entre las venas, vainas densamente escabrosas con suaves gargantas glabras, y lígulas cortas. *Poa urubambensis*, un elemento común de sotobosque no perturbado de los bosques de *Polylepis* de la Cordillera Urubamba, Cusco, se distingue de todos los otros miembros de *Poa* con panícula-abierta por tener lemas glabras con un callo suave y glabro, y sus notables anteras pequeñas. El material tipo del nombre *Poa adusta* es discutido y un lectotipo es seleccionado.

Keywords

Checklist, Gramineae, new species, Peru, *Poa*, Pooideae, *Polylepis* forest, Pooideae, Puna grassland, grass taxonomy

Introduction

The genus *Poa* L. is the largest genus of the Poaceae, containing over 500 species with a large distribution across temperate areas of the globe (Soreng et al. 2003, 2010, 2015, 2016). The first taxonomic treatment of *Poa* from Peru comes from Hitchcock's (1927) 'The grasses of Ecuador, Peru and Bolivia' in which he mentions 17 species. Standley (1936), in the Flora of Peru series, produced the first treatment of purely Peruvian grasses in which he added *P. aequatoriensis* to the country records, raising the total number of Peruvian *Poa* to 18. Following this, the renowned Peruvian agrostologist, Óscar Tovar Serpa, began his life-long work on Peruvian grasses producing a number of publications related to *Poa* (Tovar 1965, 1974, 1984, 1986) until his largest cumulatory work in 1993 where he provided a concise treatment of all grasses from Peru (Tovar 1993).

Tovar's (1993) most up-to-date taxonomic treatment, and the Checklist for Peru (Brako and Zarucchi 1993) that was published in the same year, considered the country to have either 40 or 41 species of *Poa*, respectively. This number has since varied due to taxonomic revision placing certain names in synonymy (Soreng et al. 2003, 2016), and discoveries of undescribed species (Negritto and Antón 2006; Davidse et al. 2010; Soreng

and Peterson 2010; Peterson and Soreng 2016). Additionally, DNA studies (Gillespie et al. 2007, 2008; Refulio-Rodríguez et al. 2012; Peterson and Soreng 2016) found four small, mostly closed-panicled, genera to be nested within *Poa* subg. *Poa* supersect. *Homalopoa* (Dumort.) Soreng & L.Gillespie. Species of *Anthochloa* Nees & Meyen, *Tovaro-chloa* T.D. Macfarl. & P. But, and *Dissanthelium* Trin., were thus transferred to *Poa* by Gillespie et al. (2007) and Refulio-Rodríguez et al. (2012), while species of *Aphanelytrum* (Hack.) Hack. were recently transferred to *Poa* by Peterson and Soreng (2016).

To this point, 51 species had been accepted in *Poa* for Peru (Soreng et al. 2016), four of which are considered to be exotic (*P. annua* L., *P. infirma* Kunth, *P. pratensis* L. [subsp. *alpigena* (Lindm.) Hiitonen is indigenous in North America and Patagonia], *P. trivialis* L.). Of these 51 species, 32 have open-panicled inflorescences. Panicle characteristics are good for separating Peruvian *Poa* into two distinct groups. All taxonomic treatments of *Poa* in Peru (Hitchcock 1927; Standley 1936; Tovar 1993), Bolivia (Renvoize 1998) and Ecuador (Hjorth 1991) have provided diagnostic keys that, in the first couplet, separate species into those with a congested spike-like panicle, with panicle branches appressed, and those with an open-panicled inflorescence, the branches spreading. We believe this artificial character to be convenient and reliable in separating Peruvian *Poa*.

Our objective is to provide an up-to-date summary of the open-panicled species of *Poa* in Peru including locality information using verified specimens and discussion of nomenclatural and taxonomic attributes, with the new species, *Poa ramoniana*, *P. tayacajaensis* and *P. urubambensis*, being described and illustrated. Two keys are provided to aid with identification of the open-panicled *Poa*. The main key first uses anther length to separate taxa while the Suppl. material 1 first uses lemma indumentum. We hope users of our keys will have a better chance of accurately identifying Peruvian specimens of *Poa*.

Materials and methods

In this treatment, glabrous means without pubescence (in the sense of slender, relatively soft hairs). Smooth indicates no prickly-hairs with broad bases and/or hooked or pointed apices (i.e., pubescence can occur on a smooth surface, and a rough or scabrous surface can be glabrous). Specimen localities in the checklist are cited by political region (also historically called 'departamento') (capital letters) and then province. Only herbaria where specimens have been checked and verified by the authors have been cited (acronyms following Thiers, continuously updated): Mainly MO (material on loan to US, c. 240 collections of *Poa* from Peru [*Peterson* duplicates excepted], and many more from across South America), and US, but USM specimens and types were examined in-situ by RJS (in 2006 and 2007), and CUZ and Z specimens were examined by SPS. Almost all *P.M. Peterson Poa* collections (first set at US, c. 460 collections from Peru) are duplicated at USM, although the USM duplicates have not been re-checked for this paper. Excluded species are discussed at the end of the checklist.

Results

Of the 32 species of *Poa* with open-panicles previously recognized in Peru (Soreng et al. 2016), we consider three of these species records to be erroneous and have placed five species names in synonymy. Following the discovery of three undescribed species and three new country records, we now recognize 30 species of *Poa* with open-panicles in Peru.

The new species, *Poa urubambensis*, was found in remote areas of the Cordillera Urubamba, southern Peru, during recent fieldwork by the first author. While reviewing Peruvian specimens of open-panicled *Poa* from collections in the United States National Herbarium and Missouri Botanical Garden, a further two undescribed species, *Poa ramoniana* and *Poa tayacajaensis*, were discovered. *Poa ramoniana* was discovered from collections by eminent Peruvian botanist, Ramón Alejandro Ferreyra, from Junín. *Poa tayacajaensis* was discovered from collections by the renowned Peruvian agrostologist, Óscar Tovar Serpa, from the province of Tayacaja, Huancavelica.

We report new species records for: *Poa* cf. *leioclada* Hack., previously considered endemic to Ecuador (León Yáñez et al. 2011), and *P. grisebachii* R.E. Fr., previously considered endemic to Argentina (Giussani et al. 2012). *Poa compressa* L., originating from Europe, is also reported for the first time. Three species: *Poa carazensis* Pilg., *P. ferreyrae* Tovar, and *P. tovarii* Soreng, appear to be morphologically indistinct from *P. fibrifera* Pilg. and have been placed under that name. *Poa adusta* J. Presl, known only from the type collection, and the recently described *P. pilgeri* Negritto and Antón (2006: 87) are synonymized under *P. candamoana* Pilg. Specimens of *Poa superata* Hack., previously known only from Argentina and Chile, have been collected from Peru and were determined to be morphologically indistinct from *P. grisebachii* R.E. Fr. *Poa paramoensis* Læggaard, previously considered endemic to Ecuador (Læggaard 1998), has been found to be morphologically indistinct from *P. huancavelicae* Tovar. Reports of *Poa lilloi* Hack. and *P. supina* Schrad. for Peru are considered erroneous, and *P. bromoides* Vahl (accepted by Brako and Zarucchi 1993) is currently accepted as *Eragrostis bromoides* (Vahl) Steud. by Soreng et al. (2016). These species were removed from the checklist.

Key to the open-panicled species of *Poa* in Peru

- 1 Lemmas with bifid apices that are mucronate to short-awned; spikelets glabrous, with long rachillas 1.2–4.2 mm long; glumes short, less than ½ the length of the florets, sometimes absent **2**
- Lemmas with obtuse to acute apices, never bifid, mucronate or short awned; spikelets usually with some form of indumentum, less often glabrous, with short rachillas rarely longer than 1.2 mm; glumes less than half to equaling the length of the spikelet, never absent **3**
- 2 (1) Glumes veinless, 0.1–0.5 (–0.7) mm long, minute or absent; plants straggling and stooling; culms 30–80(–100) cm tall ***P. hitchcockiana***

- Glumes veined, 1–2 mm long, lower glume 1-veined, upper glume 3- or 4-veined; plants caespitose; culms 14–24 cm tall.....***P. sanchez-vegae***
- 3 (1) Glumes exceeding the florets; spikelets 2-flowered; lemmas 3 (rarely 5)-veined, glabrous, smooth or scaberulous; low tufted (sometimes rhizomatous in *P. trollii*) perennial plants mostly less than 10 cm tall; panicles 1–3.3 cm long..... **4**
- Glumes shorter than the proximal floret; spikelets 2–4(–6)-flowered; lemmas 5(or 7)-veined, glabrous or pubescent, smooth or variously scabrous; annual or perennial plants of various habits, ranging mostly from 10–120 cm tall; panicles longer (sometimes short in the annuals).....**6**
- 4 (3) Anthers 2–2.2 mm long in staminate specimens, vestigial in pistillate specimens; lemmas smooth throughout; plants sometimes rhizomatous...***P. trollii***
- Anthers <1 mm long in lower floret of spikelets, sometimes vestigial in upper floret; lemmas scaberulous, at least on the keels (rarely smooth in *P. calycina*); plants densely tufted **5**
- 5 (4) Leaf blade abaxial surface shiny with veins indistinct ***P. calycina***
- Leaf blade abaxial surface dull with veins apparent..... ***P. swallenii***
- 6 (3) Longest anthers of proximal florets 0.2–1.5 mm long **7**
- Longest anthers of proximal florets (1.2–)1.6–3.2 mm long..... **16**
- 7 (6) Plants annual; palea keels distinctly pubescent in part (very rarely glabrous) always without any hooks; callus glabrous..... **8**
- Plants perennial; palea keels glabrous or pubescent in part, but always scabrous in part; callus glabrous or webbed, i.e. with long silky hairs (sometimes sparse) emerging from below the lemma keel (at least of the lower florets) **9**
- 8 (7) Anthers 0.2–0.5(–0.6) mm long; panicle branches ascending, spikelets usually crowded; foliage light green; plants ephemeral..... ***P. infirma***
- Anthers 0.6–1 mm long; panicle branches ascending to spreading, spikelets loosely arranged; foliage usually darker green; plants infrequently persisting for more than one season ***P. annua***
- 9 (7) Culm nodes strongly compressed, lower culm nodes exposed; culms wiry; plants strongly rhizomatous with isolated shoots; all florets of spikelets hermaphroditic (sometimes anthers aborted late in development)***P. compressa***
- Combination of characters not as above; culm nodes terete or slightly compressed, lower culm nodes usually held within sheaths; culms varying from wiry to robust; plants tufted or rhizomatous; all florets of spikelets hermaphroditic, or upper floret(s) within spikelets sometimes pistillate, with rudimentary stamens (i.e. gynomonoecious) **10**
- 10 (9) Callus glabrous ***P. urubambensis***
- Callus webbed, i.e. with long silky hairs (sometimes sparse) emerging from below the lemma keel (at least of the lower florets) **11**
- 11 (10) Leaf blades filiform or slightly broader, involute or subinvolute towards the base, 0.5–2 mm wide when expanded; lower lemma 3–4 (5?) mm long, glabrous; web only (web sometimes v. short and sparse, and present on basal florets only) ***P. pauciflora***

- Leaf blades flat or folded, usually >2 mm wide when expanded; lower lemma 2.3–6 mm long, variously glabrous or pubescent **12**
- 12 (11) Upper ligules 0.9–2(–3) mm long, truncate; plants distinctly rhizomatous; lower sheaths smooth, sometimes lightly pubescent; lower lemma keel and marginal veins distinctly pubescent; spikelets with 2–6 florets; all florets of spikelets hermaphroditic (sometimes anthers aborted late in development)...
..... ***P. pratensis***
- Combination of characters not as above; upper ligules 0.2–10 mm long, acute or rarely truncate; plants tufted (weakly rhizomatous in *P. huancavelicae*); lower sheaths smooth to densely scabrous; lower lemma keel and marginal veins varying in indumentum from glabrous to short pubescent; spikelets with 2–3 florets; upper floret within spikelets sometimes pistillate, with rudimentary stamens **13**
- 13 (12) Leaf blades folded, apex prominently naviculate (prow-tipped); plants weakly rhizomatous; lemma keels and marginal veins smooth or scaberulous, glabrous; callus webbing the only indumentum present in the spikelet ... ***P. huancavelicae***
- Leaf blades flat, apex not, or not prominently, naviculate; plants tufted, occasionally stooling and rooting at nodes; lemma keels short pubescent in the lower ½, sometimes sparingly so on the marginal veins near the base (rarely glabrous in *P. aequatoriensis*); spikelet indumentum consisting of lemma pubescence (as mentioned above) and callus webbing **14**
- 14 (13) Spikelet proximal lemmas pubescent on keel, lateral, and marginal veins; distal lemmas pubescent between the veins; sheaths densely scabrous; ligules 2–3.5 mm long ***P. tayacajensis***
- Combination of characters not as above; spikelet proximal lemmas glabrous or sparingly pubescent on the keel, and sometimes marginal veins; distal lemmas often glabrous throughout; sheaths smooth to densely scabrous; ligules 1–10 mm long **15**
- 15 (14) Lower culm sheaths usually puberulent in the throat margins and/or along the collar margins, surfaces smooth to lightly scabrous; upper culm leaf ligules 1–5(–7) mm long, abaxially puberulous or scabrous; lowest floret of spikelets hermaphroditic, upper florets commonly pistillate; spikelets 3.5–5 mm long; lower lemma 3.6–4 mm long, intermediate veins faint to moderately pronounced; palea keels usually finely scabrous to some degree; anthers mostly 0.6–1.5 mm long ***P. aequatoriensis***
- Lower culm sheaths glabrous in the throat margins, surfaces nearly smooth to densely scabrous; upper culm leaf ligules 4–10 mm long, abaxially smooth or faintly scabrous; all florets of spikelets hermaphroditic; spikelets 2.3–3.5(–4) mm long; lower lemma 2.3–3(–3.5) mm long, intermediate veins distinctly pronounced; palea keels usually muriculate, sometimes minutely scabrous; anthers (1) 1.3–1.6 (1.8) mm long ***P. trivialis***
- 16 (6) Lemmas glabrous, smooth or scabrous (rarely sericeous at the base in *P. ramifera*); callus glabrous **17**

- Lemmas, at least of the upper florets, pubescent or villous in their lower half (rarely scabrous-pubescent in *P. kurtzii*), or glabrous but then callus webbed, i.e. with long silky hairs emerging from below the lemma keel; callus glabrous or webbed **26**
- 17 (16) Culms erect, aerially branching well up the culm with lateral shoots that persist and flower in subsequent seasons *P. ramifera*
- Culms not branching, or branching only near the base, or from decumbent culms **18**
- 18 (17) Summit of sheaths with prominent triangular auricles; spikelets 4–6-flowered *P. auriculata*
- Sheaths without auricles; spikelets 2–6-flowered **19**
- 19 (18) Lemmas surface completely smooth (sometimes distally obscurely to sparsely scaberulous in *P. ramoniana* but then plants 4–6 cm tall and ligules <1 mm long) . **20**
- Lemmas slightly to strikingly scabrous between and on veins **23**
- 20 (19) Plants 4–6 cm tall; rhizomatous; ligules <1 mm long *P. ramoniana*
- Plants >10 cm tall; tufted or, if rhizomatous >100 cm tall; ligules 2–7 mm long **21**
- 21 (20) Leaf blades smooth throughout, (2–)4–9 cm long, 1–2(–2.5) mm wide when blade flattened *P. glaberrima*
- Leaf blades densely scabrous throughout, 8–40 cm long, 3–10 mm wide when blade flattened **22**
- 22 (21) Leaf blades conspicuously folded; plants 25–35 cm tall, tufted ... *P. gilgiana*
- Leaf blades flat; plants 100–150 cm tall, rhizomatous *P. ayacuchensis*
- 23 (19) Leaf blades involute or the margins distinctly involute (rarely simply folded in *P. kurtzii*), densely scabrous (at least abaxially), firm to rigid; plants tufted; ligules (2.5–)5–15 mm long **24**
- Leaf blades flat or folded, margins rarely distinctly involute, glabrous or lightly scabrous, lax or firm; plants erect (*P. fibrifera*) or rhizomatous (*P. oscariana*), sometimes tufted; ligules 1–7(–9) mm long **25**
- 24 (23) Ligules 8–15 mm long; panicles narrowly ovate, panicle branches ascending and subappressed, panicles included in the sheaths; lemmas scabrous *P. pearsonii*
- Ligules (2.5–)5–8 mm long; panicles amply ovate, panicle branches patent or reflexed, panicles exerted; lemmas scabrous or scabrous-pilose *P. kurtzii*
- 25 (23) Lower leaf sheaths often fibrous; ligules 1.5–5(–6) mm long; blades lax; spikelets 3–5-flowered, 5–9 mm long; anthers 2.4–3.5 mm long; rachilla internodes well exposed *P. fibrifera*
- Lower leaf sheaths not fibrous; ligules 6–9 mm long; blades somewhat firm; spikelets 2–3-flowered, 4.5–5 mm long; anthers 1.8–2 mm long; rachilla internodes short (compare with *P. gilgiana*) *P. oscariana*
- 26 (16) Callus glabrous; lemmas (at least the distal ones within a spikelet) softly villous-pubescent in their lower half **27**
- Callus webbed, i.e. with long silky hairs (sometimes sparse) emerging from below the lemma keel (at least of the lower florets); lemmas glabrous or dis-

- tinctly to sparsely villous or serious pubescent along the keel and marginal veins only.....**30**
- 27 (26) Plants (30–)60–150 cm tall; leaf blades flat, sometimes folded towards their apices, usually more than 3 and up to 10 mm wide; inflorescence branches commonly verticillate; plants (sub-)rhizomatous with extravaginal shoots (if blades rather firm and folded but broad as in *P. horridula*, compare with *P. gilgiana*, possibly hybrids)***P. horridula***
- Plants usually <35 cm tall; leaf blades involute to narrowly convolute and 0.5–2 mm wide, or flat to folded and 1–5 mm wide in *P. grisebachii*; inflorescence branches solitary or paired (often 3 branches in basal nodes of *P. grisebachii*); plants usually with only intravaginal shoots**28**
- 28 (27) Leaf blade abaxial surface densely scabrous; ligules (2.5–)5–8 mm long, acute; lemmas scabrous-pilose; plants of semi-arid habitats ***P. kurtzii***
- Leaf blade abaxial surface glabrous to scaberulous with prickles or hooks usually restricted to the leaf margin; ligules 0.5–3 mm long, truncate; lemmas pilose-villous towards base; plants of mesic or more arid habitats.....**29**
- 29 (28) Leaf blades usually involute, apex narrowly but abruptly naviculate (prow-tipped); spikelets usually 3-flowered, (2.8–)4.3–5.5 mm long; culm basal sheath bases slightly inflated, shiny, and tough; plants of more mesic Puna, mostly 3700–4500 m ***P. candamoana***
- Leaf blades flat or folded, somewhat lax, apex often tapered to a long slender point; spikelets 3–6-flowered, (5–)6–7.2 mm long; culm basal sheaths not as above; plants of more arid zones between 3000 and 4000 m (appears to hybridize with *P. kurtzii* where the two overlap) ***P. grisebachii***
- 30 (26) Leaf blades filiform or slightly broader, involute or sub-involute towards the base, 0.5–2 mm wide when expanded; lower lemma 3–4 (5?) mm long, glabrous; web only (web sometimes v. short and sparse, and present on basal florets only) ***P. pauciflora***
- Leaf blades flat or folded, usually >2 mm wide when expanded; lower lemma 2.3–6 mm long, variously glabrous or pubescent**31**
- 31 (30) Basal sheaths glabrous and densely scabrous; lemmas smooth (or lightly scabrous near the apex), glabrous; web only.....***P. scabrivaginata***
- Basal sheaths glabrous or lightly pubescent, smooth or lightly scabrous, or if densely scabrous then lemmas pubescent at least on the keel; lemmas smooth or scabrous, glabrous or pubescent in part.....**32**
- 32 (31) Upper ligules 0.9–2(–3) mm long, truncate; plants distinctly rhizomatous; lower sheaths smooth, sometimes lightly pubescent; lower lemma keel and marginal veins distinctly pubescent; spikelets with 2–6 florets; all florets of spikelets hermaphroditic (sometimes anthers aborted late in development) ***P. pratensis***
- Combination of characters not as above; upper ligules 0.2–10 mm long, acute or rarely truncate; plants tufted (usually with short rhizomatous shoots in *P. huancavelicae* and prominent sub-rhizomatous extravaginal shoots present in *P. leioclada*); lower sheaths smooth to densely scabrous; spikelets with

- 2–3(–4) florets; upper floret within spikelets hermaphroditic (i.e. *P. trivialis*) or commonly pistillate, with rudimentary stamens (i.e. *P. huancavelicae*, *P. cf. leioclada*) **33**
- 33 (32) Leaf blades folded, apex prominently naviculate (prow-tipped); plants weakly rhizomatous; lemma keels and marginal veins smooth or scaberulous, glabrous; web only ***P. huancavelicae***
- Leaf blades flat, apex not, or not prominently, naviculate; plants tufted, occasionally stooling and rooting at nodes (or with prominent sub-rhizomatous shoots present at the base in *P. leioclada*); lemma keels short pubescent in the lower ½, sometimes sparingly so on the marginal veins near the base **34**
- 34 (33) Spikelets glomerate on branches; culm leaf ligules 1–2 (–2.5) mm long, truncate or obtuse; short sub-rhizomatous shoots usually prominent at the base of the plant, these extravaginal, with brown cataphylls; spikelet proximal lemmas pubescent on keel, lateral, and marginal veins; distal lemmas often pubescent between the veins; spikelets 2–4-flowered; sheaths smooth; leaf blades mostly folded, sometimes flat, firm; lowest floret of spikelets hermaphroditic, upper florets commonly pistillate ***P. cf. leioclada***
- Spikelets diffuse throughout the panicle; culm leaf ligules 4–10 mm long, acute, rarely truncate in lower leaves; rhizomatous shoots absent, new shoots obscure, stoloniferous, extravaginal, with green cataphylls; spikelet proximal lemmas glabrous or sparingly pubescent on the keel, and sometimes marginal veins; all lemmas glabrous between the keel and marginal veins; spikelets 2–3-flowered; sheaths nearly smooth to densely scabrous; leaf blades mostly flat, flaccid; all florets of spikelets hermaphroditic ***P. trivialis***

Checklist to the open-panicked *Poa* species of Peru

All of the indigenous species covered (including the new ones) are accommodated in *Poa* subg. *Poa* supersect. *Homalopoa* sect. *Homalopoa* Dumort. s.l., except *P. calycina* and *P. wallenii*, which currently reside in *P.* subg. *Poa* supersect. *Homalopoa* sect. *Dissanthelium* (Trin.) Reulio, and *P. hitchcockiana* and *P. sanchez-vegae*, which reside in *Poa* subgen. *Poa* supersect. *Homalopoa* sect. *Dioicopoa* subsect. *Aphanelytrum*. The introduced species are referred to *P.* subg. *Ochlopoa* (Asch. & Graebn.) Hyl. sect. *Micrantherae* Stapf (*P. annua* and *P. infirma*); *P.* subg. *Stenopoa* (Dumort.) Soreng & L.J. Gillespie sect. *Pandemos* Asch. & Graebn. (*P. trivialis*); *P.* subg. *Poa* supersect. *Poa* sect. *Poa* (*P. pratensis*); *P.* subg. *Stenopoa* sect. *Tichopoa* Asch. & Graebn. (*P. compressa*).

Poa aequatoriensis Hack. **Ref:** Standley (1936: 125); Tovar (1965: 45, 1993: 135).

Ill: Hjorth (1991: fig. 6), Tovar (1965: lam. X, B). **Habitat:** Montane forest, Puna grassland, pathsides and open areas, rocky slopes. 2000–4600 m. **Vouchers:** PERU: AMAZONAS: Bongara, J.J. Wurdack 944 (US). AYACHUCO: Weberbauer 7573 (US fragm. Ex F). CAJAMARCA: Cajamarca, I. Sanchez Vega (MO);

Celendin, I.M. Sánchez V. 2668 (MO); San Miguel, J. Mostacero L. 1282 (MO); Santa Cruz, J. Santisteban C. & J. Guevara B. 169 (F, MO). CUSCO: Urubamba, H.H.C. Ellenberg 48232 (MO). HUÁNUCO: Pachitea, J.F. Macbride 4365 (US). JUNÍN: Concepción, J.F. Macbride 3363 (US). PIURA: Huancabamba, P.M. Peterson 15175 (US). **Discussion:** *Poa aequatoriensis* occurs from northern Peru, Ecuador, and Colombia, although one collection is known from Cusco. Brako and Zarucchi (1993) and Tovar (1993) also state *P. aequatoriensis* to occur in ANCASH, HUANCANELICA and LIMA. Commonly misidentified as *P. trivialis* and vice-versa. Reports of *P. aequatoriensis* from Bolivia by Hjorth (1991) are, most likely, another taxon. This report was probably based on material called *Poa umbrosa* Trin. by Renvoize (1998; *Renvoize & Cope* 4071, K, US!), which RJS redetermined as *Poa bradei* Pilger, a species otherwise known only from Brazil, which has spikelets with only perfect flowers and short anthers (0.5–1 mm).

***Poa annua* L. Syn:** *Ochlopoa annua* (L.) H. Scholz. **Ref:** Standley (1936: 125); Tovar (1965: 61, 1993: 127). **Ill:** Giussani et al. (2012: sp. 3, p. 294). **Habitat:** Waste and disturbed ground, pathsides, roadsides and fields. 2200–4800 m. **Vouchers:** PERU: ANCASH: Carhuaz, D.N. Smith 9561 (MO); Huari, P.M. Peterson 13872 (MO, US); Huaylas, D.N. Smith 9294 (MO); Pallasca, P.M. Peterson 13947 (MO, US); Recuay, P.M. Peterson 13827 (MO, US). AREQUIPA: Arequipa, P.M. Peterson 18256 (US); Caraveli, P.M. Peterson 16391 (US). AYACUCHO: Huanca Sancos, P.M. Peterson 16258 (US); Lucanas, P.M. Peterson 16309 (US); Parinacochas, P.M. Peterson 16328 (US). CAJAMARCA: Cajamarca, P.M. Peterson 14910 (MO, US); San Ignacio, P.M. Peterson 15129 (MO, US). CUSCO: Calca, S.P. Sylvester 1334 (CUZ, LPB, US, Z); Canchis, J. Farfán 864 (MO); Cusco, P. Núñez V. 7500 (US); Espinar, P. Núñez V. 7619 (MO); La Convención, S.P. Sylvester 1552 (CUZ, US, Z). HUANCANELICA: Huancavelica, P.M. Peterson 14173 (MO, US). JUNÍN: Junín, P.M. Peterson 14095 (MO, US); Tarma, D.N. Smith 1605 (MO). LA LIBERTAD: Bolívar, R.W. Bussmann 18047 (MO); Otuzco, A. Sagástegui A. 11567 (MO); Trujillo, J. Hudson 1027 (MO). PASCO: Oxapampa, D.N. Smith 5831 (MO). PUNO: Chucuito, P.M. Peterson 14634 (US); El Collao, P.M. Peterson 14593 (MO, US); Sandia, B.C. Bennett 1944 (MO). TACNA: Tarata, P.M. Peterson 14724 (MO, US). **Discussion:** Introduced weed from Europe. This species sometimes survives for more than one growing season and can occur with completely glabrous lemmas, where it is commonly misidentified as *Poa supina* (see ‘Species excluded’ section below). Brako and Zarucchi (1993) and Tovar (1993) also state *P. annua* to occur in HUÁNUCO, LIMA and PIURA.

Poa auriculata Soreng & P.M. Peterson **Ref & Ill:** Peterson and Soreng (2016: 121, fig. 5). **Habitat:** Known only from the type locality growing on a dry cliff face between 3100–3200 m. **Vouchers:** PERU: AMAZONAS: Chachapoyas, J.J. Wurdack 1145 (US-holotype). **Discussion:** Endemic herb. This is the first member of *P.* subg. *Poa* supersect. *Homalopoa* with prominent auricles.

Poa ayacuchensis Tovar **Ref & Ill:** Tovar (1974: 6, 1993: 129, fig. 1, 2, 3). **Habitat:** Wet ground, riversides. c. 3700 m. **Vouchers:** PERU: AYACUCHO: Lucanas, Ó.

Tovar S. & R. Foguel 7007 (MO, US, USM). **Discussion:** Endemic herb, known only from the type collection.

Poa calycina (J. Presl) Kunth **Syn:** *Brizopyrum calycinum* J. Presl; *Deschampsia mathewsii* Ball; *Dissanthelium calycinum* (J. Presl) Hitchc.; *Dissanthelium laxifolium* Swallen & Tovar; *Dissanthelium mathewsii* (Ball) R.C. Foster & L.B. Sm.; *Dissanthelium sclerochloides* Steud. ex E. Fourn.; *Dissanthelium semitectum* Swallen & Tovar; *Dissanthelium supinum* Trin.. **Ref:** Refulio-Rodríguez et al. (2012: 130); Swallen & Tovar (1965: 370–371); Tovar (1993: 154–156). **Ill:** Renvoize (1998: fig. 38 E, F). **Habitat:** Puna grassland. 2500–4500 m. **Vouchers:** PERU: ANCASH: Bolognesi, *P.M. Peterson 17974* (US); Recuay, *P.M. Peterson 17904* (US); Yungay, *P.M. Peterson 21676a* (US). AYACUCHO: Cangallo, *P.M. Peterson 18164* (US); Lucanas, *P.M. Peterson 16466* (US). CUSCO: Calca, *P.M. Peterson 18100* (US); Urubamba, *S.P. Sylvester 1706* (AAU, LPB, US). HUANCABELICA: Huancavelica, *P.M. Peterson 18100* (US). HUÁNUCO: Huamalies, *P.M. Peterson 17923* (US). JUNÍN: Huancayo, *P.M. Peterson 14209* (US); Junín, *P.M. Peterson 14105* (US); Tarma, *P.M. Peterson 14090* (US); Yauli, *P.M. Peterson 18042* (US). LIMA: Canta, *P.M. Peterson 18028* (US). PASCO: Pasco, *P.M. Peterson 18075* (US). **Discussion:** This species has a disjunct distribution. It is found in the high elevation Puna grasslands of Bolivia and Peru and the alpine volcanic slopes of Mexico (Soreng and Peterson 2012). Brako and Zarucchi (1993) report the species to occur in PUNO.

Poa candamoana Pilg. (Nom. Cons. Prop. *In prep.*) **Syn:** *Poa adusta* J. Presl, lectotype here designated *Haenke s.n.* (lectotype: PR-495759!, left-hand specimen; isolecotype: HAL-81886, W-0029634); *Poa pilgeri* Negritto & Antón. **Ref:** Standley (1936: 125); Tovar (1965: 57, 1993: 131); Negritto and Antón (2006: 88). **Ill:** Tovar (1965: lam. XIII, A); Negritto and Antón (2006: fig. 3, as *P. pilgeri*). **Habitat:** Grassland. 3400–4500 m. **Vouchers:** PERU: ANCASH: Paillon, *E. Cerrate 2685* (US); Recuay, *P.M. Peterson 21547* (US); Yungay, *P.M. Peterson 21748* (US). AREQUIPA: Arequipa, *P.M. Peterson 18254* (US). AYACUCHO: Lucanas, *H.H.C. Ellenberg 4945* (MO). CAJAMARCA: Celendin, *P.M. Peterson 21915* (US). CUSCO: Cusco, *A.S. Hitchcock 22469* (US); Espinar, *C. Vargas C. 5629* (MO); Quispicanchis, *P.M. Peterson 20599* (US). HUANCABELICA: Huancavelica, *P.M. Peterson 16422* (US); Churcampá, *O. Tovar S. 805* (US); Huaytara, *P.M. Peterson 20428a* (US); Tayacaja, *O. Tovar S. 2475* (US). HUÁNUCO: Huamalies, *P.M. Peterson 17925* (US). JUNÍN: Junín, *P.M. Peterson 14116* (US); Huancayo, *I.J. Blair 424* (K), *S. Soukup 6103* (US); Yauli, *Hirsch P243* (US). LIMA: Canta, *P.M. Peterson 20286* (US). MOQUEGUA: Gral. Sanchez Cerro, *D.B. Montesinos T. 2494* (MO, USM). PASCO: Pasco, *P.M. Peterson 14099* (US). PUNO: Azángaro, *A. Weberbauer 472* (MO, US); Puno, *O.P. Pearson 52-68* (US). **Discussion:** A common and characteristic element in the high Andean Puna grassland of Peru and Bolivia. Brako and Zarucchi (1993) state *P. candamoana* also occurs in APURIMAC.

There has long been uncertainty regarding the identity of *Poa adusta* (Standley 1936, p. 129; Tovar 1965, p. 61, Soreng et al. 2003), which is known only from the type col-

lection, *T. Haenke s.n.* (PR, HAL, W). A report from Colombia (Giraldo-Cañas 2011) represents a different species. The type description of *P. adusta* can be considered erroneous regarding the lemma indumentum, which was stated to be scabrous while the type specimens examined had pubescence present on the lemma keel marginal and intermediate veins (and at least sparingly between them). After studying the HAL isotype, a solitary flowering shoot with one full leaf, without base, we felt it most likely represented *P. candamoana*. A photo of the W isotype (which has only an inflorescence and a bit of upper culm) is also a match for the HAL specimen. Upon studying the PR isotype sheet of *P. adusta*, it was found to comprise two separate leafy shoots that differ from each other. The PR left-hand plant, has a base (with basal-most sheaths characteristic of *P. candamoana*; ie, the base slightly inflated and lustrous), and it otherwise matches the HAL sample in details. The spikelets of these plants differ from *P. candamoana* in the broad, blunt, somewhat distorted lemmas, and dark coloration (*adustus* means blackened or scorched), and do not match any species we know of. Although the dark coloration might derive from poor preservation (coming as they did from moldy bundles), we have seen similarly distorted and discolored spikelets in a few specimens of *Poa* from the region that we expect resulted from disease (given that in one case other spikelets in the same plant inflorescence were normal in shape, color, and pubescence). The PR right-hand plant, although bearing similar characteristics of lemma indumentum, is obviously quite pubescent between the veins and the lemmas are acute and not so discolored (a few spikelets are discolored and distorted to a lesser degree than in the left hand plant), lacks a base, has blade apices that are not navicular as is normal for *P. candamoana*, and the upper culm blade is far too long (longer than the panicle) and inserted too high on the culm for that species (> 10 cm and exceeding the panicle). The right hand plant is almost certainly *P. horridula*. The left hand plant could be either the result of hybridization between *P. candamoana* and *P. horridula* (see *P. horridula* discussion below), diseased material of *P. candamoana* or another species, or a rare species not yet rediscovered. Our choice is to lectotypify *Poa adusta* on the left hand plant of specimen PR-495759. We will propose conservation of *Poa candamoana* (Pilger 1906) over *P. adusta* (J. Presl 1830), rather than outright rejection, since the former name has been widely used for this commonly collected species, and the identity of the lectotype of the latter is still in doubt.

The origin of the *P. adusta* specimens has been uncertain as they might not have been collected from Peru, even though J. Presl (1830: 271) mentioned ‘Peruvia’ as place of origin in the protologue. The *P. adusta* specimen at PR was part of a bundle of specimens which were tagged with the note ‘Aus verfault P.’ (translated as ‘from rotten bundle’). The tag, written by Bohemian botanist K.M. Sternberg (sometime between 1821 and 1822), indicates that the specimen came from a damaged bundle of plants, for which the country of origin was not indicated. Haenke’s herbarium originally consisted of specimens without labels and, when the Czech National Museum purchased the bundle from the compatriot handling company of Hiecke, Ziencke & Co. in 1821, the origin was indicated only on the top of every bundle of specimens. This is the reason why Haenke’s handwriting is generally missing from all of his specimens. ‘Peruvia’, mentioned in the protologue, is J. Presl’s opinion about the origin of these specimens rather than the real place of origin for some portion of them. Hae-

nke's collections (made between 1790 and 1792) may have come from his crossing from Buenos Aires and Rio La Plata to Santiago (where he finally caught up with the Malaspina Expedition), or any (suitable) place along the Pacific Coast of America from Santiago (Chile), Lima (Peru), Acapulco (Mexico), to Monterey (California, then part of Mexico), Nootka Sound (now British Columbia), and Yakutat Bay (now Alaska), where the expedition landed (see Češka 2002). Our determination of the right hand plant at PR as *P. horridula* provides a location for the *Poa adusta* lectotype as the central Andes, where *P. horridula* and *P. candamoana* are common.

Although the set of Haenke's collections that made their way to Prague were purchased by the Czech National Museum, a substantial part of it ended up in the Prague University herbarium (now the herbarium of Charles University in Prague, PRC). J. Presl's brother (who wrote up the Gramineae, Cyperaceae, and Taccaceae), C.B. Presl, was custodian of the PR herbarium (where all or most of Haenke's Poaceae from the expedition now reside), and together, while writing the *Reliquiae Haenkeanae* (C.B. Presl 1825–1835), they offered surplus duplicate specimens for sale to other botanical institutions, which is likely how they arrived at HAL and W (Češka 2002; Otakar Sida [PR], pers. communication).

***Poa compressa* L. Ref:** Soreng and Peterson (2012: 31). **Ill:** Giussani et al. (2012: sp. 11, p. 300). **Habitat:** Cool-temperate, semi-shaded to open habitats on wet ground. **Vouchers:** PERU: JUNÍN: Corpacancha, *G.A. Sullivan* 828 (MO). **Discussion:** This species was possibly introduced to the Neotropics for soil stabilization or as a contaminant in other seed. Originating in Europe, and possibly native, but is introduced and naturalized in North America, and Asia. It is presumed to be introduced in Central and South America. This species usually has a congested inflorescence but infrequently exhibits an open inflorescence.

***Poa fibrifera* Pilg. Syn:** *Poa carazensis* Pilg.; *Poa ferreyrae* Tovar; *Poa geniculata* Tovar; *Poa tovarii* Soreng. **Ref:** Standley (1936: 126); Tovar (1965: 37–44, 1984: 8, 1993: 128–130); Soreng (1998: 200). **Ill:** Tovar (1965: lam. X, A.; VIII, B, as *P. ferreyrae*, IX, B as *P. carazensis*, 1984: fig. 6, 7, 8, as *P. geniculata*). **Habitat:** Montane forest, Puna grassland, rocky slopes. 2500–4500 m. **Vouchers:** PERU: ANCASH: Aquia, *E. Cerrate* 1577 (US); Bolognesi, *E. Cerrate* 2607 (US); Carhuaz, *D.N. Smith* 9493 (MO); Huaraz, *D.N. Smith* 10940 (MO); Huari, *D.N. Smith* 12590 (MO); Huaylas, *D.N. Smith* 9774 (MO); Pallasca, *P.M. Peterson* 13949 (US); Recuay, *P.M. Peterson* 13800 (MO, US); Santa, *A. Weberbauer* 3073 (MO, US); Ticlllos, *E. Cerrate* 2650 (US); Yungay, *P.M. Peterson* 21741 (US). AYACUCHO: Lucanas, *P.M. Peterson* 18210 (US). CAJAMARCA: Cajamarca, *I. M. Sánchez V.* 3534 (MO); Celendin, *I. M. Sánchez V.* 3488 (MO); Contumaza, *A. Sagástegui* 9647 (MO); Hualgayoc, *P.M. Peterson* 14941 (MO, US). HUANCANELICA: Huaytara, *P.M. Peterson* 18160 (US). LA LIBERTAD: Contumaza, *E.S. Anderson* 1265 (US); Otuzco, *R. Ferreyra* 7619 (MO, US); Santiago de Chuco, *A. Sagástegui* A. 11809 (MO). LIMA: Canta, *P.M. Peterson* 20262 (US); Huarochiri, *R. Ferreyra* 8252 (US). **Discussion:** Endemic herb (a voucher from Bolivia, *T. Johns* 82-108, was redetermined by RJS as *P. horridula*). *Poa ferreyrae* and *P. geniculata*

(=*P. tovarii*), known only from the type collections at La Libertad-Otuzco, and *P. carazensis*, known from the departamento of Ancash, are seen to be indistinct from *P. fibrifera* and so have been placed as synonyms of this species. Brako and Zarucchi (1993) also state *P. fibrifera* to occur in JUNÍN and HUÁNUCO. Specimens from JUNÍN originally identified as *P. fibrifera* (A.S. Hitchcock 22176; P.M. Peterson 14227) have been redetermined as *P. glaberrima* and *P. kurtzii*, respectively. It is impossible to say if either of these specimens were accepted by Brako and Zarucchi (1993) as only one specimen was cited for the country.

Poa gilgiana Pilg. **Syn:** *Melica expansa* Steud. ex Lechl. **Ref:** Standley (1936: 126); Tovar (1965: 36, 1993: 128). **Ill:** Tovar (1965: lam. VIII, A). **Habitat:** Grassland. 3700–4700 m. **Vouchers:** PERU: AREQUIPA: Arequipa, P.M. Peterson 18255 (US); Caraveli, P.M. Peterson 16394 (US). JUNÍN: Junín, A.S. Hitchcock 22251 (US). LIMA: Canta, P.M. Peterson 18025 (US). PUNO: Azángaro, A. Weberbauer 477 (MO, US); Chucuito, P.M. Peterson 14678 (US). TACNA: Tarata, P.M. Peterson 14830 (MO, US). **Discussion:** Distributed in high elevation Puna grasslands from central Peru to Bolivia. Possibly a variety of *P. horridula* which needs further study. This species is suspected to hybridize with *P. horridula* with intermediate forms being collected from ANCASH-Aquia (E. Cerrate 1564, US), HUANCANELICA-Huaytara (P.M. Peterson 20424a, US) and PUNO-Chucuito (P.M. Peterson 14669, MO, US).

Poa glaberrima Tovar **Ref:** Tovar (1965: 40, 1993: 129). **Ill:** Tovar (1965: lam. IX, A). **Habitat:** Puna tussock grassland, humid areas, wet ground. 3300–4700 m. **Vouchers:** PERU: ANCASH: Recuay, P.M. Peterson 13821 (MO, US). APURÍMAC: Ayamaraes, P.M. Peterson 16507 (US). AYACUCHO: Huamanga, P.M. Peterson 20532a (US). CUSCO: Calca, P.M. Peterson 16555 (US). HUANCANELICA: Huancavelica, P.M. Peterson 14168 (MO, US). JUNÍN: Huancayo, Anonymous 34 (US); Junín, D.N. Smith 5649 (MO); Tarma, D.N. Smith 2989 (MO); Yauli, P.M. Peterson 14044 (US). LIMA: Canta, P.M. Peterson 20282 (US); Huarochiri, J.R. Swallen 7068 (US). PUNO: Lampa, P.M. Peterson 20744 (US); Melgar, P.M. Peterson 20721 (US); Puno, H.H.C. Ellenberg 249 (US). **Discussion:** Previously considered endemic, but has been found in Ecuador, Bolivia, and Argentina according to Giussani et al. (2012: 304); we have verified specimens from Bolivia (S.A. Renvoize 4475, US) and Argentina (P.M. Peterson et al. 19577), but not from Ecuador. This species superficially resembles *P. candamoana* but the latter prefers dry ground and has hairy lemmas and lacks extravaginal shoots. Certain specimens placed under this name from southern Peru (eg. PUNO: Lampa “2 km SW of San Jose on road towards Junin” P.M. Peterson 20744, [US]; Melgar “ca. 7 km WNW of Santa Rosa on Hwy 3 and 1 km W toward Quishuara, along Rio Santa Rosa” P.M. Peterson 20624b [US]), Bolivia and northern Argentina (P.M. Peterson 19577 [US]; Giussani et al. 2012, Figure pg. 304) have odd forms with sparse inflorescences and may actually be a species new to science. They resemble *P. pauciflora*, but have completely glabrous and smooth spikelets. Future study should focus on verifying the status of the southern *P. glaberrima* populations.

Poa grisebachii R.E. Fr. **Syn:** *Poa superata* Hack. **Ref:** Giussani et al. (2012: 305, 336). **Ill:** Negritto and Antón (2000: fig 1.); Giussani et al. (2012: sp. 45, p. 305; sp. 59, p. 366, as *P. superata*). **Habitat:** Dry Puna grasslands and high Andean steppe. 3000–4500 m. **Vouchers:** PERU: AYACUCHO: Parinacochas, *P.M. Peterson* 16323 (US). JUNÍN: Yauli, Ó. Tovar S. 6447 (MO). MOQUEGUA: Carumas, *A. Weberbauer* 7310 (US); Mariscal Nieto, *P.M. Peterson* 14553 (US). TACNA: Tarata, *P.M. Peterson* 14793 (MO, US). **Discussion:** Type collections were verified of *Poa grisebachii* (ARGENTINA: JUJUY: Santa Catalina, *F. Kurtz* 11412, US fragm. ex S!) and *P. superata* (ARGENTINA: TUCUMÁN: Tañi, Cumbres Calchaquies, *T.J.V. Stuckert Herb. ARG.* 17738 ex *Lillo* 5604, US fragm. ex W!). Other collections were verified from Peru (see vouchers above), Chile (ARICA & PARINACOTA: Zapahuira, *P.M. Peterson* 15700, US; TARAPACÁ: above Pucapa, *P.M. Peterson* 15615, US) and Argentina (JUJUY: Santa Catalina, *F. Kurtz* 11409, US (fragm. ex S); SALTA: Pampa Grande, *C. Spegazzini* 60, US). Previously, *P. grisebachii* and *P. superata* were both considered endemic to Argentina (Giussani et al. 2012) and this is the first recording of the species from Peru. It is likely that, with further revision of Bolivian *Poa*, this species will also be found to occur in Bolivia. Specimens of *P. superata* were found to be morphologically indistinct from the type of *P. grisebachii* and so have been grouped as a single taxon. All material examined of this taxon exhibited soft pubescence on at least the upper lemmas of the spikelets, with the lower florets being glabrous or softly pubescent. *Poa grisebachii* can be highly variable in terms of lemma pubescence. The lectotype of *P. grisebachii* p.p. has glabrous and smooth lemmas while the isolectotype and other syntypes of *P. grisebachii* p.p. at US frags. ex UPS, and the type specimens of *P. superata* p.p., were all observed with at least sparsely pubescent lemmas. All the Peruvian material of *P. grisebachii* has pubescent lemmas, at least on the distal florets.

The plants resemble *P. fibrifera*, and are sometimes fibrous at their bases, but can usually be distinguished by the distinctly pubescent lemmas. The leaf blades are usually somewhat thin, flat, lax, and scabrous, 1.5–3.5 mm wide, tapering to a very slender apex. Certain specimens were found from AYACUCHO: Lucanas, e.g. *P.M. Peterson* 16317 (US) that bore characteristics of *P. horridula*. Another specimen from MOQUEGUA: Mariscal Nieto, *P.M. Peterson* 14553 (US), could also not be confidently placed to the species. This species may also hybridize with *P. kurtzii*, with intermediate forms being collected which exhibit narrower, firmer, involute blades and generally smaller and more scabrous spikelets.

Poa hitchcockiana Soreng & P.M. Peterson **Syn:** *Brachyelytrum procumbens* Hack.; *Aphanelytrum decumbens* Hack. ex Sodiro. **Ref & Ill:** Peterson and Soreng (2016: 111, fig. 1). **Habitat:** Paramo or moist Jalca vegetation between 2000–4025 m. **Vouchers:** PERU: CUSCO: Paucartambo, *P.M. Peterson* 16571 (US, USM); Calca, *P.M. Peterson* 16581 (US, USM); Pillco, *C. Vargas C.* 19264 (US); Quispicanche, *P.M. Peterson* 20582 (US, USM). MOQUEGUA: El Abra, *C. Vargas C.*

19104 (US). SAN MARTÍN: Huicungo, *A. Cano s.n.* (SI, USM); *B. León* 3797 (USM). **Discussion:** The only wide ranging species of *Poa* subsect. *Aphanelytrum*, this species is found from the Andes of Colombia, Ecuador, Peru, and Bolivia. *Poa hitchcockiana* also has the most unusual spikelet morphology with extremely long rachillas (1.5–4.2 mm long) and very short [0.1–0.5 (–0.7) mm long] to obscure or often absent, unveined glumes.

Poa horridula Pilg. **Syn:** *Melica expansa* Steud ex Lechl.; *Poa dumetorum* Hack.; *Poa piifontii* J. Fernandez Casas, J. Molero & A. Susanna; *Poa pufontii* Fern. Casas, Molero & Susanna; *Poa unduavensis* Hack.. **Ref:** Standley (1936: 127); Tovar (1965: 53, 1993: 131). **Ill:** Hjorth (1991: fig. 4), Tovar (1965: lam. XII, B). **Habitat:** Grasslands, rocky slopes, shrublands. 2900–4700 m. **Vouchers:** PERU: ANCASH: Bolognesi, *P.M. Peterson* 17888 (US); Pallasca, *P.M. Peterson* 21810 (US); Recuay, *P.M. Peterson* 13841 (MO, US); Santa, *A. Weberbauer* 3113 (MO, US); Yungay, *P.M. Peterson* 21631 (US). APURIMAC: Abancay, *P.M. Peterson* 16645 (US); Aymaraes, *P.M. Peterson* 16477 (US). AREQUIPA: Caylloma, *P.M. Peterson* 18298 (US). AYACUCHO: Huamanga, *P.M. Peterson* 20503 (US); Huanca Sancos, *P.M. Peterson* 16283 (US); Lucanas, *P.M. Peterson* 16289 (US); Parinacochas, *P.M. Peterson* 16346 (US). CAJAMARCA: Cajamarca, *I.M. Sánchez V.* 79 (US); Celendin, *I.M. Sánchez V.* 2911 (MO); Hualgayoc, *P.M. Peterson* 14938 (US). CUSCO: Anta, *G.R. Brunel* 283 (MO); Calca, *S.P. Sylvester* 1021 (CUZ, US, Z); Cusco, *A.S. Hitchcock* 22443 (US); La Convención, *S.P. Sylvester* 2028 (LPB, US, Z); Paruro, *P. Núñez V.* 7365 (MO); Quispicanchis, *P.M. Peterson* 20549 (US); Urubamba, *H.H.C. Ellenberg* 4824 (MO). HUANCAMELICA: Huancavelica, *P.M. Peterson* 14175 (MO, US); Huaytara, *P.M. Peterson* 18158 (US); Tayacaja, *O. Tovar S.* 4213 (MO). HUÁNUCO: Huamalies, *P.M. Peterson* 17922 (US); Yarowilca, *J.F. Macbride* 1970 (US). JUNÍN: Huancayo, *Black* 46-711 (US); Jauja, *P.M. Peterson* 14122 (US); Junín, *A.S. Hitchcock* 22213 (US). LA LIBERTAD: Bolívar, *P.M. Peterson* 21944 (US). LIMA: Canta, *P.M. Peterson* 20278 (US); Huarochiri, *P.M. Peterson* 14018 (MO, US); Yauyos, *E. Cerrate* 1083 (US). PASCO: Daniel Alcides Carrión, *A.S. Hitchcock* 22302 (US); Pasco, *A.S. Hitchcock* 22260bis (US). PUNO: Chucuito, *P.M. Peterson* 14672 (US); Puno, *H.H.C. Ellenberg* 342 (US); Sandia, *B.C. Bennett* 2323 (MO). **Discussion:** Found above 3000 m in Puna and Paramo grasslands from Colombia to Bolivia. Brako and Zarucchi (1993) and Tovar (1993) indicate that *P. horridula* also occurs in MOQUEGUA. This species is suspected to hybridize with *P. gilgiana* (see *P. gilgiana* discussion, above) and *P. candamoana*, due to the presence of intermediate forms across the ranges of these species. Specimens *Hirsch* P1399 (US) and *E. Cerrate* 2285 (US) appear to be intermediates between *P. horridula* and *P. candamoana* and could be either a short *P. horridula* or a robust *P. candamoana*.

Poa huancavelicae Tovar **Syn:** *Poa paramoensis* Lægaard. **Ref:** Tovar (1965: 52, 1993: 134); Lægaard (1998: 28). **Ill:** Tovar (1965: lam. XII, A); Lægaard (1998: fig. 2, as *P. paramoensis*). **Habitat:** Puna grassland and *Polylepis* woodland. 4000–4800 m. **Vouchers:** PERU: ANCASH: Bolognesi, *P.M. Peterson* 17953 (US); Huaraz,

D.N. Smith 10839 (MO); Recuay, *P.M. Peterson* 21540 (US); Yungay, *P.M. Peterson* 21766 (US). CUSCO: Calca, *P.M. Peterson* 16604 (US); Carhuaz, *D.N. Smith* 11206 (MO); La Convención, *S.P. Sylvester* 1565 (US, Z); Quispicanchis, *P.M. Peterson* 20589 (US); Urubamba, *H.H.C. Ellenberg* 449 (MO). HUANCANELICA: Castrovirreyna, *Ó. Tovar* S. 28 (MO). **Discussion:** Previously considered endemic to Peru and found in HUANCANELICA and CUSCO (Brako and Zarucchi 1993; Tovar 1993). *Poa paramoensis* was found to be inconsistently morphologically distinct from *P. huancavelicae*; the northern plants branches are usually fairly smooth, but the variation appears to be continuous to more scabrous forms further south in Peru, and so it has been synonymized. Specimens from La Convención, CUSCO, have proximal lemmas much shorter (3–3.5 mm) than in the original species description (4–4.5 mm) and anthers were also much shorter (1–1.3 mm). These plants were also found to be short-rhizomatous/sub-rhizomatous, while *P. paramoensis* p.p. is tufted and the isotype material of *P. huancavelicae* p.p. at MO appears tufted, although Tovar (1993) mentions it to be rhizomatous.

Poa infirma Kunth **Syn:** *Catabrosa thomsonii* Hook. f.; *Colpodium thomsonii* (Hook. f.) Hack.; *Eragrostis infirma* (Kunth) Steud.; *Megastachya infirma* (Kunth) Roem. & Schult.; *Ochlopoa infirma* (Kunth) H. Scholz; *Poa annua* subsp. *exilis* (Tomm. ex Freyn) Asch. & Graebn.; *Poa exilis* (Tomm. ex Freyn) Murb.; *Poa remotiflora* (Hack.) Murb.. **Ref:** Müller et al. (1981: 334); Tovar (1986: 56; 1993: 126). **Ill:** Giussani et al. (2012: sp. 27, p. 311). **Habitat:** Dry forest, Puna grassland. c.4400 m. **Vouchers:** PERU: CUSCO: Calca, *P. Núñez V.* 7063 (MO), *S.P. Sylvester* 1390 (US, Z). **Discussion:** Introduced from Europe. Brako and Zarucchi (1993) and Tovar (1993) state *P. infirma* occurs in HUANCANELICA and LIMA, with the specimens from LIMA being found on coastal hills in sandy soil. *Poa infirma* is the maternal diploid parent of *P. annua* (tetraploid), with *P. supina*, another diploid, being the plastid donor (Soreng et al. 2010).

Poa kurtzii R.E. Fr. **Syn:** *Poa altoperuana* R. Lara & Fern. Casas; *Poa asperiflora* Hack.; *Poa munozensis* Hack.; *Poa pflanzii* Pilg. **Ref:** Standley (1936: 125); Tovar (1965: 60, 1993: 133); Giussani et al. (2012: 312). **Ill:** Negritto and Antón (1999: fig. 2); Giussani et al. (2012: sp. 30, p. 313); Tovar (1965: lam. XII, A, as *P. asperiflora*). **Habitat:** High Andean Puna grassland, rocky slopes. 3300–5100 m. **Vouchers:** PERU: ANCASH: Huari, *D.N. Smith* 10138 (MO); Recuay, *P.M. Peterson* 21510 (US). AREQUIPA: Arequipa, *P.M. Peterson* 18260 (US); Caraveli, *P.M. Peterson* 16393 (US). AYACUCHO: Huamanga, *P.M. Peterson* 20531 (US); Huanca Sancos, *P.M. Peterson* 16244 (US); Lucanas, *P.M. Peterson* 16177 (US); Parinacochas, *P.M. Peterson* 16345 (US). HUANCANELICA: Castrovirreyna, *Ó. Tovar* S. 2838 (US); Huancavelica, *P.M. Peterson* 16416 (US); Huaytara, *P.M. Peterson* 20426 (US). JUNÍN: Huancayo, *P.M. Peterson* 14227 (US). LA LIBERTAD: Trujillo, *H.H.C. Ellenberg* 3779 (MO). MOQUEGUA: Mariscal Nieto, *P.M. Peterson* 14552 (US), *P.M. Peterson* 18312 (US). PUNO: Azángaro, *H.H.C. Ellenberg* 598 (US); Chucuito, *P.M. Peterson* 14677 (US); El Collao, *P.M. Peterson* 14591 (US). TACNA: Tacna, *P.M. Peterson* 14762 (US); Tarata, *P.M. Peterson*

14727 (US). **Discussion:** This species is found from Peru to Argentina. JUNÍN specimen *P.M. Peterson* 14227 is atypical and requires further study. Brako and Zarucchi (1993) state *P. asperifolia* (= *kurtzii*) to also occur in CUSCO and LIMA. The species is highly variable in terms of lemma indumentum, and is found in two leads in both keys (see Appendix 1) to account for this.

Poa* cf. *leioclada Hack. **Ref:** Hitchcock (1927). **Ill:** Hjorth (1991: fig. 8) **Habitat:** Humid Paramo grasslands. 3200–4300 m. **Vouchers:** PERU: ANCASH: Yungay, *D.N. Smith* 9095 (MO); Huaylas, *D.N. Smith* 9320a (MO). PIURA: Huanca-bamba, *P.M. Peterson* 15175 (US). **Discussion:** Specimens are an imperfect match of Ecuadorian material of *Poa leioclada* as they bear characteristics of both *Poa mulalensis* Kunth and *P. leioclada*. Both these species were previously considered Ecuadorian endemics. This taxon needs further study.

Poa oscariana Negritto & Antón **Ref & Ill:** Negritto and Antón (2006: 84 [88], fig. 2). **Habitat:** Puna grassland, rocky slopes. 3600–4100 m. **Discussion:** Endemic herb, only known from CUSCO, Paucartambo. None of the type or paratype specimens have been examined. This may be a variety of *Poa gilgiana*, but further study is needed.

Poa pauciflora Roem. & Schult. **Syn:** *Poa depauperata* Kunth; *Poa pardoana* Pilg. **Ref:** Standley (1936: 128); Tovar (1965: 49, 1993: 133). **Ill:** Hjorth (1991: fig. 11), Tovar (1965: lam. XI, B, as *P. pardoana*). **Habitat:** Puna grassland, rocky slopes. 3200–4900 m. **Vouchers:** PERU: ANCASH: Corongo, *P.M. Peterson* 21777 (US); Huaraz, *D.N. Smith* 10797 (MO); Huari, *P.M. Peterson* 13885 (MO, US); Huaylas, *D.N. Smith* 9930 (MO); Pallasca, *P.M. Peterson* 21842 (US); Recuay, *P.M. Peterson* 13848 (MO, US); Yungay, *P.M. Peterson* 21678 (US). CAJAMARCA: Cajamarca, *P.M. Peterson* 14887 (US), *H.H.C. Ellenberg* 1825 (US); Celendin, *P.M. Peterson* 21905 (US); San Miguel, *P.M. Peterson* 14933 (US); San Pablo, *P.M. Peterson* 14878 (US). JUNÍN: Tarma, *P.M. Peterson* 14065 (US). LA LIBERTAD: Bolivar, *P.M. Peterson* 21936 (US); Sanchez Carrion, *D.N. Smith* 2242 (MO); Santiago de Chuco, *P.M. Peterson* 13953 (US). SAN MARTÍN: Mariscal Caceres, *B. León* 1654 (MO). **Discussion:** Specimens have also been verified from Ecuador, but it is unclear whether this species extends to Colombia and Bolivia.

Poa pearsonii Reeder **Ref:** Tovar (1965: 33, 1993: 127); Giussani et al. (2012: 325). **Ill:** Giussani et al. (2012: sp. 45, p. 325). **Habitat:** Rocky Puna grassland. 4500–4900 m. **Vouchers:** PERU: PUNO: El Collao, *O.P. Pearson* 91 (US). TACNA: Tacna, *P.M. Peterson* 13953 (MO, US). **Discussion:** Found from southern Peru, Bolivia, Argentina, and is here reported for Chile (*P.M. Peterson* 15676). Brako and Zarucchi (1993) state *P. pearsonii* to also occur in LIMA and AREQUIPA.

Poa pratensis L. **Ref:** Standley (1936: 128); Tovar (1993: 135); Giussani et al. (2012: 328). **Ill:** Giussani et al. (2012: sp. 50, p. 329). **Habitat:** Open Andean grasslands. 3500–3900 m. **Vouchers:** PERU: CAJAMARCA: Cajamarca, *I.M. Sánchez V.* 2668 (MO); San Miguel, *P.M. Peterson* 14921 (MO, US). HUANCavelica: Huancavelica, *P.M. Peterson* 18107 (US). JUNÍN: Huancayo, *P.M. Peterson* 14223 (US); Yauli, *D.N. Smith* 2979 (MO). **Discussion:** Plants in Peru are presumably introduced from Europe, but the species in tropical latitudes tends

to look odd and cannot be confidently placed to subspecies. *Poa pratensis* subsp. *alpigena* (Lindm.) Hiitonon is apparently native in North and South America (in Patagonia). Brako and Zarucchi (1993) state *P. pratensis* to also occur in PUNO.

Poa ramifera Soreng & P.M. Peterson **Ref. & Ill:** Soreng and Peterson (2010: 587, fig. 1, 2, 3). **Habitat:** Shrublands. 2700–3100 m. **Vouchers:** PERU: ANCASH: Corongo, *P.M. Peterson 21804* (MO, US, USM). **Discussion:** Endemic, known only from the type locality.

Poa sanchez-vegae Soreng & P.M. Peterson **Syn:** *Aphanelytrum peruvianum* Sánchez Vega, P.M. Peterson, Soreng & Lægaard. **Ref & Ill:** Peterson and Soreng (2016: 118, fig. 4). **Habitat:** Rocky sites associated with Jalca vegetation (humid alpine grass ecosystems) at 3300 m. **Vouchers:** PERU: CAJAMARCA: Cajamarca, *I. Sánchez-Vega 11781* (CPUN, AAU, F, HAO, HUT, LOJA, MICH, MO, SI, US, USM). **Discussion:** Endemic, known only from the type locality.

Poa scabrivaginata Tovar **Ref:** Tovar (1965: 48, 1993: 134). **Ill:** Tovar (1965: lam. XI, A). **Habitat:** Shrublands. c. 4000 m. **Vouchers:** PERU: HUÁNUCO: Pachitea, Tambo de Vaca, *J.F. Macbride 4354* (MO, US-holotype). **Discussion:** Endemic herb. Known only from the type collection. A paratype from HUÁNUCO, and further specimens sometimes referred to as *P. scabrivaginata* from CAJAMARCA (e.g. Celendin, *I.M. Sánchez V. 2668* [MO]; Santa Cruz, *J. Santistaban C. & J. Guevara B. 169* [MO]) and JUNÍN (e.g. Concepción, *J.F. Macbride 3363* [US]) are better included in *P. aequatoriensis*. In the *P. scabrivaginata* type, lower sheaths are densely and coarsely scabrous, glumes are long (lower 3.5–4 mm, upper 4–4.5 mm), lemmas are glabrous except for the web and smooth except for sparsely scaberulous upper keel and apex, and anthers are 1.5–2 mm long. The other material has shorter glumes, sheaths smooth or lightly scabrous (often scabrous only on the margins), lemmas usually with pubescence on the keel and marginal veins, and anthers usually shorter.

Poa swallenii Refulio **Syn:** *Dissanthelium expansum* Swallen & Tovar. **Ref:** Refulio-Rodríguez et al. (2012: 130); Swallen and Tovar (1965: 374); Tovar 1993: 157). **Habitat:** Puna grasslands. 3600–4600 m. **Vouchers:** PERU: CUSCO: Calca, *P.M. Peterson 16594* (US), *P.M. Peterson 16569* (US), *P.M. Peterson 16612* (US); La Convención, *O.F. Cook 1305* (US), *S.P. Sylvester 1924* (US, USM, Z); Urubamba, *S.P. Sylvester 1071* (CUZ, US, Z). **Discussion:** Endemic herb. Swallen and Tovar (1965) and Tovar (1993) cite a collection of *Macbride & Featherstone 2183* from HUÁNUCO, and *P.C. Hutchison 1215* from LIMA.

Poa trivialis L. subsp. *trivialis* **Ref:** Standley (1936: 129); Tovar (1993: 134); Gius-sani et al. (2012: 336). **Ill:** Giussani et al. (2012: sp. 60, p. 337). **Habitat:** Andean slopes at middle elevations. **Vouchers:** PERU: JUNÍN: *A.S. Hitchcock 22277* (US), *A.S. Hitchcock 22279* (US), *A.S. Hitchcock 22266a* (US). **Discussion:** Introduced from Europe. Brako and Zarucchi (1993) state *P. trivialis* to also occur in CAJAMARCA. However, the collection cited by Brako and Zarucchi (1993), *J. Mostacero L. 1282* (MO), was redetermined as *P. aequatoriensis*. *Poa trivialis* and *P. aequatoriensis* bear many superficial resemblances and can be easily confused. The Hitchcock specimens had no habitat type or specific locality mentioned.

Poa trollii (Pilg.) Refulio **Syn:** *Dissanthelium trollii* Pilg. **Ref:** Tovar (1986: 51; 1993: 153). **Ill:** Renvoize (1998: fig. 38 G, H). **Habitat:** Dry Puna grassland. 4400–4800 m. **Vouchers:** PERU: PUNO: El Collao, *P.M. Peterson 18303* (US). **Discussion:** Distributed in the high Andean dry Puna grassland in southern Peru and the Potosí, Bolivia. This species normally has congested, spikelike panicles but has been collected with open panicles during anthesis.

Newly described species

***Poa ramoniana* Soreng & S.P. Sylvester, sp. nov.**

urn:lsid:ipni.org:names:77155738-1

Fig. 1

Type. PERU. Región JUNÍN. Prov. Junín: Distr. Carhuamayo, orillas de la laguna de Capillacocha, {est. vicinity: S10.86443°, W75.99256°} entre Carhuamayo y Paucartambo, Puna grassland, 4200–4300 m, 8 Jan 1949, *R. Ferreyra 5200 p.p. a* (holotype: US-2207173!; isotype: USM p.p.)

Plants gynomonoeious. **Perennials;** Rhizomatous, with well developed, slender, lateral tending, rhizomes, small tufted. **Tillers** extravaginal. **Culms** c. 5 cm tall, erect, unbranched, isolated or two together; Culm nodes terete, smooth, included in the sheaths; Culm internodes less than 1 cm long (peduncle c. 3 cm), terete, smooth. **Leaves** equally basal and cauline; Sheaths slightly laterally compressed, keeled, smooth, glabrous; Butt sheaths papery or slightly fibrous in age; Uppermost culm sheath c. 18 mm long, margins fused c. 40% their length, distal sheaths longer than their blades; Collars and throats smooth, glabrous; Ligules 1–1.5 mm long, sometimes with a central dent to 2 mm long, indistinctly decurrent, abaxially moderately densely scabrous, apices obtuse, margin irregular sometimes with a tooth, of sterile shoots similar to those of the culm; Cauline blades to 2 cm long, mostly folded or infrequently flat, with strongly inrolled margins, abaxially, marginally, and adaxially smooth, glabrous, tips distinctly prow shaped; Blades graduated up the culm, the sub-terminal one the longest; Sterile shoot blades to 4.5 cm long. **Panicles** 2–2.5 cm long, open, exerted, c. 1 cm wide, with 13–15 spikelets, proximal internode c. 6 mm long, weakly scabrous angled; Rachis with 1 branch per node; Primary branches spreading to reflexed, the upper ones ascending, distinctly angled, closely scabrous along the angles; Lateral pedicels less than 0.5 mm long, scabrous angled; Longest branches c. 7 mm, with 4–5 spikelets clustered in the distal half. **Spikelets** 3.5–4 mm long, c. 1.5 × longer than wide, broadly ovate, laterally compressed, not bulbiferous, anthocyanic and bronzy; Florets (2–)3, the proximal 1 (or 2 if 3 total) perfect, the distal 1 pistillate; Rachilla internodes 0.4–0.8 mm long, terete, distal internodes terete, smooth, glabrous, mostly hidden; Glumes more or less equal, both broadly lanceolate, or the first lanceolate, sub-lustrous in the scareous-hyaline margins, distinctly keeled, keels smooth or distally smooth or sparsely scaberulous, apices acute and pointed to obtuse and blunt and den-



Figure 1. *Poa ramoniana*. **A** Habit **B** Ligular zone **C** Terminal segment of inflorescence branch with four spikelet cluster **D** Spikelet **E** Lower glume ventral view **F** Proximal floret (perfect) **G** Upper glume dorsal view **H** Palea with immature pistil (pistillate floret), dorsal view **I** Palea with pistil (pistillate floret), staminodes, and lodicules, lateral view. Drawn from type material (*R. Ferreyra* 5200 p.p. a, US-2207173).

ticulate; Lower glumes 2.5–3 mm long, 1–3-veined; Upper glumes 3–3.2 mm long, subequal in width to the lower, 2–3-veined; Calluses glabrous; Lemmas (the lowest) 2.9–3.5, 5-veined, broadly lanceolate to ovate, green proximally, anthocyanic distally with a wide bronzy band apically, strongly laterally compressed, distinctly keeled, thin, keel smooth or obscurely scaberulous distally, smooth or mostly smooth elsewhere, glabrous, intermediate veins distinct, not extending into the scarious apical margin, edges smooth, apices scarious-hyaline bronzy for the distal c. 1 mm, edges smooth or slightly erose to denticulate, obtuse, blunt or slightly pointed; Paleas to 1 mm shorter than the lemma, glabrous, keels smooth or distally sparsely scaberulous. **Flowers** chasmogamous; Lodicules not observed; Anthers c. 2 mm long (vestigial in pistillate flowers). **Caryopses** unknown. $2n$ = unknown.

Distribution. Known only from a single locality in Junín.

Habitat. Puna grassland, 4200–4300 m, in wet margins/shore of lakes, in moss.

Etymology. The species is named in recognition of the eminent Peruvian botanist, Ramón Alejandro Ferreyra (1910–2005) who collected the type and paratype.

Conservation status. Data insufficient.

Additional specimens examined. PERU. Región JUNÍN. Prov. Junín: Distr. Carhuamayo, Capillacocha cerca a Carhuamayo, Puna grassland, 4200–4300 m, 8 Jan 1949, *R. Ferreyra 5211* (USM!).

Discussion. This new species appears like a small form of *P. glaberrima*, but differs by being extensively rhizomatous and reaching only 5 cm tall, versus densely tufted and 12–45 cm tall for *P. glaberrima*. The US holotype of *P. ramoniana* is a mixed collection, with a second taxon p.p. “b”, which appears to be *Poa gymnantha* Pilg. that is sterile, tightly tufted, with intravaginally branching shoots and involute leaf blades that are adaxially scabrous. The USM isotype also contains two species: the small rhizomatous plant is *P. ramoniana*; the taller plants appear to be *P. glaberrima*. Tovar originally determined the USM type and paratype as *Poa lilloi* (Tovar 1993), which, among other differences, has a dense habit, without rhizomes, and ascending panicles branches, densely scabrous lemmas with narrow white, scarious margins, and sometimes a web on the callus. Tovar also identified the US type as *Poa ovata* Tovar (1965: 17), which RJS considers to be a rare to uncommon sexually reproducing phase of the small form of *P. gymnantha*, a species that is otherwise predominantly pistillate and apomictic (Negritto et al. 2008). Other material determined as *P. lilloi* in Peru has been referred to *P. glaberrima* and *P. candamoana*, or small *P. kurtzii* (see excluded species, below).

***Poa tayacajaensis* Soreng & S.P. Sylvester, sp. nov.**

urn:lsid:ipni.org:names:77155739-1

Figs 2, 3

Type. PERU: Región HUANCANELICA. Prov. Tayacaja: Distr. Colcabamba, Chuspi-Hda., Tocas, entre Colcabamba y Paucarbamba, monte bajo, 2900 m, [vic. S12.5°, W74.6°], 22 Apr 1954, *Ó. Tovar*. S. 2038 (holotype: US-2181284; isotype: USM p.p.)



Figure 2. *Poa tayacajensis*. Digitized holotype specimen Ó. Tovar. S. 2038 (US-2181284).

Plants gynomonoeious. **Perennials**; tufted, without lateral or downward tending shoots. **Tillers** intravaginal. **Culms** 55–65 cm tall, erect or decumbent (when decumbent sometimes extravaginally branching at the lower culm nodes, i.e. *Peterson et al.* 20369); Culm nodes 3–4, terete, smooth, 2–3 nodes exposed at flowering; Culm internodes terete, smooth. **Leaves**; Sheaths slightly laterally compressed, keeled, lower culm and lateral ones densely scaberulous distally; Butt sheaths thin papery, somewhat loosely investing the shoots; Uppermost culm sheaths 10–13 cm long, margins fused 60–75 % their length, slightly shorter than their blades; Collars and throats smooth, glabrous; Ligules 2.0–3.5 mm long, not decurrent, abaxially sparsely to moderately densely scabrous, apices obtuse to subacute, margins densely scabrous, ligules of sterile shoots and lower culm leaves 0.5–1 mm long; Cauline blades 6–15 cm long, 3–5 mm wide, well developed, longer than their sheaths, generally flat, keeled, thin, lax, abaxially, marginally, and adaxially scabrous mainly along the veins, folded near the apex, apex gradually tapered to a slender point; Blades gradually increasing in length up the culm, flag leaf blade 10–15 cm long; Sterile shoot blades like those of the culm, but somewhat shorter and smoother. **Panicles** 18–20 cm long, loose, open, exerted, slightly lax, to 5 cm wide, with more than 100 spikelets, proximal internodes 3.5–4 cm long, smooth; Rachis with (3) 5–6 branches at lower nodes; Primary branches slender, mostly laxly ascending, sometimes spreading, one sometimes reflexed, angled, proximally smooth to moderately scabrous mainly on the angles; Lateral pedicels mostly < 1 mm long, scabrous; Longest branches 6–8 cm long, with 14–22 spikelets in the distal half, slightly overlapping. **Spikelets** 4.5–6 mm long, c. 2 × longer than wide, lanceolate, laterally compressed, not bulbiferous, greyish-green to somewhat anthocyanic at maturity; Florets (3–)4(–5), proximal florets hermaphroditic and distal one pistillate; Rachilla internodes terete, distal internodes 0.7–1 mm long, terete, smooth, glabrous; Glumes unequal, narrow lanceolate to lanceolate, herbaceous and pale green below, sometimes anthocyanic in margins and apex, veins distinct, distinctly keeled, keels sparsely short scabrous distally, surfaces smooth, margins scarious-hyaline, edges entire smooth, apices sharply acute, entire; Lower glumes 1.7–2.5 mm, 2/3–4/5 as long as adjacent lemmas, 1-veined, very narrow, slightly sickle shaped; Upper glume 2.4–3 mm, c. 2 × wider than the lower, 3-veined; Calluses webbed, with a dense, long dorsal tuft of wooly hairs; Lemmas (the lowest) 2.8–3.7 mm long, 5-veined, lanceolate in side view, the proximal one c. 5 × longer than wide at maturity, greyish-green, to strongly anthocyanic at maturity, strongly laterally compressed, distinctly keeled, thin, keel to 3/4 the length and marginal veins and sometimes the intermediate veins to 1/2 the length, loosely sericous to villous, between veins sparsely to moderately densely appressed pubescent or occasionally glabrous on the proximal lemma, keel distally weakly scabrous, intermediate veins distinct, not extending to near the margin, margins inrolling below at maturity, very narrowly hyaline above, edges smooth or with a few hooks, apices acute, briefly hyaline; Paleas shorter than the lemmas by c. 0.5 mm, keels scabrous distally, sometimes weakly so, sparsely puberulent medially or nearly so, glabrous. **Flowers** chasmogamous; Lodicules c. 0.25 mm long, obscurely lobed;



Figure 3. *Poa tayacajaensis*. Photograph of individual floret, anther, and spikelet (from top to bottom) of holotype specimen Ó. Tovar. S. 2038 (US-2181284). (Photograph by R.J. Soreng).

Anthers 1.2–1.4 mm long, vestigial in the upper floret. **Caryopsis** 1.8–2 mm long, strongly laterally compressed, sulcate, honey brown, firm, adherent to the lemma and palea, hilum 0.2 mm long, elliptical. $2n$ = unknown.

Distribution. Endemic to the central Andes of Peru. Known from Huancavelica and Huánuco, although the Huánuco specimen is only tentatively placed.

Habitat. Shrublands on Andean slopes at mid elevations.

Conservation status. Data insufficient.

Additional specimens examined. One other specimen appears to represent this species but is too immature to be certain. The specimen in question has extravaginal shoots branching from lower culm nodes; PERU: Región HUÁNUCO. Prov. Pachitea: Distr. Chaglla, canyon of the Rio Grande, c. 20 km above confluence with Rio Huallaga, E of Huánuco c. 44 air km, 1.7 air km SSW of Estación Huacachay

(Huacachi), 2650 m, S9.86836 W75.83306, 8 Mar 2007, *Peterson, Soreng & Romaschenko* 20369 (US!).

Discussion. These plants bear similarities to *Poa aequatoriensis* but differ by having lemmas which are generally shorter (2.8–3.7 mm long), pubescent between the veins, and by more densely scabrous sheaths, with more-or-less smooth glabrous throats, ligules generally shorter. Tovar (1993) placed his voucher of this form (2038) in *P. aequatoriensis*. However, among the 20 sheets and the US isotype reviewed of *P. aequatoriensis*, all have lemmas that are smooth and glabrous between the veins (consistent with the description of Ecuadorian material by Hjorth, 1991), and the keel and marginal veins can be glabrous or sparsely puberulent. The species also bears some slight similarity to *Poa myriantha* Hack. and *P. hieronymi* Hack. from the Yungas cloud-forests, Argentina, that differ by size of the anthers and ligule being much smaller (anthers <1 mm long, ligules <1 mm long) and overall habit being larger (culms 60–350 cm long with 10–15 internodes, and panicles 20–36 cm long) and glumes having both antrorse and retrorse scabrocities.

***Poa urubambensis* S.P. Sylvester & Soreng, sp. nov.**

urn:lsid:ipni.org:names:77155740-1

Fig. 4

Type. PERU. Región CUSCO. Prov. Calca: Distr. Calca, top of the prominent tower known by locals as “Kontorqayku”, 5 km NE of Huarán, 4401 m, S13°16'05.9", W72°01'17.2", 27 May 2011, *S.P. Sylvester* 1317 (holotype: USM!; isotypes: CUZ!, K-000501720!, US!, Z-000099199!)

Plants gynomonocious. **Perennials or (rarely) annuals;** Rhizomatous with well developed, slender, lateral tending, rhizomes, solitary and erect, or rarely tufted, often rooting from nodes. **Tillers** extravaginal. **Culms** (3–)15–30(–42) cm tall, decumbent to ascending, sometimes erect, fairly slender, not branching above the base, leafy; Culm nodes 1–2(–3), terete or slightly compressed, smooth, usually 1 node exposed at flowering; Culm internodes 3–15(–20) cm long, terete, smooth. **Leaves** mostly basal; Sheaths slightly compressed to keeled, smooth or scabrous along the veins; Butt sheaths papery, smooth, glabrous; Uppermost culm sheaths (3.5–)8–16 cm long, margins fused 25–60% the length, 1.8–2.7 × longer than their blades; Collars and throats smooth or scabrous, glabrous, collar margins of sterile shoot leaves sometimes flared; Ligules 1–4 mm long, not decurrent, scarious to hyaline, adaxially glabrous to scabrous, upper margins entire or irregularly dentate, apices acute and entire to irregularly dentate above, sterile shoot ligules generally shorter and more scabrous than those of the culm leaves; Cauline blades 2–15(–22) cm long, (1.5–)2–3 mm wide, flat or folded, margins often becoming involute, thin to moderately thin, soft or (rarely) curved, surfaces abaxially and adaxially lightly to moderately scabrous or rarely smooth, margins scabrous, narrowly to abruptly prow-tipped; Mid-cauline blades the longest, 10–22 cm long, shorter upward, flag leaf blade 3.5–7.7 cm long;



Figure 4. *Poa urubambensis*. **A** Habit **B** Basal portion of plant showing extravaginal shoots **C** Inflorescence **D** Ligular zone **E** Segment of inflorescence **F** Spikelet **G** Lower glume dorsal view **H** Upper glume dorsal view **I** Proximal floret **J** Lemma, lateral view **K** Palea, ventral view **L** Pistil, stamens and lodicules from perfect floret. Drawn from type material (S.P. Sylvester 1317, US).

Sterile shoot blades similar to cauline blades, sometimes more involute. **Panicles** (4–)8–13 cm long, erect, loosely contracted to open, ovoid to narrowly pyramidal, sparsely to moderately congested, with 13–40(–80) spikelets, proximal internode 1.4–3 cm long, smooth or scaberulous, usually scabrous towards its apex; Rachis with (1–)2–3(–5) branches per node; Primary branches ascending, fairly flexuous, weakly angled, moderately scabrous; Lateral pedicels mostly $3/4$ to equaling the spikelets, moderately to densely scabrous, prickles moderately coarse; Longest branches 3–5 cm long, with 5–15 spikelets in distal $1/2$, loosely arranged. **Spikelets** 3.7–6.5 mm long, to $3.7 \times$ long as wide, lanceolate, laterally compressed, not bulbiferous, two toned; Florets 2–3(–4), proximal 1 or 2 florets hermaphroditic and distal 1 or 2 pistillate or sterile; Rachilla internodes terete, distal internodes 0.6–1 mm long, terete, smooth, glabrous; Glumes equal to subequal, narrow lanceolate, herbaceous and pale green below, scarious bronzy and sometimes anthocyanic in margins and apex, veins distinct, distinctly keeled, usually scabrous purely on the veins and sometimes between veins, margins scarious-hyaline, edges entire or dentate, smooth, apices acute, entire; Lower glumes 3.1–3.5 mm long, $2/3$ – $4/5$ as long as adjacent lemmas, 1-veined, narrow; Upper glumes 3.4–3.9 mm long, c. $2 \times$ wider than the lower, 3-veined; Calluses glabrous; Lemmas (the lowest) 3.2–3.9 mm long, 5-veined, lanceolate in side-view, the proximal one c. 4 – $8 \times$ longer than wide at maturity, proximally light green and distally bronzy-anthocyanic at maturity, moderately laterally compressed, thin, keeled, keels to $1/3$ – $5/6$ and marginal veins to $3/5$ – $4/5$, proximally smooth, keel and sides distally sparsely to moderately scaberulous, intermediate veins obscure to moderately prominent, not extending to near the margin, margins broadly scarious-hyaline, edges scabrous, apices acute; Paleas to 1.6 mm shorter than the lemma, glabrous, keels distally sparsely to moderately scabrous, between keels narrow (0.3–0.4 mm). **Flowers** chasmogamous; Lodicules c. 0.25 mm long, obscurely to shallowly lobed; Anthers 0.7–1.1(–1.3) mm long, infrequently vestigial in upper florets of spikelets. **Caryopses** c. 1.9 mm long, elliptical in side-view, sulcus broad and shallow, brown, hilum 0.2 mm long, oval, grain free from the palea. $2n$ = unknown.

Distribution. Restricted to undisturbed areas of *Polylepis* woodland in hard to access areas throughout the Cordillera Urubamba, Cusco, Peru, at 4390–4802 m. Known from three localities; 1) Cliff ledges of the prominent SW facing cliff face 1.5 km S (170°) of Cancha Cancha village, Huarán. 2) Ledges of the prominent tower known by locals as “Kontorqayku”, 5 km NE of Huarán. 3) Ridgeline to the W of Laguna Manalloqsa, Área de Conservación Privada (ACP) Mantamay, 10 km up the valley from Yanahuara in the small valley 3 km E of Laguna Ipsaycocha.

Habitat. Relatively dry and exposed sites in montane *Polylepis* forest and forest edges.

Etymology. The name ‘urubambensis’ refers to the Cordillera Urubamba.

Conservation status. This narrow endemic is locally common.

Additional specimens examined. PERU. Región CUSCO. Prov. Calca: Distr. Calca, large ledge situated on the prominent SW facing cliff face 1.5 km S (170°) of Cancha Cancha village, Huarán, 4524 m, $S13^\circ14'35.1''$, $W72^\circ01'14.1''$, 21 March

2011, *S.P. Sylvester* 812 (CUZ!, MO!, US!, Z!); Distr. Calca, large ledge situated on the prominent SW facing cliff face 1.5 km S (170°) of Cancha Cancha village, Huarán, 4517 m, S13°14'35.0", W72°01'13.7", 24 March 2011, *S.P. Sylvester* 869 (CUZ!, US!, Z!); Distr. Calca, within the SW facing forest at the top of the prominent tower known by locals as "Kontorqayku", 5 km NE of Huarán, 4390 m, S13°16'07.7", W72°01'16.8", 11 June 2012, *S.P. Sylvester* 1636 (US!); Distr. Calca, within the SW facing forest at the top of the prominent tower known by locals as "Kontorqayku", 5 km NE of Huarán, 4390 m, S13°16'07.7", W72°01'16.8", 11 June 2012, *S.P. Sylvester* 1637 (CUZ!, SI!, US!, Z!); Distr. Calca, top of the prominent tower known by locals as "Kontorqayku", 5 km NE of Huarán, 4401 m, S13°16'05.9", W72°01'17.2", 11 June 2012, *S.P. Sylvester* 1695 (CUZ!, US!, Z!); Prov. Urubamba: Distr. Urubamba, ACP Mantamay, 10 km up the valley from Yanahuara in the small valley 3 km E of Laguna Ipsaycocha, ledges on cliff side 250°W of Laguna Manalloqsa, 4676 m, S13°12'01.3", W72°08'47.4", 28 January 2011, *S.P. Sylvester* 403 (CUZ!, US!); Distr. Urubamba, ACP Mantamay, 10 km up the valley from Yanahuara in the small valley 3 km E of Laguna Ipsaycocha, topmost of the ridge to the W of Laguna Manalloqsa, 4802 m, S13°12'08.9", W72°08'43.9", 25 June 2012, *S.P. Sylvester* 1727 (CUZ!, MO!, US!, Z!).

Discussion. This new species is similar to other members of *Poa* sect. *Homalopoa* s.l. from Peru, Bolivia and Argentina, all of which have open panicles and spikelets with 2–5(–8) florets, the lowermost florets hermaphroditic while the upper florets are pistillate. *Poa urubambensis* is easily recognised in the field by the combination of an open-panicked inflorescence, glabrous lemmas and calluses, and exceptionally small anthers for members of *Poa* supersect. *Homalopoa*. *Poa urubambensis* also bears resemblance to *Poa oscariana*, but is distinguished by a less robust habit, the leaf blades being mainly basal and the anthers being smaller.

This species was found during a large scale ecological study attempting to reconstruct the potential natural vegetation (PNV) and soils of the high-elevation Puna grasslands (see Heitkamp et al. 2014 and Sylvester et al. 2014 for pilot studies). In this research, pristine zonal vegetation, only accessible with mountaineering equipment, was compared with surrounding slopes which have been grazed and burnt consistently over millennia (Thompson et al. 1988; Chepstow-Lusty et al. 1996, 2009; Kuentz et al. 2011). *Poa urubambensis* was a common element in undisturbed Puna vegetation in the Cordillera Urubamba, being found associated with *Polylepis* Ruiz & Pav. forests from three different sites and also found growing alongside other species new to science, e.g. *Bartsia lydiae* S.P. Sylvester (2014: 41). Following indicator species analyses, *Poa urubambensis* has been found as an indicator species for the PNV, due to its frequency and abundance within relict patches of near natural vegetation (Sylvester et al., *unpubl. data*). This species has not been found in accessible, disturbed or secondary, vegetation at similar or lower elevations in the Andes of the Cuzco region, despite a more thorough botanical exploration. This may relate to its susceptibility to disturbance from grazing and burning (Sylvester, *pers. observation*).

Species excluded

***Poa androgyna* Pilg. Ref:** Renvoize (1998: 144). **Discussion:** *Poa androgyna* has been described for Chile and Bolivia (Renvoize 1998; Soreng et al. 2003, 2016) with Renvoize (1998) mentioning the species to occur in Peru but not citing specimens and none have been encountered so far. The name is difficult to apply and taxonomists are still unsure of what it is exactly. Past authors (Hitchcock 1927; Standley 1936; Foster 1958; Brako and Zarucchi 1993) have placed this name as a synonym of *P. horridula*, which is quite likely, but we are not certain. Plants identified as *P. androgyna* have narrower leaf blades and more reflexed panicle branches than that typical of *P. horridula*.

***Poa bromoides* Vahl = *Eragrostis bromoides* (Vahl) Steud. Ref:** Steudel (1854: 276). **Discussion:** Indiscrepancy centers around Brako and Zarucchi's (1993) inclusion of *P. bromoides* for Peru. As the type protologue of *Poa bromoides* states the plant to be cultivated: "Cult. Habitat (L)imae? Ex horto parisino habui" (Vahl 1794: 10), this effectively rules out the specimen being placed as *Poa*. Steudel's (1854) description also includes "spiculis lanceolatis 25-floris glabris" (pp. 276), i.e. spikelets lanceolate, 25-flowered, that places further doubt on the specimen belonging to *Poa*. Grassbase (Clayton et al. 2006 onwards) accepts *Poa bromoides* Vahl as *Eragrostis bromoides* (Vahl) Steud. {appl. uncert. but valid}. Soreng et al. (2016), also accept it as *E. bromoides*.

***Poa lilloi* Hack. Ref:** Tovar (1965: 32; 1993: 127); Giussani et al. (2012: 319). **Ill:** Negritto and Antón (2000: fig. 11); Giussani et al. (2012: sp. 36, p. 319). **Discussion:** Specimens of *P. lilloi* cited by Tovar (1993) to occur in Peru, *Ó. Tovar S. 2501* (US), *J.R. Swallen 7060b* (US) and *J.R. Swallen 7068* (US) have been redetermined as stunted versions of *P. glaberrima*. The *J.R. Swallen 7060a* (US) specimen was redetermined as a stunted version of *P. candamoana*. The specimens of *P. lilloi* from JUNÍN cited by Brako and Zarucchi (1993) and Tovar (1993), *R. Ferreyra 5260* (US, USM) and *E. Cerrate 988* (USM[?]; Ill: Tovar 1965, lam. VIV, A.), have not been found. Certain specimens identified as *P. lilloi* may actually be the new species *Poa ramoniana*. The type of *P. ramoniana*, *R. Ferreyra 5200* (US, USM), was previously determined as *P. lilloi*, and the USM isotype appears as a mixed collection of *P. glaberrima* and *P. ramoniana*. It is highly probable that all other specimens previously considered as *P. lilloi* from Peru are stunted versions of either *P. candamoana*, *P. glaberrima* or *P. kurtzii* that were collected from heavily grazed areas. Correctly determined specimens of *P. lilloi* have been found from Bolivia, Chile and Argentina and occur in high elevation Puna grasslands above 3200 m. This species is most easily confused with *P. kurtzii* from which it can be distinguished by being 7–20 cm tall, scabrous across the glume and lemma surfaces, lemmas 3–3.5 mm long, sometimes with a bit of pubescence on the lemma keel, sometimes a tiny web emerging from the dorsal side of the callus. *Poa kurtzii* is 20–70 cm tall, has smooth glumes and densely scabrous lemmas, lemmas 4–4.5 mm long. *Poa kurtzii* is also gynomonecious, while *P. lilloi* is gynodioecious.

Poa supina Schrader **Ref:** Tovar (1993: 126); Soreng 2007: 529. **Ill:** Soreng (2007: p. 529). **Discussion:** This taxon is highly unlikely to occur in South America with all specimens identified as *P. supina*, so far encountered, pertaining to *Poa annua*. These include all specimens encountered from Ecuador and Bolivia (Simon Læggaard *pers. communication*). Tovar (1993) includes *P. supina* in his treatment of Peru separating it from *P. annua* and *P. infirma* by having glabrous lemmas, or only lightly pubescent on the nerves, and swollen culms. However, the main distinction between *P. supina* and *P. annua*, aside from sparser lemma pubescence, is in the length of the anthers with *P. supina* having anthers (1.2–)1.6–2(–2.5) mm while *P. annua* has anthers 0.7–1(–1.2) mm. Specimens examined of *P. supina* from Peru (J. Espinoza 2 [US]) were redetermined as *P. annua*, but the voucher collections Tovar & Rivas Martinez 7720 and Tovar 7855 accepted by Tovar (1993) have not been seen by us. Also see note under *Poa infirma* about the origin of *P. annua*.

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Supplementary material I

Supplementary key to the open-panicled species of *Poa* in Peru

Authors: Steven P. Sylvester, Robert J. Soreng, Paul M. Peterson, Mitsy D.P.V. Sylvester
Data type: Adobe PDF file

Explanation note: This morphological key emphasizes lemma indumentum.

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Typifications and synonymy in *Polystichum* (Dryopteridaceae) from Chile and Argentina

Rita E. Morero^{1,2}, David S. Barrington³, Monique A. McHenry³,
João P. S. Condack⁴, Gloria E. Barboza^{1,2}

1 Departamento de Farmacia, Facultad de Ciencias Químicas, Universidad Nacional de Córdoba, (UNC), Av. Medina Allende y Haya de la Torre. Ciudad Universitaria, Córdoba. Argentina **2** Instituto Multidisciplinario de Biología Vegetal (IMBIV-CONICET), Casilla de Correo 495, 5000 Córdoba **3** University of Vermont, Pringle Herbarium, Torrey Hall, 27 Colchester Ave, Burlington, VT 05405 **4** Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista s.n., São Cristóvão, Rio de Janeiro, Brazil 20940-040

Corresponding authors: Rita E. Morero (ritamorero@gmail.com); Gloria E. Barboza (gbarboza@imbiv.unc.edu.ar)

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Abstract

Polystichum Roth is one of the largest and most taxonomically challenging fern genera. South American species have a rich and complex nomenclatural history; many of the early names are inadequately typified. Based on extensive examination of original type material, we designate eleven lectotypes (including *Aspidium mohrioides*, *A. montevidense* f. *imbricata*, *A. montevidense* f. *squamulosa*, *A. plicatum*, *A. pycnolepis*, *Dicksonia andina*, *Polystichum elegans*, *P. mohrioides* f. *latifolia*, *P. multifidum* var. *autranii*, *P. platyphyllum* var. *kurtziana*, and *Polypodium polystichoides*), and one neotype (*P. brongniartianum*) for *Polystichum* taxa. Furthermore, three new synonyms are proposed.

Resumen

Polystichum Roth es uno de los géneros de helechos más grandes y de mayor complejidad taxonómica. Las especies sudamericanas tienen una rica y compleja historia nomenclatural, con muchos de los nombres inadecuadamente tipificados. En base a un minucioso examen del material tipo original, designamos lectotipos para once taxones de *Polystichum* (que incluyen *Aspidium mohrioides*, *A. montevidense* f. *imbricata*, *A. montevidense* f. *squamulosa*, *A. plicatum*, *A. pycnolepis*, *Dicksonia andina*, *Polystichum elegans*, *P. mohrioides* f. *latifolia*, *P. multifidum* var. *autranii*, *P. platyphyllum* var. *kurtziana* y *Polypodium polystichoides*) y un neotipo (*P. brongniartianum*). Además, se proponen 3 nuevos sinónimos.

Keywords

Ferns, taxonomy, typification, nomenclature, South America

Palabras clave

Helechos, taxonomía, tipificación, nomenclatura, Sudamérica

Introduction

Polystichum Roth (Dryopteridaceae) is a worldwide, taxonomically complex genus of \pm 360–400 species (Zhang and Barrington 2013), characterized by highly variable species and convergent morphology (Kessler et al. 2005). Frequent hybridization, polyploidy (especially allopolyploidy), and apomixis hinder taxonomic delimitation of species (Little and Barrington 2003, Morero et al. 2015).

Taxa in the genus *Polystichum* can be recognized morphologically by stems usually ascending or erect, short internodes, and a dictyostelic stele. The monomorphic leaves bear several kinds of scales (hairs are rare); the ultimate segments are mostly asymmetric at base, often acroscopically auriculate, and ordinarily spinulose or at least dentate-mucronate at the margins. The sori are indusiate or not, when present the indusia are rounded-peltate.

South America, with ~40 species (43% of species in the New World), is an important world center of diversity (McHenry and Barrington 2014). The South American taxa have been studied largely using floristic and taxonomic approaches (Remy 1854, Fée 1869, 1873, Baker 1870, 1873, 1891, Hieronymus 1897, Christ 1905, Rosenstock 1906–1907, 1915, Hicken 1906, 1907a–b, 1909, Christensen 1910, Hosseus 1915, Looser 1939, 1968, Diem 1943, 1958, de la Sota 1977, Pichi-Sermolli and Bizzarri 1978, Sehnem 1979, Smith 1985, Rodríguez Ríos 1987, Tryon and Stolze 1991, Marticorena and Rodríguez Ríos 1995, de la Sota et al. 1998, Kessler et al. 2005).

Recent work has revealed that the polystichums of Chile and Argentina pertain to two different monophyletic lineages, an exindusiate tropical Andean clade (Condack 2012, Condack et al. 2013, McHenry and Barrington 2014) and an indusiate austral South American clade (Morero et al. 2015, Barrington, unpublished data). A significant insight is that the tropical Andean taxa extend down the east face of the Andes and can reach the sea in southernmost Brazil and Uruguay (Condack 2012), whereas the austral Andean taxa are mainly confined to the subantarctic region from 37° S to Cabo de Hornos (Morero et al. 2015).

In the course of work on revisions of *Polystichum* from Argentina and Chile we became aware that critical nomenclatural work with original materials was needed for a number of the taxa. In this manuscript we designate lectotypes for eleven taxa, one neotype, and propose three new synonyms for Central Andean and Southern Andean *Polystichum* which inhabits Argentina and Chile. We report the novelties for the two regions separately, alphabetically by basionym species name.

Materials and methods

Review of types was based on examination of specimens in herbaria (BA, CONC, CORD, LIL, LP, SGO, SI; acronyms according to Thiers 2013), of digital images provided by source herbaria (B, BM, E, F, GENT, GH, GOET, K, LE, M, MPU, NY, P, S, US, W), or of digital images available via the JSTOR Global Plants portal (<http://plants.jstor.org>). All original protologues were reviewed.

Information about botanical publications, authors, dates, collectors and their herbarium and types, were taken from Stafleu and Cowan (1976–1988). The Melbourne Code (McNeill et al. 2012) was used for the proposed typification. The specimens selected as lectotypes are the best-preserved and most complete. The lectotype sheets are cited with the barcode number or indicated by the herbarium number, the former are cited with no space between the herbarium acronym and the number, while for accession numbers we have inserted a hyphen between the acronym and the number. The lectotype localities correspond to the geographical site mentioned on the specimen itself. If present, additional information (country and first subdivision) about collecting localities is indicated in square brackets. Photographs of the lectotypified specimens that are not available on JSTOR Global Plants are included here.

Taxonomy

Austral-Andean indusiate taxa

1. *Aspidium mohrioides* d'Urv., Flore des Iles Malouines: 26. 1825. Type: [Islas Malvinas] "I. Soledad", n.d., *D. d'Urville* 92. Lectotype (designated here): P! (P00636426 [<http://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.p00636426>]). Syntypes remaining: [Islas Malvinas] "Iles Malouines, *D. d'Urville* s.n. – P! (P00636427 [<https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636427>]). Iles Malouines, [year] 1815, *M. Lesson* s.n. – P! (P0036428 [<https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636428>]).

= *Polystichum mohrioides* (d'Urv.) C.Presl, Tent. Pterid.: 83. 1836.

Three specimens are stored at P from Islas Malvinas, two collected by J. S. C. Dumont d'Urville (P00636426 and P00636427) and the third by R. P. Lesson (P00636428). The ferns were collected during a circumnavigation in the corvette "Le Coquille" (1822–1825) under the command of Captain L. Duperrey, in which Dumont d'Urville was a second officer and Lesson surgeon and naturalist (Duperrey 1828). Probably Dumont-d'Urville described *Aspidium mohrioides* based on these three specimens but he clearly cited "I. Soledad" as the collection site for the ferns collected in his voyage (Dumont-D'Urville 1825: 26). We designated P00636426 as the lectotype because it

is the only one with the locality “I. Soledad”, and it is also the most complete sheet, consisting of a fertile plant and two additional fronds. The other two specimens comprise two (P00636428) or three (P00636427) mainly juvenile fronds.

2. *Aspidium plicatum* Poepp. ex Kunze, *Linnaea* 9: 94. 1834. Type: [CHILE. Bio-Bio:] “Chile austr. in rupibus mont. Pico de Pilque in Cordillera de Antuco”, Dec 1828. *E. F. Poeppig* (*Diar.* 745). Lectotype (designated here): W! [W-0003927]; isolectotypes: LE! (LE00008146 [<http://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.le00008146>], LE00008147 [<http://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.le00008147>], LE00008148 [<http://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.le00008148>]), P! (P00636429 [https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636429], P00636430 [https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636430], P00636431 [https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636431]). Fig. 1A

= *Polystichum plicatum* (Poepp. ex Kunze) Hicken ex Hosseus, *Trab. Inst. Bot. Farmacol.* (Buenos Aires) 33: 9. 1915.

When Kunze (1834: 94) described *Aspidium plicatum*, no specimen referable as type was cited. At the same time, he recognized two named varieties (*α laxum* and *β rigidum*), citing one type specimen for each variety. According to the International Code of Nomenclature, Arts. 9.5 and 26.2 (McNeill et al. 2012), one lectotype for the species can be selected from the types of either of the two varieties. The features given in the protologue for var. *rigidum* closely match the description of *A. plicatum*; for this reason, we select one sheet of the type collection of this variety as lectotype (W-0003927!). Among LE's isolectotypes, there are two sheets (LE00008146! and LE00008148!), with incomplete data on their original labels; these labels state: *Aspidium plicatum* and *Aspidium plicatum β* respectively, being both Poeppig's gatherings; it is supposed that they are also duplicates.

3. *Dicksonia andina* Phil., *Anales Univ. Chile* 94: 359. 1896. Type: [CHILE. Valdivia:] “Cuesta de Lipela, Cord. de Ranco”, Jan 1887, *O. Philippi s.n.* Lectotype [designated here (second step lectotypification after Rodríguez Ríos 1987: 51)]: SGO! (SGO000000511 [http://plants.jstor.org/stable/10.5555/al.ap.specimen.sgo000000511]); isolectotype: SGO! (SGO000000512 [http://plants.jstor.org/stable/10.5555/al.ap.specimen.sgo000000512]). Syntypes remaining: [CHILE. Valdivia:] “ad flumen Palena”, Jan-Feb 1887, *A. Hirth s.n.* – SGO! (SGO 000000513 [http://plants.jstor.org/stable/10.5555/al.ap.specimen.sgo000000513]). [CHILE. Valdivia:] “Prope flumen Manso raram leg. Dr. Reiche” (not found).

= *Polystichum multifidum* (Mett.) T. Moore, *Index Fil.* (T. Moore): 84. 1857. Basynym: *Aspidium multifidum* Mett., *Fil. Lechl.* 1: 20. 1856.



Figure 1. Lectotypes. **A** Lectotype of *Aspidium plicatum* (W) **B** Neotype of *Polystichum brongniartianum* (CONC) **C** Lectotype of *P. mohrioides* f. *latifolia* (CORD) **D** Lectotype of *A. montevidense* f. *imbricata* (CORD).

Rudolph A. Philippi misapplied the name *Dicksonia* (Fam. Dicksoniaceae), a genus of tree ferns, to specimens of *Polystichum*. We found three sheets at SGO. Of these, two were collected by his grandson Otto Philippi and the third one by Hirth. The original Philippi label of SGO000000513!, indicates “*F. Hirth*” as the collector name in error, the correct name is “Ad. [Adolfo] Hirth”, as it is written in the protologue. Both accessions of O. Philippi’s collection are well preserved. Rodríguez Ríos (1987) unintentionally lectotypified a Philippi’s specimen (“SGO-isosyntypus!”). As in SGO exists two sheets of Philippi, a second step lectotypification is here proposed in accordance to Art. 9.17. The selected lectotype (SGO000000511!) is the most complete sheet including one leaf (with intact lamina and petiole).

4. *Polystichum brongniartianum* J. Rémy, in Fl. Chil. [Gay] 6: 518. 1854. Type: [CHILE. Concepción]: “Chile Austral, Concepción” C. Gay s.n., not localized. Neotype (designated here): CHILE. Llanquihue: Peulla. 13 Jun 1953, A. Pfister s.n. CONC! (CONC-13555). Fig. 1B

= *Polystichum subintegerrimum* (Hook. & Arn.) R. Rodr., Gayana. Bot. 44: 48. 1987. Basyonym: *Aspidium subintegerrimum* Hook. & Arn., Bot. Beechey Voy.: 52. 1832.

The type specimen of *P. brongniartianum* (C. Gay s. n.) cited by Rémy (1854), is supposed to be housed at P; after a careful search in P, we have found no type material of this name. Neither was any found by other fern taxonomists in other herbaria (Christensen 1910, Looser 1968, Rodríguez Ríos 1987). We propose CONC-13555 as neotype, as it fits Rémy’s description in its narrowest interpretation.

5. *Polystichum elegans* J. Rémy, in Fl. Chil. [Gay] 6: 514. 1854. Type: [CHILE. Prov. Colchagua: “Cordillera de Talcalegué, pie le Volcán de Cordier”, Feb 1831, C. Gay 29. Lectotype [designated here (second step lectotypification after Rodríguez Ríos 1987: 49)]: P! (P00636434 [http://plants.jstor.org/stable/10.5555/al.ap.specimen.p00636434?searchUri=filter%3Dname%26so%3Dps_group_by_genus_species%2Basc%26Query%3Dpolystichum%2Belegans]); isolectotypes: P! (P00636432 [<https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636432>], P00636435 [<https://science.mnhn.fr/institution/mnhn/collection/p/item/p00636435>])).

= *Polystichum plicatum* (Poepp. ex Kunze) Hicken ex Hosseus, Trab. Inst. Bot. Farmacol. (Buenos Aires) 33: 9. 1915. Basyonym: *Aspidium plicatum* Poepp. ex Kunze, Linnaea 9: 94. 1834.

There are three sheets of Gay at P, two sheets are housed as Gay 29 (P00636434! and P00636432!) with data of the collection place, while the third sheet (P00636435!) lacks collector number and only “Chili” is indicated as the collection location. Rod-

ríguez Ríos (1987) wrote “Se halla en las altas cordilleras de Talcaregue, provincia de Colchagua, en las orillas de los arroyos, cerca del volcán en donde es algo rara (P!)”. The Gay 29’s collection has a label with the same information cited by Rodríguez Ríos. As a second step lectotypification is necessary, we select P00636434 as the second step lectotype because it includes the diagnostic character for this taxon and it is the most complete accession (three fronds and the petiole scales are intact).

6. *Polystichum mohrioides* (d’Urv.) C. Presl f. *latifolia* Hicken, Anales Soc. Ci. Argent. 62: 171. 1906. Type: [ARGENTINA. Mendoza. Dpto. San Carlos:] “Cordillera del Portillo de La Llaretta entre El Paso del Portillo (4300 m.s.m.) y la Laguna del Diamante (3324 m.s.m.). La Resguardia del Portillo, in petros, umbrosis passim. Leg. Arturo Lemos”, Mar 1900, *F. Kurtz 11173*. Lectotype (designated here): CORD! (CORD00006865 Hoja A); isoelectotypes: CORD! (CORD00006866 Hoja B), SI! (SI000111). Syntypes remaining: [ARGENTINA. Tierra del Fuego:] “Canal Beagle. Punta Remolino, 1300 m.” Mar 1903, *M. S. Pennington 422* – SI! (SI-60478).[ARGENTINA] “Prov. Neuquén. Departam. Huiliches. Junín de los Andes, entre Fortín Maipú y Laguna Lolog” 13-14, IV, 1888, *F. Kurtz 6391*– CORD! (CORD00006867 Hoja A, CORD00006869 Hoja B, CORD00006884). Fig. 1C.

= *Polystichum plicatum* (Poepp. ex Kunze) Hicken ex Hosseus, Trab. Inst. Bot. Farmacol. (Buenos Aires) 33: 9. 1915. Basyonym: *Aspidium plicatum* Poepp. ex Kunze, Linnaea 9: 94. 1834.

We examined the three syntypes of *P. mohrioides* f. *latifolia*. All three are of good quality; two are preserved at CORD, and the third at SI. One of the two sheets of Kurtz 11173 (leg. A. Lemos) at CORD is designated as lectotype: CORD 00006865! Hoja A. This accession consists of three mature fertile fronds versus Hoja B (isoelectotype) with all three sterile leaves.

7. *Polystichum multifidum* (Mett.) T.Moore var. *autranii* Hicken, Anales Soc. Ci. Argent. 62: 172. 1906. Type: [ARGENTINA] “Chubut: Laguna Blanca, *J. Koslowsky n° 240*”. Lectotype (designated here): SI000112!; isoelectotypes: SI000113!

= *Polystichum multifidum* (Mett.) T. Moore, Index Fil. (T. Moore): 84. 1857. Basyonym: *Aspidium multifidum* Mett., Fil. Lechl. 1: 20. 1856.

Although there are two sheets of this variety at SI, each indicated as holotype and isotype respectively, it is not possible to be sure that it is from the protologue. Holotype and isotype labels have been added by the SI herbarium staff after Hicken’s death. We select as lectotype, SI000112 sheet since it has a label with detailed collection data and consists of two complete fronds.

8. *Polystichum multifidum* (Mett.) T.Moore var. *dusenii* C.Chr., Ark. Bot. 10 (2): 19. 1910. **syn. nov.** Type: [CHILE, Aysén:] “Patagonia Occ. in valle fluminis Aysén”, 15 Jan 1897, *P. Dusén* 489 Holotype: S! (S05-10906 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.s05-10906>])

= *Polystichum chilense* (H.Christ) Diels, Nat. Pflanzenfam. [Engler & Prantl] 1: 192. 1899. Basyonym: *Aspidium aculeatum* var. *chilense* (H.Christ) Ber. Schweiz. Bot. Ges. 3: 39. 1893.

Christensen (1910) recognized *P. multifidum* var. *dusenii* based on lamina division (twice pinnate-pinnatifid lamina), and shape and margin of pinnules (pinnules obovate with slightly dentate margins). Looser (1968) suggested that this set of plants should be considered a variety of *P. chilense*; later, Rodríguez Ríos (1987) agreed and added another diagnostic character (coriaceous pinnules), to support this position and formalized the recognition of the variety: *P. chilense* var. *dusenii* (C.Chr.) R.Rodr. We observed frequent variation in the lamina division among *P. chilense* populations, even within the same population. This variability is often associated with the size and age of the plant (Barrington 2012). Consequently, we synonymize var. *dusenii* under *P. chilense*.

9. *Polystichum pearcei* Phil., Linnaea 33: 305. 1865. **syn. nov.** Type. [CHILE] Valdivia, Cordillera de Ranco, s.f., *R. Pearce* s.n. Holotype: SGO! (SGO000000478 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.sgo000000478>])

= *Polystichum multifidum* (Mett.) T. Moore, Index Fil. (T. Moore): 84. 1857. Basyonym: *Aspidium multifidum* Mett., Fil. Lechl. 1: 20. 1856.

The main diagnostic characters for *P. pearcei* are the 3-pinnate frond and the rachis slightly scaly (Philippi 1865). Rodríguez Ríos (1987) considered the same diagnostic characters but subordinated this species as a variety under *P. multifidum*. Analyzing herbarium specimens and field observations of *P. multifidum*, we found high variability in the lamina division and density of scales on the rachis. In addition, when *P. multifidum* grows in warmer and/or drier conditions, the leaves are smaller, less divided, and not as scaly (Morero, pers. obs.). Since the type of *Polystichum pearcei* falls within the variation of *P. multifidum*, we propose it as a synonym. Molecular studies in progress support this proposal (Barrington pers. comm.).

Tropical Andean exindusiate taxa

10. *Aspidium montevidense* (Spreng.) Hieron. f. *imbricata* Hieron., Bot. Jahrb. Syst. 22 (3): 366. 1897. Type: [ARGENTINA, Tucumán:] “Siambón, Sierra de Tucumán”, 8 May 1872, *P. G. Lorentz* 158. Lectotype (designated here): CORD! (CORD00006873);

isolectotypes: CORD! (CORD00006874!), SI! (SI-088094), US! (US00067142[<http://plants.jstor.org/stable/10.5555/al.ap.specimen.us00067142>]). Syntype remaining: [ARGENTINA, Tucumán:] “En las pendientes y las quebradas de la cuesta de Garabatal, cerca de Siambón, Sierra de Tucumán”, 27 Jan 1874, *P. G. Lorentz & G. Hieronymus 801* – (isosyntype: CORD! [CORD00006875]). Fig. 1D.

= *Polystichum montevidense* (Spreng.) Rosenst., Hedwigia: 46: 111, 1906. Basyonym: *Polypodium montevidense* Spreng., Syst. Veg. (ed. 16) [Sprengel] 4 (1): 59. 1827.

This name was based on two syntypes both from Tucumán hills (Argentina): *Lorentz 158* and *Lorentz & Hieronymus 801*. Hieronymus described this taxon with the specimens deposited at B, but a careful search of B does not yield them. Four duplicates of *Lorentz 158* exist in herbaria: two housed at CORD, one at US, and a fourth at SI. We select CORD00006873 as the lectotype because it represents an entire plant including a rhizome, fertile fronds with petiole base and rhizome born intact. Characters used to diagnose the species by Condack et al. (2013)—rhizome and petiole scale color, shape, and margin along with the shape and margin of the pinnules—are present in our selected lectotype.

11. *Aspidium montevidense* (Spreng.) Hieron. f. *squamulosa* Hieron., Bot. Jahrb. Syst. 22 (3): 366. 1897. Type: [ARGENTINA, Córdoba:] “Las Ramadas cerca de San Miguel, Sierra Achala de Córdoba”, 14 Mar 1876, *G. Hieronymus 479*. Lectotype (designated here): CORD! (CORD00006871); isolectotypes: CORD (CORD00006887), F! (F0075611 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.f0075611f>]), SI! (SI-088100). Syntypes remaining: [ARGENTINA, Córdoba:] “Sierra de Achala, cerca del Puerto Alegre”, 5 Feb 1877, *G. Hieronymus 805* – CORD! (CORD00006870, CORD00006886), F! (F0075612 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.f0075612f>]), US! (US00067143! [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.us00067143>])). [ARGENTINA, Córdoba:] “mit der hauptform in einer Schlucht am westlichen Fuß der Gigantes (*G. Hieronymus s.n.* 2 Feb 1883)”, (not found). Fig. 2A.

= *Polystichum pycnolepis* (Kunze ex Klotzsch) Hieron., Bot. Jahrb. Syst. 34 (4): 452. 1904. Basyonym: *Aspidium pycnolepis* Kunze ex Klotzsch, Linnaea 20: 365. 1847.

We located two of the three syntypes cited by Hieronymus (1897). Both are high-quality specimens in agreement with the diagnosis. We have selected Hieronymus 479 at CORD as the lectotype because it is a more complete specimen including all the diagnostic characters for this taxon (the rhizome scales are intact and there are two fronds with fragments of petioles and blades). After a careful analysis of morphological characters of type specimens we have found that their identifying characters (large petiole scales bicolorous with the center atropurpureous and the edge rufous; pinnules



Figure 2. Lectotypes. **A** Lectotype of *Aspidium montevidense* f. *squamulosa* (CORD) **B** Lectotype of *Polypodium polystichoides* (B).

coriaceous and revolute with margins serrate and spinules well developed), match fairly the diagnostic characters of *P. pycnolepis*. Therefore, we confirm the synonymy of this form under *P. pycnolepis*, as proposed by Condack et al. (2013).

12. *Aspidium pycnolepis* Kunze ex Klotzsch, *Linnaea* 20: 365. 1847. Type: [VENEZUELA] “Columbia, Col. Tovar”. 1856. *J. W. K. Moritz* 296 b. Lectotype (designated here): B! (B200148046-b [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=83712&idThumb=279937&SpecimenSequenz=1&loan=0]); isolectotypes: B! (B200148045-b [http://ww2.bgbm.org/herbarium /specimen.cfm?SpecimenPK=166846&idThumb=279936&SpecimenSequenz=1&loan=0]); K! (K000512992 [http://apps.kew.org/herbcat/detailsQuery.do?imageId=231125&pageCode=1&presentPage=1&queryId=2&sessionId=E0DC715CEF51CFBB8FB85F938E0D6780&barcode=K000512992]). Syntypes remaining: [VENEZUELA] “Columbia”. 1856. *J. W. K. Moritz* 296 – B! (B200148177 [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=83714&idThumb=279972&SpecimenSequenz=1&loan=0], B200148176 [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=83713&idThumb=279971&SpecimenSequenz=1&loan=0]); K! (K000512989 [http://apps.kew.org/herbcat/detailsQuery.do?imageId=231122&pageCode=1&presentPage=1&queryId=1&sessionId=E0DC715CEF51

CFBB8FB85F938E0D6780&barcode=K000512989]), M! (not available on line), NY! (not available on line). [VENEZUELA] “Columbia”. 1856. *J. W. K. Moritz* 295 – B! (B200127536 [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=72797&idThumb=265393&SpecimenSequenz=1&loan=0]), B200148175 [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=83711&idThumb=279970&SpecimenSequenz=1&loan=0]); M! (not available on line); P! (P00604457 [https://science.mnhn.fr/institution/mnhn/collection/p/item/p00604457?listIndex=4&listCount=30]); *J. W. K. Moritz s.n.* K! (K000512992[http://apps.kew.org/herbcat/detailsQuery.do?imageId=231125&pageCode=1&presentPage=1&queryId=3&sessionId=E0DC715CEF51CFBB8FB85F938E0D6780&barcode=K000512992]). [VENEZUELA] “Columbia”, *G. K. W. Karsten Coll. II. a.* B! – (B200148170 [http://ww2.bgbm.org/herbarium/specimen.cfm?SpecimenPK=83716&idThumb=279969&SpecimenSequenz=1&loan=0]).

= *Polystichum pycnolepis* (Kunze ex Klotzsch) Hieron., Bot. Jahrb. Syst. 34 (4): 452. 1904.

The type material of *Aspidium pycnolepis* is a mixed collection. In order to stabilize the application of this name in the sense that it has been used by most other botanists, we choose *Moritz* 296 b (B200148046!) since most closely represents the original description. The remaining syntypes, after the designation of the lectotype of *A. pycnolepis*, pertain to at least three species, only one of which is *P. pycnolepis*. We have seen the following: “Columbia, Páramo de la Culata”, *Moritz* 296 (B! [det. *P. orbiculatum* and *P. gelidum*, see annotation labels]; K! [det. *P. gelidum*]; M! [det. *P. pycnolepis*]; NY! [det. *P. pycnolepis*]; P-photo! [det. *P. gelidum*]); same locality *Moritz* 295 (B! [det. *P. pycnolepis* and *P. orbiculatum*, see annotation labels]; M! [det. *P. pycnolepis*]; *Moritz s.n.* – K! [det. *P. pycnolepis*].

13. *Polypodium polystichoides* Klotzsch, Linnaea 20: 383, 1847, **syn. nov.** Type: [COLOMBIA] “Columbien 1846 (Col. II)”, s.d. *H. Karsten* 5. Lectotype (designated here): B! (B200148238 [http://herbarium.bgbm.org/object/B200148238]); isolectotypes: B! (B200148237 [http://herbarium.bgbm.org/object/B200148237]), B200148239 [http://herbarium.bgbm.org/object/B200148239]); LE (not found). Fig. 2B.

= *Polystichum platyphyllum* (Willd.) C.Presl, Tent. Pterid. 84. 1836. Basyonym: *Aspidium platyphyllum*, Sp. Pl. ed. 4, 5 (1): 255. 1810.

There are three sheets of Karsten at B (one more, not found, may be housed at LE); from among these, we select B200148238 as the lectotype, because it is a more complete accession containing an entire plant. Based on a careful observation of the three specimens, we consider that all pertain to *Polystichum platyphyllum* — by the lamina dissection, the shape and color of petiole scales, and the elongate once-pinnate and bulbil-bearing lamina apex — which are diagnostic characters of this taxon.

14. *Polystichum platyphyllum* (Willd.) C.Presl var. *kurtziana* Hicken, *Anales Soc. Ci. Argent.* 63: 169. 1907. Type: [ARGENTINA] “Prov. Córdoba: Departam. San Alberto. Sierra Grande: Cuesta del Tránsito: Región del Tabaquillo. An feuchten Orten in grossen Gruppen; zerstreut”, 6–13 Jan 1895, *F. Kurtz* 8352. Lectotype (designated here): SI! (SI000116 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.si000116>]); isoelectotypes: CORD! (CORD00006736 Hoja A; CORD00006737 Hoja B), NY! (NY00149457 [<http://plants.jstor.org/stable/10.5555/al.ap.specimen.ny00149457>]).

= *Polystichum montevidense* (Spreng.) Rosenst., *Hedwigia*: 46: 111. 1906. Basyonym: *Polypodium montevidense* Spreng., *Syst. Veg.* (ed. 16) [Sprengel] 4(1): 59. 1827.

A single collection was cited in the protologue of this varietal name. Of the four duplicates of the type collection, two are housed at CORD, one at NY and the fourth at SI. The last one, with a Hicken’s handwritten label with the inscription “au var? nova?”, was supposedly used by this author for the diagnosis. According to the recommendation of the International Code of Nomenclature (Rec. 9A.3, McNeill et al. 2012), the specimen with an author’s annotations on herbarium sheets should be given preference in choosing the lectotype; therefore, SI000116 is designated here as the lectotype.

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***Bulbophyllum pingnanense* (Orchidaceae, Epidendroideae, Dendrobiinae), a new species from Fujian, China**

Jiang-Feng Liu^{1,3}, Si-Ren Lan¹, Bi-Zhu He², Yi-Chi Liang¹

1 College of Landscape Architecture, Fujian Agriculture and Forestry University, Fuzhou 350002, China

2 College of Horticulture, Fujian Agriculture and Forestry University, Fuzhou 350002, China **3** Management Office of Yushan Scenic Area, Fuzhou 350001, China

Corresponding author: Yi-Chi Liang (fafulyc@126.com)

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Abstract

A new orchid species, *Bulbophyllum pingnanense*, is described and illustrated from Fujian, China. It is similar to *B. brevipedunculatum* and *B. albociliatum* in vegetative and floral morphology, but it can be distinguished from *B. brevipedunculatum* by having a longer dorsal sepal with longer white ciliate on margin, longer and lanceolate lateral sepals, and a glabrous lip. It can be distinguished from *B. albociliatum* by having a shorter inflorescence, and a longer dorsal sepal.

Keywords

Bulbophyllum, Eastern China, Fujian, Orchidaceae

Introduction

Bulbophyllum Thouars is one of the largest orchid genera. It includes more than 1900 species and extends widely from tropical America, Africa, Madagascar, and mainland Asia to Australasia (Lindley 1830, Pearce and Cribb 2002, Seidenfaden 1979, 1992, Chen et al. 2009, Pridgeon et al. 2014). There are about 105 species of *Bulbophyllum* in China, according to the most recent revision and recently published new species (Chen et al. 2009, Jin et al. 2014, Hu et al. 2015). Section *Cirrhopetalum* (Lindley) Reichenbach is characterized by sub-umbellate inflorescence, shorter dorsal than lateral sepals, twisting

and connected lateral sepals, and hairy dorsal sepal and petals (Seidenfaden 1979). *Cirrhopetalum* includes 57 species, 17 (10 endemic) of which are found in China (Chen et al. 2009). During fieldwork in Pingnan County, northeastern Fujian, a new species of *Bulbophyllum*, best placed under the section *Cirrhopetalum*, was found and described below.

Materials and methods

Gross morphological data were obtained during fieldwork. Measurements, shapes, colours and other details given in the description were based on living material. The images of flowering plant were photographed with the Canon S100v digital camera. The floral anatomy was conducted under a XTL-340Z stereomicroscope.

Taxonomy

***Bulbophyllum pingnanense* J.F. Liu, S.R. Lan & Y.C. Liang, sp. nov.**

urn:lsid:ipni.org:names:77155742-1

Figs 1, 2

Type. China. Fujian: Pingnan County, Shuangxi Town, on rock along Yuanyan River, 800–900 m, 27°01'N, 119°05'E, 23 June 2013, J.F. Liu 201312 (holotype: FAFU!; isotype: NOCC!).

Diagnosis. *Bulbophyllum pingnanense* is similar to *B. brevipedunculatum* T.C. Hsu & S.W. Chung and *B. albociliatum* (T.S. Liu & H.Y. Su) K. Nackejima. It differs from *B. brevipedunculatum* by having a longer dorsal sepal with either an obtuse or an acute apex and longer white ciliate on margins; longer and lanceolate lateral sepals; and glabrous lip. It can be distinguished from *B. albociliatum* by its shorter inflorescence, a longer dorsal sepal with either an obtuse or an acute apex.

Description. Epiphytic herb. Rhizome creeping, slender, 0.6–1 mm in diam. Pseudobulbs 0.6–2.5 cm apart on rhizome, obovate-elliptic, 0.5–1.7 cm, 3–6 mm in diam., with a terminal leaf. Leaf sessile; blade oblong to linear-oblong, 1.8–6.6 × 0.6–1.2 cm, apex obtuse to retuse. Scape arising from base of pseudobulb, ca. 1.1 cm, umbel 3–5 flowered; peduncle slender, ca. 0.6 mm in diam., with 3 or 4 sheaths; floral bracts triangular, 2–3 mm. Pedicel and ovary ca. 4 mm. Flowers orange red. Dorsal sepal concave, ovate, abaxially papillose, ca. 5 × 3 mm, margins long white ciliate, apex obtuse or acute; lateral sepals lanceolate, abaxially papillose, 10–12 × ca. 2 mm, slightly twisted near the base, with their upper and lower edges often loosely adhering, margins glabrous, apex acute. Petals ovate, 2.7–3.0 × 1.2–2.0 mm, margins long white ciliate, apex rounded. Lip recurved, ovate-triangular, ca. 3 mm, abaxially deeply grooved, base attached to end of column foot by a mobile joint. Column yellow, subterete, ca. 1–2 mm, with a distinct foot, ca. 1.0–2.5 mm, conspicuously winged; stelia triangular, slender; anther cap subglobose; pollinia 4, in 2 pairs, without appendages.

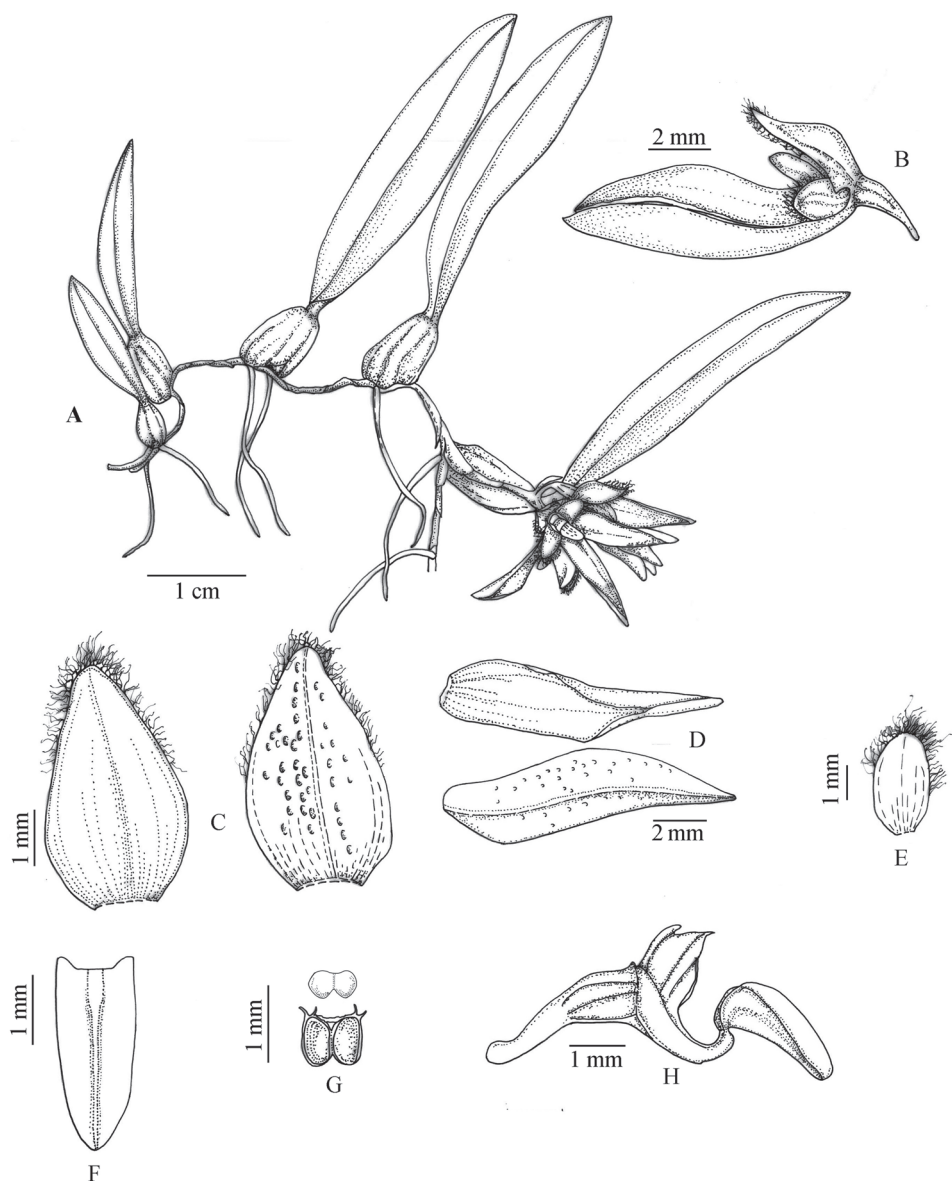


Figure 1. *Bulbophyllum pingnanense* sp. nov. **A** plant **B** flower **C** dorsal sepal **D** lateral sepal **E** petal **F** lip **G** pollinia and anther cap **H** lip, column, pedicel and ovary, side view (Drawn from the holotype by Bi-Dan Lai).

Distribution and habitat. *Bulbophyllum pingnanense* is so far only known within Pingnan, Fujian, China (Fig. 3). It is epiphytic on steep rock in the edge of evergreen coniferous and broad-leaved mixed forest, which is mainly composed of *Castanopsis eyrei* (Champ. ex Benth.) Hutch. (Fagaceae), *Cunninghamia lanceolata* (Lamb.) Hook. (Taxodiaceae). Other orchids, *Amitostigma gracile* (Bl.) Schltr., *Pholidota cantonensis* Rolfe, *Cymbidium floribundum* Lindl. and *Pleione formosana* Hayata, were found growing nearby this new species.

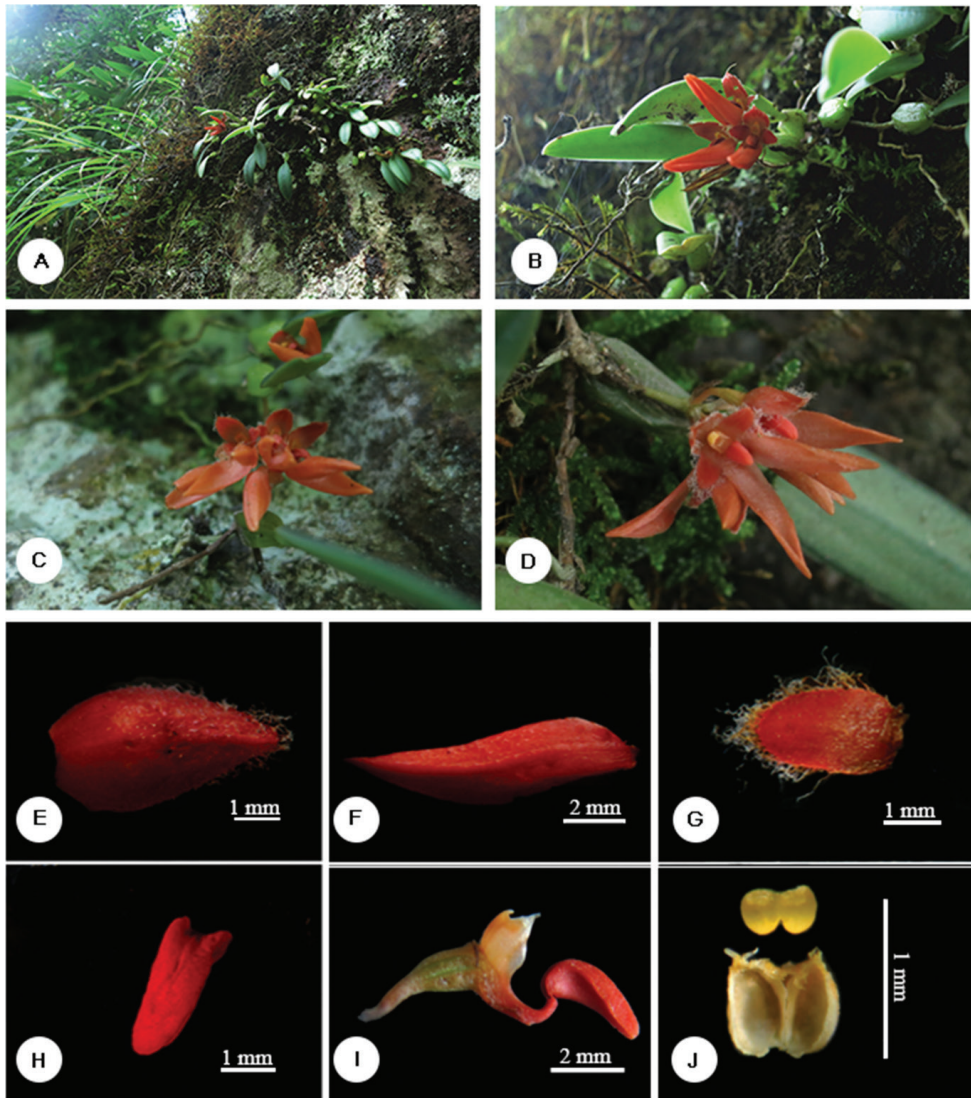


Figure 2. *Bulbophyllum pingnanense* J.F. Liu, S.R. Lan & Y.C. Liang. **A** habitat and habit **B–D** flower **E** dorsal sepal **F** lateral sepal **G** petal **H** lip **I** lip, column, pedicel and ovary, side view **J** pollinia and anther cap.

Phenology. Flowering from June to July.

Conservation status. *Bulbophyllum pingnanense* is known only from the type locality, and only one population of ca. 3000 individual plants was discovered in a small area of ca. 0.002 km² during two years of botanical surveys. Based on the extent of occurrence estimated to be less than 100 km² (CR B1) and the area of occupancy less than 10 km² (CR B2), species existing at a single location (CR B1a + B2a), *B. pingnanense* is assigned a preliminary status of Critically Endangered (CR B1a + B2a) according to the IUCN

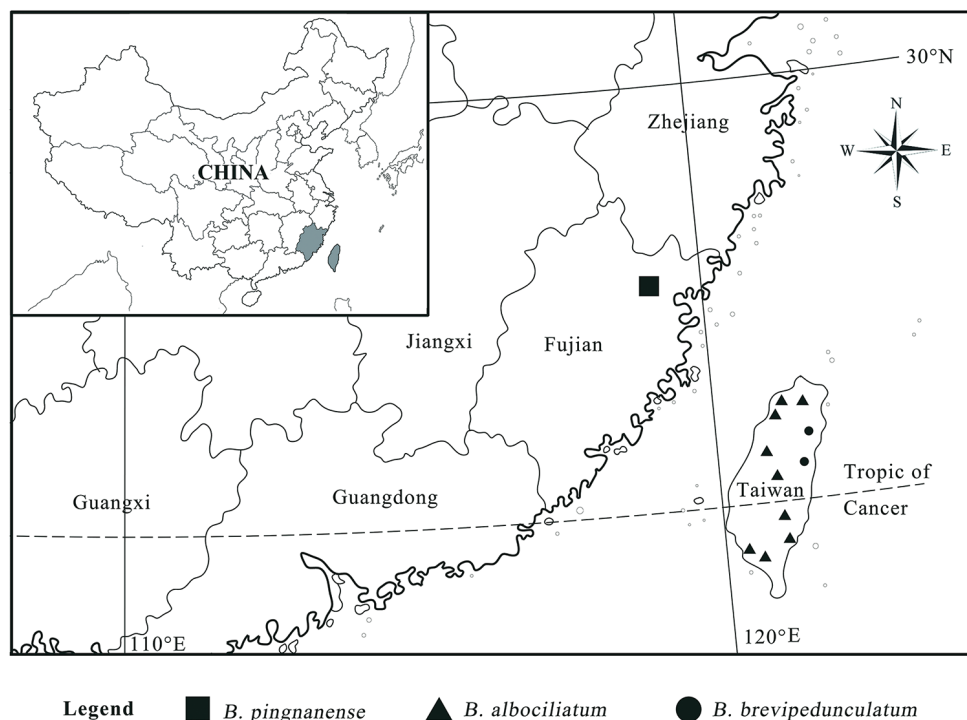


Figure 3. Distribution of *Bulbophyllum pingnanense*, *B. brevipedunculatum* and *B. albociliatum*.

Categories and Criteria (IUCN 2012). In addition, the plants of *Bulbophyllum* are used as herbal medicine in the locality. It is possible that *B. pingnanense* might also be collected for using as herbal medicine. Therefore, immediate conservation strategy should be taken.

Etymology. The species epithet refers to Pingnan County where this new species was found.

Taxonomic notes. Several morphological characters, such as the dorsal sepal being much shorter than the lateral sepals, and the lateral sepals twisting and connected, indicate that this species belongs to sect. *Cirrhopetalum*. *Bulbophyllum pingnanense* is closely related to *B. brevipedunculatum*, but it can be distinguished by having a longer (ca. 5 mm vs. ca. 3.5 mm) dorsal sepal with either an obtuse or an acute (vs. rounded) apex and longer white ciliate (vs. short white ciliate) on margins, longer (10–12 mm vs. 5–7 mm) and lanceolate (vs. near rectangular) lateral sepals, glabrous (vs. adaxially papillose) lip. In addition, the two species had different flowering seasons that never overlapped (June–July vs. March–April), and the nearest distance between them is ca. 370 km, separated by the sea (Fig. 3). The new species is also closely related to *B. albociliatum*, but it can be distinguished by having a shorter (ca. 1.1 cm vs. 4–6 cm) inflorescence, and a longer (ca. 5 mm vs. 3–4 mm) dorsal sepal with either an obtuse or an acute (vs. rounded) apex; the nearest distance between the two species is ca. 350 km, separated by the sea (Fig. 3).

Key to the related species of *Bulbophyllum pingnanense*

- 1 Scape ca. as long as pseudobulb **2**
- Scape much longer than pseudobulb..... **4**
- 2 Lateral sepals near rectangular, 5–7 mm long, ca. 2 × as long as dorsal sepal or shorter ***B. brevipedunculatum***
- Lateral sepals narrowly oblong or lanceolate, ca. 10 mm long, ca. 2 × as long as dorsal sepal or longer **3**
- 3 Scape ca. 4 mm, sepals yellow, lip triangular-lanceolate ***B. henanense***
- Scape ca. 11 mm, sepals orange red, lip ovate-triangular ***B. pingnanense***
- 4 Adaxial surface of lip glabrous, lateral sepals 0.7–1.1 cm ***B. albociliatum***
- Adaxial surface of lip partly papillose, lateral sepals 1.2–1.4 cm ... ***B. kuanwuense***

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Telipogon diabolicus (Orchidaceae, Oncidiinae), a new species from southern Colombia

Marta Kolanowska^{1,2}, Dariusz L. Szlachetko¹, Ramiro Medina Trejo³

1 Department of Plant Taxonomy and Nature Conservation, The University of Gdańsk, Wita Stwosza 59, 80-308 Gdańsk, Poland **2** Department of Biodiversity Research, Global Change Research Institute AS CR, Bělidla 4a, 603 00 Brno, Czech Republic **3** Sibundoy Valley, Alto Putumayo, Colombia

Corresponding author: Marta Kolanowska (martakolanowska@wp.pl)

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Abstract

A new species of the orchid genus *Telipogon*, *T. diabolicus*, is described and illustrated. The information about its habitat is provided. The novelty resembles *T. tabanensis* and *T. guacamayensis* and it is characterized by the translucent flowers, the glabrous, distinctly clawed petals, the transversely elliptic lip, and the gynostemium ornamented with long setose hairs on both sides and shorter hairs at the apex.

Keywords

Andean orchid, biodiversity, new species, Putumayo

Introduction

The Neotropical genus *Telipogon* was established about 200 years ago by Karl Kunth (1816) who recognized only two species within newly published taxon: *T. angustifolius* and *T. latifolius*. The former orchid was earlier recognized as *Tradescantia nervosa* and transferred to *Telipogon* by Druce (1917). During the 19th century, over 40 new species within the genus were described by Reichenbach (e.g. Reichenbach 1854, 1877). Pfitzer (1887) included *Telipogon* in Notylieae tribe while Schlechter (1915) proposed to unite *Trichoceros*, *Telipogon* and *Stellilabium* in a separated subtribe named *Telipo-*

goninae. Dressler and Dodson (1960) classified those genera in *Ornithocephalus* alliance, but Schlechter's proposal was accepted by subsequent morphological taxonomists (e.g. Burns-Balogh and Funk 1986, Dressler 1993, Szlachetko 1995). The results of molecular studies provoked Chase et al. (2003, 2015) to lump all genera mentioned before together with over 50 other taxa in Oncidiinae.

Until 2005 about 190 specific epithets were applied to *Telipogon*. Williams et al. (2005) revealed that, according to the results of phylogenetic studies, *Stellilabium* is embedded within *Telipogon* and 36 species of the former genus were transferred by the authors to *Telipogon*. The novelties within the genus have been frequently published in the last years (e.g. Dressler 2007, Nauray Huari and Galán de Mera 2008, Baquero and Fortunato 2012, Jiménez Pérez 2012, Collantes and Martel 2015) and so far a total of about 250 specific epithets are listed under *Telipogon* according to The International Plant Names Index (2016).

In the most recent catalogue of Colombian plants (Bernal et al. 2015) almost 3600 orchid species representing nearly 250 genera are included. However, there is no doubt that hundreds of species occurring in this country remain undiscovered. Only in 2015 over 20 novelties were published based on material collected in Colombia (e.g. Kolanowska and Szlachetko 2015, Rodríguez Martínez and Blanco 2015, Szlachetko and Kolanowska 2015, Vieira-Urbe and Jost 2015). During the recent studies on Colombian orchids a distinctive species of *Telipogon* was found and it is described here as new species.

Description of the new species

***Telipogon diabolicus* Kolan., Szlach. & Medina Tr., sp. nov.**

urn:lsid:ipni.org:names:77155897-1

Figs 1, 2

Diagnosis. Species similar to *T. tabanensis* and *T. guacamayensis*, distinguished by the translucent, relatively small flowers with sepals reaching 9–10 mm in length, transversely elliptic lip and prominently clawed petals.

Type. COLOMBIA. Putumayo/Nariño: Páramo de Bordoncillo, 3180 m, 7 Nov 2015, R. Medina et al. S15/13 (Holotype JAUM!; Isotype JAUM!; UGDA-DLSz! - drawing).

Description. Stem 5.5–9 cm tall, stem abbreviated. Leaves 2–4.5 × 0.4–1.3 cm, conduplicate, relatively fleshy, ovate-lanceolate to oblanceolate, attenuate towards the base, subacute. Inflorescence 6–9 cm long, 2–3-flowered, peduncle triquetrous. Flowers simultaneous, tepals translucent with reddish veins, gynostemium and lip callus dark violet-maroon. Floral bracts 7–9 mm long, cucullate, ovate, acute. Pedicel and ovary 15–20 mm long, triquetrous. Sepals similar, keeled on the back side. Dorsal sepal 9–9.5 × 4–4.5 mm, concave, ovate-elliptic, acute, 3-veined. Lateral sepals 9–10 × 3–4 mm, concave, ovate-elliptic, acute, somewhat oblique, 3-veined. Petals 10–12 × 9–9.3 mm,

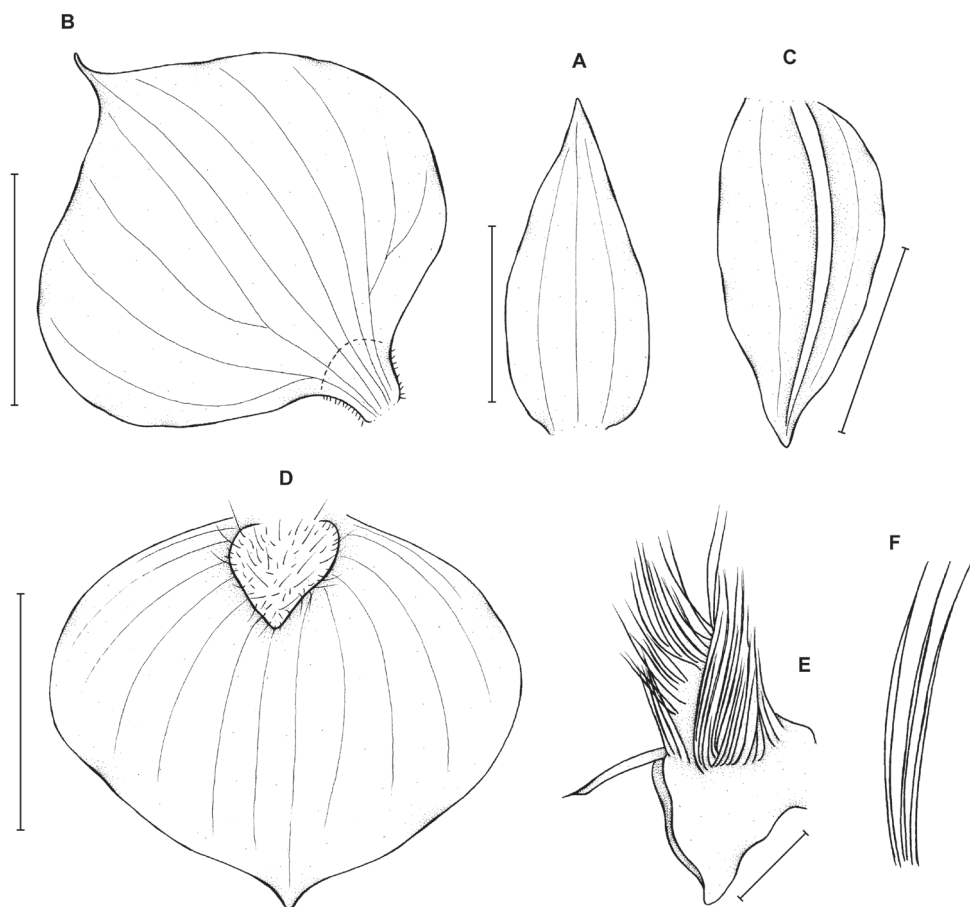


Figure 1. *Telipogon diabolicus* Kolan., Szlach. & Medina Tr. **A** Dorsal sepal **B** Petal **C** Lateral sepal **D** Lip **E** Gynostemium **F** Setae of the gynostemium. Drawn by N. Olędryńska from the holotype. Scale bars: **A–D** = 5 mm, **E** = 2 mm.

rhombic in outline, broadly elliptic ovate to transversely elliptic above prominent claw, acuminate, 9-veined, claw basally thickened and densely ciliolate with papillate margins. Lip 9–9.3 mm long, 10–11 mm wide, transversely elliptic, acute at the apex, 15-veined, margins glandular-ciliate, basal margins with short spines; callus 3–4 mm × 2.5–3 mm, ovate-cordate, densely ciliate with several setae spread all over its surface. Gynostemium about 3 mm tall, clinandrium 3-lobed, lateral bundles of setose hairs elongate up to 3 mm long, the dorsal bundle covering the anther much shorter, area around the stigma papillate, with several setae. Capsule 15–20 mm long.

Etymology. The specific name refers to the distinctive gynostemium which resembles devil's head.

Distribution and ecology. So far this species is known exclusively from southern Colombia, on the border between departments Putumayo and Nariño. It was found



Figure 2. *Telipogon diabolicus* Kolan., Szlach. & Medina Tr. **A–B** Plant habit **C** Flower closeup. Photos by M. Kolanowska.

growing epiphytically in wet, dwarf montane forest at the edge of páramo. The population which was observed during the field study consists of about 30 specimens of which only several were adult, flowering plants.

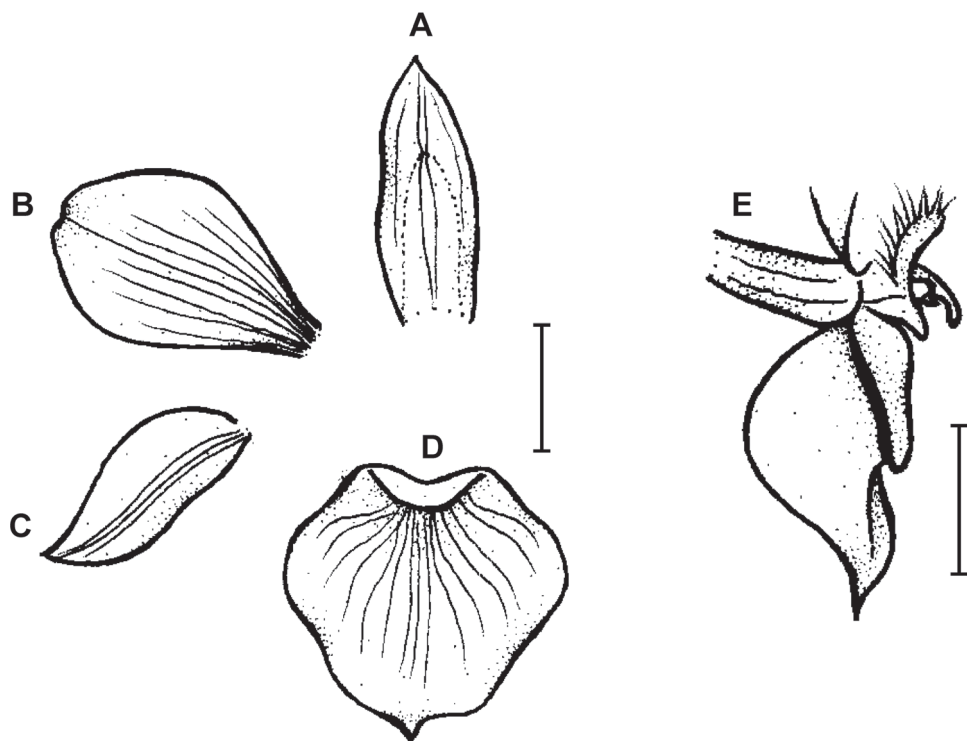


Figure 3. *Telipogon guacamayensis* Dodson & R. Escobar. **A** Dorsal sepal **B** Petal **C**: Lateral sepal **D** Lip **E** Lip, side view. Redrawn by N. Olędzzyńska from original illustration presented by Dodson and Escobar (in Dodson 1989a). Scale bars: 5 mm.

Conservation status. IUCN Red List category: Critically Endangered, [CR B2ab(iii)]. This species is only known from the type specimens, which represent one location in highly vulnerable habitat near the main road Pasto-Mocoa. It is expected that the current reconstruction of this road will have negative impact on the habitat of *T. diabolicus*.

Discussion. The new species can be misidentified with its Colombian congener *T. tabanensis* Dodson & R. Escobar (1993) and Ecuadorian *T. guacamayensis* Dodson & R. Escobar (in Dodson 1989a), but both those orchids are characterized by yellow flowers with dark (wine-red to maroon) gynostemium and callus (vs flowers translucent in *T. diabolicus*). Flowers of both *T. tabanensis* and *T. diabolicus* are resupinate (non-resupinate in *T. guacamayensis*), but those of *T. tabanensis* are much larger – sepals are about 17 mm long (vs 9–10 mm in *T. diabolicus*), petals reach 20 mm in length (vs 12 mm). Petals of the former are densely spinose-hirsute at the base while in the new species and in *T. guacamayensis* (Fig. 3) they are glabrous. In both *T. tabanensis* (Fig. 4) and *T. guacamayensis* the lip is 17-veined (vs 15-veined in *T. diabolicus*) and it is subtrullate (*T. guacamayensis*) or elliptic (*T. tabanensis*). All three species are

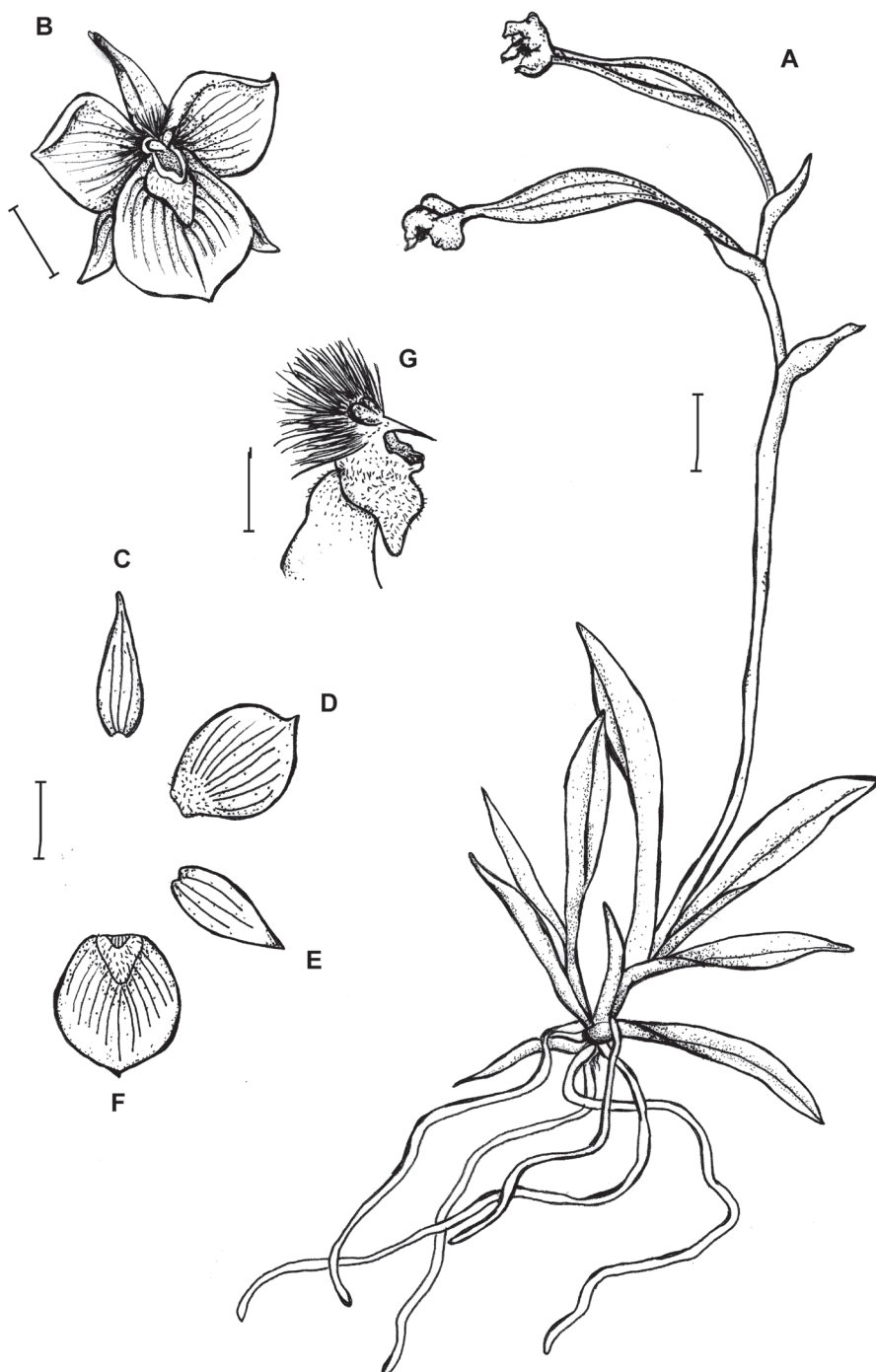


Figure 4. *Telipogon tabanensis* Dodson & R. Escobar **A** Habit **B** Flower **C** Dorsal sepal **D** Petal **E** Lateral sepal **F** Lip **G** Gynostemium and lip callus, side view. Redrawn by M. Staroń from original illustration presented by Dodson and Escobar (1993). Scale bars: **A–F** = 10 mm, **G** = 5 mm.

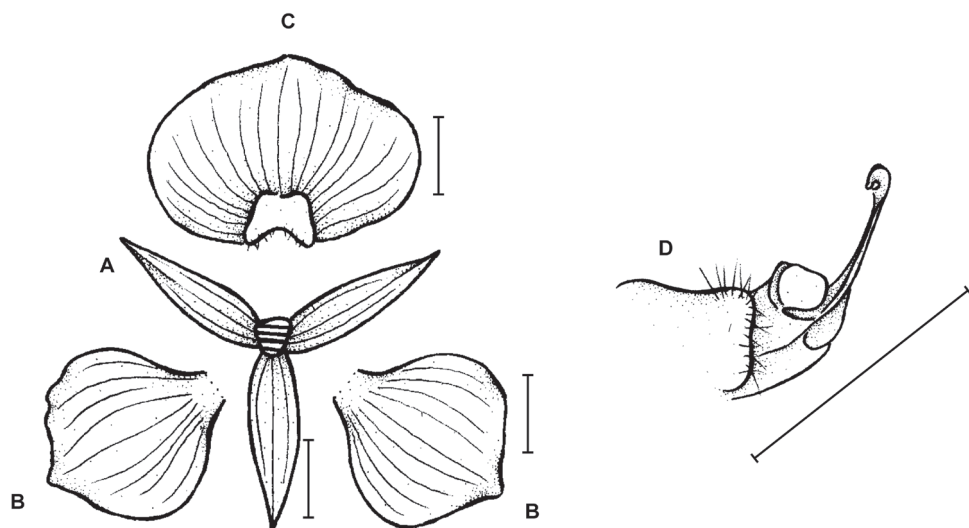


Figure 5. *Telipogon intis* Braas **A** Sepals **B** Petal **C** Lip **D** Gynostemium. Redrawn by N. Olędryńska from Dodson and Bennett (in Dodson 1989). Scale bars: 10 mm.

characterized by presence of prominent, more or less cordate basal lip callus which is about 6 mm long in *T. tabanensis* and *T. guacamayensis* (up to 4 mm in *T. diabolicus*). Only in *T. diabolicus* the basal lip margin is covered with short spines. The additional difference between *T. tabanensis* and the new species is found in the gynostemium ornamentation. In the former orchid it is covered with equally long setose hairs while in *T. diabolicus* (and *T. guacamayensis*) the lateral bundles of hairs are elongated, longer than the dorsal bundle covering the anther.

The most distinguishing character of the new species are prominently clawed petals. At the best of our knowledge, this character is not found in any other Colombian species of the genus. Interestingly, at least 3 species from Peru share this feature, i.e. *T. intis* Braas (Fig. 5), *T. lueri* Dodson & Bennett (Fig. 6) and *T. mendiolae* Dodson & Bennett (Fig. 7). In the first of the Peruvian species aforementioned the obtuse lip has 17 nerves, petals are acute and gynostemium is sparsely setose on clinandrium. *T. mendiolae* can be characterized by transversely elliptic, obtuse lip with 17 nerves, and transversely elliptic, shortly apiculate petals. Flowers of this species are about twice larger than those of *T. diabolicus*. *T. lueri* differs from our new species by having twice larger flowers, densely setose gynostemium and petals with 11 nerves.

Telipogon diabolicus somewhat resembles also Ecuadorian *T. ecuadorensis* Schltr. (Fig. 9) and *T. bruchmuelleri* Rchb.f. (Fig. 8) known from Ecuador and Venezuela. In all aforementioned species the lip is similar in form, i.e. more or less transversely elliptic with ovate-cordate basal callus. Unlike in *T. diabolicus* the gynostemium of *T. bruchmuelleri* and *T. ecuadorensis* is densely covered by setose hairs (vs setose hairs found only on clinandrium), and petals are sessile (vs clawed).

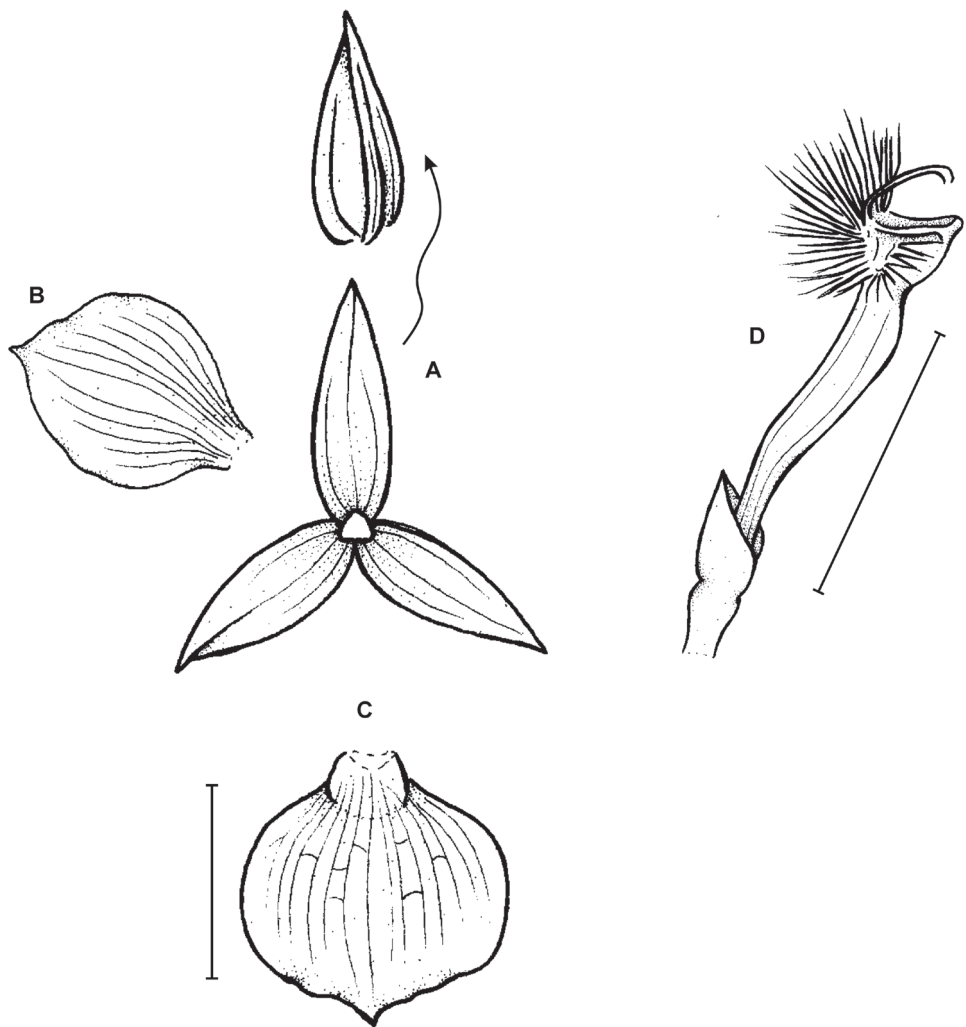


Figure 6. *Telipogon lueri* Dodson & Bennett **A** Sepals **B** Petal **C** Lip **D** Gynostemium. Redrawn by N. Olędryńska from original illustration presented by Dodson and Bennett (*in* Dodson 1989b). Scale bars: 20 mm.

Key to identification of *T. diabolicus* and similar species

- 1 Petals distinctly clawed2
- Petals subsessile.....5
- 2 Gynostemium almost glabrous, very sparsely setose exclusively on clinandrium *T. intis*
- Gynostemium densely covered by hairs3
- 3 Lip ecallose4
- Lip with prominent, ovate-cordate callus *T. diabolicus*

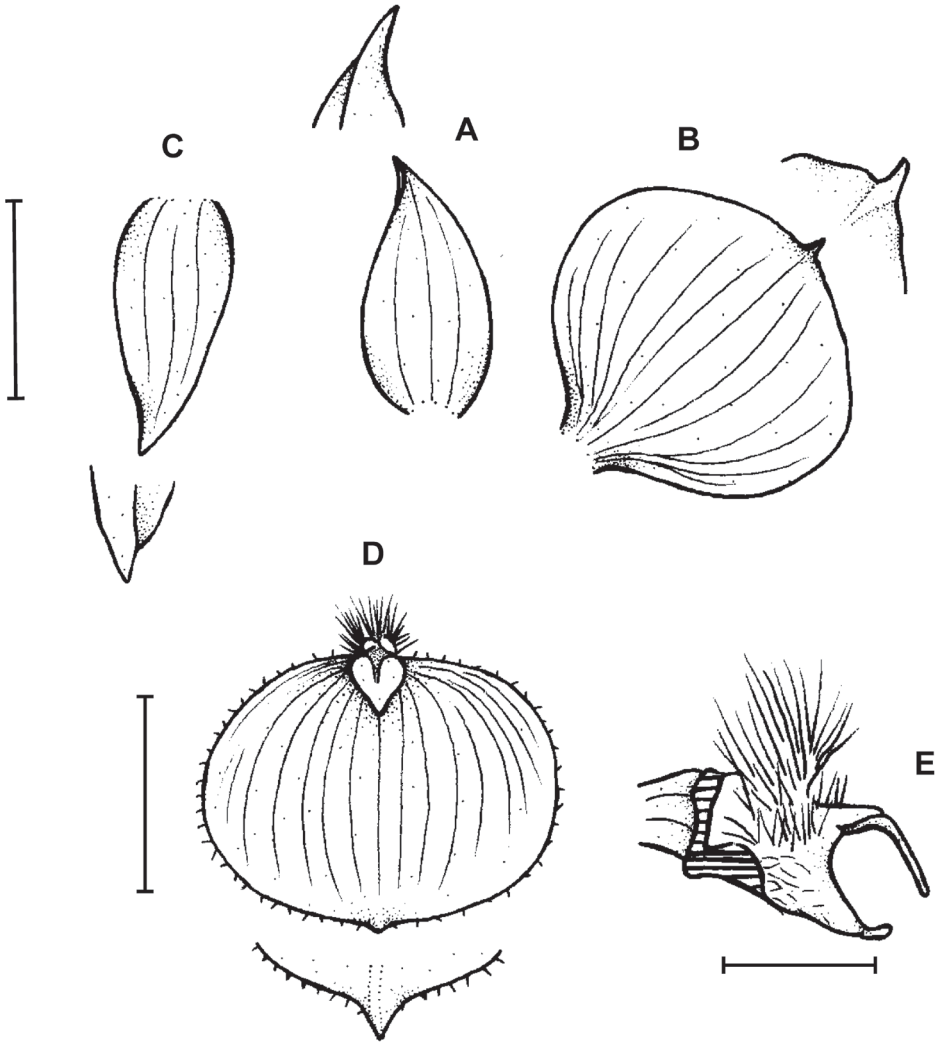


Figure 7. *Telipogon mendiolae* Dodson & Bennet. **A** Dorsal sepal **B** Petal **C** Lateral sepal **D** Lip **E** Gynostemium. Redrawn by N. Olędrzyńska from original illustration presented by Dodson and Bennett (in Dodson 1989b). Scale bars: **A–D** = 10 mm, **E** = 3 mm.

4	Petals transversely elliptic.....	<i>T. mendiolae</i>
–	Petals ovate.....	<i>T. lueri</i>
5	Petals densely spinose-hirsute at the base.....	<i>T. tabanensis</i>
–	Petals glabrous.....	6
6	Petals 5- or 7-veined.....	<i>T. bruchmuelleri</i>
–	Petals 9-veined.....	7
7	Lip 13 × 12 mm, 17-veined.....	<i>T. guacamayensis</i>
–	Lip 23 × 26 mm, 15-veined.....	<i>T. ecuadorensis</i>

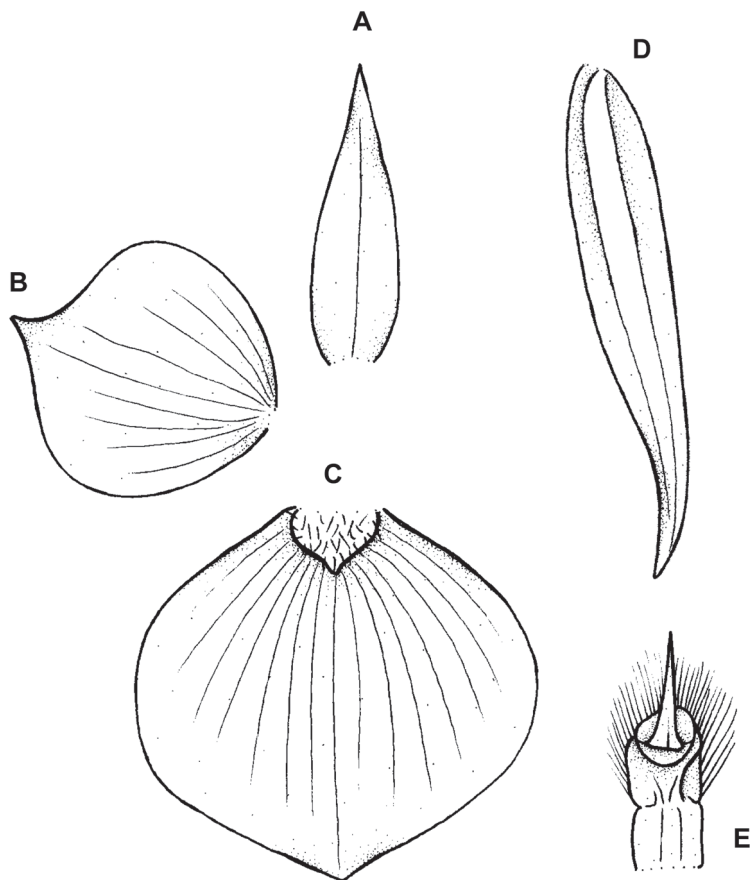


Figure 8. *Telipogon ecuadorensis* Schltr. **A** Dorsal sepal **B** Petal **C** Lateral sepal **D** Lip **E** Gynostemium. Redrawn by N. Olędrzyńska from Schlechter (1929).

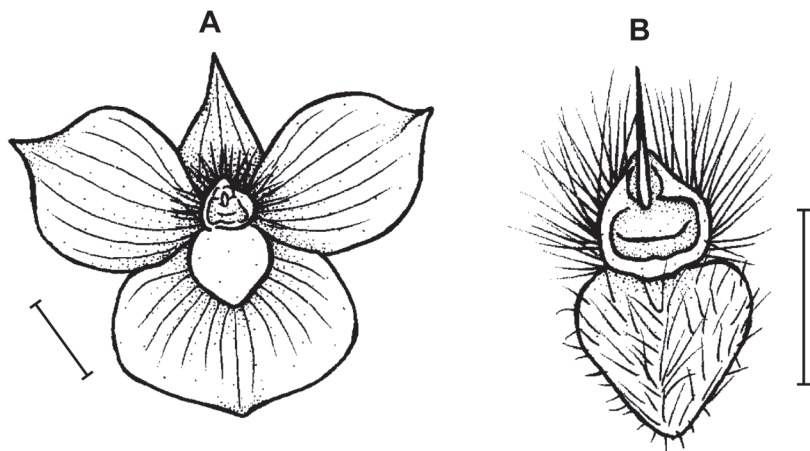


Figure 9. *Telipogon bruchmuelleri* Rchb.f **A** Flower **B** Gynostemium and lip callus. Redrawn by N. Olędrzyńska from Dodson and Dodson (*in* Dodson 1984). Scale bars: 5 mm.

Acknowledgments

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Popowia bachmaensis (Annonaceae), a new species from Bach Ma National Park, Central Vietnam

Nguyen Van Ngoc^{1,2}, Shuichiro Tagane¹, Hoang Thi Binh^{1,2}, Hironori Toyama¹,
Norikazu Okabe¹, Chinh Nguyen Duy², Tetsukazu Yahara¹

1 Center for Asian Conservation Ecology, Kyushu University, 744 Motoooka, Fukuoka, 819-0395, Japan **2** Department of Biology, Dalat University, 01 – Phu Dong Thien Vuong, Dalat, Vietnam

Corresponding author: *Nguyen Van Ngoc* (ngocnv@dlu.edu.vn)

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Abstract

A new species, *Popowia bachmaensis* Ngoc, Tagane & Yahara, **sp. nov.** is described from Bach Ma National Park in Thua Thien Hue Province, Central Vietnam. This species is morphologically similar to *Popowia pisocarpa* (Blume) Endl. ex Walp., but can be readily distinguished from it by its lower stems, smaller leaves, shorter flowering pedicels, shorter carpels, longer sepals and inner petals. A detailed description, comprising illustrations, and supplemented with DNA barcodes of the two regions of *rbcL* and *matK*, are provided.

Keywords

Annonaceae, Bach Ma National Park, new species, *Popowia*, Vietnam

Introduction

Popowia Endlicher is a small genus of the family Annonaceae. It was firstly described in the Genera Plantarum secundum Ordines Naturales for the type species, *Popowia pisocarpa* (Blume) Endl. ex Walp. (Endlicher 1839). The species is a shrub or a small tree, characterized mainly by its (sub)granular leaves with asymmetric base, inner petals being larger than outer ones, apically broadly flat-topped to slightly concave stamen connectives, 1 or 2(–4) ovule(s) per carpel (Moeljono 2009; Li and Gilbert 2011). The genus comprises approximately 50–90 species, but many of these could in fact belong to other genera (Sinclair 1955). The majority are distributed in tropical Africa, and also recorded from Madagascar,

India, Myanmar, Thailand, Malaysia, Vietnam, China, Indonesia, Philippines, and Papua New Guinea to Australia. (Sinclair 1955; Moeljono 2009; Li and Gilbert 2011).

The genus *Popowia* has been classified within tribe Mitrephoreae Hook. f. & Thomson with the genus *Goniothalamus* (Blume) Hook.f. & Thomson, *Mitrephora* Hook.f. & Thomson, *Neouvaria* Airy Shaw, *Oxymitra* Hook. f. & Thomson and *Pseuduvaria* Miq. (Sinclair 1955; Moeljono 2009). Recent molecular analyses suggested its placement under tribe Miliuseae including a total of 25 genera and ca. 510 species and also strongly supports its monophyly with *Polyalthia* s. str. as a sister clade (Chatrou et al. 2012; Xue et al. 2012; Mols and Keßler 2013; Chaowasku et al. 2014). The species of *Popowia* and *Polyalthia* s. str. are usually characterized by the asymmetrical leaf base, but they are differentiated in the patterns of secondary leaf venation (eucamptodromous in *Popowia* vs. brochidodromous in *Polyalthia* s. str.), and the number of ovules per carpel [1 or 2(–4) vs. 2–6] (Xue et al. 2012).

In a recent taxonomic revision of Annonaceae in Vietnam, Bân (2000) reported three species with one variety of *Popowia*: *P. cambodica* Finet & Gagnep., *P. cambodica* var. *canaensis* Bân, *P. helferi* Hook.f. & Thomson and *P. pisocarpa*. However, specimens of “*P. cambodica* and *P. cambodica* var. *canaensis*” identified by Bân (2000) are identical with *Polyalthia debilis* (Pierre) Finet & Gagnep (digitalized specimen images examined). As for “*P. helferi*”, the description by Bân (2000) does not match with the original description by Hook and Thomson (1872). Therefore, only *P. pisocarpa* can be considered as a reliable record in Vietnam.

Here, the second Vietnamese species of *Popowia* is reported, which was found in Bach Ma National Park, Phu Loc District, Thua Thien Hue Province. This national park was established in 1991 with a total area of 37,487 hectares and is recognized as a biodiversity hotspot because of its unique topography, high species richness and highly threatened biodiversity. The peak of Bach Ma Mt. is 1,450 m high and is covered by clouds almost throughout the year. The park preserves virgin forests, which depending on their altitudinal distribution can be classified as follows: seasonal evergreen forests, hill evergreen forests, and lower montane forests. So far 2,373 species of vascular plants, accounting for approximately 17% species of the total flora of Vietnam, have been recorded from the National Park (Bach Ma National Park 2016).

During our botanical inventory of Bach Ma National Park in 2015, a new species of genus *Popowia* was discovered, *P. bachmaensis* Ngoc, Tagane & Yahara, sp. nov. Here, it is described, illustrated and the DNA barcodes are provided of the two plastid regions *rbcL* and *matK* (CBOL Plant Working Group 2009) of the new species.

Material and methods

Morphological analysis

The new species was recognized through literature review, examined specimens in the herbaria ANDA, BKF, BM, BO, HN, K, L, P and online digitized plant specimens

(e.g. JSTOR Global Plants). The measurements of sepals, petals, carpels and stamens was measured using a digital caliper (Absolute Digimatic 547-401, Mitutoyo, Japan, resolution 0.001 mm).

DNA barcoding

Leaf pieces were dried using silica-gel in the field and DNA isolation was performed by the CTAB method (Doyle and Doyle 1987) with minor modifications described in Toyama et al. (2015). Two DNA barcode regions were amplified and sequenced according to published protocols (Kress et al. 2009, Dunning and Savolainen 2010).

Taxonomy

***Popowia bachmaensis* Ngoc, Tagane & Yahara, sp. nov.**

urn:lsid:ipni.org:names:77155959-1

Figs 1, 2

Diagnosis. Similar to *Popowia pisocarpa* (Blume) Endl. ex Walp., but distinguished from that species by having small habits (30–60 cm tall vs. 3–7 m tall in *P. pisocarpa*), smaller leaves (4.6–10.8 cm × 2.0–5.6 cm vs. 5.5–14 cm × 2.5–7 cm in *P. pisocarpa*), longer petioles (ca. 1.8–3 mm vs. 2–5 mm long) shorter flowering pedicels (2–3.5 vs. 4–7 mm long), longer sepals (ca. 3 mm vs. 2 mm long), longer inner petals (6 mm vs. 3 mm long), shorter carpels (2.1 mm vs. 10 mm long) (The measurements of *P. pisocarpa* derive from Sinclair 1955).

Type. VIETNAM. Thua Thien Hue Province, Bach Ma National Park, in evergreen forest, 16°13'41.60"N, 107°51'09.35"E (DMS), alt. 485 m, 23 May 2015, with flowers and young fruits, *Yahara T*, *Tagane S.*, *Toyama H.*, *Nguyen Ngoc*, *Nguyen Chinh*, *Okabe N.* V2557 (holotype: KYO!; isotypes: BKF!, DLU!, FU!, the herbarium of Bach Ma National Park!).

Description. Shrubs, 30–60 cm tall. Young twigs hirtellous with yellowish brown hairs, glabrescent, blackish. Leaves alternate; petioles 1.8–3 mm long, hirtellous; blades elliptic, elliptic-obovate, obovate, (3.7–)4.6–10.8(–15) × 2.0–5.6 cm, length/width ratio 1.7–2.5(–3.2), base obtuse, usually asymmetric, apex acuminate, acumen up to 1.4 cm long, margin entire, ciliate, papery, dull greyish green to dull blackish brown adaxially, pale green, dull greyish green, or greyish brown abaxially, minutely granular, pubescent on both surfaces when young, glabrescent adaxially when old; midribs prominent abaxially, pubescent on both surfaces; secondary veins 7–11 pairs, arising at angle of 45–55 degrees from a midrib, prominent abaxially when dry, pubescent on both surfaces; tertiary veins faintly visible, scalariform-reticulate. Inflorescences extra-axillary or leave-opposed, fascicles of 1–3 flowers. Pedicels 2–3.5 mm long, hirtellous; bracts triangular, ca. 1 mm long, ca. 0.5 mm wide, brownish pubescent outside and

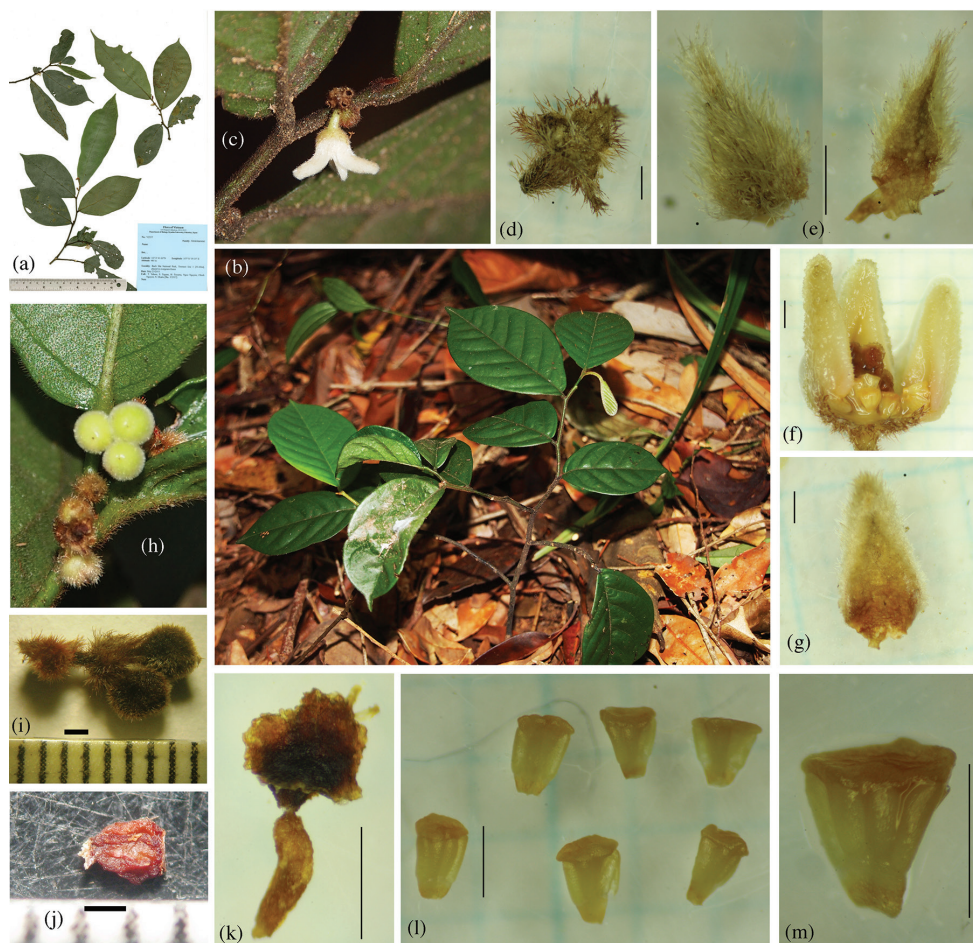


Figure 1. *Popowia bachmaensis*, sp. nov. **a** Holotype (KYO) **b** habit **c** flower **d** pedicel and sepals **e** sepals **f** section of flower **g** inner petal **h** fruit on branch **i** dried fruit **j** seed **k** carpel **l, m** stamens. Materials from *Yahara et al.* V2557 (KYO). Scale bars: **d–g, i–m** = 1 mm.

margin, glabrous inside, bracteoles caducous. Sepals 3, broadly ovate, ca. 3×3 mm, pubescent outside, glabrous inside. Petals 6, white; outer petals ovate-triangular, ca. 2.7×1.5 mm, pubescent outside, glabrous inside; inner petals narrowly ovate-triangular, ca. 6×3.2 mm, pubescent on both surfaces except lower part of inside. Stamens 22 per flower, reverse truncated pyramid, ca. 1.1×0.8 mm, glabrous, the connective truncate, flat-topped or slightly concave, ca. 0.1–0.2 mm long; anthers ca. 0.7 mm long. Carpels 6 per flower, ca. 2.1 mm long; ovary ca. 1.1 mm long, glabrous; stigmas and pseudostyles reverse conical, ca. 1×0.7 mm. Immature fruiting pedicels ca. 3.5–4.0 mm long, pubescent with reddish brown hairs; monocarp three, globose, ca. 2.2 mm in diam., pubescent with short white hairs, hairs blackish brown when dried. Seeds one per monocarp, ca. 1.5 mm long, reddish brown, glabrous, furrowed when dried.

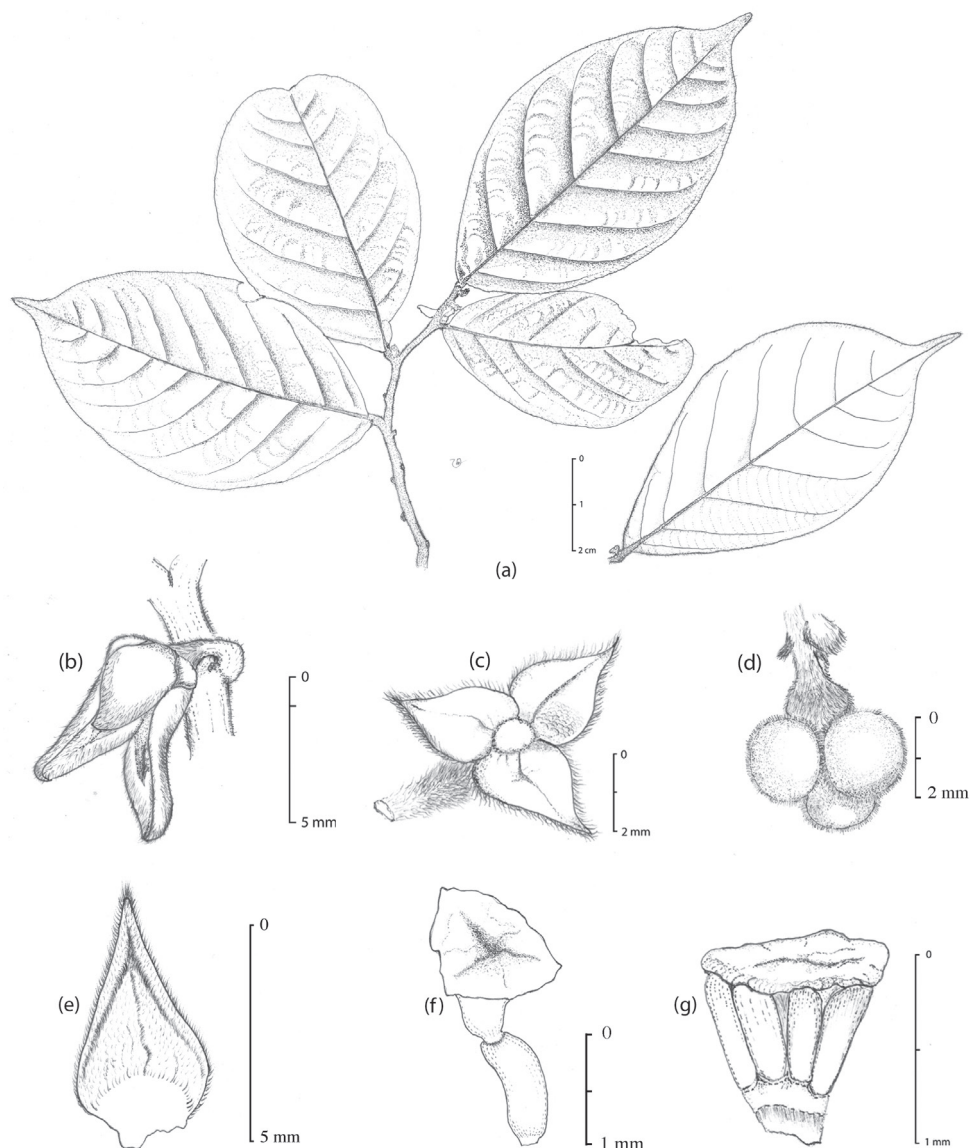


Figure 2. Illustration of *Popowia bachmaensis*, sp. nov. **a** Leafy twig **b** Flower **c** Pedicel and sepals **d** Fruit **e** Inner petal **f** Carpel and **g** Stamen. Materials all from Yahara et al. V2557 (FU). Drawn by Ngoc & Binh.

Distribution and habitat. Vietnam (so far known only from its type locality).

Phenology. Mature flowers and young fruits were collected in May.

Etymology. The specific epithet '*bachmaensis*' is derived from the type locality, Mt. Bach Ma, Vietnam.

GeneBank accession No. *Yahara et al.* V2557: LC090861 (*rbcl*), LC090860 (*matK*).

Conservation status. Data Deficient (DD). During the botanical inventory carried out from 21 to 28 May 2015 from the foot to the top of Mt. Bach Ma, 15 individuals of *Popowia bachmaensis* were observed in all. They were found on the slopes of secondary hilly evergreen forest, at ca. 500 m elevation. Among them, only two individuals produced flowers, one produced fruits, and the others are just saplings. According to the population size observed, this species can be qualified as Critically Endangered (CR) (IUCN 2012). However, only a limited area of the forest in the vicinity of the type locality was surveyed, and further field surveys are needed to determine the actual population size within Bach Ma National Park. The forest of the type locality was slightly disturbed in the past, but it is now well-protected from human activities.

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