Plant diversity of Southeast Asia-II

Edited by

Xiao-Hua Jin, Nian-He Xia, Yun-Hong Tan

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Contents

1 **Documentation of plant diversity of Southeast Asia: the new role of Belt and Road Initiative**
Mung Htoi Aung, De Zhu Li, Yun Hong Tan, Nian He Xia, Rui Chuan Quan, Xiao Hua Jin

3 **Three new fossil records of *Equisetum* (Equisetaceae) from the Neogene of south-western China and northern Vietnam**
Aye Thida Aung, Jian Huang, Truong Van Do, Ai Song, Jia Liu, Zhe-Kun Zhou, Tao Su

17 **A new species and two new records of *Goniothalamus* (Annonaceae) from Lao PDR**
Bin Yang, Ren-Bin Zhu, Hong-Bo Ding, Somsanith Bouamanivong, Yun-Hong Tan

27 **Two new species of *Alseodaphnopsis* (Lauraceae) from southwestern China and northern Myanmar: evidence from morphological and molecular analyses**
Lang Li, Yun-Hong Tan, Hong-Hu Meng, Hui Ma, Jie Li

41 ***Colocasia kachinensis*, a new species of Araceae from Myanmar**
Shi-Shun Zhou, Rui-Chang Quan, Ren Li, Qiang Liu, Jian-Tao Yin

49 **An annotated checklist of Myanmar orchid flora**
Ye Lwin Aung, Aye Thin Mu, Mung Htoi Aung, Qiang Liu, Xiaohua Jin

113 **Notes on the genus *Gastrochilus* (Orchidaceae) in Myanmar**
Qiang Liu, Shi-Shun Zhou, Ren Li, Yun-Hong Tan, Myint Zyaw, Xiao-Ke Xing, Jiang-Yun Gao

125 ***Bulbophyllum papuaense* (Orchidaceae), a new species from Indonesia**
Dongliang Lin, Kailing Zhou, Arief Hidayat, Xiao-Hua Jin

131 **A new species of *Zingiber* (Zingiberaceae) from Natma Taung National Park, Chin State, Myanmar**
Ren Li, Law Shine, Wu Li, Shi-Shun Zhou

139 **Taxonomic studies on *Amomum* Roxburgh s.l. (Zingiberaceae) in Myanmar II: one new species and five new records for the flora of Myanmar**
Hong-Bo Ding, Bin Yang, Mya Bhone Maw, Pyae Pyae Win, Yun-Hong Tan

155 **A new species and two new combinations of *Monolophus* (Zingiberaceae) from Indo-Burma**
Hong-Bo Ding, Bin Yang, Mya Bhone Maw, Pyae Pyae Win, Yun-Hong Tan

163 ***Khoonmengia honbaensis*, a new genus and species of temperate bamboo (Poaceae, Bambusoideae) from central-southern Vietnam**
Yi-Hua Tong, Xi-Rong Zheng, You Yuan Zhang, Qiao-Mei Qin, Jing-Bo Ni, Tien Chinh Vu, Nian-He Xia

179 ***Schizostachyum dakrongense* (Poaceae, Bambusoideae), a new species from Dakrong Nature Reserve, Vietnam**
Zhuo-Yu Cai, Yi-Hua Tong, Tien-Chinh Vu, Jing-Bo Ni, Nian-He Xia

187 **An updated checklist of *Begonia* (Begoniaceae) in Laos, with two new species and five new records**
Hong-Bo Ding, Mya Bhone Maw, Bin Yang, Somsanith Bouamanivong, Yun-Hong Tan

203 **Taxonomic studies on *Begonia* (Begoniaceae) in Myanmar I: three new species and supplementary description of *Begonia rheophytica* from Northern Myanmar**
Mya Bhone Maw, Hong-Bo Ding, Bin Yang, Pyae Pyae Win, Yun-Hong Tan

219 ***Ophiorrhiza monsvictoriae* (Rubiaceae, Rubioideae), a new species from Myanmar**
Shi-Shun Zhou, Ren Li, Rui-Chang Quan, Law Shine, Lin-Dong Duan

225 ***Blumea htamanthii* (Asteraceae), a new species from Myanmar**
Yulan Peng, Chenxuan Yang, Yan Luo

233 ***Ainsliaea daheishanensis* (Asteraceae): a new species from China**
Yulan Peng, Chenxuan Yang, Yan Luo

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EDITORIAL

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Documentation of plant diversity of Southeast Asia: the new role of Belt and Road Initiative

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Myers et al. (2000) identified 25 global biodiversity hotspots, four of these hotspots, namely Indo-Burma, Sundaland, Wallacea and Phillipines, being in Southeast (SE) Asia. Biodiversity in SE Asia is under various threats (Schipper et al. 2008, Hughes 2017, Aung et al. 2020). It was estimated that SE Asia has become one of the areas with the highest deforestation rates in the world and, if the deforestation rates were to continue at the present levels (0.3% loss per year), SE Asia will lose almost three-quarters of its original forest by the next century 2100, resulting in loss of its biodiversity by up to 42% (Sodhi et al. 2004). The support of international cooperation and research efforts from regional and international expertise for biodiversity research are urgently needed in SE Asia (Sodhi et al. 2004, Hughes 2017).

The Belt and Road Initiative (BRI) is a long term programme to connect the world with the aim of increasing trade and economic growth and accerelating regional integration. BRI extends into global biodiversity conservation. SE Asia is one of the BRI regions. In order to conserve high biodiversity and promote sustainable development in SE Asia, the Southeast Asian Biodiversity Research Institute (SEABRI) was established by the Chinese Academy of Sciences (CAS), in Nay Pyi Taw in 2015 (mistakenly printed as '2014' in Jin et al. 2018) in cooperation with the Forest Research Institute under the

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auspices of the Ministry of Environmental Conservation and Forestry of Myanmar. With financial and personnel support from CAS, SEABRI actively participates in conservation actions by undertaking local awareness of biodiversity and public education training, awarding scholarships for young scientists and supporting regional capacity building.

The documentation of the rich biodiversity in SE Asia is the very first step towards understanding and conservation of biodiversity (Cai et al. 2019). The first special issue of the documentation of plant diversity in SE Asia by SEABRI was published in Phytokeys in 2018 (Jin et al. 2018). This successive special issue represents new contributions by SEABRI to promote our understanding of the biodiversity and conservation in the region. Seventeen articles have been contributed mainly by young botanists from Southeast Asian countries with support from SEABRI. Most articles in the issue involve the documentation of taxonomic discovery by a cooperation team of SEABRI and local botanists and includes new taxa and new records from botanical surveys in the region. They include three new fossil records of *Equisetum* (Equisetaceae) from the Neogene of South-Western China and Northern Vietnam, a new genus and species of temperate bamboo (Poaceae, Bambusoideae) from Central-Southern Vietnam and a new species of paleotropical bamboo genus *Schizostachyum* (Poaceae, Bambusoideae) from Vietnam, a new species and two new records of *Goniothalamus* (Annonaceae) from Laos and studies of *Begonia* (Begoniaceae) from Laos and Myanmar, a new species of *Bulbophyllum* (Orchidaceae) from Indonesia, two new species of *Alseodaphnopsis* (Lauraceae) from South-Western China and Northern Myanmar, a new species of *Ainsliaea* (Asteraceae) from near the border of Myanmar and China, new species of *Colocasia* (Araceae), *Ophiorrhiza* (Rubiaceae), *Blumea* (Asteraceae) and *Zingiber* (Zingiberaceae) from Myanmar and taxonomic studies on *Amomum* (Zingiberaceae) from Myanmar, an annotated checklist of Orchidaceae and notes on *Gastrochillus* (Orchidaceae) from Myanmar and a new species and two new combinations of *Monolophus* (Zingiberaceae) from Indo-Burma. All these studies were financially supported by the CAS.

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RESEARCH ARTICLE

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Three new fossil records of *Equisetum* (Equisetaceae) from the Neogene of south-western China and northern Vietnam

Aye Thida Aung[1,2,3], Jian Huang[1], Truong Van Do[4,5], Ai Song[1,6], Jia Liu[1], Zhe-Kun Zhou[1,7], Tao Su[1,2,3]

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Abstract

Three fossil species of *Equisetum* (Equisetaceae) were reported from the Neogene of south-western China and northern Vietnam, based on well-preserved rhizomes with tubers. *Equisetum* cf. *pratense* Ehrhart from the middle Miocene of Zhenyuan County, Yunnan Province, China is characterised by a bunch of three ovate tubers with longitudinal ridges on the surface. *Equisetum yenbaiense* A.T. Aung, T. Su, T.V. Do & Z.K. Zhou, **sp. nov.** from the late Miocene of Yenbai Province, Vietnam is characterised by four bunches of elongate tubers arranged in a whorl on a node. *Equisetum yongpingense* A.T. Aung, T. Su & Z.K. Zhou, **sp. nov.** from the late Pliocene of Yunnan is characterised by fibrous roots on most nodes and two to four bunches of large cylindrical tubers arranged in a whorl on a node. Floristic assemblages suggest that these species might have grown near a riverside or lakeshore. These new fossil records improve our understanding of species richness of *Equisetum* and their distribution range during the Neogene in Asia.

Keywords

Diversity, *Equisetum*, Miocene, Pliocene, rhizome tubers

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Introduction

The order Equisetales, including Calamitaceae, Tchernoviaceae, Gonduanostachyaceae and Equisetaceae, has a very long evolutionary history that can be dated back to the Devonian (Gu and Shi 1974; Wang et al. 2005). Amongst the families, only Equisetaceae is extant. The earliest fossil record of Equisetaceae could be traced back to the Carboniferous, with *Equisetites hemingwayii* from the early Pennsylvanian of Yorkshire, UK (Kidston 1883). *Equisetum* (Horsetails) is the only living genus in the family Equisetaceae, with about 15 species distributed widely around the world, except for Antarctica (Kenrick and Crane 1997). It is characterised by hollow aerial stems with nodes and reduced leaves, which are similar to their arborescent ancestors. *Equisetum laterale* from the Middle Triassic of Australia is the oldest fossil species in *Equisetum* (Gould 1968). Even some *Equisetum*-like fossils from the Mesozoic have been identified as *Equisetum*, the divergence of *Equisetum* species occurred during the late Eocene (~40 Ma) according to molecular data, with the main radiation during the Neogene (Des Marais et al. 2003; Elgorriaga et al. 2018).

In *Equisetum* fossils, tuberous rhizomes are the most commonly preserved organ in the Cenozoic strata around the world, such as in North America (Lesquereux 1878; Bell 1949; Becker 1969; Skog and Dilcher 1994), Europe (Watson and Batten 1990; Denk et al. 2005) and Asia (Kon'no 1962; Wu 1999; Sun et al. 2001). In China, the fossil records are rich, but most fossils are limited in northern China, for examples, in the Lower Cretaceous Yixian Formation and Fuxin Formation in Liaoning (Chen et al. 1988; Sun et al. 2001), the Lower Cretaceous Muling Formation of Jixi Basin, Heilongjiang (Yang 2003) and the Middle Eocene Hunchun Formation in Jilin (Guo 2000). In south-western China, only four fossil records of *Equisetum* have been found, i.e. *Equisetum* cf. *oppositum* from the Paleocene-Eocene of the Niubao Formation in Nima Basin, northern Tibet (Yang et al. 2016), *Equisetum oppositum* from the Lower Oligocene Lawula Formation in eastern Tibet (Ma et al. 2012), *Equisetum* cf. *pratense* from the Lower Oligocene of Lühe coal-mine in south-central Yunnan (Zhang et al. 2007) and *Equisetum* sp. from the Middle Miocene Wulong Formation in southern Tibet (Geng and Tao 1982).

Although some species of *Equisetum* still survive in Asia nowadays, such as *Equisetum diffusum*, *Equisetum hyemale* and *Equisetum pratense*, its fossil records remain limited, especially during the Neogene. In this study, we describe three fossil species of *Equisetum* from the Neogene of south-western China and northern Vietnam. Further, we discuss the ecological and biogeographic implications, based on these new fossil records.

Materials and methods

Fossil localities

Zhenyuan, south-western China (the middle Miocene). A fossil was found in the Dajie Formation, Sanzhangtian Village, Zhenyuan County, central Yunnan Province, south-western China (Fig. 1). The Dajie Formation, which is mainly distributed in

central Yunnan, is assigned to the middle Miocene in age, based on lithological and palynological comparisons (Bureau of Geology and Mineral Resources of Yunnan Province (BGMRYP) 1990). Fossil in this study is from light yellow mudstone of the upper layer in the stratum. Many plant fossil species have been previously reported from the same site, including *Palaeosorum ellipticum* (Jacques et al. 2013), *Bambusium angustifolia*, *B. latifolia*, *Bambusiculmus angustus*, *B. latus* (Wang et al. 2013), *Celastrus caducidentatus* (Liang et al. 2016a), *Populus zhenyuanensis* (Liang et al. 2016b), *Cladium zhenyuanensis* (Liang et al. 2017), *Zygogynum poratus* (Liang et al. 2018), and *Metasequoia* cf. *glyptostroboides* (Wang et al. 2019).

Yen Bai, northern Vietnam (the late Miocene). Fossils were found in the Co Phuc Formation, Hop Thanh Village, Tuy Loc Commune, Yen Bai Province, northern Vietnam (Fig. 1). The fossil site is situated in the Yen Bai Basin along the Red River Fault Zone, which is a main Cenozoic strike-slip zone in Southeast Asia. The Co Phuc Formation belongs to the late Miocene in age which mainly consists of siltstone and fine sandstone (Wysocka and Świerczewska 2010). The fossils included in this study were collected from the yellow siltstone of the upper layer. Plant fossils such as Polypodiaceae, Palmae and Lauraceae have been previously reported from the fossil site (Zeiller 1903; Colani 1920).

Yongping, south-western China (the late Pliocene). The fossils were found in the Sanying Formation, Longmen Village, Yongping County, Yunnan Province, south-western China (Fig. 1). According to a recent paleomagnetic study, the Sanying Formation was dated from the late Miocene to the early Pleistocene (Li et al. 2013). This formation is widely distributed in western and north-western Yunnan Province (BGMRYP 1990). Fossils here are from siltstone in the middle part of the stratum, which is dominated by *Quercus* section *Heterobalanus* (evergreen sclerophyllous oak) (Su 2010). Some other species, including *Drynaria callispora* (Su et al. 2011) and *Cedrus angusta* (Su et al. 2013b) have been reported from the same site. According to paleoclimate reconstruction using leaf assemblage of the flora, a warmer and more humid climate than nowadays existed in western Yunnan during the late Pliocene (Su et al. 2013a).

Morphological observation

Equisetum fossils were imaged to view gross morphology by using a digital camera (Nikon D700) with a Kaiser 5510 stand and oblique light. To observe morphological characters in detail, fossils were photographed by stereoscope microscopes (Leica A8APO and ZEISS Smart Zoom 5). The contrast of images was slightly adjusted using the software Adobe Photoshop (version CC 2018). Morphological characters were measured by ImageJ (version 1.52). For comparison with previously published fossil taxa, we checked fossil records from online databases, for examples, Web of Science and Google Scholar. All fossil specimens in this study are deposited in the Paleoecology Collections, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and Vietnam National Museum of Nature, Vietnam Academy of Science and Technology.

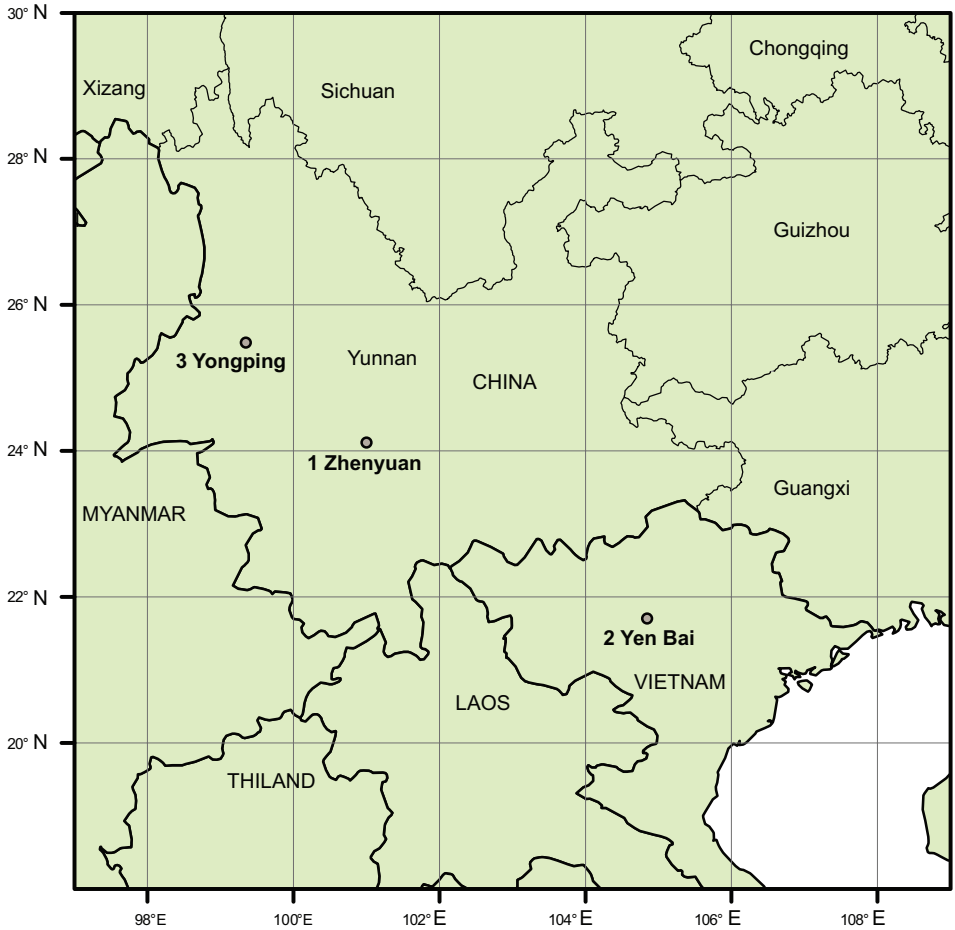

Figure 1. Map showing the locations of the fossils collected in this study. 1. Sanzhangtian, Zhenyuan County, Yunnan, south-western China (the middle Miocene); 2. Hop Thanh Village, Tuy Loc Commune, Yen Bai Province, northern Vietnam (the late Miocene); 3. Longmen, Yongping County, Yunnan Province, south-western China (the late Pliocene).

Results

Order Equisetales Dumortier
Family Equisetaceae A. Michaux ex Alph. De Candolle
Genus *Equisetum* Linnaeus

Equisetum fossils from Zhenyuan, south-western China

***Equisetum* cf. *pratense* Ehrhart**

Specimens checked. XTBGSZTF0001 (Fig. 2A–B)

Locality. Dajie Formation, Sanzhangtian Village, Zhenyuan County, central Yunnan Province, South-western China (24.100N, 101.216E).

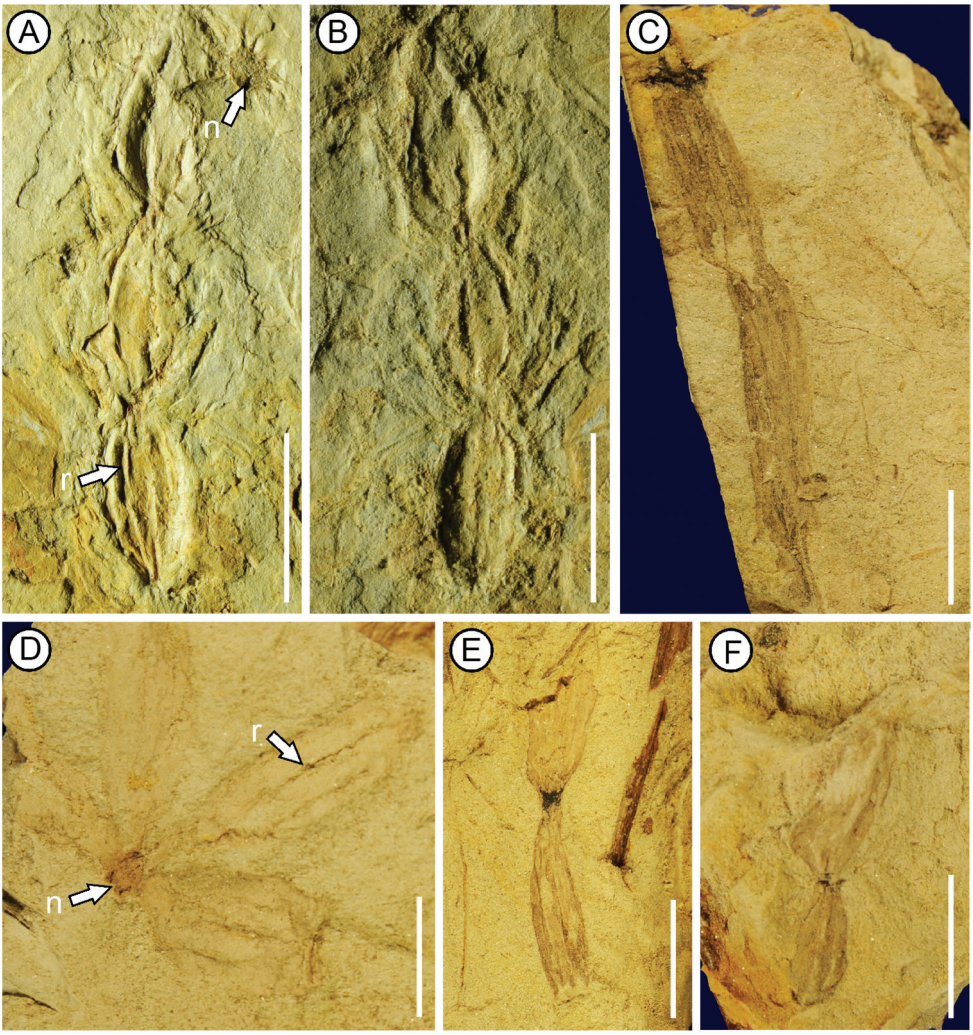

Figure 2. A–B *Equisetum* cf. *pratense* Ehrhart **C–F** *Equisetum yenbaiense* A.T.Aung, T.Su, T.V.Do & Z.K.Zhou, sp. nov. Specimen numbers: **A–B** XTBGSZTF0001 (counterparts) **C** XTBGVNMN4002 **D** XTBGVNMN4001 **E** XTBGVNMN4003 **F** XTBGVNMN4004. **n** = node; **r** = ridge. Scale bars: 1cm.

Age. The middle Miocene.

Repository. Paleoecology Collections, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences.

Description. Only one bunch of tubers are preserved on the specimen, tubers are ovate in shape, three tubers of equal size are arranged in one row (Fig. 2A–B). The length and width of the tubers are ~ 0.9 to 1.2 cm and 0.6 to 0.8 cm, respectively. Two to three longitudinal ridges are present on the surface of each tuber (Fig. 2A–B). The tip of the tuber is mucronate (Fig. 2A–B). These characters fit well within the morphology of *E.* cf. *pratense*, a fossil species reported from the early Oligocene in the Lühe coal-mine, south-central Yunnan (Zhang et al. 2007; Linnemann et al. 2018).

Equisetum fossils from Yen Bai, northern Vietnam

Equisetum yenbaiense **A.T.Aung, T.Su, T.V.Do & Z.K.Zhou, sp. nov.**

Holotype. XTBGVNMN4001 (Fig. 2D).

Paratypes. XTBGVNMN4002-4004 (Fig. 2C, E–F).

Locality. Hop Thanh Village, Tuy Loc Commune, Yen Bai Province, northern Vietnam (21.725N, 104.849E).

Age. The late Miocene.

Repository. Paleoecology Collections, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and Vietnam National Museum of Nature, Vietnam Academy of Science and Technology.

Etymology. The species name '*yenbaiense*' means that fossils are from Yen Bai Province, northern Vietnam.

Diagnosis. Rhizomes with internodes and nodes, node round; Four bunches of tubers arranged in a whorl on a node (Fig. 2D); most tubers elongate in shape, with one to two tubers in each bunch (Fig. 2C–D); longitudinal ridges on the surface of tuber; the tip of tuber mucronate (Fig. 2F).

Description. Rhizomes have both internodes and nodes (Fig. 2D). The internode is ~0.2–0.3 cm in width, the length could not be observed, three longitudinal ridges are on the surface of the internode (Fig. 2D). The node is round and ~0.2 cm in diameter (Fig. 2D). Four bunches of tubers attach to one node and arrange in a whorl (Fig. 2D). Only one tuber is preserved on each bunch, but it is likely that there are more than one tuber on each bunch (Fig. 2E–F). Most tubers are elongate (Fig. 2D); few are elliptical (Fig. 2F), being~ 0.8 to 3.0 cm long and 0.4 to 1.0 cm wide. Two to four ridges are on the surface of each tuber (Fig. 2D). The tip of tuber is mucronate (Fig. 2F).

Equisetum fossils from Yongping, South-western China

Equisetum yongpingense **A.T.Aung, T.Su & Z.K. Zhou, sp. nov.**

Holotype. XTBGYP0748 (Fig. 3A).

Paratypes. XTBGYP0747 (Fig. 3B), XTBGYP1014 (Fig. 3C), XTBGYP1015 (Fig. 3D), XTBGYP0750 (Fig. 3E), XTBGYP0749 (Fig. 3F).

Locality. Sanying Formation, Longmen Village, Yongping County, western Yunnan Province, south-western China (25.518N, 99.519E).

Age. The late Pliocene.

Repository. Paleoecology Collections, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences.

Etymology. The species name '*yongpingense*' means that fossils are from Yongping County, south-western China.

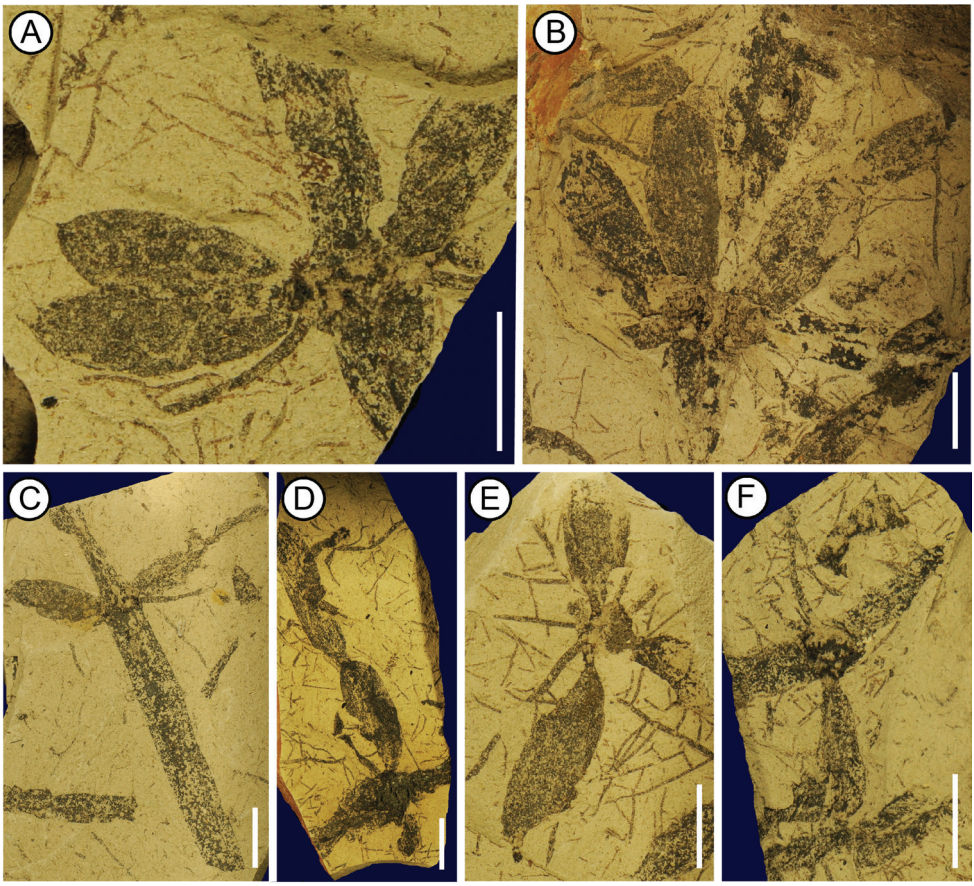

Figure 3. *Equisetum yongpingense* A.T.Aung, T.Su & Z.K.Zhou, sp. nov. Specimen numbers: **A** XTBGYP0748 **B** XTBGYP0747 **C** XTBGYP1014 **D** XTBGYP1015 **E** XTBGYP0750 **F** XTBGYP0749. Scale bars: 1cm.

Diagnosis. Rhizomes with internodes and round nodes; fibrous roots on most nodes; two to four bunches of tubers arranged in a whorl on a node (Fig. 3A); tubers cylindrical in shape, one to two tubers on each bunch (Fig. 3A–B); longitudinal ridges not observed on the surface of tuber; the tip of tuber mucronate (Fig. 3A).

Description. Rhizomes have both internodes and nodes (Fig. 3A). The internode is ~0.5 to 0.8 cm wide, the length is up to 5.1 cm (Fig. 3A). The node is round and ~0.7 to 1.0 cm in diameter (Fig. 3A–B). Most nodes have fibrous roots ~ 0.1 to 0.2 cm wide. Two to six bunches of tubers attach on one node and are arranged in a whorl (Fig. 3A–B). One to two tubers are preserved on each bunch (Fig. 3A–B). Tubers are cylindrical, ~ 1.5 to 3.4 cm long and 0.6 to 1.2 cm wide (Fig. 3A–F). Ridges were not observed on the surface of each tuber (Fig. 3A–B, E). The tip of tuber is mucronate (Fig. 3A).

Discussion

In this study, we reported three new fossil records of *Equisetum* from south-western China and northern Vietnam, based on well-preserved rhizomes with tubers. In *Equisetum*, tubers are the most commonly preserved organ in the fossil records. They are mainly characterised by either a single tuber or one bunch of tubers with longitudinal ridges on the surface, present on fossils we collected (Figs 2–4). These three new fossil records vary in morphological characters, such as the shape and size of tubers (Table 1). They are also different from living species of *Equisetum*, for example, *Equisetum pratense*, as they have lager tuber sizes, based on available information (Zhang et al. 2007; Sun et al. 2013).

Equisetum cf. *pratense* from the middle Miocene of Zhenyuan, south-western China have an ovate tuber shape, which is similar to most fossil records of *Equisetum*, but different from some fossil species, for example, the tubers of *Equisetites longevaginatus* are elliptical or round in shape (Table 1). The size of tubers in *E.* cf. *pratense* is smaller than other fossil species, such as *Equisetum oppositum*, *Equisetum* cf. *oppositum* and *Equisetum hunchunense* (Table 1). Generally, all observed morphological characters of the fossil, such as the size and shape of tubers, as well as the mucronate tip of tubers, were in accordance with *E.* cf. *pratense*, a fossil species previously reported from the early Oligocene of the Lühe coal-mine, south-central Yunnan (Zhang et al. 2007). However, we only found one bunch of tubers at the fossil site, whereas the fossils from the Lühe coal-mine have one to four bunches of tubers with an acervate arrangement on rhizome nodes. More fossils are needed to further determine the arrangement of tubers to better understand the systematic relationship between these two fossil records. Judging by the high morphological similarity, we assign the fossil from Zhenyuan as *E.* cf. *pratense*.

For *Equisetum yenbaiense* from the late Miocene of northern Vietnam, the tuber arrangement is a whorl on a rhizome node, which also occurs in *E. hunchunense* and *E.* cf. *arcticum*. However, both *E. hunchunense* and *E.* cf. *arcticum* have two to three tubers per bunch, whereas *E. yenbaiense* only has one or two tubers per bunch, which might be partly due to the preservation of the fossil. In addition, there are more than three tubers per bunch in *E. oppositum* and *E.* cf. *oppositum* (Table 1). The shape of tubers in *E. yenbaiense* is elongate, the ratio between length and width is higher than most other fossil species, except for *E.* cf. *arcticum*. We noted that the tuber size in *E. yenbaiense* is larger than that in *E.* cf. *arcticum* (Table 1). Therefore, we designate the new fossil specimens from northern Vietnam as a new species, namely, *E. yenbaiense* A.T. Aung, T. Su, T.V. Do & Z.K. Zhou, sp. nov.

In *Equisetum yongpingense*, there are two to four bunches of tubers arranged in a whorl on a node, which has the same pattern as *E. hunchunense* and *E.* cf. *arcticum*. The tip of the tubers is mucronate in *E. yongpingense*, which is also present on other previously reported fossil species (Table 1). However, the tuber shape of *E. yongpingense* is cylindrical, which is different from other fossil records. Ridges on the surface of tubers are not prominent in *E. yongpingense*, whereas ridges are present in other fossil species.

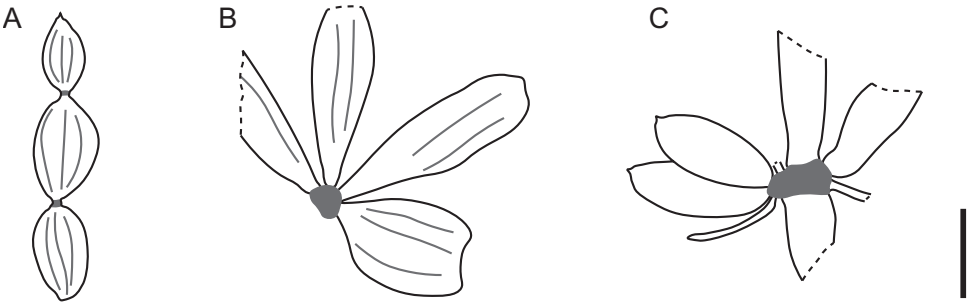

Figure 4. Reconstruction of *Equisetum* from **A** Zhenyuan, south-western China, specimen number XTBGSZTF0001 **B** Yanbei, northern Vietnam, specimen number XTBGVNMN4001; and **C** Yongping, south-western China, specimen number XTBGYP0748. Scale bar: 1.5 cm.

Table 1. Morphological comparisons between new fossil records in this study and previously reported *Equisetum* and *Equisetites* fossil species.

Species	Tuber arrangement	Number of tubers per bunch	Shape of tuber	Tuber length (cm)	Tuber width (cm)	Age	Locality	References
Equisetum sp.	?	3	Elliptical	1.0–1.2	0.6–0.8	Miocene	Iceland	Denk et al. 2005
Equisetum cf. *arcticum*	Whorl	2–3	Elongate, ovate, round	1.5–2.5	0.5–0.7	Oligocene to Miocene	America	Becker 1969
Equisetum hunchunense	Whorl	2–3	Elliptical, ovate	1.5	0.4–0.9	Eocene	China	Guo 2000
Equisetum jiuquanense	Single to acervate	2–3	Elliptical, ovate, round	0.3–0.8	0.4–0.7	Early Cretaceous	China	Sun et al. 2013
Equisetites longevaginatus	Single or opposite	2–3	Elliptical, round	0.5–0.8	0.3–0.5	Cretaceous	China	Sun et al. 2001
Equisetum oppositum	Opposite	6	Round, elliptical, ovate	1.0–1.6	0.8–1.2	Early Oligocene	China	Ma et al. 2012
Equisetum cf. *oppositum*	Single	5–6	Elliptical, ovate, and nearly round	1.0–1.6	0.8–1.2	Paleocene-Eocene	China	Yang et al. 2016
Equisetum cf. *pratense*	?	3	Ovate	0.9–1.2	0.6–0.8	Middle Miocene	China	This study
Equisetites vittatus	Whorl	1–2	Elliptical, elongate	0.8–3.0	0.4–1.0	Late Miocene	Vietnam	This study
Equisetum yongpingense	Whorl	1–2	Cylindrical	1.5–3.4	0.6–1.2	Late Pliocene	China	This study

In *E. yongpingense*, fibrous roots were also observed on the rhizome node, which is not observed on other fossil species. Therefore, we name these fossil specimens from Yongping as *E. yongpingense* A.T.Aung, T.Su & Z.K.Zhou, sp. nov.

The three new fossil records described in this study expand the distribution of *Equisetum* during the Neogene in Asia. These findings and previous fossil records indicate that *Equisetum* has been widely distributed in Asia since the Paleocene and become diverse in Asia since the Oligocene. According to fossil assemblages, *Equisetum* mainly grew under wet conditions. Other taxa that were reported from the same stratum in Zhenyuan, such as *Palaeosorum ellipticum* (Jacques et al. 2013), *Bambusium angustifolia*, *B. latifolia*, *Bambusiculmus angustus*, *B. latus* (Wang et al. 2013) and *Metasequoia* cf. *glyptostroboides* (Wang et al. 2019), tend to grow near the riverside or lakeshore. Therefore, we considered that *E.* cf. *pratense* might favour a similar habitat. In addition,

E. yongpingense was found in the Upper Pliocene of western Yunnan, where numerous fruits from *Trapa*, an aquatic plant, had also been found in the same layer (Su 2010). Therefore, this habit might have persisted throughout the Cenozoic. Tubers indicate a perennial living form and should contribute to the adaptation of *Equisetum* under seasonally unfavourable conditions by storing starch (Taiz and Zeiger 2010). Eventually, tubers became important elements in local vegetation, which was evidenced by the abundance of specimens in many fossil sites (Becker 1969; Guo 2000; Ma et al. 2012; Yang et al. 2016).

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RESEARCH ARTICLE

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A new species and two new records of *Goniothalamus* (Annonaceae) from Lao PDR

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Abstract

Goniothalamus saccopetaloides Y.H. Tan & Bin Yang, a new species is described and illustrated from Laos. This species shows morphological similarities to *G. yunnanensis* W.T. Wang, but it differs from the latter by having almost fleshy, involute and saccate outer petals, subglobose monocarps, and single seeded monocarps. *Goniothalamus cheliensis*, and *G. calvicarpus* are new records for the Flora of Lao PDR. A key to *Goniothalamus* species indigenous to Laos is provided here.

Keywords

Goniothalamus, Laos, field survey, new species, new record

Introduction

Goniothalamus (Blume) Hook.f. & Thomson, comprising over 130 species of trees and shrubs, are one of the largest palaeotropical genera in the Annonaceae, mainly distributed from India and Sri Lanka to tropical Australia and the South Pacific Islands (Saun-

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ders and Chalermglin 2008; Nakkuntod et al. 2009; Turner 2014; Thomas et al. 2017). The genus is characterized by flowers with two whorls of petals of which the inner petals are smaller than the outer ones; three inner petals form a distinctive mitriform dome over the reproductive organs acting as a pollination chamber (Saunders and Chalermglin 2008; Tang et al. 2015), and stamens with apical connectives. Although the genus *Mitrephora* J. D. Hooker & Thomson also shares these similar features, *Goniothalamus* can be distinguished easily by its linear-oblong stamens, inner petals each with a short claw or stipe (Li et al. 2011). The genus shows considerable diversity in flowers of different size and shape, hairy indumentum, and color usually cream, yellow or red at maturity, and fruit morphology, with fruit of different size and shape (Saunders and Chalermglin 2008; Tang 2014; Tang et al. 2015). Species of the genus are widely distributed in tropical South-East Asian lowland and submontane forests (Tang 2014). Several *Goniothalamus* species have been described in recent years, including four new species from Thailand (Saunders and Chalermglin 2008), four new species from Borneo (Turner and Saunders 2008), and a new species from Palawan, the Philippines (Tang et al. 2013). In Laos, *Goniothalamus* are represented by four species (Newman et al. 2007; Lee 2016), i.e., *Goniothalamus laoticus* (Finet & Gagnep.) Bân, *Goniothalamus repevensis* Pierre ex Finet & Gagnep., *Goniothalamus marcanii* Craib and *Goniothalamus saigonensis* Pierre ex Finet & Gagnep., whereas the latter two were respectively treated as synonyms of *Goniothalamus tamirensis* Pierre ex Finet & Gagnep. (Saunders and Chalermglin 2008) and *Goniothalamus gabriacianus* (Baill.) Ast (Li et al. 2011).

In recent years, the authors examined the flowering material of Annonaceae cultivated in the living collections of Xishuangbanna Tropical Botanical Garden (XTBG), Chinese Academy of Sciences (CAS) and found an unknown species, which is very distinctive and belongs to the genus *Goniothalamus*; the records showed that this accession was originally collected in 2002, from Lao PDR (although the exact location remains unknown). Based on the morphological characters, we compared it to all other currently known species and concluded that it is new to science. As part of the botanical inventory of China-Laos transboundary biodiversity conservation, we carried out floristic surveys in the Nam Ha National Biodiversity Conservation Area in Luang Namtha Province and Phou Hin Phee National Biodiversity Conservation Area in Oudomxay Province of the northern Laos. During the fieldwork in March and October of 2018, we encountered two species of *Goniothalamus* representing new records for the flora of Laos. Therefore, the new and noteworthy species of *Goniothalamus* from Laos are provided and updated in this study.

Material and methods

Our study of the new taxon was predominantly based on plant material newly collected in XTBG. The records showed that this accession was originally collected in 2002, from Laos, although the exact location remains unknown. Ten individuals cultivated in

two living collections were observed. Morphological characterizations were measured in the field. We compared our samples with type specimens of similar species deposited in herbaria. Specimens of *Goniothalamus* from Laos and neighboring regions were examined from the following herbaria: HITBC, IBSC, SING, A, K, BK, high-resolution digital images of specimens (especially types) from JSTOR Global Plants (https://plants.jstor.org/) and other virtual herbarium websites (http://www.cvh.ac.cn/), as well as the taxonomic literature for species identification.

Taxonomic treatments

Goniothalamus saccopetaloides **Y.H.Tan & Bin Yang, sp. nov.**
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Fig. 1

Diagnosis. *Goniothalamus saccopetaloides* is morphologically similar to *G. yunnanensis* W.T. Wang with elliptic-oblong to oblong leaf blades and broadly lanceolate, pinkish orange to reddish brown outer petals, but easily distinguished by having almost fleshy, involute, saccate outer petals, subglobose and single seeded monocarps.

Type. Lao PDR. Specific location unknown. Voucher from a cultivated plant at the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, 2 May 2019, *B. Yang*, *XTBG-0054* (holotype, HITBC!).

Description. Shrub to small tree, to 3 m tall. Young branches glabrous. Leaf laminas 15.5–27.8 cm long, 4.5–8.2 cm wide, length/width ratio ca. 3.4, elliptic-oblong to oblong, apex acuminate, base cuneate to attenuate, papyraceous, glabrous abaxially and adaxially; midrib glabrous and (strong) prominent abaxially, glabrous and impressed adaxially; secondary veins 13–18 pairs, (slightly) impressed adaxially; tertiary veins percurrent, distinct; petioles 5–12 mm long, 2–3 mm in diameter, glabrous. Flowers 1–7, often on the main trunk (cauliflory) and on older branches (ramiflory), pendents; flowering pedicels 2–5 mm long, sparsely hairy; pedicel bracts 3–6, 1–2 mm long. Sepals 5–6 mm long, 5–7 mm wide, basally connate, apex acuminate, broad ovate, puberulous abaxially, glabrous adaxially, greenish-yellow, venation longitudinal slightly conspicuous adaxially, indistinct abaxially. Outer petals 1.4–2.7 cm long, 0.7–1.2 mm wide, length/width ratio 1.6–3.0, almost fleshy, involute, saccate, elliptic lanceolate to broadly lanceolate, sparsely puberulous abaxially, subglabrous adaxially, yellowish green in young stage, pinkish orange to reddish brown in mature stage, venation slightly distinct adaxially, occasionally slightly distinct abaxially. Inner petals 6.5–12 mm long, 5–10 mm wide, length/width ratio 1.1–2.2, broadly ovate to obovate, sparsely puberulous abaxially, pubescent adaxially, yellowish green in young stage, pinkish orange to reddish brown in mature stage, base attenuate to a 2–3 mm claw. Stamens ca. 80 per flower, 1.2–1.5 mm long, 0.6–0.7 mm wide; connectives truncate. Carpels 18–22 per flower, ovary 1.5–2 mm long, light green, with

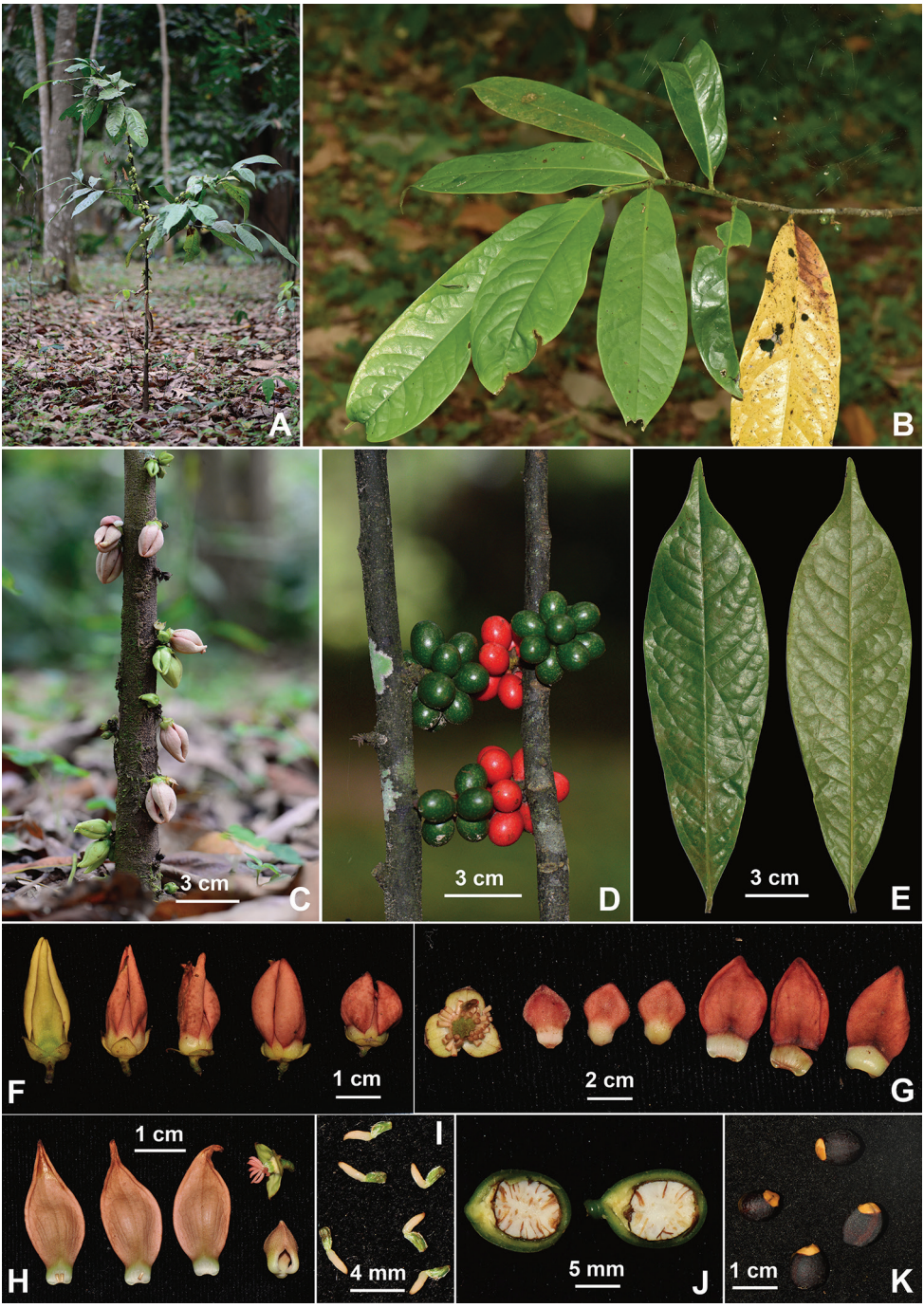

Figure 1. *Goniothalamus saccopetaloides* Y.H.Tan & Bin Yang, sp. nov. **A** habit **B** leafy branch **C** flowers on main trunk **D** fruits on main trunk **E** leaves (adaxial and abaxial surface) **F** flowers **G–H** dissected flowers **I** carpels **J** longitudinally dissected monocarp **K** seeds. Photographed by R.B. Zhu and B. Yang.

white hairs; stigma and style 2–3 mm long, glabrous. Immature fruits green, with small white dots, mature fruits orange to red; fruiting pedicels 3–5 mm long, 1.5–2 mm in diameter, subglabrous. Monocarps one seeded, 12–13 mm long, 9–11 mm wide, length/width ratio 1.2–1.3, subglobose to ellipsoid, base and apex rounded, smooth, subglabrous, glossy, pericarp medium-thick, ca. 1.5 mm thick, stipes subsessile to 1.5 mm long, ca. 2 mm in diameter, glabrous. Seeds 9–10 mm long, ca. 7 mm wide, length/width ratio 1.3–1.4, ellipsoids, testa slightly rugose, dark brown to black brown, aril orange.

Etymology. The new species is named after its saccate and almost fleshy outer petals.

Phenology. *Goniothalamus saccopetaloides* has been observed in flowers from the end of March to May and in fruits from July to September.

Distribution and habitat. *G. saccopetaloides* was originally distributed in Laos; the exact location and its wild habitat remains unknown. Additional collections in the future may help to clarify its full distribution.

Conservation status. Due to insufficient field surveys so far, very limited details about its natural distribution and population status are currently known. Further investigation is required to determine more distribution sites and conservation status of the new species; at this moment we consider it as data deficient (DD) according to the IUCN Red List Categories (IUCN 2012).

Additional specimen examined (paratype). Lao PDR. Specific location unknown. Voucher from the cultivated plants at the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, 2 May 2019, *B. Yang*, *XTBG-0055* (HITBC!).

Notes. *Goniothalamus saccopetaloides* is morphologically similar to *G. yunnanensis*; however, in addition to the description in the diagnosis, the two species can be easily distinguished by other characters. *Goniothalamus saccopetaloides* has 1 to 7 flowers, often on the main trunk (cauliflory) and on older branches (ramiflory), scarcely on young growth, whereas *G. yunnanensis* has 1 to 2 flowers, axillary, often on young growth, sometimes from leafless nodes (Li et al. 2011). Moreover, *G. saccopetaloides* has one ovule per carpel, subglobose monocarps and seeds with rounded apices, and *G. yunnanensis* has 2 ovules per carpel, ellipsoid monocarps and seeds with acute apices (Li et al. 2011).

New records for Laos

Goniothalamus calvicarpus **Craib**

Fig. 2 (A–D)

Goniothalamus calvicarpus Craib, Bull. Misc. Inform. Kew. 1922: 227 (1922). – TYPE: Thailand: Sukotai, Kao Luang, Sukhothai Province, Northern Thailand, 4 May 1922, *A.F.G. Kerr 5946* (holotype: K!; isotypes: BK!, BM!).

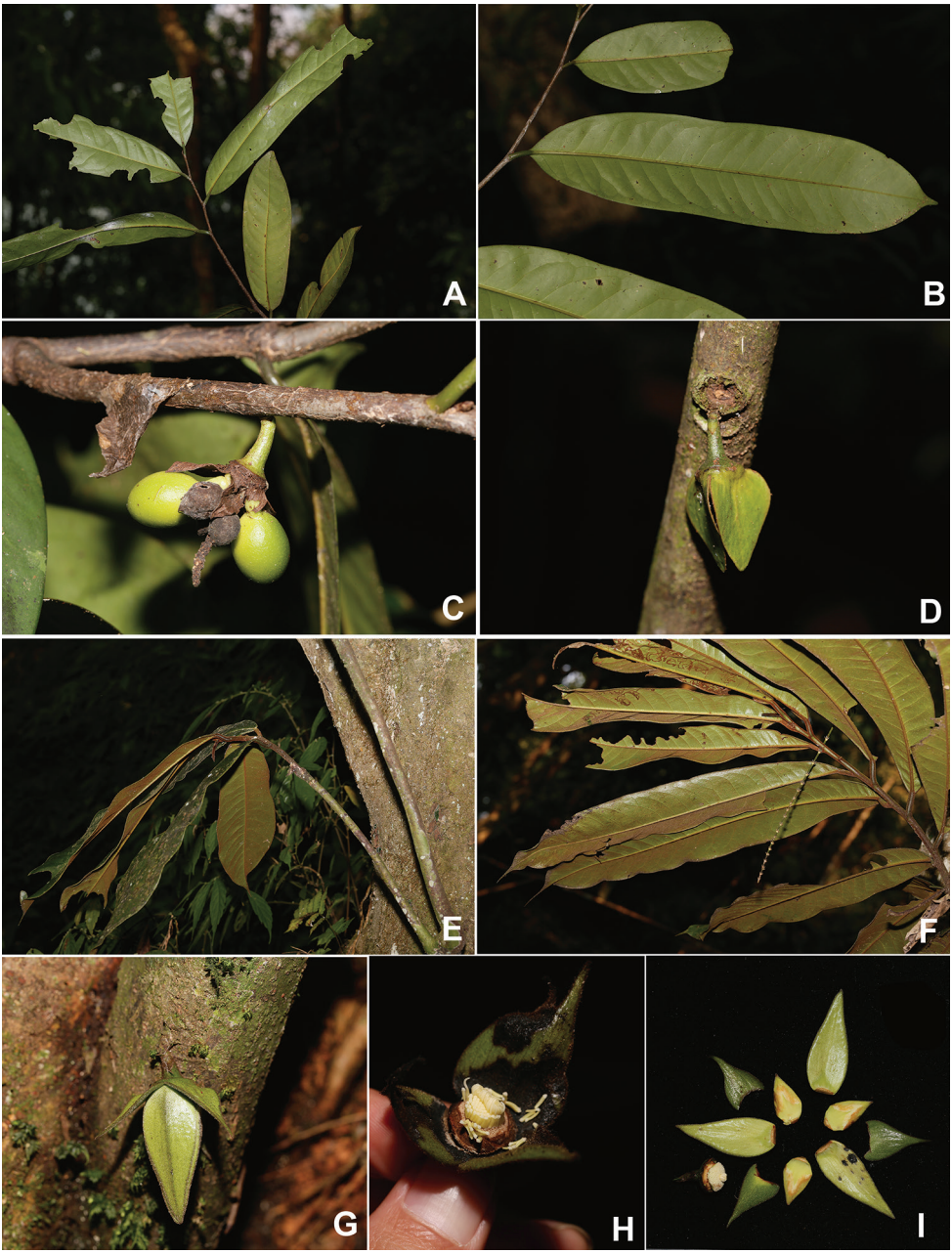

Figure 2. *Goniothalamus calvicarpus* Craib **A** leafy branch **B** leaves (abaxial) **C** fruit **D** flower (epibiotic sepels); *Goniothalamus cheliensis* Hu **E** leafy branch **F** leaves (abaxial) **G** flower **H** flower (picked petals, showing stamens and carpels) **I** dissected flowers. Photographed by H.B. Ding.

Distribution and habitat. Thailand (Saunders and Chalermglin 2008), China (Li et al. 2011) and Northern Laos (Luang Namtha Province), mountain slopes, 800–1500 m.

Specimens examined. Laos: Tha Se Village, Nam Ha National Biodiversity Conservation Area, Luang Namtha Province, Northern Laos, tropical lower montane forest, 938 m, 20°49'59.42"N, 101°15'48.05"E, 21 Oct 2018, *Y.H. Tan et al.*, *L0757* (HITBC); idem, 21 Oct 2018, *Y.H. Tan et al.*, *L0764* (HITBC); idem, 26 Mar 2018, *Y.H. Tan et al.*, *L0183* (HITBC); Nam Sing Village, Nam Ha National Biodiversity Conservation Area, Luang Namtha Province, Northern Laos, stone forest, 900 m, 20°45'09"N, 101°12'08"E, 25 Mar 2018, *Y.H. Tan et al.*, *L0153* (HITBC).

Notes. There has been considerable taxonomic confusion between *G. calvicarpus* and *G. griffithii* Hook. f. & Thomson (Saunders and Chalermglin 2008), the Chinese material identified as *G. griffithii* to be more correctly placed in *G. calvicarpus* (Saunders and Chalermglin 2008; Li et al. 2011). *Goniothalamus calvicarpus* is relatively widely distributed in the lower mountain evergreen forest in Xishuangbanna, southern Yunnan, compared with our materials collected in Northern Laos, the characters of flowers and fruits are exactly in line with *G. calvicarpus*; it is also not very hard to encounter around the adjacent areas in Northern Laos bordering southern Yunnan.

Goniothalamus cheliensis **Hu**

Fig. 2 (E–I)

Goniothalamus cheliensis Hu, Bull. Fan Mem. Inst. Biol. 10: 122 (1940). – TYPE: China: Che-Li Hsien, Maan-Shang, Yunnan, Sep. 1936, *C.W. Wang 78573* (holotype: TAI!, isotypes: A!, IBSC!].

Distribution and habitat. Northern Thailand (Saunders and Chalermglin 2008), China (Li et al. 2011) and Northern Laos (Oudomxay Province), Montane forests; 1000–1500 m.

Specimens examined. Laos: Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, Oudomxay province, 1357 m, 20°43'19.12"N, 102°08'46.61"E, 30 March 2018, *Y.H. Tan et al.*, *L0350* (HITBC); ibdem, 1372 m, 20°43'18.24"N, 102°08'47.31"E, 30 March 2018, *Y.H. Tan et al.*, *L0351* (HITBC).

Notes. *Goniothalamus cheliensis* is a very distinctive species, with leaves, flowers and fruits very large and densely rust-colored hirsute (Saunders and Chalermglin 2008), according to our personal observation, the monocarps of *G. cheliensis* can be up to 15 cm long.

With the addition of *Goniothalamus saccopetaloides*, *Goniothalamus cheliensis*, and *Goniothalamus calvicarpus*, seven species are currently recognized in Laos (Newman et al. 2007; Saunders and Chalermglin 2008; Li et al. 2011; Lee 2016). A key is provided below to further elucidate the morphological differences among the species occurring in Laos.

Key to the *Goniothalamus* species in Laos and along with *G. yunnanensis*

1 Young branches densely hairy to velutinous, leaf midrib and petiole (very densely) hairy abaxially **2**
– Young branches glabrous, leaf midrib and petiole glabrous to sparsely hairy abaxially **3**
2 Leaf blade 50–76 × 13–22 cm, stamen connectives apiculate, monocarps oblong, 3–15 cm long and densely hairy ..... ***G. cheliensis***
– Leaf blade 12–17 × 3.7–4.7 cm, stamen connectives truncate, monocarps ovoid, less than 3 cm long and glabrous ..... ***G. tamirensis***
3 Adaxial surface of leaves with very prominent secondary and tertiary veins **4**
– Adaxial surface of leaves with impressed or only slightly prominent secondary and tertiary veins **6**
4 Stamen connectives apiculate, sepals 11–18.5 mm long ..... ***G. calvicarpus***
– Stamen connectives truncate, sepals 5–8 mm long **5**
5 Flowers on older branches and young growth, outer petals not fleshy, never involute, monocarps ellipsoid, 1.8–2.5 cm long, apex acute ..... ***G. yunnanensis***
– Flowers on main trunk and older branches, outer petals almost fleshy, involute, monocarps subglobose to ellipsoid, 1.2–1.3 cm long, apex rounded ..... ***G. saccopetaloides***
6 Ovules 8–10 per carpel, monocarps oblate, with its longitudinal ridge ..... ***G. laoticus***
– Ovules 1–2 per carpel, monocarps oblong-ellipsoid to ellipsoid, or elliptic-ovoid **7**
7 Leaf blades with short to long acuminate apices, outer petal venation distinct, sparsely puberulous to glabrous abaxially ..... ***G. repevensis***
– Leaf blades with acute to attenuate apices, outer petal venation indistinct, hispidulous abaxially ..... ***G. gabriacianus***

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The authors cordially thank staff of the Biotechnology and Ecology Institute (BEI), Nam Ha National Biodiversity Conservation Area in Laung Namtha Province and Phou Hin Phee National Biodiversity Conservation Area, Oudomxay province of Lao PDR for their support of field works in the protected area. We are grateful to Dr. Liang Song, Dr. Hua-Zheng Lu, Dr. Su Li, Mr. Ren Li, Mr. Xiao-Dong Zeng, Ms. Zhong-Li Gan and Ms. Dong-Li Quan for their kind help in the field. This research was funded by Lancang-Mekong Cooperation (LMC) Special Fund (Biodiversity Monitoring and Network Construction along Lancang-Mekong River Basin project) and the CAS 135 program (No. 2017XTBG-F03), and the project of the Southeast Asia biodiversity research institute, Chinese Academy of Sciences (Y4ZK111B01).

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RESEARCH ARTICLE

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Two new species of *Alseodaphnopsis* (Lauraceae) from southwestern China and northern Myanmar: evidence from morphological and molecular analyses

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Abstract

Alseodaphnopsis maguanensis and *A. putaoensis*, two new species of *Alseodaphnopsis* (Lauraceae) from southwestern China (Yunnan Province) and northern Myanmar (Kachin State), are here described and illustrated based on both morphological and molecular evidence. They are morphologically similar to *Alseodaphnopsis rugosa* and phylogenetically closely related to *A. rugosa* and *A. hainanensis* respectively. Their preliminary conservation status is also estimated according to the IUCN Red List Categories and Criteria.

Keywords

Kachin state, phylogenetic analysis, taxonomy, tropical montane forest, Yunnan province

Introduction

Alseodaphnopsis H. W. Li & J. Li, including nine species at present, is a recently described new genus of the Lauraceae (Mo et al. 2017a). Mo et al. (2017a) separated *Alseodaphnopsis* from the traditionally recognized tropical Asian genus *Alseodaphne* Nees based on both morphological and molecular evidence. The combination of principal morphologi-

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cal characters to distinguish the two genera (*Alseodaphnopsis* vs. *Alseodaphne*) includes: 1) twigs thick, 4–11 mm in diameter, not obviously whitish in color vs. thin, 2.5–4.5 mm in diameter, obviously whitish in color; 2) terminal buds perulate vs. not perulate; 3) perianth lobes persistent at least in young fruit vs. early deciduous; 4) inflorescences relatively large, 8.5–35 cm long, generally many-flowered, with 3–4 order of branching vs. 3–20 cm long, few-flowered, with 1–2 orders of branching; and 5) mature fruit relatively large, 3–5 cm vs. < 2.5cm in diameter (Mo et al. 2017a). In addition, *Alseodaphnopsis* species are distributed in the northern marginal zone of Asian tropics in southwestern China (also in Hainan island) and northern Vietnam while *Alseodaphne* species are mostly found in the tropics of south and southeast Asia (Kostermans 1973; Li et al. 2008; Mo et al. 2017a).

During recent field surveys in southwestern China (Maguan, Yunnan Province) and northern Myanmar (Putao, Kachin State), two unknown Lauraceae species were collected. Based on both morphological and molecular evidence, they were confirmed as new species of *Alseodaphnopsis* and closely related to *Alseodaphnopsis rugosa* (Merr. & Chun) H. W. Li & J. Li and *A. hainanensis* (Merr.) H. W. Li & J. Li respectively. In the work of Mo et al. (2017b), the specimens collected in Maguan (Yunnan Province, China) were treated as synonyms of *Alseodaphnopsis rugosa.* In this paper, these new *Alseodaphnopsis* species are described and illustrated.

Material and methods

Morphological studies

Morphological characters of the two new *Alseodaphnopsis* species were examined in detail based on dried specimens and fresh materials in field observations and compared with possible relatives based on the specimens from the HITBC, IBK, IBSC and KUN herbaria as well as images of specimens available on JSTOR Global Plants (http://plants.jstor.org/).

Molecular studies and phylogenetic analyses

Total genomic DNA was extracted from silica-gel dried leaf material using the Plant Genomic DNA Kit (Tiangen, Beijing, China). Two nuclear DNA fragments, internal transcribed *spacer* (ITS) and the second intron of *LEAFY* gene (*LEAFY* intron II), were amplified and sequenced following the work of Li et al. (2011). ITS and *LEAFY* intron II sequences of other possibly related species involved here were obtained from GenBank according to the works of Li et al. (2011) and Mo et al. (2017a). Species examined in this study, voucher information, collection locality and GenBank accession numbers for ITS and *LEAFY* sequences are given in Table 1.

DNA sequences were aligned using Clustal X 2.1 (Larkin et al. 2007) and adjusted manually. The combined dataset including ITS and *LEAFY* intron II sequences for phylogenetic analysis was built according to the works of Li et al. (2011) and Mo et al. (2017a).

Table 1. Species examined in this study, voucher information, collection locality and GenBank accession numbers for ITS and *LEAFY* sequences.

Taxon	Voucher	Locality	ITS	*LEAFY*
Ingroups				
***Alseodaphne* (4)**				
A. gigaphylla Kosterm.	Arifiani DA657 (BO)	Indonesia, Java	HQ697181	HQ697004
A. gracilis Kosterm.	Li L. 20070187 (HITBC)	China, Yunnan	HQ697187	HQ697036
A. huanglianshanensis H. W. Li & Y. M. Shui	Li L. 20080006 (HITBC)	China, Yunnan	HQ697182	HQ697007
A. semecarpifolia Nees	Arifiani DA658 (BO)	Indonesia, Java	HQ697184	HQ697015
***Alseodaphnopsis* (8)**				
A. andersonii (King ex Hook. f.) Kosterm.	Li J. & Li L. 20070074 (HITBC)	China, Yunnan	FM957793	HQ697002
A. hainanensis Merr.	Li L. & Wang Z. H. JFL07 (HITBC)	China, Hainan	MG188587	MG188634
	Li L. & Wang Z. H. LMS10 (HITBC)	China, Hainan	MG188586	MG188633
A. maguanensis L. Li & J. Li	Li L. et al. GLQ45 (HITBC)	China, Yunnan	MN906900	MN906896
	Li L. et al. GLQ46 (HITBC)	China, Yunnan	MN906901	MN906897
A. petiolaris (Meissn.) Hook. f.	Chen J. Q. 07003 (HITBC)	China, Yunnan	FM957796	HQ697008
A. putaoensis L. Li, Y. H. Tan & J. Li	Li L. & Ma H. MM254 (HITBC)	Myanmar, *Kachin*	MN906902	MN906898
	Li L. & Ma H. MM266 (HITBC)	Myanmar, *Kachin*	MN906903	MN906899
A. rugosa Merr. & Chun	Li L. & Wang Z. H. MYH02 (HITBC)	China, Hainan	MG188585	MG188635
	Li L. & Wang Z. H. MYH08 (HITBC)	China, Hainan	MG188584	MG188640
A. sichourensis H. W. Li	Song Y. 33225 (HITBC)	China, Yunnan	MG188597	MG188626
A. ximengensis H.W. Li & J. Li	Li J. W. 1235 (HITBC)	China, Yunnan	MG188591	MG188599
***Dehaasia* (1)**				
D. hainanensis Kosterm.	Li L. & Wang Z. H. 20070373 (HITBC)	China, Hainan	FJ719308	HQ697026
***Machilus* (8)**				
M. duthiei King ex Hook. f.	Zhong J. S. 2006094 (HITBC)	China, Yunnan	FJ755425	HQ697055
M. gongshanensis H. W. Li	Chen J. Q. 07002 (HITBC)	China, Yunnan	FJ755416	HQ697047
M. grijsii Hance	Chen J. Q. et al. 2006028 (HITBC)	China, Guangdong	FJ755420	HQ697049
M. kwangtungensis Yang	Chen J. Q. et al. 2006027 (HITBC)	China, Guangdong	FJ755424	HQ697051
M. monticola S. Lee	Li L. & Wang Z. H. 20070323 (HITBC)	China, Hainan	FJ755418	HQ697057
M. platycarpa Chun	Chen J. Q. et al. 2006073 (HITBC)	China, Guangdong	FJ755421	HQ697067
M. robusta W. W. Sm.	Li J. 2002116 (HITBC)	China, Guangxi	FJ755426	HQ697071
M. yunnanensis Lec.	Zhong J. S. 2006093 (HITBC)	China, Yunnan	FJ755415	HQ697084
***Nothaphoebe* (1)**				
N. umbelliflora (Blume) Blume	Arifiani DA495 (BO)	Indonesia, Java	HQ697191	HQ697088

Taxon	Voucher	Locality	ITS	*LEAFY*
***Phoebe* (6)**				
P. chekiangensis C. B. Shang	Li J. & Li L. 20070188 (HITBC)	China, Zhejiang	FJ755407	HQ697128
P. cuneata (Blume) Blume	Arifiani 40 (MO)	Indonesia, Java	HQ697202	HQ697130
P. formosana (Hayata) Hayata	Rohwer 156 (MJG)	Germany, Bonn	HQ697205	HQ697136
P. lanceolata (Wall. ex Nees) Nees	Chen J. Q. et al. 2006093 (HITBC)	China, Guangdong	FJ755410	HQ697141
P. nanmu (Oliv.) Gamble	Chen J. Q. et al. 2005002 (HITBC)	China, Yunnan	FJ755409	HQ697150
P. neurantha (Hemsl.) Gamble	Li J. & Li L. 20070214 (HITBC)	China, Zhejiang	HQ697209	HQ697151
Outgroups				
***Actinodaphne* (1)**				
A. trichocarpa C. K. Allen	Li L. 20070282 (HITBC)	China, Sichuan	HQ697214	HQ697166
***Lindera* (1)**				
L. erythrocarpa Makino	Li J. & Li L. 20070203 (HITBC)	China, Zhejiang	HQ697215	HQ697167
***Litsea* (1)**				
L. auriculata Chien & Cheng	Li J. & Li L. 20070195 (HITBC)	China, Zhejiang	HQ697217	HQ697174
***Neolitsea* (1)**				
N. howii C. K. Allen	Li L. & Wang Z. H. 20070379 (HITBC)	China, Hainan	HQ697220	HQ697178

Phylogenetic analyses were performed using the maximum parsimony (MP) and Bayesian inference (BI) methods.

The MP analysis was performed using PAUP* 4.0b10 (Swofford 2003). The heuristic search was performed with 1000 random sequence addition replicates, tree-bisection-reconnection (TBR) swapping, MulTrees on, and all characters equally weighted. Bootstrap values of the internal nodes were obtained with 1000 bootstrap replicates. The BI analysis was performed using MrBayes v.3.2.6 (Ronquist and Huelsenbeck 2003). Different DNA sequences were defined as separate data partitions. The evolutionary model for each partition (ITS: TVM+I+G; *LEAFY* intron II: HKY+G) was estimated using jModelTest v.2.1.10 (Darriba et al., 2012) with the Akaike information criterion (AIC) (Akaike 1974; Posada and Buckley 2004). The Markov chain Monte Carlo (MCMC) algorithm was run for 10 million generations with a sampling frequency of one every 1000 generations, and the first 25% trees were discarded as burn-in.

Results

The MP and BI analyses of the ITS + *LEAFY* intron II combined dataset generated congruent topologies. The Bayesian consensus tree with MP bootstrap (BS) and Bayesian posterior probability (PP) values is shown in Fig. 1. All *Alseodaphnopsis* individuals investigated in the present study formed a monophyletic clade that receives a BS of 86% and a PP of 1.00. Within the *Alseodaphnopsis* clade, two well-supported subclades are found, each consisting of four species. The new species *Alseodaphnopsis maguanensis* is sister to *A. rugosa* (BS 89%, PP 1.00) and new species *A. putaoensis* is sister to *A. hainanensis* (BS 88%, PP 1.00).

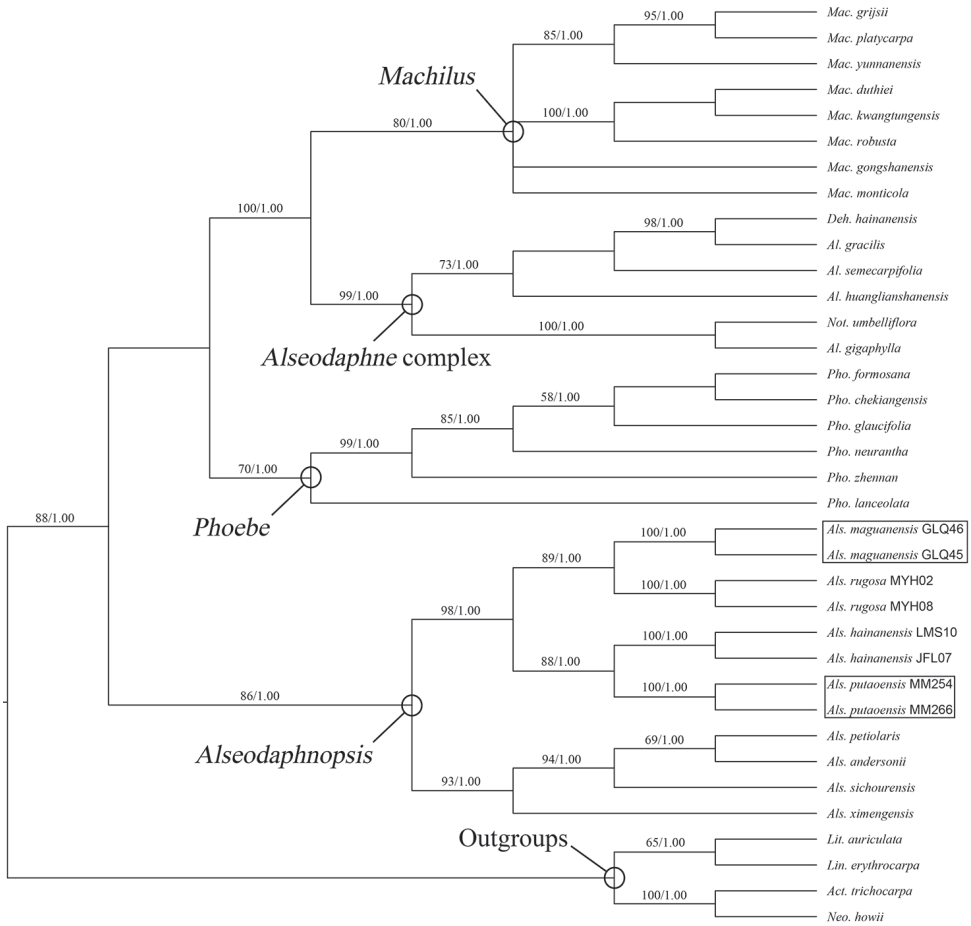

Figure 1. Bayesian consensus tree of ITS + *LEAFY* intron II combined dataset. MP bootstrap (BS ≥ 50%) and Bayesian posterior probability (PP ≥ 0.95) values are shown above branches. *Act.* = *Actinodaphne*, *Al.* = *Alseodaphne*, *Als.*= *Alseodaphnopsis*, *Deh.* = *Dehaasia*, *Lin.* = *Lindera*, *Lit.* = *Litsea*, *Mac.* = *Machilus*, *Neo.* = *Neolitsea*, *Not.* = *Nothaphoebe*, *Pho.* = *Phoebe*.

Taxonomic treatments

***Alseodaphnopsis maguanensis* L.Li & J.Li, sp. nov.**
urn:lsid:ipni.org:names:77204194-1
Figs 2, 3

Diagnosis. *Alseodaphnopsis maguanensis* is morphologically similar and phylogenetically closely related to *A. rugosa*, but can be distinguished by its much larger fruit (4–5 × 5–6 cm vs. ca. 2.5 × 3 cm), mature fruit color (brown vs. deep purple or black) and different fruiting phenology.

Type. China. Yunnan Province: Maguan County, Houcao, Gulinqing Provincial Natural Reserve, in tropical montane forest, 800 m a.s.l., 14 May 2016, flowering, Lang Li et al., *GLQ26* (holotype: HITBC!).

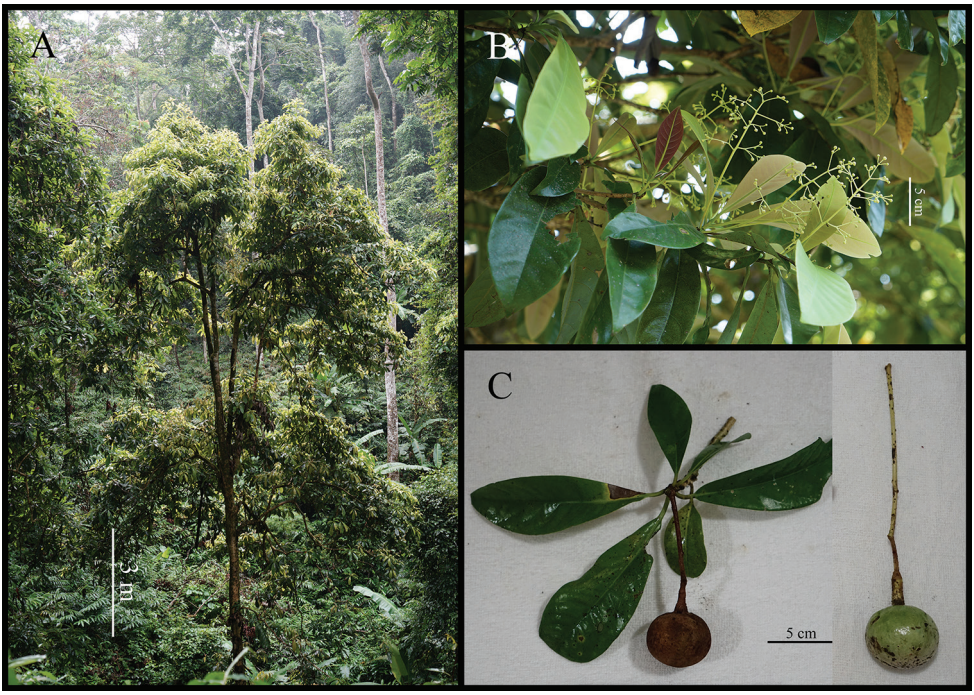

Figure 2. *Alseodaphnopsis maguanensis* **A** habitat **B** branchlet with inflorescences **C** branchlet with mature fruit, immature fruit. Photographed by Lang Li.

Description. Trees evergreen, up to 20 m tall. Branchlets terete, 3–6 mm in diameter, grayish, glabrous, wrinkled, with lenticels and leaf scars. Terminal buds glabrous. Leaves clustered at apex of branchlet, alternate or subverticillate; petiole robust, 2–3 mm thick, 1.5–2.5 cm long, concave-convex; leaf blade green adaxially, glaucous abaxially when young but green or pale green when mature, oblong-obovate or oblong-oblanceolate, 12–32 × 3.5–9 cm, leathery, glabrous on both surfaces, midrib conspicuously elevated abaxially, impressed adaxially, lateral veins 8–12 pairs, veins and veinlets conspicuous, reticulate, elevated on both surfaces when dry, base cuneate, apex shortly acuminate. Panicles subterminal, clustered at apex of branchlet, 15–20 cm, many-flowered; peduncle 4.5–10 cm, glabrous. Pedicels slender, 5–8 mm, glabrous. Perianth lobes 6, glabrous outside, white pubescent inside, outer ones broadly ovate, ca. 2 × 1.5 mm, acute, inner ones broadly ovate, ca. 2.5 × 2 mm, acute, all deciduous when in fruit. Fertile stamens 9, ca. 2 mm in 1st and 2nd whorls, ca. 2.2 mm in 3rd whorl; filaments villous, almost as long as anthers in 1st and 2nd whorls, slightly longer than anthers in 3rd whorl, those of 3rd whorl each with 2 shortly stalked orbicular-cordate glands, others glandless; anthers of 1st and 2nd whorls ovate, with 2 upper smaller cells and 2 lower large cells, cells all introrse, anthers of 3rd whorl elliptic, with 4 extrorse cells. Staminodes conspicuous, ca. 1.5 mm, sagittate, stalked. Ovary ovoid, ca. 1.2 mm, glabrous, attenuate into a ca. 0.8 mm long style; stigma discoid, inconspicuous. Infructescence subterminal, 10–18 cm, robust, glabrous, with only one well-

Figure 3. *Alseodaphnopsis maguanensis* **A** outer perianth lobe (inside view) **B** inner perianth lobe (inside view) **C** third whorl stamen **D** pistil **E** flowering branch **F** second whorl stamen **G** staminode **H** first whorl stamen **I** flower (lateral view). Illustration by Ling Wang from Mo et al. (2017b).

developed fruit. Fruit large, oblate, 4–5 × 5–6 cm, immature fruit green, brown when mature, fruit stalk robust, 3–4 mm in diameter, apex dilated, 5–10 mm in diameter, sometimes nearly cylindric, fleshy and warty when fresh.

Phenology. Flowering from May to June and fruiting from July to September.

Etymology. The species is named after the type locality, Maguan County, in Yunnan Province, China.

Distribution and habitat. Currently known only from the type locality in Maguan, Yunnan Province, southwestern China. Tropical montane forests in valleys; ca. 800m.

Preliminary conservation status. Currently, *A. maguanensis* is only known from Maguan (Yunnan Province, China) with two populations, which are all located in a small natural reserve (ca. 71 km^2), each population with less than 50 mature individuals (seedlings can be found near the mature individuals), and no other occurrence in adjacent regions of SE Yunnan and N Vietnam. Thus, the preliminary conservation status for *A. maguanensis* is suggested as critically endangered (CR C2a(i)) according to the IUCN Red List Categories and Criteria (IUCN 2012).

Additional specimen examined (paratype). China. Yunnan Province: Maguan County, Shangba, Gulinqing Provincial Natural Reserve, in tropical montane forest, 800 m a.s.l., 28 August 2016, fruiting, Lang Li et al., *2016033* (HITBC!).

Alseodaphnopsis putaoensis **L.Li, Y.H.Tan & J.Li, sp. nov.**
urn:lsid:ipni.org:names:77204195-1
Fig. 4

Diagnosis. *Alseodaphnopsis putaoensis* is morphologically similar to *A. rugosa*, but phylogenetically closely related to *A. hainanensis*. It can be distinguished from them by its fruit stalk characters (apex slightly dilated, not fleshy, red and warty when fresh vs. apex dilated, nearly cylindric, fleshy, red and warty when fresh), much larger fruit (6–6.5 × 7–10 cm vs. ca. 2.5 × 3 cm and 1.2–2 cm), mature fruit color (brown vs. deep purple or black) and different fruiting phenology.

Type. Myanmar. Kachin State: Putao County, on the way from Masabu to Namti, in tropical montane forest, 1000 m a.s.l., 13 May 2017, fruiting, Lang Li & Hui Ma *MM271* (holotype: HITBC!).

Description. Trees evergreen, up to 15 m tall. Branchlets terete, robust, 7–10 mm in diameter, brownish or dark brown, glabrous, wrinkled, with lenticels and leaf scars. Terminal buds glabrous. Leaves clustered at apex of branchlet, subverticillate; petiole robust, 2–3 mm thick, 2.5–4.5 cm long, concave-convex; leaf blade green adaxially, glaucous abaxially, oblong-obovate or oblong-oblanceolate, 18–35 × 6–9 cm, leathery, glabrous on both surfaces, midrib conspicuously elevated abaxially, impressed adaxially, lateral veins 8–12 pairs, veins and veinlets conspicuous, reticulate, elevated on both surfaces when dry, base cuneate, apex shortly acuminate. Flowers unknown. Infructescence subterminal, 8–10 cm, robust, glabrous, with only one well-developed fruit. Fruit large, oblate, 6–6.5 × 7–10 cm, immature fruit green, brown when mature, fruit stalk robust, 3–4 mm in diameter, apex slightly dilated, 5–6 mm in diameter.

Phenology. Individuals with immature or mature fruits have been collected in May, fruiting may be from April to June.

Etymology. The species is named after the type locality, Putao County, in Kachin State, Myanmar.

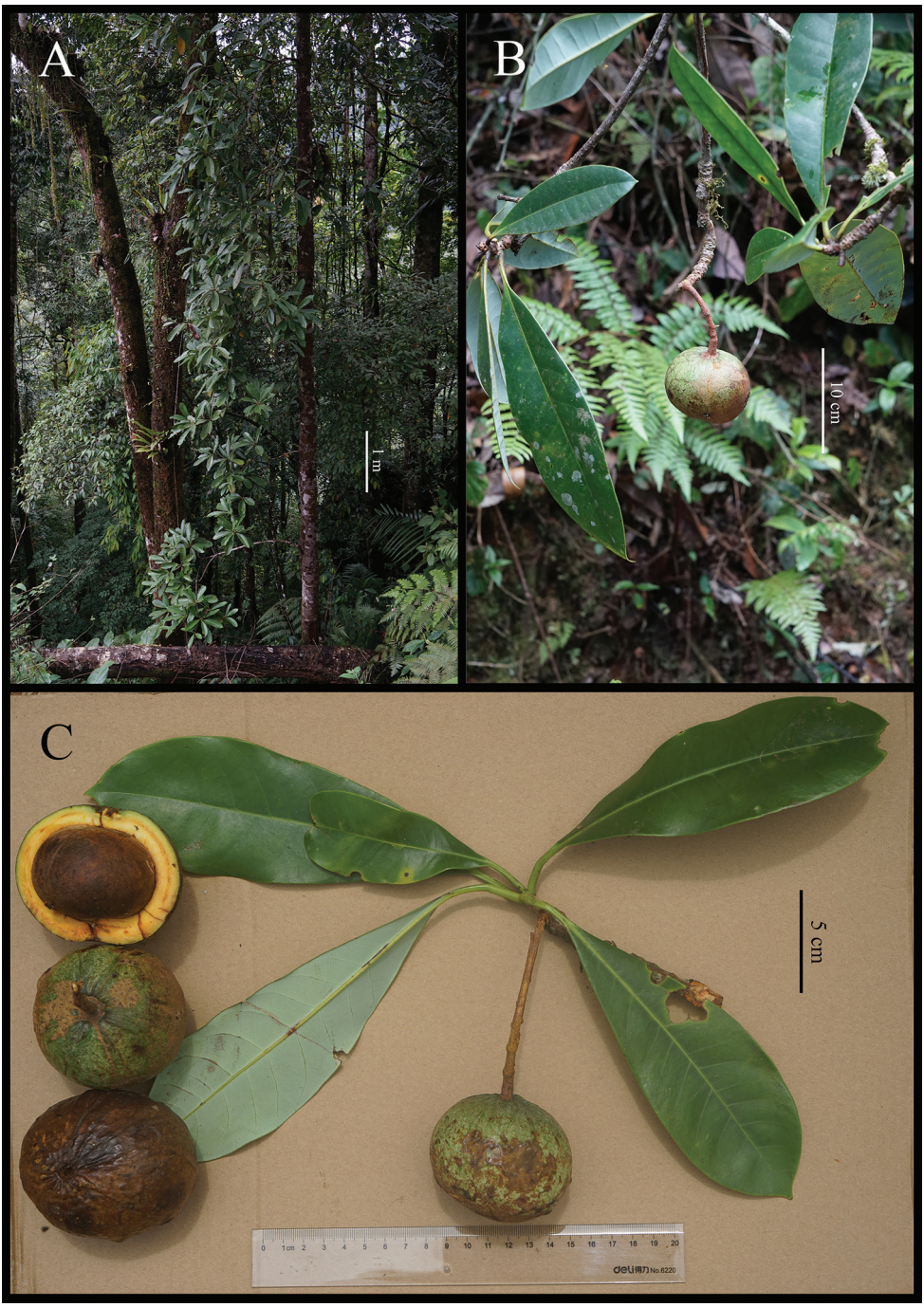

Figure 4. *Alseodaphnopsis putaoensis* **A** habitat **B** branchlet with immature fruit **C** branchlet with immature fruit, immature and mature fruits. Photographed by Lang Li.

Distribution and habitat. Currently known only from the type locality in Putao, Kachin State, northern Myanmar. Tropical montane forests on mountain slopes or in valleys; 600–1400m.

Preliminary conservation status. During the field survey in Putao (Kachin State, Myanmar), several populations of *A. putaoensis* were found and at least two of them with more than 50 mature individuals (seedlings could be found near the mature individuals) each. In future field surveys, potential populations and more individuals are expected to be found in Putao and adjacent regions. Currently, some localities of *A. putaoensis* have not been legally protected. The habitat fragmentation, as well as ongoing road construction and continuous logging, are threatening its survival. Thus, the preliminary conservation status for *A. putaoensis* is suggested as vulnerable (VU C12a(i)) according to the IUCN Red List Categories and Criteria (IUCN 2012).

Additional specimen examined (paratype). Myanmar. Kachin State: Putao County, on the way from Masabu to Namti, in tropical montane forest, 900 m a.s.l., 13 May 2017, fruiting, Lang Li & Hui Ma *MM254* (HITBC!).

Discussion

The close relationships of *Alseodaphnopsis maguanensis*, *A. rugosa*, *A. putaoensis* and *A. hainanensis* were indicated by the phylogenetic analyses. They formed a well-supported subclade within the *Alseodaphnopsis* clade, and *A. maguanensis* is sister to *A. rugosa* while *A. putaoensis* is sister to *A. hainanensis* (Fig. 1). *Alseodaphnopsis maguanensis*, *A. putaoensis* and *A. rugosa* are very similar in their vegetative characters (e.g. leaf and branchlet characters), but *A. hainanensis* can be easily distinguished from them by its narrowly elliptic and smaller leaves (vs. oblong-obovate or oblong-oblanceolate and larger leaves of *A. maguanensis*, *A. putaoensis* and *A. rugosa*) (Li et al. 2008). The fruit stalk and fruit characters are very important to distinguish *Alseodaphnopsis maguanensis*, *A. putaoensis* and *A. rugosa*. *Alseodaphnopsis putaoensis* has the largest fruit (6–6.5 × 7–10 cm, brown when mature) with the fruit stalk slightly dilated at the top (not fleshy and warty when fresh), while *A. maguanensis* and *A. rugosa* have relative smaller fruits (4–5 × 5–6 cm, brown when mature and ca. 2.5 × 3 cm, deep purple or black when mature) with the fruit stalks distinctly dilated at the top (nearly cylindric, fleshy and warty when fresh).

Alseodaphnopsis maguanensis, *A. rugosa*, *A. putaoensis* and *A. hainanensis* also have different fruiting phenologies. *Alseodaphnopsis maguanensis* is fruiting from July to September, both immature and mature fruits can be found in August. According to the work of Li et al. (2008), *Alseodaphnopsis rugosa* is fruiting from July to December. However, based on specimen and field observations, very few individuals with young fruits were collected in August, most fruiting individuals were collected from October to December. For *Alseodaphnopsis putaoensis*, individuals with immature or mature fruits have been collected in May, fruiting may be from April to June. *Alseodaphnopsis hainanensis* is fruiting from October to February (Li et al. 2008). A detailed comparison of the morphological differences among these four taxa, as well as their phenologies and distributions, is given in Table 2.

Table 2. Comparison of key morphological characters, phenologies and distributions of *Alseodaphnopsis maguanensis*, *A. rugosa*, *A. putaoensis* and *A. hainanensis*.

Morphological characters	*Alseodaphnopsis maguanensis*	*Alseodaphnopsis rugosa*	*Alseodaphnopsis putaoensis*	*Alseodaphnopsis hainanensis*
Leaf blade	oblong-obovate or oblong-oblanceolate, 12–32 × 3.5–9 cm, green adaxially, glaucous abaxially when young but green or pale green when mature	oblong-obovate or oblong-oblanceolate, 15–36 × 4–10 cm, green adaxially, glaucous abaxially	oblong-obovate or oblong-oblanceolate, 18–33 × 6–9 cm, green adaxially, glaucous abaxially	narrowly elliptic, 6–16 × 1.5–4.2 cm, green adaxially, glaucous abaxially when young but green or pale green when mature
Infructescence	with only one well-developed fruit	with one or several well-developed fruits	with only one well-developed fruit	with one or several well-developed fruits
Fruit stalk	apex dilated, 5–10 mm in diam., sometimes nearly cylindric, fleshy and warty when fresh	apex dilated, nearly cylindric, 5–8 mm in diam., fleshy, red and warty when fresh	apex slightly dilated, 5–6 mm in diam.	apex dilated, nearly cylindric, 5–8 mm in diam., fleshy, red and warty when fresh
Fruit	oblate, 4–5 × 5–6 cm, brown when mature	oblate, ca. 2.5 × 3 cm, deep purple or black when mature	oblate, 6–6.5 × 7–10 cm, brown when mature	globose or ovoid, 1.2–2 cm, deep purple or black when mature
Flowering Phenology	May–Jun	–	–	Jul
Fruiting Phenology	Jul–Sep	Jul–Dec (Fruits mostly found from Oct to Dec)	Apr–Jun	Oct–Feb of next year
Distribution	SW China (Yunnan)	S China (Hainan)	N Myanmar (Kachin)	S China (Hainan), N Vietnam (Lào Cai)

Unfortunately, the flowers of *Alseodaphnopsis putaoensis* and *A. rugosa* remain unknown. The evidence from both phylogenetic and morphological analyses support the recognition of *Alseodaphnopsis maguanensis* and *A. putaoensis* as distinct species in the genus.

With *Alseodaphnopsis maguanensis*, *A. putaoensis* and the recently described *A. ximengensis* H. W. Li & J. Li from Ximeng, Yunnan Province, China (Mo et al. 2017a) included, *Alseodaphnopsis* currently has only 11 recorded species, indicating that the species diversity of the genus is still in need of investigation and open to discovery. More new species of *Alseodaphnopsis* are expected to be discovered in the northern marginal zone of the Asian tropics when more field investigations are conducted in this region.

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RESEARCH ARTICLE

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Colocasia kachinensis, a new species of Araceae from Myanmar

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Abstract

Colocasia kachinensis S.S. Zhou & J.T. Yin, is described and illustrated as a new species of Araceae from Kachin, Mynamar. The morphological characters are compared to those of other *Colocasia* species. *Colocasia kachinensis* is closely related to *C. menglaensis* J.T Yin, H. Li & Z.F. Xu, 2004, but differs from in having an erect stem, no stolons, smaller size, a different pattern of surface bristle distribution and male flowers 1–4-androus with stamens connate in truncate synandrium.

Keywords

Araceae, *Colocasia kachinensis*, Mynamar, Holotype, *Colocasia menglaensis*

Introduction

Colocasia is a genus of about 20 species distributed in tropical and subtropical Asia (Li and Boyce 2010). Currently, two sections are recognised within the genus: sect. Colocasia and sect. Caulescentes (Mayo et al. 1997). This new species belongs to section Caulescentes Engl., characterised by an erect stem.

Including the species described here, four *Colocasia* species are known in Myanmar (Kress et al. 2003): *C. affinis* Schott, *C. esculenta* (L.) Schott, *C. kachinensis* and *C. menglaensis* J.T. Yin, H. Li & Z.F. Xu. *Colocasia menglaensis* was first found in the same habitat as *C. kachinensis*.

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During an expedition to Kachin in April 2016, two populations of an unusual *Colocasia* were encountered growing along the roadside in the understorey of a mountain rain forest. For the next two years, the authors monitored the in-situ population, as well as plants established in ex-situ collection and meticulously examined and documented flowering episodes of the species. The unusual *Colocasia sp.* was compared with closely allied species and the gathered evidence revealed that the species was new to science.

Taxonomy

Colocasia kachinensis **S.S.Zhou & J.T.Yin, sp. nov.**
urn:lsid:ipni.org:names:77204196-1
Figures 1–4

Colocasia sect. *Caulescentes* Engl.

Diagnosis. The morphological characteristics of *C. kachinensis* are closely related to those of *C. menglaensis* but *C. kachinensis* differs in having an erect stem (see Fig. 3), no stolons, smaller leaf and inflorescence and glossy petiole and peduncle.

Type. MYANMAR. Kachin State. Putao Township, Hponkanrazi Wildlife Sanctuary, Namse Village, 97°18'30.3"E, 27°17'49.7"N, alt. 1238 m, 26 April 2016, Jian-Tao Yin 2483 (Fig. 2) (holotype, HITBC!, isotype: HITBC!)

Description. Terrestrial perennial herbs with an erect stem. Plant 54 cm high; erect stem 12 cm long, 3 cm in diam. Leaves 3–4; petiole cylindric, pale greenish, glossy, 32 cm long, 0.6 cm in diam., sheath 16 cm long, 6 cm in diam.; leaf blade oblong-ovate, peltate, 18 cm long, 12 cm wide, upper surface glossy green, lower surface greyish-white; primary lateral veins pinnate, 5 pairs, pale green on upper surface, white and raised on the lower surface. Inflorescences (1-)3(-4) emerging when the leaves unfold, 27 cm long; peduncle cylindrical, pale green, glossy, 17 cm long, 0.5 cm in diam. Spathe constricted in the lower third, lower convolute part (tube) pale green, farinose, 3.5 cm long, 1.5 cm in diam., nearly cylindrical; lamina oblong-lanceolate, erect during early blooming period, pale yellow, 6.5 cm long, 3 cm wide. Spadix 7 cm long, female zone 2.5 cm long, 0.8 cm in diam.; sterile zone between female and male zones, cylindrical, white, 0.8 cm long, 0.3 cm in diam.; male zone, white, 2 cm long, 0.6 cm in diam.; appendix white, long conical, wrinkled, 2 cm long, 0.4 cm in diam. Flowers unisexual, perigone absent. Male flower: 1–4-androus, stamens connate in truncate synandrium, thecae lateral, oblong-lineal, dehiscing by apical pore. Female flower: ovary ovoid to oblong, 1 mm long, unilocular; ovules many, 42–58, n = 2, fusiform, translucent; placentae 3–5, parietal; stylar region absent; stigma discoid-capitate; berry not seen.

Phenology. Flowering in March to April. Fruiting unknown.

Distribution and habitat. *C. kachinensis* is so far known from a single population in Kachin State, northern Myanmar, where it grows in humid dense mountain rain for-

Figure 1. *C. kachinensis*. **A** plant **B** inflorescence **C** lower surface of leaf **D** spadix.

est (cover degree 70%) at alt. 1100–1400 m. In the same habitat, other plants encountered were *C. menglaensis*, *Liquidambar excelsa*, *Terminalia myriocarpa*, *Caryota urens*, *Magnolia* sp., *Musa itinerans*, *Saprosma ternate*, *Dendrocalamus* sp., *Phrynium rheedei*.

Etymology. The species is named after the holotype region, Kachin State, Myanmar.

Additional examined specimens (Paratype). MYANMAR. Putao Township, Kachin State, alt. 1300 m, 26 April 2016, Jian-Tao Yin 2482 (paratype: HITBC!)

Figure 2. Holotype of *C. kachinensis*. See text for collection details.

Figure 3. Stem of *C. kachinensis* and morphological comparison between *C. menglaensis* and *C. kachinensis*. **A** stem of *C. kachinensis* **B** lower surface of leaf ×100 of *C. menglaensis* **C** lower surface of leaf ×100 of *C. kachinensis.*

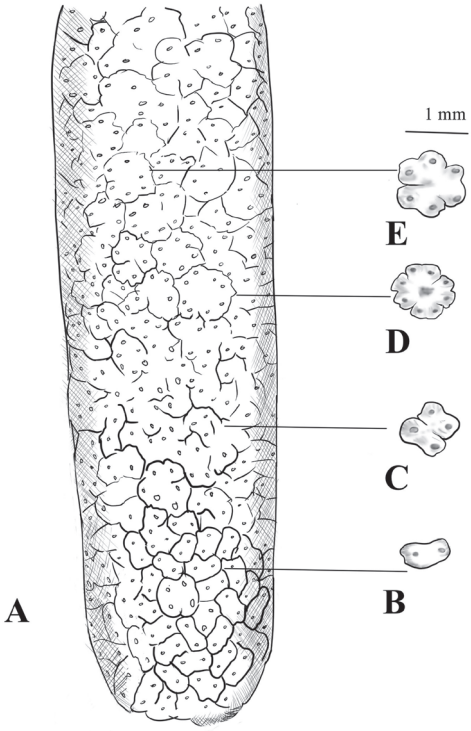

Figure 4. Male flower of *C. kachinensis.* Drawn by Mr. Bo Pan from the holotype. **A** Male part of spadix **B** 1-androus flower **C** 2-androus flower **D** 4-androus flower **E** 3-androus flower.

Table 1. Morphological differences between *C. kachinensis* and *C. menglaensis*.

Characters	*C. kachinensis*	*C. menglaensis*
Rhizome	erect	decumbent
Stolon	none	6–10 per plant,15–20 cm long, 4 mm in diam.
Petiole	glossy	pubescent
Blade	18 × 12 cm	40 × 25 cm
Primary lateral vein	5 pairs	7–9 pairs
Penducle	glossy	pubescent
Spathe lamina	milk yellow, 6.5 × 3 cm	yellowish, 13–18 × 4–6 cm
Female zone	2.5 cm long, 0.8 cm in diam.	2 cm long, 1 cm in diam.
Male zone	2 cm long, 0.6 cm in diam.	3.5 cm long, 0.7 cm in diam.
Appendix	2 cm long, 0.4 cm in diam.	3.5 cm long, 0.5 cm in diam.
Male flower	1–4-androus	8–11-androus

Discussion

Colocasia kachinensis is similar to *C. menglaensis*, described by Yin et al (2004), because they both have similar pubescent leaves. It differs from the latter by having (i) an erect stem (see Fig. 3), (ii) no stolons, (iii) smaller leaf and inflorescence and (iv) glossy petiole and peduncle.

Colocasia menglaensis and *C. kachinenis*, which were introduced from Myanmar, have been grown in a small yard of Xishuangbanna Tropical Botanical Garden, Yunnan China. We then collected leaves of two species for observation. The lower surface of the leaf blade, observed with a 100× magnification, also shows that *C. kachinensis* differs from *C. menglaensis*. The short bristles of the former are uniformly distributed on the abaxial surface of the leaf, while those of *C. menglaensis* are concentrated on the veins on the abaxial surface (see Fig. 3).

Colocasia kachinensis is also different from other species in this genus by having 1–4-androus male flowers, with stamens connate in truncate synandrium (see Figure 4). In the genus of *Colocasia*, one usually finds 3–6-androus male flowers, with stamens connate in ± truncate synandrium (Mayo et al. 1997). Further differences are listed in Table 1.

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CHECKLIST

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An annotated checklist of Myanmar orchid flora

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Abstract

Myanmar is situated in Southeast Asia, where species richness and diversity are very high. Myanmar orchid flora is very rich, but still poorly known because botanical explorations have sharply decreased in Myanmar since 1950. The present study provides a checklist of Myanmar orchid flora which includes 1040 species and 151 genera currently known from Myanmar, based on the herbarium specimens, literature and online databases. The number of species is increased by approximately 200 species more than that given in the checklist of Kress et al. (2003), mainly due to recent discoveries of new species to science and new records for Myanmar. There are 76 endemic species of Orchidaceae in Myanmar. It is estimated that ca. 150–300 species still remain as unidentified and are expected to be discovered in further studies on Myanmar orchid flora.

Keywords

Orchidaceae, Checklist, herbarium specimens, Myanmar

Introduction

Southeast Asia is a region of high species richness and endemism, encompassing four major global biodiversity hotspots, namely Indo-Burma hotspot, Sundaland hotspot, Wallacea hotspot and Phillipines hotspot (Myers et al. 2000, Mittermeier et al. 2011). Biodiversity in this region is under various threats to species survival, such as habitat loss and fragmentation, land use change, climate change and deforestation. Under

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such circumstances, Southeast Asian countries face various challenges for biodiversity conservation and the lack of financial and technical assets (Myers et al. 2000, Sodhi et al. 2004, 2010, Mittermeier et al. 2011).

Myanmar is situated in Southeast Asia and is also part of the Indo-Burma biodiversity hotspot, with high species richness and diversity (Myers et al. 2000, Mittermeier et al. 2011). Due to its broad latitudinal range (tropical to subtropical), topographical (mostly mountainous) and climatic (monsoonal) factors, there are various types of ecosystems in Myanmar, from southern tropical evergreen rainforest ecosystem to northern subtropical montane forest ecosystem through central dry deciduous forests.

On the other hand, as biodiversity research is very limited in Myanmar, many species of fauna and flora still remain unidentified. Biodiversity conservation is urgently needed to secure the sustainability of existing biodiversity resources in Myanmar (Giam et al. 2010, Webb et al. 2010, Forest Department 2015, Jin et al. 2018a). According to the checklist of Myanmar flora (Kress et al. 2003), there are 273 families, 2371 genera and over 11,800 species of vascular plants, including ca. 800 species of Orchidaceae recorded from Myanmar (Kress et al. 2003, Kurzweil and Lwin 2014).

Botanical explorations have sharply decreased in Myanmar since 1950, leading to a large gap of knowledge on flora of Myanmar (Kress et al. 2003). Unlike neighbouring countries with intensive botanic investigation and a modern taxonomic treatment on orchid biodiversity, the orchid flora of Myanmar is very poorly known and lacks a modern taxonomic treatment (see Pearce and Cribb 2002, Ormerod and Sathish Kumar 2003, Ormerod 2005, 2012, Chen et al. 2009, Pedersen et al. 2011, 2014, Kurzweil and Lwin 2014).

At the start of the 21st century, botanical explorations resumed in Myanmar, with the support of international cooperation for biodiversity conservation and research. As a result, there are discoveries of species new to science and new species records for Myanmar orchid flora over recent years (Ormerod 2005, Tanaka et al. 2010, 2015, 2018, Kurzweil et al. 2010, Kurzweil and Lwin 2012a, b, 2014, 2015, Kurzweil 2013, Watthana et al. 2015, Aung et al. 2017, Jin and Kyaw 2017, Liu et al. 2017, Yang et al. 2017, Aung and Jin 2018, Aung et al. 2018, Kurzweil and Ormerod 2018, Liu et al. 2018, Kang et al. 2019, Mu et al. 2019, Ya et al. 2019). In the review on Orchidaceae in the checklist of Kress et al. (2003), there are many species needed to be revised taxonomically due to recent advances in orchid taxonomy and systematics. For example, the genera *Drymoda* Lindley (1838: 8), *Ione* Lindley (1853: 1), *Monomeria* Lindley (1830b: 61), *Sunipia* Lindley (1826a: 14, 21, 25), *Trias* Lindley (1830a: 60) have been merged into *Bulbophyllum* Thouars (1822: 3), leading to nomenclatural changes in *Bulbophyllum* (Pridgeon et al. 2014, Vermeulen et al. 2014).

In addition, there is a sharp increase in the number of species of Orchidaceae due to recent discoveries of species new to science and new species records for Myanmar. For example, one new species of *Bulbophyllum* Thouars (1822: 3), two new species of *Calanthe* Brown (1821: 573), three new species of *Coelogyne* Lindley (1821: 33), two new species of *Dendrobium* Swartz (1799: 2, 6: 82), two new species of *Gastrodia* Brown (1810: 330), one new species of *Pinalia* Lindley (1826b: 14, 21, 23), one

new species of *Odontochilus* Blume (1858: 79) and one new species of *Vanda* Jones ex Brown (1820: 6: 506) have been described from Myanmar over recent years (Roberts et al. 2008, Ormerod and Wood 2010, Tanaka et al. 2010, Kurzweil 2013, Aung et al. 2017, 2018, Jin and Kyaw 2017, Liu et al. 2017, 2018, Yang et al. 2017, Aung and Jin 2018, Kurzweil and Ormerod 2018, Zhou et al. 2018a). Recently Kurzweil and Ormerod (2018) also reported 38 new records for Myanmar, also leading to an increase in the number of species of Myanmar orchid flora. Under the main theme of biodiversity conservation and research, the present study investigates the species richness of Myanmar orchid flora, based on the field investigation, herbarium specimens, literature and online databases. The present study will contribute to the floristic studies and biodiversity conservation in Myanmar.

Material and methods

Study areas

In order to investigate species richness of Myanmar orchid flora, a programme of fieldwork has been conducted in almost all ecosystems across Myanmar. Seven protected areas across Myanmar, namely Hponkanrazi Wildlife Sanctuary and Hkakaborazi National Park of Kachin State, Popa Mountain Park of Mandalay Region, Nat Ma Taung National Park of Chin State, Alaungdaw Kathapa National Park of Sagaing Region, Taunggyi Bird Sanctuary and its adjacent areas of Shan State and Tanintharyi Nature Reserve of Tanintharyi Region, have been investigated two to five times in each protected area during 2014–2018 (Fig. 1).

Specimen collections and identification

In total, approximately 1,000 specimens of orchids were collected for vouchers, kept in PE and RAF (Thiers 2019, http://sweetgum.nybg.org/ih/). More than 75% of the total specimens were collected from Hponkanrazi Wildlife Sanctuary and Hkakaborazi National Park, Putao District, Kachin State, Northern Myanmar. Putao is the northernmost district of Myanmar where there are vast areas of primary forest with high species richness and diversity. The remaining proportions were collected from other study areas. In the collections, most species are *Dendrobium* species, *Bulbophyllum* species and *Coelogyne* species. The remaining proportions are species of common genera *Eria*, *Liparis*, and *Oberonia*.

All collected specimens were taxonomically identified based on relevant literature, field notes, photographs taken during fieldwork, herbarium specimens (PE) and online herbarium specimens such as Kew Herbarium Catalogue and Chinese Virtual Herbarium (Seidenfaden 1992, Dressler 1993, Pedersen 1995, Pridgeon et al. 2001, 2005, 2014, Pedersen et al. 2002, 2011, 2014, Kress et al. 2003, Chen et al. 2009, Kurzweil

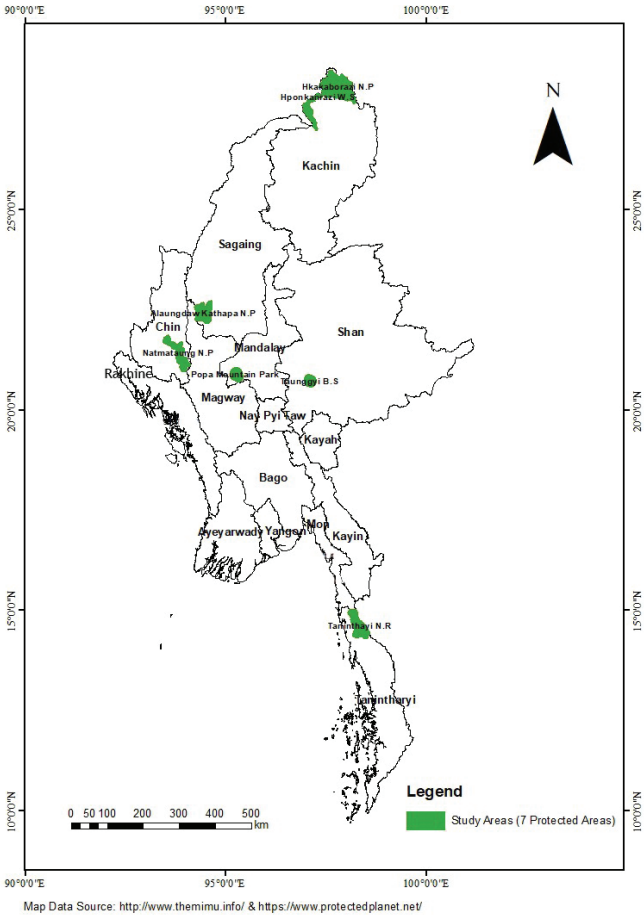

Figure 1. Map of Myanmar, showing the location of study areas for orchid survey.

and Lwin 2014, Chase et al. 2015, Chinese Virtual Herbarium 2018, Royal Botanic Gardens Kew 2018). For verification of taxonomic status of all species, literature and online databases, such as WCSP, were reviewed to confirm its respective taxonomic status (Pridgeon et al. 2001, 2005, 2014, Chen et al. 2009, Gardiner 2012, Gardiner et al. 2013, Vermeulen et al. 2014, Jin et al. 2014, Chase et al. 2015, Raskoti et al. 2016, 2017, Ng et al. 2018, WCSP 2019).

Investigation of herbarium specimens

In total, there were ca. 3,000 herbarium specimens examined, including specimens of our own collections (PE), Kew herbarium specimens (K) and specimen records from online herbaria: AMES, BM, E, GH, K, L, NY, P, US and W (Thiers 2019, http://sweetgum.nybg.org/ih/).

All available datasets of herbarium specimens (ca. 1500 specimens) and specimen photographs were downloaded from online herbaria and examined to enumerate the number of species and to investigate the species occurrences in Myanmar. The following are specimen records downloaded from each online herbarium, AMES (12 records), BM (420 records), E (496 records), GH (3 records), K (324 records), L (39 records), NY (116 records), P (87 records), US (81 records) and W (11 records) (Natural History Museum 2014, Royal Botanic Gardens Kew 2018, The BioPortal of Naturalis Biodiversity Center 2019, Smithsonian National Museum of Natural History 2019, New York Botanical Garden 2019, Royal Botanic Garden Edinburgh 2019, The Index of Botanical Specimens, Harvard University Herbaria and Libraries 2019, The Vascular Plants, Muséum National d'Histoire Naturelle 2019, The Virtual Herbaria, Naturhistorisches Museum Wien 2019). During our field trips in Myanmar, some old herbarium specimens at RAF (ca. 200 specimens) were also examined at herbarium (RAF) of Forest Research Institute in Yezin, Nay Pyi Taw.

As for species occurrences, the herbarium specimens (BM, E, K) provide the information on past record of species occurrences in Myanmar, for example, old collections (past 100 years) by some well-known plant collectors, such as Charles Parish, George Forrest, J. H. Lace, Frank Kingdon-Ward, W. A. Robertson, F. G. Dickason and C. W. D. Kermode during last half of the 19th century and first half of the 20th century. The herbarium specimens (PE) provide information on the current status of species occurrences across Myanmar.

In addition, some literature provides information on specimens from Myanmar that can be cited as specimen-based species occurrences in Myanmar (Kurzweil and Lwin 2015, Tanaka et al. 2015, 2018, Watthana et al. 2015, Aung et al. 2017, 2018, Jin and Kyaw 2017, Liu et al. 2017, 2018, Yang et al. 2017, Aung and Jin 2018, Kurzweil and Ormerod 2018, Zhou et al. 2018a, Ding et al. 2019, Kang et al. 2019, Mu et al. 2019, Ya et al. 2019).

Verification of species occurrence and taxonomic status

The number of species in the updated checklist is a result of taxonomic attempts, mainly based on our own collections, all available herbarium specimens, checklist of Kress et al. (2003) and all relevant literature. As for taxonomic status, we followed the updated classification of Orchidaceae (Chase et al. 2015) and all relevant papers of orchid taxonomy and systematics (Pridgeon et al. 2001, 2005, 2014, Chen et al. 2009, Gardiner 2012, Gardiner et al. 2013, Jin et al. 2014, Vermeulen et al. 2014, Raskoti et al. 2016, Raskoti et al. 2017, Govaerts 2018, Ng et al. 2018). In addition, all papers of new species descriptions and new records of Myanmar orchid flora were reviewed to identify the species occurrences and distribution in Myanmar (Kress et al. 2003, Roberts et al. 2008, Chen et al. 2009, Tanaka et al. 2010, 2015, 2018, Ormerod 2012, Pedersen et al. 2011, 2014, Kurzweil and Lwin 2012a, b, Kurzweil 2013, Kurzweil and Lwin 2014, Aung et al. 2017, 2018, Jin and Kyaw 2017, Koopowitz

et al. 2017, Liu et al. 2017, 2018, Yang et al. 2017, Aung and Jin 2018, Kurzweil and Ormerod 2018, Zhou et al. 2018a, Ding et al. 2019, Kang et al. 2019, Mu et al. 2019, Ya et al. 2019).

Both the number of species and their taxonomic status were also verified with reliable online databases such as the World Checklist of Selected Plant Families (WCSP 2019), International Plant Names Index (IPNI 2012) and the Plant List (The Plant List 2013). Global Biodiversity Information Facility (GBIF 2019) and relevant online herbaria (AMES, BM, E, GH, K, L, NY, P, US and W) were also consulted to check the species occurrences of Orchidaceae in Myanmar.

Results

The present study results in a checklist of Myanmar orchid flora which includes 1040 species in 151 genera, with the number of species increased by ca. 200 species more than that given in the checklist of Kress et al. (2003). The increase in number of species is mainly due to the recent discoveries of species new to science, as well as new records for Myanmar (Figs 2–4). In the last few years, there were 19 new species of Orchidaceae discovered from Myanmar, preliminarily assigned the conservation status based on the IUCN Red List Categories and Criteria (Table 1). In Myanmar, there are 76 endemic species of Orchidaceae which need high conservation attention (IUCN 2012, IUCN Standards and Petitions Subcommittee 2019) (Table 2).

Local distribution information is provided for almost all species, usually at Region/State (Provincial) level distribution ranges (Table 3). Specific distribution locality infor-

Figure 2. *Coelogyne putaoensis* X.H.Jin, L.A.Ye & Schuit., new species discovered from Myanmar **A** habit of *Coelogyne putaoensis* **B** close-up of flower of *Coelogyne putaoensis.* Photos by X.H. Jin.

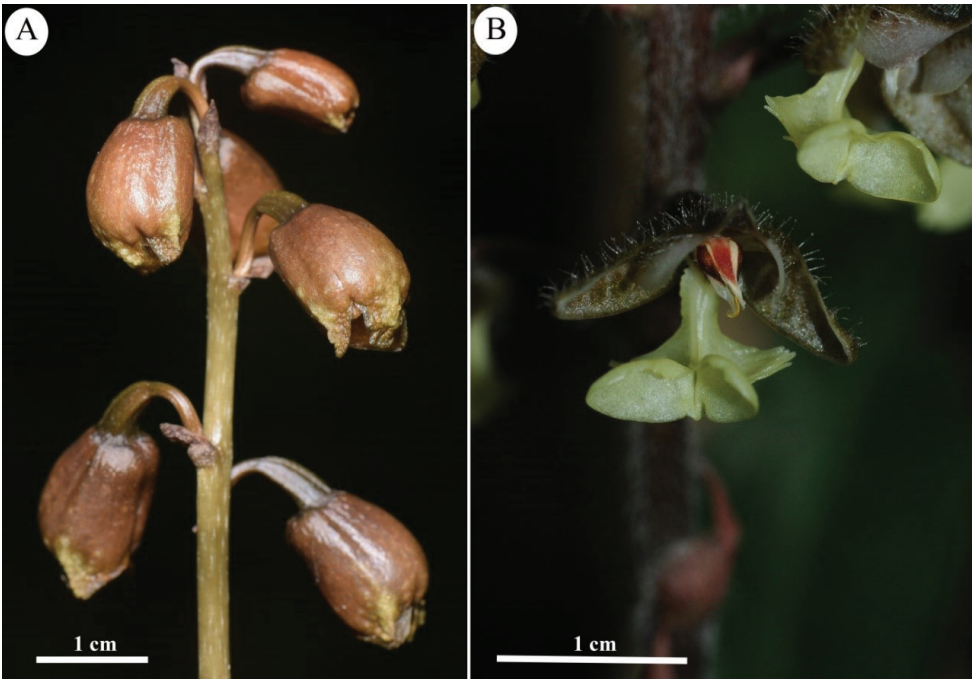

Figure 3. New species discovered from Myanmar **A** *Gastrodia kachinensis* X.H.Jin & L.A.Ye. **B** *Odontochilus putaoensis* X.H.Jin, L.A.Ye & A.T.Mu. Photos by X.H. Jin.

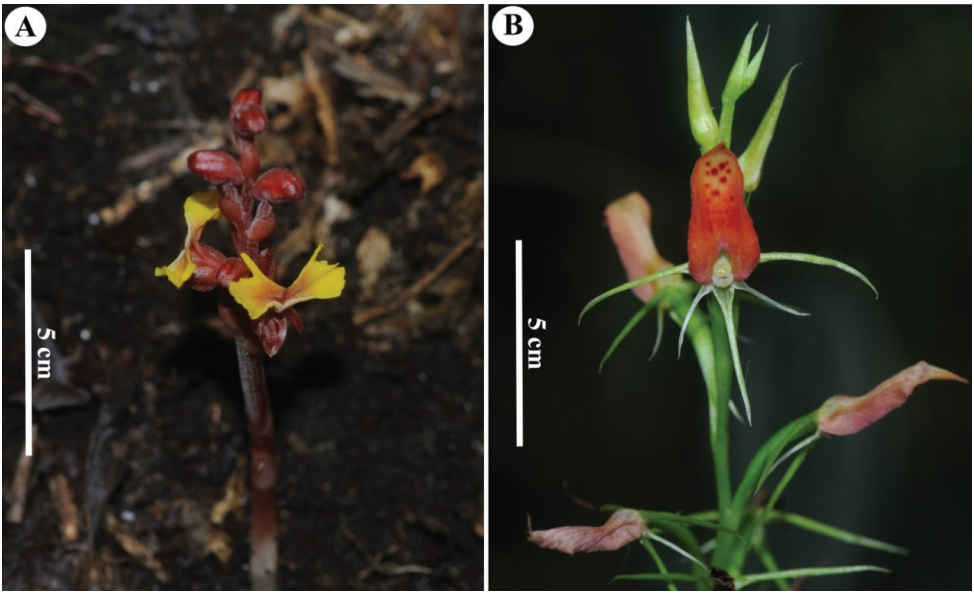

Figure 4. New records discovered from Myanmar **A** *Odontochilus poilanei* (Gagnep.) Ormerod **B** *Cryptostylis arachnites* (Blume) Hassk. Photos by Ye Lwin Aung.

Table 1. New species of Orchidaceae discovered from Myanmar.

No.	Species	Conservation status (IUCN)
1	*Biermannia burmanica* Y.H. Tan & Bin Yang	LC
2	*Bulbophyllum putaoensis* Q.Liu	LC
3	*Calanthe kermodei* Ormerod & Kurzweil	LC
4	*Calanthe punctata* Kurzweil	LC
5	*Coelogyne magnifica* Y.H.Tan, S.S.Zhou & B.Yang	EN
6	*Coelogyne putaoensis* X.H.Jin, L.A.Ye & Schuit.	EN
7	*Coelogyne victoria-reginae* Q.Liu & S.S.Zhou	EN
8	*Cylindrolobus glabriflorus* X.H.Jin & J.D.Ya	LC
9	*Dendrobium hkinhumense* Ormerod & Kumar	EN
10	*Dendrobium koyamae* Nb. Tanaka, T. Yuakawa & J. Murata	LC
11	*Dendrobium naungmungense* Q.Liu & X.H.Jin	CR
12	*Gastrodia kachinensis* X.H.Jin & L.A.Ye	EN
13	*Gastrodia putaoensis* X.H.Jin	EN
14	*Liparis popaensis* X.H.Jin, A.T.Mu & L.A.Ye	LC
15	*Odontochilus putaoensis* X.H. Jin, L.A. Ye & A.T. Mu	EN
16	*Paphiopedilum myanmaricum* Koop., Iamwir. & S.Laohap.	EN
17	*Phalaenopsis natmataungensis* (T.Yukawa, Nob.Tanaka & J.Murata) Dalstrom & Ormerod	EN
18	*Pinalia shiuyingiana* Ormerod & Wood	NT
19	*Vanda longitepala* D.L.Roberts, L.M.Gardiner & Mote	EN

Table 2. Endemic species of Orchidaceae in Myanmar.

No.	Species endemic to Myanmar	Conservation status (IUCN)
1	*Biermannia burmanica* Y.H. Tan & Bin Yang	LC
2	*Bletilla chartacea* (King & Pantl.) Tang & Wang	EN
3	*Bulbophyllum birmense* Schltr.	DD
4	*Bulbophyllum kachinense* (Seidenf.) J.J.Verm., Schuit. & de Vogel	EN
5	*Bulbophyllum oligoglossum* Rchb. f.	DD
6	*Bulbophyllum putaoensis* Q.Liu	LC
7	*Bulbophyllum sillemianum* Rchb.f.	DD
8	*Calanthe punctata* Kurzweil	LC
9	*Cheirostylis pubescens* Parish & Rchb. f.	DD
10	*Coelogyne magnifica* Y.H.Tan, S.S.Zhou & B.Yang	EN
11	*Coelogyne picta* Schltr.	EN
12	*Coelogyne putaoensis* X.H.Jin, L.A.Ye & Schuit.	EN
13	*Coelogyne victoria-reginae* Q.Liu & S.S.Zhou	EN
14	*Cymbidium parishii* Rchb. f.	CR
15	*Dendrobium aphrodite* Rchb. f.	LC
16	*Dendrobium calothyrsos* Schltr.	EN
17	*Dendrobium hirtulum* Rolfe	EN
18	*Dendrobium hkinhumense* Ormerod & Kumar	EN
19	*Dendrobium koyamae* Nb. Tanaka, T. Yuakawa & J. Murata	LC
20	*Dendrobium laterale* L.O. Williams	EN
21	*Dendrobium leucochlorum* Rchb. f.	EN
22	*Dendrobium luteolum* Bateman	EN
23	*Dendrobium marmoratum* Rchb. f.	DD
24	*Dendrobium naungmungense* Q.Liu & X.H.Jin	CR
25	*Dendrobium pedilochilum* Schltr.	EN

No.	Species endemic to Myanmar	Conservation status (IUCN)
26	*Dendrobium praetermissum* Seidenf.	EN
27	*Dendrobium rhodocentrum* Rchb. f.	EN
28	*Dendrobium sarmentosum* Rolfe	DD
29	*Dilochia subsessilis* (Rolfe) S. Thomas	DD
30	*Eria sicaria* Lindl.	DD
31	*Gastrochilus pechei* Schltr.	DD
32	*Gastrodia kachinensis* X.H.Jin & L.A.Ye	EN
33	*Gastrodia putaoensis* X.H.Jin	EN
34	*Goodyera myanmarica* Ormerod & C.S.Kumar	EN
35	*Habenaria corticicola* W.W. Sm.	EN
36	*Habenaria ditricha* Hook. f.	NT
37	*Habenaria linearis* King & Pantl.	EN
38	*Habenaria massoniana* King & Pantl.	EN
39	*Habenaria mientienensis* Tang & F.T. Wang	NT
40	*Habenaria prazeri* King & Pantl.	EN
41	*Habenaria shweliensis* W.W. Sm. & Banerji	NT
42	*Habenaria spatulifolia* Parish & Rchb. f.	EN
43	*Habenaria triquetra* Rolfe	EN
44	*Habenaria yomensis* Gage	EN
45	*Liparis forrestii* Rolfe	EN
46	*Liparis popaensis* X.H.Jin, A.T.Mu & L.A.Ye	LC
47	*Liparis stenoglossa* Parish & Rchb. f.	DD
48	*Luisia amesiana* Rolfe	NT
49	*Luisia cantharis* Rolfe	NT
50	*Luisia primulina* Parish & Rchb. f.	NT
51	*Micropera secunda* (Rolfe) T. Tang & F.T. Wang	LC
52	*Neottia flabellata* (W.W.Sm.) Szlach.	EN
53	*Neottia unguiculata* (W.W.Sm.) Szlach.	EN
54	*Odontochilus putaoensis* X.H. Jin, L.A. Ye & A.T. Mu	EN
55	*Oreorchis aurantiaca* Pearce & Gibbs	EN
56	*Paphiopedilum myanmaricum* Koop., Iamwir. & S.Laohap.	EN
57	*Papilionanthe sillemiana* (Rchb. f.) Garay	EN
58	*Phalaenopsis natmataungensis* (T.Yukawa, Nob.Tanaka & J.Murata) Dalstrom & Ormerod	EN
59	*Pholidota advena* Parish & Rchb. f.	LC
60	*Pinalia brownei* (Braid) Ormerod	LC
61	*Pinalia dasypus* (Rchb.f.) Kuntze	LC
62	*Pinalia rimannii* (Rchb.f.) Kuntze	LC
63	*Pinalia shanensis* (King & Pantl.) Ormerod	DD
64	*Pinalia shiuyingiana* Ormerod & Wood	NT
65	*Platanthera longibracteata* Lindl.	EN
66	*Renanthera hennisiana* Schltr.	EN
67	*Renanthera pulchella* Rolfe	EN
68	*Rhomboda wardii* Ormerod	LC
69	*Stereochilus laxus* (Rchb. f.) Garay	LC
70	*Tainia hennisiana* (Schltr.) P.F.Hunt	DD
71	*Thunia brymeriana* Rolfe	EN
72	*Thunia candidissima* Rchb. f.	EN
73	*Uncifera verrucosa* Summerh.	DD
74	*Vanda longitepala* D.L.Roberts, L.M.Gardiner & Mote	EN
75	*Vanda vipanii* Rchb. f.	EN
76	*Vandopsis shanica* (Phillimore & W.W. Sm.) Garay	LC

Table 3. Local distribution of Orchidaceae in Myanmar.

No.	Administrative Provinces	Number of species known
1	Ayeyarwaddy Region	5
2	Bago Region	52
3	Chin State	227
4	Kachin State	394
5	Kayah State	4
6	Kayin State	30
7	Magway Region	29
8	Mandalay Region	219
9	Mon State	187
10	Nay Pyi Taw Union Territory	16
11	Rakhine State	29
12	Sagaing Region	105
13	Shan State	146
14	Tanintharyi Region	307
15	Yangon Region	32

mation is also provided if known for some species. Voucher specimen citations are also provided for almost all species. In cases where herbarium specimens are lacking, the species occurrences are mainly based on the most reliable references of Kress et al. (2003) and Kurzweil and Lwin (2014). By the number of species, most genera consist of one to ten species per genus, while genera *Dendrobium* and *Bulbophyllum* consist of more than 100 species in each (Table 4). The updated checklist is mentioned in the following detail.

Discussion

Botanical collections are still needed to cover the whole floristic diversity of Myanmar, because botanical explorations have sharply decreased in Myanmar since 1950 (Kress et al. 2003). There is a large gap of knowledge on Myanmar flora. Perhaps there are many species to be discovered in Myanmar. The fundamental data on the number of plant species and its distribution range is still not fully known so that it needs much more research for effective plant conservation in Myanmar. In addition, it needs modern taxonomic treatments for each family or genus so as to update their classification.

The orchid flora of Myanmar is very species-rich but still poorly known until now. The present study resulted in a checklist of Myanmar orchid flora which includes 1040 species and 151 genera. Botanical investigations are, however, still needed to better understand the orchid biodiversity of Myanmar. Compared with neighbouring countries with intensive orchid studies, Myanmar orchid flora have lagged behind being well-documented and well-studied. In this regard, it can be estimated that about 150–300 species still remain unexplored and are expected to be discovered in future studies on Myanmar orchid flora. As for conservation, all orchid species are legally protected by national legislation but most orchids are still under various threats for

Table 4. Number of species in each genus in the updated checklist of Myanmar orchid flora.

No.	Genera	Number of species	No.	Genera	Number of species	No.	Genera	Number of species
1	*Acampe*	5	52	*Diplomeris*	2	103	*Phalaenopsis*	14
2	*Acanthephippium*	1	53	*Diploprora*	2	104	*Pholidota*	11
3	*Acriopsis*	2	54	*Disperis*	1	105	*Pinalia*	33
4	*Aerides*	5	55	*Epipactis*	4	106	*Platanthera*	16
5	*Aeridostachya*	1	56	*Epipogium*	2	107	*Pleione*	10
6	*Agrostophyllum*	6	57	*Eria*	8	108	*Podochilus*	4
7	*Ania*	2	58	*Eriodes*	1	109	*Pogonia*	1
8	*Anoectochilus*	5	59	*Erythrodes*	2	110	*Polystachya*	1
9	*Anthogonium*	1	60	*Erythrorchis*	1	111	*Pomatocalpa*	2
10	*Aphyllorchis*	1	61	*Eulophia*	14	112	*Ponerorchis*	5
11	*Apostasia*	3	62	*Galearis*	3	113	*Porpax*	12
12	*Appendicula*	1	63	*Galeola*	2	114	*Pteroceras*	3
13	*Arachnis*	3	64	*Gastrochilus*	10	115	*Renanthera*	5
14	*Arundina*	1	65	*Gastrodia*	4	116	*Rhomboda*	3
15	*Bambuseria*	1	66	*Geodorum*	5	117	*Rhynchostylis*	2
16	*Biermannia*	1	67	*Goodyera*	11	118	*Risleya*	1
17	*Bletilla*	4	68	*Grammatophyllum*	1	119	*Robiquetia*	3
18	*Brachycorythis*	6	69	*Grosourdya*	1	120	*Saccolabiopsis*	1
19	*Bromheadia*	2	70	*Gymnadenia*	1	121	*Sarcoglyphis*	3
20	*Bryobium*	1	71	*Habenaria*	49	122	*Satyrium*	1
21	*Bulbophyllum*	119	72	*Hemipilia*	3	123	*Schoenorchis*	2
22	*Bulleyia*	1	73	*Herminium*	10	124	*Seidenfadenia*	1
23	*Calanthe*	30	74	*Herpysma*	1	125	*Sirindhornia*	1
24	*Callostylis*	3	75	*Hetaeria*	4	126	*Smitinandia*	2
25	*Cephalanthera*	2	76	*Holcoglossum*	4	127	*Spathoglottis*	4
26	*Cephalantheropsis*	3	77	*Lecanorchis*	3	128	*Spiranthes*	1
27	*Ceratostylis*	4	78	*Liparis*	29	129	*Stereochilus*	3
28	*Cheirostylis*	8	79	*Ludisia*	1	130	*Stereosandra*	1
29	*Chiloschista*	4	80	*Luisia*	14	131	*Stichorkis*	1
30	*Chrysoglossum*	1	81	*Malaxis*	2	132	*Strongyleria*	1
31	*Cleisomeria*	2	82	*Micropera*	5	133	*Taeniophyllum*	1
32	*Cleisostoma*	15	83	*Microsaccus*	1	134	*Tainia*	4
33	*Coelogyne*	45	84	*Mycaranthes*	3	135	*Thecostele*	1
34	*Collabium*	2	85	*Myrmechis*	2	136	*Thelasis*	5
35	*Corymborkis*	1	86	*Neogyna*	1	137	*Thrixspermum*	5
36	*Cremastra*	1	87	*Neottia*	6	138	*Thunia*	5
37	*Crepidium*	8	88	*Nephelaphyllum*	3	139	*Thuniopsis*	1
38	*Cryptochilus*	4	89	*Nervilia*	6	140	*Tipularia*	1
39	*Cryptostylis*	2	90	*Oberonia*	29	141	*Trachoma*	1
40	*Cylindrolobus*	7	91	*Odontochilus*	8	142	*Trichoglottis*	5
41	*Cymbidium*	25	92	*Oreorchis*	5	143	*Trichotosia*	8
42	*Cypripedium*	3	93	*Otochilus*	4	144	*Tropidia*	2
43	*Cyrtosia*	1	94	*Oxystophyllum*	1	145	*Tuberolabium*	1
44	*Dendrobium*	144	95	*Pachystoma*	1	146	*Uncifera*	2
45	*Dendrochilum*	2	96	*Panisea*	6	147	*Vanda*	17
46	*Dendrolirium*	3	97	*Paphiopedilum*	14	148	*Vandopsis*	3
47	*Dickasonia*	1	98	*Papilionanthe*	5	149	*Vanilla*	3
48	*Didymoplexis*	1	99	*Pecteilis*	4	150	*Vrydagzynea*	2
49	*Dienia*	2	100	*Pelatantheria*	3	151	*Zeuxine*	9
50	*Diglyphosa*	1	101	*Peristylus*	10			
51	*Dilochia*	1	102	*Phaius*	6	**Total**		**1040**

their survival, such as habitat loss due to deforestion and land use change. Orchids are, however, regarded as special plants in Myanmar society in terms of cultural ornamental purposes. Historically, *Bulbophyllum auricomum* Lindl. has been recognised as a royal flower in Myanmar during the period of Konbaung dynasty (1752–1885). Nowadays, it has been recognised as one of the national flowers of Myanmar, indicating the special attention of Myanmar society on orchids (Hinsley et al. 2018). Thus, it is obvious that the special role of orchids might enhance the orchid biodiversity conservation in Myanmar.

As for plant species richness in Myanmar, there are many new species described from Myanmar over recent years, for example, two new species of Annonaceae, one new species of Aristolochiaceae, one new species of Asteraceae, three new species of Balsaminaceae, one new species of Begoniaceae, two new species of Lamiaceae, one new species of Magnoliaceae, 10 new species of Orchidaceae, one new species of Phyllanthaceae and one new species of Zingiberaceae (Aung et al. 2017, 2018, Jin and Kyaw 2017, Liu et al. 2017, Tan et al. 2017, Tseng et al. 2017, Yang et al. 2017, 2018a, b, Aung and Jin 2018, Ding et al. 2018, Liu et al. 2018, Li and Ren 2018, Ruchisansakun et al. 2018, Tan et al. 2018, Ya et al. 2019, Yao et al. 2018, Zhou et al. 2018a, b, Mu et al. 2019).

Recently there are discoveries of two new plant familial records for Myanmar, namely Petrosaviaceae and Triuridaceae (Jin and Mint 2018, Jin et al. 2018b). It is very obvious that species richness is very high in Myanmar, with evidence of recent discoveries of species new to science and new records. With many more botanical explorations, the knowledge gap on the flora of Myanmar can be filled in the future.

Checklist

The checklist consists of the following data (Table 5):

1. Accepted taxon name and its author (s). Endemic species are mentioned in bold text, 76 species in total.
2. Local Distribution in Myanmar, usually Region/State (Provincial) level. In Myanmar, there are 15 administrative provinces including Nay Pyi Taw Union Territory, seven Regions (Ayeyarwaddy, Bago, Magway, Mandalay, Sagaing, Tanintharyi and Yangon) and seven States (Chin, Kachin, Kayah, Kayin, Mon, Rakhine and Shan). Specific localities are provided if known.
3. Specimen Citations: Collector (s), Collection number (s) and Herbarium codes (Thiers 2019, http://sweetgum.nybg.org/ih/). All specimens cited with exclamation mark (!) have been examined. Some specimens without exclamation mark (!) are studied and known from literature of new species description or new species records.

Table 5. Checklist of Myanmar orchid flora.

No.	Species	Local distribution	Specimen citations
1	*Acampe carinata* (Griff.) Panigr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
2	*Acampe cephalotes* Lindl.	Putao, Kachin; Taunggyi, Shan	Xiaohua Jin et al. PT-5240 (PE!); Ye Lwin Aung PT-7601 (PE!)
3	*Acampe joiceyana* (J.J. Sm.) Seidenf.	Mt. Popa, Mandalay	Khin Myo Htwe 102 (spirit collection-MBK, TNS)
4	*Acampe ochracea* (Lindl.) Hochr.	YePhyu, Tanintharyi; Mt. Victoria, Chin	Ye Lwin Aung PT- 7307, PT-7542, PT-7356 (PE!)
5	*Acampe praemorsa* (Roxb.) Blatter & McCann	Mt. Popa, Mandalay; Bago (Pegu); Tanintharyi	s.coll. s.n. (P!); Khin Myo Htwe 13 (spirit collection-MBK, TNS)
6	*Acanthephippium sylhetense* Lindl.	Chin; Kachin; Magway; Mon; Sagaing; Taunggyi, Shan	Ye Lwin Aung PT-7594 (PE!)
7	*Acriopsis indica* Wight	Tanintharyi Nature Reserve, YePhyu,Tanintharyi; Mt. Victoria, Chin	Ye Lwin Aung PT-7269, PT-7350, PT-7565 (PE!); Hlaing Ko 19 (NY!)
8	*Acriopsis liliifolia* (Koen.) Ormerod	YePhyu, Tanintharyi	Ye Lwin Aung PT-7333 (PE!)
9	*Aerides crassifolia* Parish ex Burb.	Mt. Popa, Mandalay	Khin Myo Htwe 14 (spirit collection-TNS), Tanaka et al. 036165 (MBK)
10	*Aerides falcata* Lindl. & Paxton	Mt. Popa, Mandalay	Lace 6204 (E!); Khin Myo Htwe 33 (spirit collection-TNS)
11	*Aerides multiflora* Roxb.	Mon	Herb. Helfer 5222 (NY!)
12	*Aerides odorata* Lour.	Reported from Myanmar	Kress et al. 2003
13	*Aerides rosea* Lodd. ex Lindl. & Paxton	Putao, Kachin	Xiaohua Jin et al. PT-6998 (PE!)
14	*Aeridostachya crassipes* (Ridl.) Rauschert	Putao, Kachin	Xiaohua Jin et al. PT-2045, PT-2071, PT-5283 (PE!)
15	*Agrostophyllum brevipes* King & Pantl.	Putao, Kachin	Xiaohua Jin et al. PT-5243 (PE!), Ye Lwin Aung PT-7043 (PE!)
16	*Agrostophyllum callosum* Rchb. f.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan, Tanintharyi	Ye Lwin Aung PT-7178 (PE!)
17	*Agrostophyllum glumaceum* Hook.f.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7325, PT-7346 (PE!)
18	*Agrostophyllum planicaule* (Wall. ex Lindl.) Rechb.f.	Mandalay; YePhyu & Dawei (Tavoy), Tanintharyi	Ye Lwin Aung PT-7291, PT-7293 (PE!); R.C.F. Swinhoe 71 (K!); Keenan et al. 5094 (E!)
19	*Agrostophyllum stipulatum* (Griff.) Schltr.	Myeik (Mergui), Tanintharyi	Griffith 5220 (K!)
20	*Agrostophyllum superpositum* Schltr.	Putao, Kachin	Ye Lwin Aung PT-7116 (PE!)
21	*Ania angustifolia Lindl.*	Dawei (Tavoy), Tanintharyi	Wallich 3740 (E!) & (BM!); Keenan et al. 1596 (E!); Kingdon-Ward 22717 (BM!)
22	*Ania viridifusca* (Hook.) Tang & W.T.Wang ex Summerh.	Chin; Kachin; Kyaikkahmi (Amherst), Mon	Lace 5622 (E!); Keenan et al. 3817 (E!); Kingdon-Ward 21737 (BM!)
23	*Anoectochilus albolineatus* Parish & Rchb. f.	Mt. Victoria, Chin; Moulmein, Mon; Tanintharyi	Parish 325 (K); Kingdon-Ward 22872 (BM!)
24	*Anoectochilus burmannicus* Rolfe	Kadat Reserve, Bago (Pegu)	Roger s.n. (K!)
25	*Anoectochilus chapaensis* Gagnep	Putao, Kachin	Qiang Liu 319 (HTIBC!)

No.	Species	Local distribution	Specimen citations
26	*Anoectochilus lylei* Rolfe ex Downie	Kachin; Katha, Sagaing	Kingdon-Ward 20499 (BM!); Lace s.n. (E!)
27	*Anoectochilus roxburghii* Lindl.	Chin; Putao, Kachin	Xiaohua Jin et al. PT-ET 246, PT-ET 1110 (PE!); Kate Armstrong 2331 (NY!); Kingdon-Ward 21519 (BM!)
28	*Anthogonium gracile* Lindl.	Putao, Kachin; Mogok, Mandalay; Shan; Mon; Tanintharyi	Xiaohua Jin et al. PT-ET 454 (PE!); Lace 6016 (E!); MacGregor 818 (E!)
29	*Aphyllorchis montana* Rchb. f.	Chin	Kingdon-Ward 22609 (BM!)
30	*Apostasia nuda* R. Br.	Myeik (Mergui), Tanintharyi	Griffith 100 (K!)
31	*Apostasia odorata* Blume	Putao, Kachin	Xiaohua Jin et al. PT-2544 (PE!)
32	*Apostasia wallichii* R. Br.	Mt. Popa, Mandalay; Putao, Kachin	Xiaohua Jin et al. PT-ET 156 (PE!); Prazer 101 (E!); Keenan et al. 983 (E!); Khin Myo Htwe 030019 (MBK)
33	*Appendicula cornuta* Blume	Putao, Kachin; Tanintharyi	Ye Lwin Aung PT-7171, PT-7180 (PE!)
34	*Arachnis clarkei* J.J.Sm.	Chin; Shan	Kingdon-Ward 22876 & 22718 (BM!); Phillimore s.n. (P!)
35	*Arachnis labrosa* (Lindl. & Paxton) Rchb. f.	Putao, Kachin; Mon; Tanintharyi; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-5342 (PE!); Tanaka et al. 036150 (MBK)
36	*Arachnis siamensis* (Schltr.) Tang & F.T.Wang	Mt. Popa, Mandalay	Khin Myo Htwe 108 (spirit collection-MBK, TNS)
37	*Arundina graminifolia* (D. Don) Hochr.	Chin; Putao, Kachin; Magway; Mandalay; Mon; Sagaing; Shan	Xiaohua Jin et al. PT-6771 (PE!); G. Forrest 24662 (E!); Prazer 102 (E!); MacGregor 823 (E!); Keenan et al. 3928 (E!); Kate Armstrong 2281 (NY!); Kingdon-Ward 22509 (BM!)
38	*Bambuseria bambusifolia* (Lindl.) Schuit., Y.P.Ng & H.A.Pedersen	Sumprabum, Kachin; Southern Shan State	Keenan et al. 3823 (K!) & (E!); W.A. Robertson 84 (K!); Kingdon-Ward 21664 (BM!)
39	***Biermannia burmanica* Y.H. Tan & Bin Yang**	Putao, Kachin	Y.H. Tan, B. Yang, H.B. Ding, M.B. Maw & T.S. Tin M1593 (holotype, HITBC)
40	***Bletilla chartacea* (King & Pantl.) Tang & Wang**	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
41	*Bletilla foliosa* (King & Pantl.) Tang & Wang	Pyin Oo Lwin (Maymyo), Mandalay	Lace 5883 (E!); English 145 (E!)
42	*Bletilla formosana* (Hayata) Schltr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
43	*Bletilla striata* (Thunb.) Rchb. f.	Kachin; Mon; Taunggyi, Shan	Farrer 994 (E!); Forrest 29728 (E!); Kingdon-ward 16780 (E!); Maung Po Khant 16337 (E!); Dickason 837 (P!)
44	*Brachycorythis acuta* (Rchb.f.) Summerh.	Paungbyin Reserve, Upper Chindwin, Sagaing; Mindat, Chin	Lace 4222 (K!) & (E!); Prazer 89 (E!); Kingdon-Ward 22426 (BM!)
45	*Brachycorythis galeandra* (Rchb. f.) Summerh.	Myikyina, Kachin; Ayeyarwaddy	Mokim 22 (BM!) & 82 (P!) & (US); Belcher 9480 (US)
46	*Brachycorythis helferi* (Rchb. f.) Summerh.	Mt. ZweKaBin, Kayin; Mon	Xiaohua Jin et al. PT-2570 (PE!); Parish s.n. (K!); Helfer 244 (K!); Keenan et al. 890 (E!)

No.	Species	Local distribution	Specimen citations
47	*Brachycorythis henryi* (Schltr.) Summerh.	Shan	Maung Po Khant 16312 (E!)
48	*Brachycorythis neglecta* Pedersen	Pyin Oo Lwin (Maymyo), Mandalay; Lashio, Shan	Lace 4827, 5304 & 5837 (E!); Keenan et al. 575 (E!); MacGregor 678 (E!)
49	*Brachycorythis obcordata* (Lindl.) Summerh.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
50	*Bromheadia aporoides* Rchb. f.	Mon, Tanintharyi	Kress et al. 2003
51	*Bromheadia finlaysoniana* (Lindl.) Miq.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
52	*Bryobium pudicum* (Ridl.) Y.P.Ng & P.J.Cribb	Putao, Kachin	Xiaohua Jin et al. PT-2444 (PE!), Ye Lwin Aung PT-7068, PT-7073, PT-7080, PT-7099, PT-7111 (PE!)
53	*Bulbophyllum affine* Lindl.	Recorded from Myanmar	s.coll.s.n. (E!)
54	*Bulbophyllum alcicorne* Parish & Rchb. f.	Mon, Tanintharyi	Kress et al. 2003
55	*Bulbophyllum amplifolium* (Rolfe) Balakr. & Chowdhury	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
56	*Bulbophyllum andersonii* (Hook.f.) J.J.Sm.	Putao, Kachin	Ye Lwin Aung PT-7114 (PE!)
57	*Bulbophyllum apodum* Hook.f.	Shan	s.coll. s.n. (K!)
58	*Bulbophyllum auricomum* Lindl.	Taunggoo, Bago; Haka, Chin; Kachin; Mon; Rakhine; Tanintharyi; Yangon	Venning 6 (K!); Wallich 1985 (K!); s.coll. s.n. (K!); Lace s.n. (E!); Reynaud 60 (P!); Griffith s.n. (P!)
59	*Bulbophyllum bifurcatoflorens* (Fukuy.) J.J.Verm., Schuit. & de Vogel	Recorded from Myanmar	Kress et al. 2003
60	***Bulbophyllum birmense* Schltr.**	Reported from Myanmar	Kress et al. 2003
61	*Bulbophyllum blepharistes* Rchb. f.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7245, PT-7341, PT-7252, PT-7260 (PE!)
62	*Bulbophyllum candidum* (Lindl.) Hook.f.	Putao Township, Kachin State	Kurzweil & Saw Lwin KL 2637 (SING, spirit collection)
63	*Bulbophyllum canlaonense* Ames	Putao, Kachin	Ye Lwin Aung PT-7199, PT-7198, PT-7118 (PE!)
64	*Bulbophyllum capillipes* Parish & Rchb. f.	Chin, Mon, Tanintharyi	Kress et al. 2003
65	*Bulbophyllum capnophyton* J.J.Verm., Schuit. & de Vogel	YePhyu, Tanintharyi	Saw Lwin et al. TNRO 162 (SING, SING(spirit), Herbarium of Tanintharyi Nature Reserve Education Centre)
66	*Bulbophyllum careyanum* Spreng.	Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Alaungdaw Kathapa National Park, Sagaing; Mt. Victoria, Chin; Kalaw, Shan	Ye Lwin Aung PT-7383, PT-7384, PT-7452, PT-7453, PT-7577 (PE!); Lois & Soren Egerod B-82 (K!)
67	*Bulbophyllum cariniflorum* Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
68	*Bulbophyllum caudatum* Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-2500 (PE!)
69	*Bulbophyllum cauliflorum* Hook. f.	Putao, Kachin; Mon	Ye Lwin Aung PT-7052, PT-7159, PT-7164, PT-7051, PT-7202, PT-7212 (PE!)
70	*Bulbophyllum clandestinum* Lindl.	Myeik (Mergui), Tanintharyi; Andaman Island	S. Kurz s.n. (K!); Griffith 5295 (K!)

No.	Species	Local distribution	Specimen citations
71	*Bulbophyllum collettii* King & Pantl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
72	*Bulbophyllum comosum* Collett & Hemsl.	Taunggyi, Shan	H. Collett 100 (K!); s.coll. s.n. (K!)
73	*Bulbophyllum crabro* (C.S.P.Parish & Rchb.f.) J.J.Verm., Schuit. & de Vogel	Putao, Kachin; Kayin; Mon; Tanintharyi	Ye Lwin Aung PT-2264 (PE!); s.coll. s.n. (K!); Kingdon-Ward 10181 (BM!)
74	*Bulbophyllum crassipes* Hook. f.	Kayin; Moulmein, Mon; Rakhine; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7440, PT-7441 (PE!); A. Meebold 17424 (K!)
75	*Bulbophyllum cupreum* Lindl.	Kachin; Bago; Mon; Tanintharyi	Bull 48 (K!); Lace 6097 (E!)
76	*Bulbophyllum cylindraceum* Wall. ex Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-2389, PT-2547 (PE!), Ye Lwin Aung PT-7107 (PE!)
77	*Bulbophyllum dayanum* Rchb. f.	Mon, Tanintharyi	Kress et al. 2003
78	*Bulbophyllum delitescens* Hance	Putao, Kachin	Qiang Liu 500 (HITBC!)
79	*Bulbophyllum dickasonii* Seidenf.	Putao, Kachin	Xiaohua Jin et al. PT-6143 (PE!); Dickason 8444 (AMES)
80	*Bulbophyllum drymoda* J.J.Verm., Schuit. & de Vogel	Kayin, Tanintharyi	Kress et al. 2003
81	*Bulbophyllum drymoglossum* Maxim.	Putao, Kachin	Xiaohua Jin et al. PT-6891 (PE!)
82	*Bulbophyllum elatum* (Hook.f.) J.J. Sm.	Nogmung Township, Kachin State	Kingdon-Ward 7408 (K)
83	*Bulbophyllum emarginatum* (Finet) J.J.Sm.	Kachin	Kingdon-Ward 73 (BM!) & (NY!)
84	*Bulbophyllum eublepharum* Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
85	*Bulbophyllum farreri* (W.W. Sm.) Seidenf.	Htawgaw, Upper Burma	Kingdon-Ward 1560 (E!)
86	*Bulbophyllum forrestii* Seidenf.	Putao & Hpimaw, Kachin	Xiaohua Jin et al. PT-5279 (PE!); Kingdon-Ward 1554 (E!); Forrest 26609 (P!) & (US)
87	*Bulbophyllum gracillimum* (Rolfe) Rolfe	Recorded from Myanmar	s.coll. s.n. (K!)
88	*Bulbophyllum guttulatum* Wall. ex Hook. f.	Reported from Myanmar	Kress et al. 2003
89	*Bulbophyllum haniffii* Carr	Mon, Tanintharyi	Kress et al. 2003
90	*Bulbophyllum helenae* (Kuntze) J.J. Sm.	Mt. Victoria, Chin	Ye Lwin Aung PT-7516, PT-7551 (PE!); Forrest 26609 (E!)
91	*Bulbophyllum hirtum* Lindl.	Putao, Kachin; Chin; Shan; Tanintharyi	Xiaohua Jin et al. PT-5280 (PE!); Keenan et al. 3033 (E!); MacGregor 2524 (E!); Kate Armstrong 2408 (NY!)
92	*Bulbophyllum intricatum* Seidenf.	Putao, Kachin; southwestern part of Shan; Webula, Falam, Chin	Qiang Liu M16-29 (HITBC!); Fujikawa et al. 101848 (MBK); Daun 44 (K!)
93	***Bulbophyllum kachinense* (Seidenf.) J.J.Verm., Schuit. & de Vogel**	Kachin	Kress et al. 2003
94	*Bulbophyllum kanburiense* Seidenf.	Reported from Myanmar	Kress et al. 2003
95	*Bulbophyllum khasyanum* Griff.	Putao, Kachin; Tanintharyi	Qiang Liu 477 (HITBC!)
96	*Bulbophyllum kingii* Hook.f.	Recorded from Myanmar	Kingdon-Ward 13507 (BM!)
97	*Bulbophyllum lasiochilum* Parish & Rchb. f.	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
98	*Bulbophyllum laxiflorum* (Blume) Lindl.	Mon, Tanintharyi	Kress et al. 2003
99	*Bulbophyllum lemniscatum* Parish ex Hook. f.	Mon; Tanintharyi; Taunggoo, Bago	Lhin 4411 (K!); Parish 211 (K!)
100	*Bulbophyllum leopardinum* (Wall.) Lindl.	Mt. Victoria, Chin	Ye Lwin Aung PT-7530 (PE!)
101	*Bulbophyllum lepidum* (Blume) J.J.Sm.	Chin; YePhyu, Tanintharyi	Ye Lwin Aung PT-7358 (PE!)
102	*Bulbophyllum limbatum* Parish & Rchb. f.	Reported from Myanmar	Kress et al. 2003
103	*Bulbophyllum lindleyanum* Griff.	Reported from Myanmar	Kress et al. 2003
104	*Bulbophyllum lineatum* (Teijsm. & Binn.) J.J. Sm.	Bago, Tanintharyi, Yangon	s.coll. 89 (K!)
105	*Bulbophyllum lobbii* Lindl.	Kayin, Rakhine, Tanintharyi	Lace s.n. (E!)
106	*Bulbophyllum longipes* Rchb.f.	Mon, Tanintharyi	Kress et al. 2003
107	*Bulbophyllum lopalanthum* J.J.Verm., Schuit. & de Vogel	Mandalay	Xiaohua Jin et al. PT-5235 (PE!)
108	*Bulbophyllum macphersonii* Rupp	Tanintharyi	Kress et al. 2003
109	*Bulbophyllum macranthum* Hook. f.	Bago, Tanintharyi	Kress et al. 2003
110	*Bulbophyllum microtepalum* Rchb. f.	Mon, Tanintharyi	Kress et al. 2003
111	*Bulbophyllum moniliforme* Parish & Rchb. f.	Mt. Victoria, Chin; Mon; YePhyu, Tanintharyi; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7407, PT-7337, PT-7480 (PE!); Parish 96 (K!)
112	*Bulbophyllum muscarirubrum* Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
113	*Bulbophyllum nasutum* Rchb.f.	Mon, Tanintharyi	Parish 263 (K!)
114	*Bulbophyllum nigrescens* Rolfe	Myitkyina, Kachin; PyinOoLwin (Maymyo), Mandalay; Shan	Kermode 17332 (AMES) & (K!); A. Samuel 13537 (K!); Egerod B-17 (US)
115	*Bulbophyllum oblongum* Rchb.f.	Mon, Tanintharyi	Parish 264 (K!); Griffith s.n. (P!)
116	*Bulbophyllum odoratissimum* Lindl.	Myitkyina & Putao, Kachin; Webula, Falam, Chin; Myeik(Mergui), Tanintharyi; Taunggoo, Bago	Xiaohua Jin et al. PT-2043, PT-2073, PT-2385, PT-2457 (PE!); Ye Lwin Aung PT-7042, PT-7117, PT-7161, PT-7162, PT-7165, PT-7048, PT-7194 (PE!); C.Bagg B-13 (K!); Su Kae 10032 (K!); Daun 35 (K!); C.W.D. Kermode 17329 (K!); A.F.G. Kerr 01005 (K!); Inokum s.n. (K!); Mokum s.n. (US)
117	***Bulbophyllum oligoglossum* Rchb. f.**	Reported from Myanmar	Kress et al. 2003
118	*Bulbophyllum orientale* Seidenf.	Recorded from Myanmar	SBGO 3651 (SING, spirit collection)
119	*Bulbophyllum ornatissimum* (Rchb. f.) J.J. Sm.	Reported from Myanmar	Kress et al. 2003
120	*Bulbophyllum parviflorum* Parish & Rchb. f.	Putao, Kachina; Mon; Tanintharyi	Qiang Liu M16-4 (HITBC!)
121	*Bulbophyllum pectinatum* Finet	Mt. Victoria, Chin; Near Black Rock, Myitkyina, Kachin	Ye Lwin Aung PT-7477, PT-7537, PT-7539, PT-7553 (PE!); R.C.F. Swinhoe R 113, 35 (K!); C.W.D. Kermode 17328 (K!); Bull 135 (K!)

No.	Species	Local distribution	Specimen citations
122	*Bulbophyllum penicillium* Parish & Rchb. f.	Mon, Tanintharyi	Ye Lwin Aung PT-7330 (PE!); s.coll. s.n. (K!); Parish 303 (K!)
123	*Bulbophyllum pictum* C.S.P.Parish & Rchb.f.	Mon, Tanintharyi	Kress et al. 2003
124	*Bulbophyllum picturatum* (Lodd.) Rchb. f.	Mt. Popa, Mandalay	Khin Myo Htwe 133 (spirit collection-TNS)
125	*Bulbophyllum polliculosum* Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
126	*Bulbophyllum polyrrhizum* Lindl.	Webula, Kalaymyo, Chin; Shan; Mt. Popa, Mandalay	R.C.F. Swinhoe 91 & 94 (K!); F.G. Dickason 7225 (K!); Egerod B-225 (US); Khin Myo Htwe 98 (spirit collection-MBK)
127	*Bulbophyllum protractum* Hook. f.	Tanintharyi	Kress et al. 2003
128	*Bulbophyllum pseudopicturatum* (Garay) Sieder & Kiehn	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
129	*Bulbophyllum psittacoglossum* Rchb. f.	Tanintharyi	Kress et al. 2003
130	*Bulbophyllum pteroglossum* Schltr.	Putao, Kachin	Xiaohua Jin et al. PT-ET 1060 (PE!)
131	*Bulbophyllum pumilio* Parish & Rchb. f.	Kalamataung, Mon; Tanintharyi	Parish 220 (K!)
132	*Bulbophyllum purpureofuscum* J.J.Verm., Schuit. & de Vogel	Putao, Kachin	Xiaohua Jin et al. PT-2442 (PE!)
133	***Bulbophyllum putaoensis* Q.Liu**	Wasadam village, Putao County, Kachin State	Q. Liu 330 (holotype, HITBC!)
134	*Bulbophyllum reclusum* Seidenf.	Mt. Popa, Mandalay	Khin Myo Htwe 53 (spirit collection-MBK, TNS), Khin Myo Htwe 25 (spirit collection-MBK, TNS)
135	*Bulbophyllum refractum* (Zoll.) Rchb. f.	Chin, Tanintharyi	Kress et al. 2003
136	*Bulbophyllum reichenbachii* (Kuntze) Schltr.	Kayin, Mon	Parish 200 (K!); s.coll. s.n. (K!)
137	*Bulbophyllum repens* Griff.	Tanintharyi	Kress et al. 2003
138	*Bulbophyllum reptans* Griff.	Putao, Kachin; Mt. Victoria, Chin	Xiaohua Jin et al. PT-2548 (PE!), Ye Lwin Aung PT-7535, PT-7536 (PE!); Dackason 7500 (K!); Forrest 26516 (E!) & (US!); Kate Armstrong 1951 (NY!); Forrest 26516 (NY!); Kingdon-Ward 384 (NY!)
139	*Bulbophyllum retusiusculum* Rchb. f.	Mt. Victoria, Chin; Dawei (Tavoy), Tanintharyi	Keenan et al. 5615 (E!); Cooper 6082 (E!); Forrest 26603 (US)
140	*Bulbophyllum rimannii* (Rchb.f.) J.J.Verm., Schuit. & de Vogel	Shan	Phillimore s.n. (K!)
141	*Bulbophyllum rolfei* (Kuntze) Seidenf.	Nogmung Township, Kachin State	Saw Lwin KSL 1080, 1089 (RAF)
142	*Bulbophyllum roseopictum* J.J.Verm., Schuit. & de Vogel	Putao, Kachin	Kate Armstrong 2063 (NY!)
143	*Bulbophyllum roseum* Ridl.	Mon, Rakhine, Tanintharyi	Kress et al. 2003
144	*Bulbophyllum rufilabrum* Parish	Tanintharyi	Kress et al. 2003
145	*Bulbophyllum rufinum* Rchb. f.	Mandalay; Tanintharyi	R.C.F. Swinhoe K77 (K!)
146	*Bulbophyllum sarcophyllum* (King & Pantl.) J.J. Sm.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014

No.	Species	Local distribution	Specimen citations
147	*Bulbophyllum scabratum* Rchb.f.	Nogmung Township, Chipwi Township, Northeastern Part, Kachin State	Toppin 6265 (K!); Forrest 26603 (K & E!); Saw Lwin KSL 1082 (RAF)
148	*Bulbophyllum scaphiforme* Verm.	Kentung, Shan State	Dickason 9693 (AMES)
149	*Bulbophyllum secundum* Parish & Rchb. f.	Mt. Victoria, Chin; Kachin; Magway; PyinOoLwin (Maymyo), Mandalay; Sagaing; Shan	A. Samuel 13549 (K!); R.C.F. Swinhoe 122 (K!); White 380 (US)
150	*Bulbophyllum serratotruncatum* Rchb. f.	Reported from Myanmar	Kress et al. 2003
151	*Bulbophyllum shanicum* King & Pantl.	Shan	Abdul Huk s.n. (K!)
152	*Bulbophyllum sicyobulbon* Parish & Rchb. f.	Mt. Popa, Mandalay; Mon; Tanintharyi	Ye Lwin Aung PT-7458 (PE!); R.C.F. Swinhoe 95 (K!)
153	***Bulbophyllum sillemianum* Rchb.f.**	Recorded from Myanmar	Perrin s.n. (P!)
154	*Bulbophyllum spathulatum* (Rolfe ex Cooper) Seidenf.	Shan	s.coll. s.n. (K!)
155	*Bulbophyllum stenobulbon* Parish & Rchb. f.	Putao, Kachin; Mon; Tanintharyi	Ye Lwin Aung PT-7197, PT-7186, PT-7192, PT-7218 (PE!)
156	*Bulbophyllum sterile* (Lam.) Suresh	Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Mon	Ye Lwin Aung PT-7375 (PE!)
157	*Bulbophyllum striatum* (Griff.) Rchb.f.	Nogmung Township, Kachin State	Saw Lwin KSL 1063 (RAF)
158	*Bulbophyllum suavissimum* Rolfe	Chin; Kachin; Magway; Mandalay; Kyaikkami(Amherst), Mon; Sagaing; Shan	C.E. Parkinson 5114 (K!); Brassen s.n. (K!); Cooper s.n. (K!); Lace 5606 (E!)
159	*Bulbophyllum sulcatum* (Blume) Lindl.	Putao, Kachin; Mt. Victoria, Chin; YePhyu, Tanintharyi	Ye Lwin Aung PT-7324, PT-7361, PT-7517, PT-7187, PT-7219, PT-7360 (PE!)
160	*Bulbophyllum sunipia* J.J.Verm., Schuit. & de Vogel	Putao, Kachin; Mt. Victoria, Chin; Mon; Taunggyi, Shan; Tanintharyi	Xiaohua Jin et al. PT-2050, PT-2074, PT-2099 (PE!); Ye Lwin Aung PT-7557, PT-7579 (PE!); Su Lay 10014 (K!); Kingdon-Ward 3028 (E!)
161	*Bulbophyllum taeniophyllum* Parish & Rchb. f.	Mon, Shan, Tanintharyi	Kingdon-Ward 20634 (BM!)
162	*Bulbophyllum thaiorum* J.J. Sm.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
163	*Bulbophyllum tripudians* Parish & Rchb. f.	Mt. Victoria, Chin	Ye Lwin Aung PT-7518, PT-7519 (PE!)
164	*Bulbophyllum triste* Rchb. f.	Mt. Victoria, Chin; Taunggyi, Shan; Bago; Tanintharyi	Ye Lwin Aung PT-7538 (PE!); Parish 207 (K!); MacKee 6184 (P!)
165	*Bulbophyllum umbellatum* Lindl.	Near Kangfang, Myitkyina & Putao, Kachin; Falam, Chin	Kermode 17288 (K!); Daun 73 (K!); Kingdon-Ward 9348 (BM!)
166	*Bulbophyllum wallichii* Rchb.f.	Kachin; Hkamti, Sagaing	Mokim 5 (E!); Kate Armstrong 3107 (NY!)
167	*Bulbophyllum wendlandianum* (Krzl.) Dammar	Reported from Myanmar	Kress et al. 2003
168	*Bulbophyllum wightii* Rchb. f.	Reported from Myanmar	Kress et al. 2003
169	*Bulbophyllum xylophyllum* Parish & Rchb. f.	Mon, Rakhine, Tanintharyi	Parish 82 (K!)
170	*Bulbophyllum yoksunense* J.J.Sm.	Putao, Kachin	Kingdon-Ward 13304 (BM!)
171	*Bulbophyllum yunnanense* Rolfe	Putao, Kachin	Ye Lwin Aung PT-7035 (PE!)

No.	Species	Local distribution	Specimen citations
172	*Bulleyia yunnanensis* Schltr.	Chipwi Township, Kachin State	Kingdon-Ward 1837 & s.n. (E!)
173	*Calanthe alismifolia* Lindl.	Putao Township, Kachin State	Xiaohua Jin et al. PT-2082, PT-2203, PT-2381, PT-2382 (PE!); Kurzweil & Lwin 2693 (SING, spirit)
174	*Calanthe alpina* Hook.f. ex Lindl.	Upper Myanmar, Kachin State; valley of the Dichu	Kingdon-Ward 21170 (AMES); F.K.W. 7126 (K!); Kingdon-Ward 1653 (E); s.coll. S.n. (E!)
175	*Calanthe arcuata* Rolfe	valley of the Dichu; Chipwi Township, Kachin State	Kingdon-Ward 7177 (K!); Kingdon-Ward 1654, 1696, 1721 (E); s.coll. s.n. (E!)
176	*Calanthe baliensis* J.J.Wood & J.B.Comber	Putao, Kachin	Ye Lwin Aung PT-7166 (PE!)
177	*Calanthe biloba* Lindl.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	Kress et al. 2003
178	*Calanthe brevicornu* Lindl.	Kachin	Kingdon-Ward 3048 (E!)
179	*Calanthe ceciliae* Rchb. f.	Shan	Imschort s.n. (K!)
180	*Calanthe clavata* Lindl.	Recorded from Myanmar	Kingdon-Ward 9088 & 10222 (BM!)
181	*Calanthe densiflora* Lindl.	Putao, Kachin	Ye Lwin Aung PT-7124 (PE!); s.coll. s.n. (E!); Kingdon-Ward 21351 (BM!)
182	*Calanthe griffithii* Lindl.	Upper Myanmar	Forrest 26671 (K!)
183	*Calanthe hancockii* Rolfe	Kangfang-hlawpaw, Myitkyina, Kachin	Lulay 9862 (K!)
184	*Calanthe herbacea* Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-2070 (PE!); Toppin 2736 (E!)
185	*Calanthe kermodei* Ormerod & Kurzweil	Laikam to Fengshuiling road, southeastern part of Myitkyina District, Kachin State	Kermode 17210 (Holotype, AMES!; Isotype, K)
186	*Calanthe labrosa* (Rchb. f.) Rchb. f.	Tanintharyi	Richard Abbott 27951 (NY!)
187	*Calanthe lamellosa* Rolfe	Kachin (Upper Burma)	Forrest 26655 & 26671 (E!) & (US)
188	*Calanthe lyroglossa* Rchb. f.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	Kress et al. 2003
189	*Calanthe mannii* Hook.f.	Near Htawgaw & Kangfang-Black Rock Road, Myitkyina, Kachin	Kermode 17024 & 17325 (K!); s.coll. s.n. (E!); Kingdon-Ward 20645 & 9456 (BM!)
190	*Calanthe masuca* (D.Don) Lindl.	Kyungdaing-ywa-kyeni-in, MayMyo township, Mandalay	Maung Po Khant 16379 (K!)
191	*Calanthe odora* Griff.	Mandalay, Shan	Kress et al. 2003
192	*Calanthe plantaginea* Lindl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
193	*Calanthe puberula* Lindl.	collected place 6.44 km far from Kang-fang, Myitkyina & Putao, Kachin	Ye Lwin Aung PT-7208 (PE!); Naw Mu Pa 17436 (K!)
194	***Calanthe punctata* Kurzweil**	Yae Kan Taung, Dawei, Tanintharyi	Saw Lwin et al. TNRO 153 (Holotype, SING; Isotype, Myanmar Floriculturist Association)
195	*Calanthe rosea* (Lindl.) Benth.	Mon, Tanintharyi	Kress et al. 2003
196	*Calanthe simplex* Seidenf.	Haka District, Chin State	Daun 101 (K!); Venning 1 (K!)
197	*Calanthe tricarinata* Lindl.	Sunghku laung	Kingdon-Ward 6817 (K!); s.coll. s.n. (E!)

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198	*Calanthe trifida* Tang & F.T. Wang	Upper Chindwin, Sagaing	Sulay 9045 (K!)
199	*Calanthe triplicata* (Willem.) Ames	MayMyo Plateau & Mt. Popa, Mandalay; Shan State	Mg Sein 13507 (K!); forest botanist 1554 (K!); Hugh s.n. (K!); Kingdon-Ward 21144 (BM!); Khin Myo Htwe 28 (spirit collection-MBK)
200	*Calanthe trulliformis* King & Pantl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
201	*Calanthe vestita* Lindl.	Mon, Tanintharyi	Kress et al. 2003
202	*Calanthe whiteana* King & Pantl.	Chin; collected place 6.44 km from Kangfang, Myitkyina, Kachin; Magway; Mandalay; Sagaing; Shan	Naw Mu Pa 17417 (K!); Kingdon-ward 1661, 1734 (E!) & (BM!); Farrer 1040 (E!)
203	*Callostylis bambusifolia* (Lindl.) Chen & Wood	Putao, Kachin	Xiaohua Jin et al. PT-5255 (PE!)
204	*Callostylis pulchella* (Lindl.) S.C.Chen & Z.H.Tsi	Kachin, Mandalay, Tanintharyi	Kress et al. 2003
205	*Callostylis rigida* Blume	Myitkyina, Kachin; MayMyo, Mandalay	C.E. Parkinson 2455 (K!); A. Samuel 13528 (K!)
206	*Cephalanthera damasonium* (Mill.) Druce	Kachin (Upper Burma); Kanpetlet, Chin	Forrest 26554 (E!); Cooper 6122 & 6131 (E!)
207	*Cephalanthera pusilla* (Hook. f.) Seidenf.	Bago	s.coll. s.n. (K!)
208	*Cephalantheropsis halconensis* (Ames) S.S.Ying	Putao, Kachin	Ye Lwin Aung PT-7131 (PE!)
209	*Cephalantheropsis longipes* (Hook. f.) Ormerod	Nam Tamai valley, Putao, Kachin	Kingdon-Ward 13443 (E!) & (BM!); Kate Armstrong 2347 (NY!)
210	*Cephalantheropsis obcordata* (Lindl.) Ormerod	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	Griffith 5279 (K!); Kingdon-Ward 21635 & 9141 (BM!)
211	*Ceratostylis himalaica* Hook.f.	Putao, Kachin; Htawgaw, Upper Myanmar	Xiaohua Jin et al. PT-5344 (PE!), Ye Lwin Aung PT-7148 (PE!); Forrest 27015 (K!) & (E!)
212	*Ceratostylis pleurothallis* (Parish & Rchb. f.) Seidenf.	Kayin, Tanintharyi	s.n. (K!)
213	*Ceratostylis radiata* J.J. Sm.	Putao, Kachin	Ye Lwin Aung PT-7076 (PE!); Kurzweil & Lwin 2609 (SING, SING[spirit])
214	*Ceratostylis subulata* Blume	Putao, Kachin	Kate Armstrong 2280 (NY!); Kurzweil & Lwin 2379 (SING [spirit])
215	*Cheirostylis chinensis* Rolfe	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
216	*Cheirostylis flabellata* (A.Rich.) Wight	Mon	Parish 104 & 123 (K!)
217	*Cheirostylis griffithii* Lindl.	Taunggoo, Bago; Kachin	Parish 236 (K!); Kingdon-Ward 487 (NY!)
218	*Cheirostylis montana* Blume	Tanintharyi	Kress et al. 2003
219	***Cheirostylis pubescens* Parish & Rchb. f.**	Mon, Tanintharyi	Kress et al. 2003
220	*Cheirostylis pusilla* Lindl.	Tanintharyi	Kress et al. 2003
221	*Cheirostylis spathulata* J.J. Sm.	Mindat, Chin; Mt. Popa, Mandalay	Kingdon-Ward 21776 (BM!); Tsujita et al. 036251 (spirit collection-TNS); Khin Myo Htwe 90 (spirit collection-TNS); Tetsuo Ohi-Toma 035000 (MBK)

No.	Species	Local distribution	Specimen citations
222	*Cheirostylis yunnanensis* Lindl.	Tamu-Chipwi New Road, Myitkyina, Kachin	Kermode 16649 (K!)
223	*Chiloschista lunifera* (Rchb. f.) J.J. Sm.	Kachin, Mandalay; Mawlamyine (Moulmein), Mon; Tanintharyi	Forrest 12326 (E!); Parish 26237 (W!)
224	*Chiloschista parishii* Seidenf.	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7398 (PE!)
225	*Chiloschista usneoides* (D. Don) Lindl.	Mt. Popa, Mandalay	Tsujita et al. 036178 (spirit collection-TNS), Khin Myo Htwe 035053 (MBK)
226	*Chrysoglossum assamicum* Hook.f.	Putao, Kachin	Xiaohua Jin et al. PT-ET-190 (PE!)
227	*Chrysoglossum ornatum* Blume	Putao & Nogmung Township, Kachin State	Xiaohua Jin et al. PT-2047, PT-2443 (PE!); Kingdon-Ward 6692 (K)
228	*Cleisomeria lanatum* (Lindl.) Lindl. ex G. Don	Moulmein, Mon; Tanintharyi	s.coll. s.n. (E!)
229	*Cleisomeria pilosulum* (Gagnep.) Seidenf. & Garay	Mt. Popa, Mandalay	Khin Myo Htwe 25, 39 (spirit collection-TNS)
230	*Cleisostoma appendiculatum* (Lindl.) Benth. & Hook. f.	Mon, Tanintharyi	Kress et al. 2003
231	*Cleisostoma arietinum* (Rchb.f.) Garay	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
232	*Cleisostoma aspersum* (Rchb. f.) Garay	Putao, Kachin; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7413, PT-7041 (PE!)
233	*Cleisostoma birmanicum* (Schltr.) Garay	Reported from Myanmar	Kress et al. 2003
234	*Cleisostoma duplicilobum* (J.J. Sm.) Garay	Falam, Chin	Daun 74 (K)
235	*Cleisostoma filiforme* (Lindl.) Garay	Falam, Chin; Kachin; PyinOoLwin (Maymyo), Mandalay; Tanintharyi	A. Samuel 13509 (K!); Daun 40 (K!); C.T. Bogg B.G. 7 (K!); s.coll. s.n. (E!); McMillen 259 (US)
236	*Cleisostoma fuerstenbergianum* Kraenzl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
237	*Cleisostoma linearilobatum* (Seidenf. & Smitinand) Garay	Putao Township, Kachin State	Kurzweil & Lwin 2684 (SING [spirit]), Kurzweil & Lwin 2772 (SING [spirit])
238	*Cleisostoma parishii* (Hook. f.) Garay	Putao, Kachin; Mon; Tanintharyi	Xiaohua Jin et al. PT-2052 (PE!)
239	*Cleisostoma racemiferum* (Lindl.) Garay	Mandalay; Kyaikkami(Amherst), Mon; Tanintharyi	R. C. Swinhoe R.123 & 49 (K!)
240	*Cleisostoma rolfeanum* (King & Pantl.) Garay	Taunggyi, Shan	R. C. Swinhoe R.124 (K!)
241	*Cleisostoma rostratum* (Lindl.) Garay	Putao, Kachin	Ye Lwin Aung PT-7127 (PE!); McMillen 7 (US)
242	*Cleisostoma simondii* (Gagnep.) Garay	Reported from Myanmar	Kress et al. 2003
243	*Cleisostoma subulatum* Blume	Reported from Myanmar	Kress et al. 2003
244	*Cleisostoma williamsonii* (Rchb. f.) Garay	Mon, Tanintharyi	Kress et al. 2003
245	*Coelogyne anceps* Hook.f.	Putao, Kachin; Mt. Victoria, Chin	Ye Lwin Aung PT-7033, PT-7153, PT-7575 (PE!)
246	*Coelogyne assamica* Linden & Rchb.f.	Putao, Kachin	Xiaohua Jin et al. PT-5353 (PE!)

No.	Species	Local distribution	Specimen citations
247	*Coelogyne barbata* Griff.	valley of the Saunghku & Nwai valley, Putao, Kachin	Kingdon-Ward 7423 (K!); Kingdon-Ward 1941 (E!); Kate Armstrong 1914 (NY!)
248	*Coelogyne brachyptera* Rchb. f.	Mt. Victoria, Chin; Mandalay	Ye Lwin Aung PT-7500, PT-7501, PT-7502 (PE!); R.C.F. Swinhoe 37 (K!)
249	*Coelogyne calcicola* Kerr	Chin; Myitkyina, Kachin	U Aung Din 2902 (K!)
250	*Coelogyne corymbosa* Lindl.	Putao & Myitkyina, Kachin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Mt. Victoria & Falam, Chin; Feng-Shiling camp, Upper Myanmar	Xiaohua Jin et al. PT-2115, PT-2204, PT-2256, PT-2266 (PE!), Ye Lwin Aung PT-7390, PT-7494, PT-7509, PT-7545 (PE!); Daun 22 (K!); Forrest 26558 (K!) & (US); Kermode 17357 (K!); Farrer 981 (E!); Kingdon-Ward 1569 & 1630 (E!)
251	*Coelogyne cristata* Lindl.	Shan, Tanintharyi	Kress et al. 2003
252	*Coelogyne ecarinata* C. Schweinf.	Kachin	Kingdon-Ward 434 (NY!) & (AMES!)
253	*Coelogyne fimbriata* Lindl.	Putao, Kachin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Mandalay	Xiaohua Jin et al. PT-ET 257, PT-5351 (PE!), Ye Lwin Aung PT-7047, PT-7059, PT-7070, PT-7214, PT-7217, PT-7389 (PE!); R.C.F. Swinhoe 90 (K!)
254	*Coelogyne flaccida* Lindl.	Putao, Kachin; Upper Myanmar; Tanintharyi	Ye Lwin Aung PT-7169, PT-7204 (PE!); F.K.W. 6660 (K!); s.coll. s.n. (K!)
255	*Coelogyne fuscescens* Lindl.	Putao, Kachin; Kayin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7024, PT-7156, PT-7294, PT-7369, PT-7370, PT-7393 (PE!); Generla Tylter B.G. 21 (K!); Parish 195 (K!)
256	*Coelogyne gongshanensis* H.Li ex S.C.Chen	Kachin (Upper Burma)	Forrest 26558 (E!) & (NY!); Farrer 889 & 1561 (E!)
257	*Coelogyne griffithii* Hook.f.	Seinghku-taung, Upper Myanmar	Kingdon-Ward 6730 (K!)
258	*Coelogyne holochila* P.F. Hunt & Summerh.	Mt. Victoria, Chin	Ye Lwin Aung PT-7558 (PE!); Cuffe 1 (K!)
259	*Coelogyne huettneriana* Rchb. f.	Mandalay; Moulmein, Mon	Swinhoe s.n. (K!); Parish 143 (K!)
260	*Coelogyne lentiginosa* Lindl.	Mon; Tanintharyi; Mt. Popa, Mandalay; Southern Shan State	Robertson 137 (K!)
261	*Coelogyne leucantha* W.W. Sm.	Chin; Kachin; Upper Myanmar; Magway; Mandalay; Sagaing; Shan	Forrest 27098 (K!) & (E!); Kingdon-Ward 1669 (E!)
262	*Coelogyne longipes* Hook. f.	Putao, Kachin; Inle lake, Taunggyi, Shan	Xiaohua Jin et al. PT-2110, PT-5097 (PE!)
263	***Coelogyne magnifica* Y.H.Tan, S.S.Zhou & B.Yang**	Hponkanrazi Wildlife Sanctuary, Putao Township, Kachin State	Myanmar Exped. 2046 (holotype, HITBC)
264	*Coelogyne micrantha* Lindl.	Sumprabum & Putao, Kachin; Mt. Victoria, Chin; Mon; Tanintharyi	Xiaohua Jin et al. PT-5273 (PE!), Ye Lwin Aung PT-7014, PT-7026, PT-7210, PT-7572 (PE!); Keenan et al. 3821 (K!) & (E!)
265	*Coelogyne nervosa* A.Rich.	Mt. Victoria, Chin	Ye Lwin Aung PT-7493, PT-7497, PT-7498 (PE!)

No.	Species	Local distribution	Specimen citations
266	*Coelogyne nitida* Lindl.	Seinghku taung, Myitkyina, Bhamo, Sumprabum, Putao, Kachin; Haka, Chin; Taunggyi, Shan; Moulmein, Mon; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-5272 (PE!), Ye Lwin Aung PT-7136, PT-7362, PT-7364, PT-7591, PT-7175 (PE!); Maung Wy 4991 (K!); F.K.W. 6799 (K!); C.W.D. Kermode 16683 & 17018 (K!); Venning 50 (K!); J. Keenan et al. 3208 (K!); Parish 150 (K!); Forrest 852 (E!), 26567 (E!) & (P!)
267	*Coelogyne occultata* Hook. f.	Kachin (Upper Myanmar)	Forrest 27060 (K!), (E!) & (NY!); Farrer 1088 (E!); Kingdon-Ward 1767 (E!)
268	*Coelogyne ovalis* Lindl.	Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Kayin; Mon; Sagaing; Bago; Mandalay	Ye Lwin Aung PT-7368, PT-7381 (PE!)
269	*Coelogyne parishii* Hook. f.	Thaton, Mon; Thaungyin, Tanintharyi	Baldwin 13568 (K!); Lace s.n. (E!)
270	***Coelogyne picta* Schltr.**	Chin, Kachin, Mandalay, Sagaing	Kress et al. 2003
271	*Coelogyne prolifera* Lindl.	Putao & Myitkyina, Kachin; Mt. Victoria, Chin; Mandalay; YePhyu, Tanintharyi	Ye Lwin Aung PT-7495, PT-7499, PT-7573, PT-7334, PT-7082 (PE!); Su Lay 10028 (K!); Swinhoe 103 (K!); Cooper 6083 (E!)
272	*Coelogyne pulchella* Rolfe	Mulayit, East Dawna	s.coll. 13527 (K!); s.coll. s.n. (K!)
273	*Coelogyne punctulata* Lindl.	Myitkyina & Putao, Kachin; Mogok, Mandalay	Ye Lwin Aung PT-7130, PT-7029, PT-7036 (PE!); Mg Mya BG 15 (K!); Bogg 13513 (K!); Keenan et al. 3208 & 3079 (E!); Kingdon-Ward 17385 & 18463 (NY!)
274	***Coelogyne putaoensis* X.H.Jin, L.A.Ye & Schuit.**	Hponkanrazi Wildlife Sanctuary, Putao Township, Kachin State	Xiaohua Jin et al. PT-2116 (Holotype, PE!)
275	*Coelogyne rigida* Parish & Rchb. f.	Putao, Kachin; Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7106, PT-7357 (PE!); Parish 42 (K!); Kingdon-Ward 20986 & 20650 (BM!)
276	*Coelogyne sanderae* Kranz.	Chin; Putao, Kachin; Magway; Mandalay; Sagaing; Shan	Xiaohua Jin et al. PT-2546 (PE!), Ye Lwin Aung PT-7018 (PE!)
277	*Coelogyne schilleriana* Rchb. f.	Reported from Myanmar	Kress et al. 2003
278	*Coelogyne schultesii* S.K. Jain & S. Das	Mt. Victoria, Kanpetlet, Chin; Myitkyina, Kachin	Ye Lwin Aung PT-7496, PT-7523 (PE!); Dickason 8441 (K!); Kermode 17320 (K!); Kingdon-Ward s.n. (E!); Kingdon-Ward 21816 (BM!)
279	*Coelogyne speciosa* Lindl.	Bago	Kress et al. 2003
280	*Coelogyne stricta* (D. Don) Schltr.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	s.coll. s.n. (K!)
281	*Coelogyne suaveolens* (Lindl.)	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
282	*Coelogyne tenasserimensis* Seidenf.	Mandalay	R.C.F. Swinhoe 99 (K!)
283	*Coelogyne testacea* Lindl.	Reported from Myanmar	Kress et al. 2003
284	*Coelogyne tomentosa* Lindl.	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
285	*Coelogyne trinervis* Lindl.	Kyaingtong (Kengtun), Shan; YePhyu, Tanintharyi; Dawna hills-Tenesserim hills, Kyaikkami (Amherst) & Moulmein, Mon	Ye Lwin Aung PT-7359 (PE!); A.F.G. Kerr s.n. (K!); Myron Kimnach 57.268-1 (K!); G.E.R. Cooper 1701 (K!); Bogg B.G. 19 (K!); Keenan et al. 5466 (E!)
286	*Coelogyne triplicatula* Rchb.f.	Dawna Hill, Kayin; Moulmein, Mon	G.E.R. Cooper & C.E. Parkinson 6404 (K!); Parish 160 (K!)
287	*Coelogyne ustulata* Parish & Rchb. f.	Putao, Kachin; Mandalay; Mon; Tanintharyi	Ye Lwin Aung PT-7141 (PE!); Parish 174 (K!); Daun 27 (K!)
288	***Coelogyne victoria-reginae* Q.Liu & S.S.Zhou**	Mt. Victoria, Chin	Ye Lwin Aung PT-7546 (PE!); Qiang Liu M17-18 (holotype, HITBC, isotypes, RAF)
289	*Coelogyne viscosa* Rchb. f.	Mt. Victoria, Chin; Mon; Tanintharyi	R. Unwin 13521 (K!); Parish 252 (K!)
290	*Collabium chapaense* (Gagnep.) Seidenf. & Ormerod	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
291	*Collabium formosanum* Hayata	Putao, Kachin	Ye Lwin Aung PT-7150 (PE!)
292	*Corymborkis veratrifolia* Blume	Kyaingtong (Kengtun), Shan	Rock 1945 (E!) & (P!) & (US)
293	*Cremastra appendiculata* (D. Don) Makino	Mt. Victoria, Chin; Putao, Kachin	Xiaohua Jin et al. PT-ET 1095 (PE!); K. Fujikawa et al. 089099 (MBK, spirit collection); N. Tanaka et al. 030828 (MBK)
294	*Crepidium acuminatum* (D. Don) Szlach.	Putao, Kachin; Mindat, Chin; Mt. Popa, Mandalay; Moulmein, Mon	Xiaohua Jin et al. PT-2092 (PE!); Parish 147 (K!); Kingdon-Ward 22492 (BM!); Khin Myo Htwe 48 (spirit collection-TNS)
295	*Crepidium biauritum* (Lindl.) Szlach.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
296	*Crepidium calophyllum* (Rchb.f.) Szlach.	Putao, Kachin; Bago; Yangon; Maymyo, Mandalay; Moulmein, Mon	Xiaohua Jin et al. PT-6964 (PE!); A. Samuel 13677 (K!); Parish 191 (K!)
297	*Crepidium khasianum* (Hook.f.) Szlach.	Chin	Fujikawa et al. 053114 (MBK), Yasuda 060072 (MBK), Tanaka & Yukawa 081194 (MBK), Ling Shein Man et al. 087417 (MBK), Mu Mu Aung et al. 092458 (MBK), Ling Shein Mang 093057 (MBK), Fujikawa et al. 094196 (MBK)
298	*Crepidium mackinnoniii* (Duthie) Szlach.	Mindat, Chin	Kingdon-Ward 22598 (BM!)
299	*Crepidium polyodon* (Hook.f.) Szlach.	Mon, Tanintharyi	s.coll. 215 (K!)
300	*Crepidium purpureum* (Lindl.) Szlach.	Reported from Myanmar	Kress et al. 2003
301	*Crepidium szemaoense* (Tang & F.T. Wang) Nuammee, Seelanan, Suddee & H.A. Pedersen	Chin	Mu Mu Aung et al. 092359 (MBK)

No.	Species	Local distribution	Specimen citations
302	*Cryptochilus luteus* Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-ET 543 & PT-2267 (PE!); s.coll.s.n. (E!); Kingdon-Ward 20984 (BM!)
303	*Cryptochilus roseus* (Lindl.) S.C.Chen & J.J.Wood	Putao, Kachin	Xiaohua Jin et al. PT-5282 (PE!), Ye Lwin Aung PT-7170 (PE!)
304	*Cryptochilus sanguineus* Wall.	Recorded from Myanmar	Kingdon-Ward 12850 (BM!)
305	*Cryptochilus strictus* (Lindl.) Schuit., Y.P.Ng & H.A.Pedersen	Putao, Kachin	Kate Armstrong 1002 (NY!); Kingdon-Ward 9068 & 13524 (BM!)
306	*Cryptostylis arachnites* (Blume) Hassk.	Putao, Kachin	Ye Lwin Aung PT-7144, PT-7196 (PE!)
307	*Cryptostylis carinata* J.J.Sm.	Putao, Kachin	Ye Lwin Aung PT-7071, PT-7100, PT-7113 (PE!)
308	*Cylindrolobus biflorus* (Griff.) Rauschert	Putao, Kachin; YePhyu & Myeik (Mergui), Tanintharyi	Ye Lwin Aung PT-7328, PT-7286, PT-7200 (PE!); Griffith 830 (K!)
309	*Cylindrolobus clavicaulis* (Lindl.) Rauschert	Putao, Kachin; Falam, Chin; Arakan Yoma, Rakhine	Xiaohua Jin et al. PT-5266 (PE!); Ye Lwin Aung PT-7096 (PE!); R.C.F. Swinhoe 78 (K!); Daun 39 (K!)
310	*Cylindrolobus cristatus* (Rolfe) S.C.Chen & J.J.Wood	Putao, Kachin; Mt. Victoria, Chin; Moulmein, Mon	Ye Lwin Aung PT-7157, PT-7503 (PE!); s.coll. s.n. (K!)
311	*Cylindrolobus foetidus* (Aver.) Schuit., Y.P.Ng & H.A.Pedersen	Putao, Kachin	Ye Lwin Aung PT-7094 (PE!)
312	*Cylindrolobus glabriflorus* X.H.Jin & J.D.Ya	Hponkanrazi Wildlife Sanctuary, Putao Township, Kachin State	Xiao-Hua Jin, Ji-Dong Ya 18HT1618 (holotype: KUN!)
313	*Cylindrolobus marginatus* (Rolfe) S.C.Chen & J.J.Wood	Kyaikkahmi (Amherst), Mon	Lace 5644 (E!)
314	*Cylindrolobus truncatus* (Lindl.) Rauschert	Mon, Tanintharyi	Kress et al. 2003
315	*Cymbidium aloifolium* (L.) Sw.	Mt. Victoria, Chin; YePhyu, Tanintharyi	Ye Lwin Aung PT-7315, PT-7354, PT-7531 (PE!); Kingdon-Ward 22138 (BM!)
316	*Cymbidium bicolor* Lindl.	Pantha drainage, Upper Chindwin; Haka & Falam, Chin	Rule s.n. (K!); Glin 5754 (K!); Venning 48 (K!); Daun 66 (K!)
317	*Cymbidium cochleare* Lindl.	Mt. Victoria, Chin	Ye Lwin Aung PT-7532 (PE!)
318	*Cymbidium crassifolium* Wall.	Putao, Kachin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Taunggyi, Shan; YePhyu, Tanintharyi	Ye Lwin Aung PT-7401, PT-7438 (PE!); Ye Lwin Aung PT-7295, PT-7297, PT-7445, PT-7602, PT-7184 (PE!)
319	*Cymbidium cyperifolium* Wall.	Mt. Victoria, Chin; PyinOoLwin (Maymyo), Mandalay	Xiaohua Jin et al. PT-5177 (PE!); R.C.F. Swinhoe 133 (K!)
320	*Cymbidium dayanum* Rchb. f.	Recorded from Myanmar	Rule s.n. (K!)
321	*Cymbidium devonianum* Paxton	Kachin	Kingdon-Ward 20808 (BM!); McMillen 200 (US)
322	*Cymbidium eburneum* Lindl.	Recorded from Myanmar	Kress et al. 2003
323	*Cymbidium elegans* Lindl.	Putao, Kachin; Falam & Haka, Chin	Forrest 27694 (K!) & (E!); Daun 60 (K!); Venning 55 (K!); Kate Armstrong 2087 (NY!); Kingdon-Ward 21617 (BM!)

No.	Species	Local distribution	Specimen citations
324	*Cymbidium ensifolium* (L.) Sw.	Mt. Popa, Mandalay	Khin Myo Htwe 118 (spirit collection-TNS), Tanaka et al. 036213 (MBK), Tsujita et al. 036209, 036214 (spirit collection-TNS)
325	*Cymbidium erythraeum* Lindl.	Chin, Kachin, Mandalay, Sagaing	s.coll. s.n. (E!)
326	*Cymbidium faberi* Rolfe	Mt. Victoria, Chin	Cooper 6017 (E!)
327	*Cymbidium finlaysonianum* Lindl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
328	*Cymbidium hookerianum* Rchb. f.	11.27 km from Kangfang, Myitkyina, Kachin	Naw Mu Pa 15503 (K!); Kingdon-Ward 298 (NY!)
329	*Cymbidium iridioides* D. Don	Recorded from Myanmar	s.coll. s.n. (K!)
330	*Cymbidium lancifolium* W.J. Hook.	Putao, Kachin; Mt. Victoria, Chin; Kalaw, Shan; Delu valley	Ye Lwin Aung PT-7056, PT-7524 (PE!); Baldworth 13546 (K!); s.coll. 24 (K!); Kingdon-Ward 8491 (K!); Venning 20 (K!); Kingdon-Ward 1933 (E!)
331	*Cymbidium lowianum* (Rchb. f.) Rchb. f.	Kachin, Yangon	Kingdon-Ward 206 (E!)
332	*Cymbidium macrorhizon* Lindl.	Chin; Shan; Mt. Popa, Mandalay	Prain 12 (K!); Lace s.n. (E!); Kingdon-Ward 17499 (NY!); Kingdon-Ward 20799 & 22157 (BM!); Tanaka et al. 020495 (MBK), Khin Myo Htwe 58 (spirit collection-TNS)
333	*Cymbidium mastersii* Griff. ex Lindl.	Recorded from Myanmar	s.coll. s.n. (E!)
334	***Cymbidium parishii* Rchb. f.**	Kayin, Shan, Tanintharyi	s.coll. s.n. (K!)
335	*Cymbidium sinense* (Jacks.) Willd.	Kachin	Keenan et al. 3301 (E!)
336	*Cymbidium suavissimum* Sander	Recorded from Myanmar	s.coll. s.n. (K!)
337	*Cymbidium tigrinum* Parish ex Hook.	Mulayit, Kayin; Dawna, Kyaikkami (Amherst) & Moulmein, Mon; Tanintharyi	Parish 144 (K!); Bogg B.G. 29 (K!); Shwe Nyar Tha 5 (K!)
338	*Cymbidium tracyanum* Hort.	Chin, Kachin, Shan	Kress et al. 2003
339	*Cymbidium wilsonii* (Rolfe ex Cook) Rolfe	Kalewa, Sagaing	Prazer s.n. (K!); s.coll. s.n. (E!)
340	*Cypripedium guttatum* Sw.	Adung valley, Putao, Kachin	Kingdon-Ward 9677 (BM!)
341	*Cypripedium himalaicum* Rolfe	Adung valley, Putao, Kachin	Kingdon-Ward 9680 (BM!)
342	*Cypripedium lichiangense* S.C. Chen & Cribb	Recorded from Myanmar	Kingdon-Ward 1643 (E!)
343	*Cyrtosia javanica* Blume	Putao, Kachin	Xiaohua Jin et al. PT-6334, PT-6262 (PE!); Myanmar Exped. M4012 (HITBC, RAF)
344	*Dendrobium acerosum* Lindl.	Tanintharyi	Kress et al. 2003
345	*Dendrobium acinaciforme* Roxb.	Putao, Kachin	Xiaohua Jin et al. PT-5348 (PE!)
346	*Dendrobium aduncum* Wall. ex Lindl.	Chin; Kachin; Magway; Maymyo, Mandalay; Alaungdaw Kathapa National Park, Sagaing; YePhyu, Tanintharyi	Ye Lwin Aung PT-7448, PT-7273 (PE!); R.C.F. Swinhoe 132 (K!)
347	*Dendrobium albosanguineum* Lindl. & Paxton	Mon; Rakhine; Tanintharyi; Pyay (Prome), Bago	s.coll. s.n. (K!); Whitin s.n. (US)
348	*Dendrobium aloifolium* (Blume) Rchb. f.	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
349	*Dendrobium amoenum* Wall.	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7405 (PE!); McMillen 197 (US)
350	*Dendrobium amplum* Lindl.	Putao, Kachin	Ye Lwin Aung PT-7038 (PE!); Kingdon-Ward 21420 (BM!)
351	*Dendrobium anceps* Sw.	Mandalay; Shan; YePhyu, Tanintharyi	Ye Lwin Aung PT-7285, PT-7287, PT-7342 (PE!)
352	*Dendrobium angulatum* Lindl.	YePhyu, Tanintharyi; Eastern Tenasserim	Ye Lwin Aung PT-7327 (PE!); A.F.G. Kerr 01001 (K!) & (P!); Peche 612 (BM!)
353	*Dendrobium angustifolium* (Blume) Lindl.	Putao, Kachin; Tanintharyi	Ye Lwin Aung PT-7132 (PE!)
354	***Dendrobium aphrodite* Rchb. f.**	PyinOoLwin (Maymyo), Mandalay; Mon; Tanintharyi;	Ellison s.n. (K!)
355	*Dendrobium aphyllum* (Roxb.) Fischer	Mt. Popa & Pyin Oo Lwin (Maymyo), Mandalay; foot of YayTheiChin Hill, Upper Chindwin; Falam & Mindat, Chin; Mawlamyine, Mon	Daun 15 (K!); Glin 5821 (K!); Lace s.n. (E!); Kingdon-Ward 21824 (BM!); Lobb 9 (BM!); Khin Myo Htwe 8 (spirit collection-TNS), Khin Myo Htwe 27 (spirit collection-TNS), Khin Myo Htwe 32 (spirit collection-TNS), Khin Myo Htwe 035054 (MBK)
356	*Dendrobium appendiculatum* (Blume) Lindl.	Reported from Myanmar	Kress et al. 2003
357	*Dendrobium attenuatum* Lindl.	Putao, Kachin	Ye Lwin Aung PT-7025 (PE!)
358	*Dendrobium bellatulum* Rolfe	Mt. Victoria, Chin; Taunggyi & Kalaw, Shan	Ye Lwin Aung PT-7527, PT-7528, PT-7584 (PE!); Baldworth 13545 (K!)
359	*Dendrobium bensoniae* Rchb. f.	Mt. Victoria, Chin; Bago; Rakhine; Tanintharyi; Yangon; Mt. Popa & Maymyo, Mandalay	Ye Lwin Aung PT-7555, PT-7563 (PE!); A. Samuel 13575 (K!); s.coll. s.n. (K!); Khin Myo Htwe 35 (spirit collection-TNS), Tanaka et al. 036101, 036103 (spirit collection-MBK, TNS), Tanaka et al. 036193 (spirit collection-MBK, TNS),
360	*Dendrobium bicameratum* Lindl.	Mt. Victoria, Chin; Mandalay; YePhyu, Tanintharyi	Ye Lwin Aung PT-7482, PT-7241 (PE!); R.C.F. Swinhoe 55 & R 126 (K!)
361	*Dendrobium brymerianum* Rchb. f.	Chin; Putao, Kachin; Magway; Mandalay; Sagaing; Shan	Xiaohua Jin et al. PT-6727 (PE!); s.coll. s.n. (K!); Kingdon-Ward 20759 (BM!)
362	*Dendrobium calcariferum* Carr	Putao, Kachin	Ye Lwin Aung PT-7087 (PE!)
363	***Dendrobium calothyrsos* Schltr.**	Reported from Myanmar	Kress et al. 2003
364	*Dendrobium capillipes* Rchb. f.	Haka, Chin; Magway; Mon; Shan; Tanintharyi; Mt. Popa, Mandalay	R.C.F. Swinhoe 43 (K!); Venning 61 (K!); McMillen 203 (US); Khin Myo Htwe 57 (spirit collection-TNS)
365	*Dendrobium cariniferum* Rchb. f.	Chin; Kachin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Taunggyi, Shan	Ye Lwin Aung PT-7404, PT-7595 (PE!); Kingdon-Ward s.n. (E!); Khin Myo Htwe 95 (spirit collection-TNS), Tanaka et al. 036151 (MBK)
366	*Dendrobium chiengmaiense* Schuit. & Peter B.Adams	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
367	*Dendrobium chrysanthum* Lindl.	Chin; Putao, Kachin; Mt. Popa, Mandalay; Taunggyi, Shan	Ye Lwin Aung PT-7105 (PE!); F.G. Dickason 8279 (K!)
368	*Dendrobium chryseum* Rolfe	Mt. Popa & PyinOoLwin (MayMyo), Mandalay; Alaungdaw Kathapa National Park, Sagaing; YePhyu, Tanintharyi	Ye Lwin Aung PT-7423, PT-7274 (PE!); Cooper 6084 (E!); Khin Myo Htwe 5 (spirit collection-TNS); Maung Sin 13538 (K!)
369	*Dendrobium chrysocrepis* Parish & Rchb. f. ex Hook. f.	Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7310 (PE!)
370	*Dendrobium chrysotoxum* Lindl.	Mt. Victoria, Chin; Kachin; Magway; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Shan; Yangon	Ye Lwin Aung PT-7248, PT-7450, PT-7486, PT-7492, PT-7556, PT-7576, PT-7254 (PE!); Kingdon-Ward 21807 (BM!); McMillen 247 (US); Harrison s.n. (US); Khin Myo Htwe 2 (spirit collection-TNS), Tanaka et al. 036164 (MBK)
371	*Dendrobium comatum* (Blume) Lindl.	Reported from Myanmar	Kress et al. 2003
372	*Dendrobium compactum* Rolfe ex W. Hackett	PyinOoLwin (MayMyo), Mandalay	Lace 6282 (K!) & (E!); Swinhoe 70 (K!); Samuel 13515 (K!);
373	*Dendrobium conspicuum* Bakh.f.	Tanintharyi	Kress et al. 2003
374	*Dendrobium convexum* (Blume) Lindl.	Reported from Myanmar	Kress et al. 2003
375	*Dendrobium crepidatum* Lindl.	Chin, Kachin, Mandalay, Sagaing, Shan, Mt. Popa of Madalay Region	Ye Lwin Aung PT-7366, PT-7377, PT-7380, PT-7382, PT-7387, PT-7463, PT-7488, PT-7580 (PE!); s.coll. s.n. (NY!); Tanaka et al. 036184, 036186 (MBK), Khin Myo Htwe 19 (spirit collection-TNS)
376	*Dendrobium cruentum* Lindl.	Tanintharyi	Kress et al. 2003
377	*Dendrobium crumenatum* Sw.	Tanintharyi	Griffith 5149 (P!); s.coll. s.n. (NY!)
378	*Dendrobium crystallinum* Rchb. f.	Mt. Popa, Mandalay; Mon; Rakhine; Shan; Tanintharyi	Abdul Khalil s.n. (BM!) & (L!) & (P!); Khin Myo Htwe 3 (spirit collection-TNS), Khin Myo Htwe 21 (spirit collection-TNS)
379	*Dendrobium cumulatum* Lindl.	Chin; Kachin; Mandalay; Sagaing; Dawei (Tavoy), Tanintharyi	Keenan et al. 1620 (E!)
380	*Dendrobium curviflorum* Rolfe	Putao, Kachin; PyinOoLwin (MayMyo), Mandalay	Qiang Liu 440 (HITBC!); Swinhoe B.G. 2 (K!); Mg Sein 13503 (K!)
381	*Dendrobium cuspidatum* Lindl.	Dawei (Tavoy), Tanintharyi	Swinhoe 64 (K!); Keenan et al. 5309 (E!); Lobb 406 (BM!)
382	*Dendrobium dantaniense* Guillaumin	Mt. Popa, Mandalay	Khin Myo Htwe 53, 54 (spirit collection-TNS), Tanaka et al. 036154 (MBK)
383	*Dendrobium delacourii* Guill.	Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Thayet, Magway; Mon; Rakhine; Tanintharyi	Lace 6262 & 6357 (E!); Buchanan-Hamilton s.n. (BM!); Khin Myo Htwe 36 (spirit collection-TNS)
384	*Dendrobium denneanum* Kerr	Recorded from Myanmar	F.G. Dickason 8365 (K!)

No.	Species	Local distribution	Specimen citations
385	*Dendrobium densiflorum* Lindl. ex Wall.	Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Alaungdaw Kathapa National Park, Sagaing; Taunggyi, Shan; YePhyu, Tanintharyi; Bamaw, Kachin; Pyin Oo Lwin, Mandalay	Ye Lwin Aung PT-7367, PT-7451, PT-7590, PT-7272 (PE!); Parkinson 8722 (RAF!); U Tha Hla 1939 (RAF!)
386	*Dendrobium denudans* D. Don	Mt. Victoria, Chin; Kachin; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7402, PT-7409, PT-7476 (PE!); Kingdon-Ward 108 (NY!)
387	*Dendrobium devonianum* Paxton	Chin; Kachin; Kayin; Kadaik, Thaton, Mon; Homalin stream, Upper Chindwin & Katha District, Sagaing; Tanintharyi	Glin 6575 (RAF!); Sou Po Chin 5842 (RAF!); AR 492 (RAF!)
388	*Dendrobium dickasonii* L.O. Williams	Mt. Victoria, Haka & Falam, Chin; Taunggyi, Shan; YePhyu, Tanintharyi; Madalay	Ye Lwin Aung PT-7474, PT-7585, PT-7261 (PE!); Daun 21 (K!); R.C.F. Swinhoe 36 (K!); Venning 60 (K!); Hildebrand D (K!); Dickason 8756 & 7779 (AMES!); Kingdon-Ward 22222 (BM!); Kingdon-Ward 22244 (BM!)
389	*Dendrobium dixanthum* Rchb. f.	Bhamo, Kachin; Mon; Tanintharyi	Bogg 13534 (K!); Swinhoe R 128 (K!)
390	*Dendrobium draconis* Rchb. f.	Mt. Victoria, Chin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7394, PT-7561 (PE!), Khin Myo Htwe 34 (spirit collection-TNS)
391	*Dendrobium ellipsophyllum* Tang & F.T. Wang	Mandalay	R.C.F. Swinhoe 60 (K!); s.coll. s.n. (K!)
392	*Dendrobium eriiflorum* Griff.	Putao, Kachin; Chin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Mandalay; Myaukhlaing reserve, Insein, Yangon	Xiaohua Jin et al. PT-5288 (PE!), Ye Lwin Aung PT-7378 (PE!); Swinhoe 84 (K!); Po Khant 696 (RAF!); Mokim s.n. (BM!)
393	*Dendrobium falconeri* Hook.	Chin; Kachin; Sagaing; Taunggyi, Shan	Ye Lwin Aung PT-7587 (PE!); s.coll.s.n. (E!); Kingdon-Ward 20951 (BM!)
394	*Dendrobium farmeri* Paxton	Mon, Tanintharyi	Kress et al. 2003
395	*Dendrobium fimbriatum* Hook.	Chin; valley of the Seinghku, Putao, Kachin; Kayah; Mon; Rakhine; Sagaing; YePhyu, Tanintharyi; Yangon	Xiaohua Jin et al. PT-2019 (PE!); Ye Lwin Aung PT-7317, PT-7318 (PE!); Kingdon-Ward 7256 (K!)
396	*Dendrobium findlayanum* Parish & Rchb. f.	Shan, Yangon	Parish 192 (K!); Hallowell s.n. (US)
397	*Dendrobium finetianum* Schltr.	Putao, Kachin	Ye Lwin Aung PT-7119, PT-7182, PT-7201 (PE!)
398	*Dendrobium formosum* Roxb. ex Lindl.	Chin, Kachin, Bago, Mon, Rakhine, Sagaing, Tanintharyi, Yangon	Wallace 136 (BM!); s.coll. s.n. (K!); Mokim S 634 (L!)
399	*Dendrobium fugax* Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
400	*Dendrobium fuscescens* Griff.	valley of the Seinghku, Putao, Kachin	Kingdon-Ward 7623 (K!); Kate Armstrong 2130 (NY!)
401	*Dendrobium fytchianum* Bateman	Mon; Nothern Bago (Pegu); Rakhine; Tanintharyi; Nyanglepin reserve, Taikkyi range, Insein, Yangon	C.W.D. Kermode 16760 (K!); Ba Pe 340 (RAF!)
402	*Dendrobium gibsonii* Paxt.	Putao, Kachin; Shan; Bago; Mandalay; Myeik (Mergui), Tanintharyi	Xiaohua Jin et al. PT-2085 (PE!); Griffith 1040 (K!); Kaulback 123, 124 & 387 (BM!); Kingdon-Ward 21205 (BM!)

No.	Species	Local distribution	Specimen citations
403	*Dendrobium grande* Hook.f.	Tanintharyi	Helfer 5065 (K!)
404	*Dendrobium gratiosissimum* Rchb. f.	Mon, Tanintharyi	R.C.F. Swinhoe R 107 (K!)
405	*Dendrobium griffithianum* Lindl.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7249, PT-7321 (PE!); Griffith 1038 (P!)
406	*Dendrobium hancockii* Rolfe	Recorded from Myanmar	Forrest 29786 (BM!)
407	*Dendrobium harveyanum* Rchb. f.	Mt. Victoria, Chin; Mt. Popa, Mandalay	Ye Lwin Aung PT-7456, PT-7457, PT-7483, PT-7487 (PE!)
408	*Dendrobium hendersonii* A.D. Hawkes & A.H. Heller	Reported from Myanmar	Kress et al. 2003
409	*Dendrobium hercoglossum* Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
410	*Dendrobium heterocarpum* Wall.	Chin; Kachin; Magway; Mt. Popa, Mandalay; Sagaing; Shan	Mokim s.n. (P!); Khin Myo Htwe 75 (spirit collection-MBK)
411	***Dendrobium hirtulum* Rolfe**	Haka, Chin	Daun 26 (K!); s.coll. s.n. (K!)
412	***Dendrobium hkinhumense* Ormerod & Kumar**	Kachin	Kingdon-Ward 21198 (BM!)
413	*Dendrobium hookerianum* Lindl.	Mindat, Chin; Putao, Kachin	Xiaohua Jin et al. PT-ET 487, PT-ET 669 (PE!); Farrer 1089 (RAF!); Kingdon-Ward 1776 (E!); Kingdon-Ward 21777 & 21333 (BM!)
414	*Dendrobium hymenanthum* Rchb. f.	Reported from Myanmar	Kress et al. 2003
415	*Dendrobium incurvum* Lindl.	Putao, Kachin; Shan; YePhyu, Tanintharyi	Ye Lwin Aung PT-7280, PT-7021, PT-7030, PT-7054, PT-7060, PT-7163, PT-7277 (PE!); Parish 176 (K!)
416	*Dendrobium indivisum* (Blume) Miq.	Kayin, Mon, Rakhine, Sagaing, Tanintharyi	Kerr 1002 (P!)
417	*Dendrobium indragiriense* Schltr.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7331 (PE!)
418	*Dendrobium infundibulum* Lindl.	Mt. Victoria, Falam & Haka, Chin; Kayah; Kayin; Magway; Mandalay; Kyaikkami(Amherst), Mon; Rakhine; Shan	Xiaohua Jin et al. PT-5169 (PE!); J.H. Lace 6294 (K!); Daun 9 (K!); Po Khant 2408 (RAF!); Unwin 3002 & 3077 (E!); Kingdon-Ward 21999 (BM!)
419	*Dendrobium jenkinsii* Wall. ex Lindl.	Alaungdaw Kathapa National Park, Sagaing; PyinOoLwin (Maymyo), Mandalay; YePhyu, Tanintharyi	Ye Lwin Aung PT-7396, PT-7403, PT-7298 (PE!); A. Samuel 13535 (K!)
420	*Dendrobium kentrophyllum* Hook. f.	Tanintharyi	Kress et al. 2003
421	***Dendrobium koyamae* Nb. Tanaka, T. Yuakawa & J. Murata**	Mt. Victoria, Chin	Nobuyuki Tanaka et al. 20040042 (holotype-MBK, spirit collection)
422	*Dendrobium lamellatum* (Blume) Lindl.	Mon, Tanintharyi	Kress et al. 2003
423	*Dendrobium lasioglossum* Rchb. f.	Reported from Myanmar	Kress et al. 2003
424	***Dendrobium laterale* L.O. Williams**	Haka, Chin	Venning 7 (K!); Dickason 7359 & 7378 (AMES!)
425	***Dendrobium leucochlorum* Rchb. f.**	Mon, Tanintharyi	Kress et al. 2003
426	*Dendrobium lindleyi* Steud.	Kachin; Kayin; Mandalay; Mon; Rakhine; Sagaing; Shan; Tanintharyi; Yangon; Tamon reserve, Taunggoo, Bago	Ba Pe 9391 (RAF!); Griffith 1014 (P!)
427	*Dendrobium lituiflorum* Lindl.	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
428	*Dendrobium longicornu* Lindl.	Putao, Kachin; Mt. Victoria & Haka, Chin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-ET 801, PT-2102, PT-2402, PT-5196 (PE!), Ye Lwin Aung PT-7031, PT-7195, PT-7339, PT-7363, PT-7376, PT-7562 (PE!); Venning 2 (K!); Kingdon-Ward 5505 & 3531 (E!); Kate Armstrong 1911 (NY!)
429	***Dendrobium luteolum* Bateman**	Chin, Mon, Tanintharyi	s.coll. s.n. (K!)
430	*Dendrobium macraei* Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-2499 (PE!)
431	*Dendrobium macrostachyum* Lindl.	Kyaukpadaung Township, Mandalay Region	Saw Lwin MPO 050 (SING, SING [spirit])
432	*Dendrobium mannii* Ridl.	Mandalay	R.C.F. Swinhoe 3 (K!)
433	***Dendrobium marmoratum* Rchb. f.**	Reported from Myanmar	Kress et al. 2003
434	*Dendrobium minutiflorum* Kraenzl.	Putao, Kachin	Xiaohua Jin et al. PT-5287, PT-5352 (PE!)
435	*Dendrobium moniliforme* (L.) Sw.	Mt. Victoria, Chin; Lukpyi-Kyanyingu Rd, Myitkyina & Putao, Kachin	Ye Lwin Aung PT-7544 (PE!); Xiaohua Jin et al. PT-6142 (PE!); C.W.D. Kermode 17123 (K!); Farrer 853 (E!); Kingdon-Ward 22139 (BM!)
436	*Dendrobium monticola* P.F.Hunt & Summerh.	Putao, Kachin	Qiang Liu 307 (HITBC!)
437	*Dendrobium moschatum* (Buch.-Ham.) Sw.	Ayeyarwaddy; Bago; Chin; Kayin; Mt. Popa, Mandalay; Magway; Mon; Rakhine; Shan; Tanintharyi; Yangon	Buchanan-Hamilton s.n. (BM!); Tanaka et al. 036153 (MBK)
438	*Dendrobium nathanielis* Rchb. f.	Mon, Shan, Tanintharyi	Maung Hla 3672 (K!); Kurz 360 (BM!)
439	***Dendrobium naungmungense* Q.Liu & X.H.Jin**	Naungmung Township, Putao County, Kachin State	Xiaohua Jin et al. PT-ET 133, PT-ET 1232 (PE!); Qiang Liu 430 (Holotype, HITBC)
440	*Dendrobium nobile* Lindl.	Chin; Putao, Kachin; Sagaing	Ye Lwin Aung PT-7091 (PE!); Forrest 26605 (E!) & (US); Kingdon-Ward 1553 (E!); McMillen 204 (US)
441	*Dendrobium numaldeorii* C. Deori, Hynn. & Phukan	Chipwi Township, Kachin State	Kingdon-Ward 108 (AMES, NY)
442	*Dendrobium ochreatum* Lindl.	Mt. Victoria & Falam, Chin; Mt. Popa, Mandalay	Ye Lwin Aung PT-7455, PT-7473, PT-7481, PT-7484, PT-7491 (PE!), Tanaka et al. 036156 (MBK); Daun 23 (K!)
443	*Dendrobium pachyglossum* Parish & Rchb. f.	Mon, Tanintharyi, Mandalay	R.C.F. Swinhoe 63 (K!)
444	*Dendrobium pachyphyllum* (Kuntze) Bakh. f.	Ayeyarwaddy, Bago, Kayin, Mon, Rakhine, Tanintharyi, Yangon	Kress et al. 2003
445	*Dendrobium palpebrae* Lindl.	Moulmein, Mon	s.coll. s.n. (K!)
446	*Dendrobium panduriferum* Hook. f.	Bago, Yangon	Kress et al. 2003
447	*Dendrobium parcum* Rchb. f.	Chin; Kachin; Magway; Mt. Popa, Mandalay; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Sagaing; Shan; Tanintharyi	Ye Lwin Aung PT-7388 (PE!); Swinhoe 92 (K!); Forrest 12608 (E!); Khin Myo Htwe 18 (spirit collection-TNS), Khin Myo Htwe 035056 (MBK);

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448	*Dendrobium parishii* Rchb. f.	Mt. Victoria, Chin; Kachin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Shan; Mon; Tanintharyi	Ye Lwin Aung PT-7447, PT-7554, PT-7540 (PE!), Khin Myo Htwe 7 (spirit collection-TNS), Khin Myo Htwe 30 (spirit collection-TNS)
449	***Dendrobium pedilochilum* Schltr.**	Reported from Myanmar	Kress et al. 2003
450	*Dendrobium peguanum* Lindl.	Bago, Mon, Tanintharyi	Beddome 8183 (BM!)
451	*Dendrobium pendulum* Roxb.	Chin, Mon, Rakhine, Shan	Kress et al. 2003
452	*Dendrobium plicatile* Lindl.	Mt. Victoria, Chin; Mandalay; Alaungdaw Kathapa National Park, Sagaing; Tanintharyi	Ye Lwin Aung PT-7449, PT-7564 (PE!)
453	*Dendrobium polyanthum* Lindl.	Mt. Popa, Mandalay; Taunggyi, Shan	Ye Lwin Aung PT-7586 (PE!); Kingdon-Ward 22062 (BM!); McMillen 198 (US); Khin Myo Htwe 49 (spirit collection-TNS), Khin Myo Htwe 94 (spirit collection-MBK, TNS)
454	*Dendrobium porphyrochilum* Lindl.	Kalaw & Taunggyi, Shan	Xiaohua Jin et al. PT-5100 (PE!); Ye Lwin Aung PT-7588, PT-7589 (PE!); Kingdon-Ward 20985 & 22670 (BM!)
455	*Dendrobium praecinctum* Rchb.f.	Ho Pone Township, Shan State	Xiaohua Jin et al. PT-6738 (PE!); Saw Lwin SL 49 (herbarium of Myanmar Floriculturist Association)
456	***Dendrobium praetermissum* Seidenf.**	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
457	*Dendrobium pulchellum* Roxb. ex Lindl.	Bago; Mt. Popa, Mandalay; Rakhine; Tanintharyi; Yangon	Mokim s.n. (BM!); Khin Myo Htwe 11 (spirit collection-TNS), Tanaka 036159 (MBK)
458	*Dendrobium pycnostachyum* Lindl.	Tanintharyi	Beddome 8124 (BM!)
459	*Dendrobium revolutum* Lindl.	Recorded from Myanmar	Peche s.n. (BM!)
460	***Dendrobium rhodocentrum* Rchb. f.**	Reported from Myanmar	Kress et al. 2003
461	*Dendrobium rotundatum* (Lindl.) Hook.f.	Chin; Myitkyina, Kachin	Kermode 17164 (K!); Kingdon-Ward 20686 (BM!)
462	*Dendrobium ruckeri* Lindl.	Nogmung, Kachin	Kingdon-Ward 6645 (K!);
463	*Dendrobium salaccense* (Blume) Lindl.	Reported from Myanmar	Kress et al. 2003
464	***Dendrobium sarmentosum* Rolfe**	Recorded from Myanmar	s.coll. s.n. (K!)
465	*Dendrobium scabrilingue* Lindl.	Bago; Thaton & Moulmein, Mon; Tanintharyi; Ywathit Salween valley, Karmai	Glin 6440 (K!); s.coll. s.n. (K!); Parish 134 (K!)
466	*Dendrobium secundum* (Blume) Lindl.	Rakhine; Thaungyin, Tanintharyi; Yangon; Mandalay	Bogg 13536 (K!); R.C.F. Swinhoe 26 (K!)
467	*Dendrobium senile* Parish ex Rchb. f.	Mon, Sagaing	s.coll. s.n. (K!)
468	*Dendrobium signatum* Rchb. f.	Southern Shan	W. A. Robertson 272 (K!); Hildebrand A, B & C (K!); s.coll. s.n. (K!)
469	*Dendrobium spatella* Rchb. f.	Chin; Kachin; Magway; Mandalay; Alaungdaw Kathapa National Park, Sagaing; Shan; Thaton, Mon	Ye Lwin Aung PT-7417, PT-7418 (PE!); L. T. Bogg 13553 (K!)
470	*Dendrobium strongylanthum* Rchb. f.	Recorded from Myanmar	Kingdon-Ward 22843 (BM!)
471	*Dendrobium stuposum* Lindl.	Moulmein, Mon; Tanintharyi	Parish 358 (K!)

No.	Species	Local distribution	Specimen citations
472	*Dendrobium sulcatum* Lindl.	Mt. Victoria, Chin	Ye Lwin Aung PT-7485 (PE!)
473	*Dendrobium sutepense* Rolfe ex Downie	Kalaw, Shan	Xiaohua Jin et al. PT-5098 (PE!)
474	*Dendrobium terminale* Parish & Rchb. f.	Mandalay; Alaungdaw Kathapa National Park, Sagaing; Ye Phyu & Dawei (Tavoy), Tanintharyi	Ye Lwin Aung PT-7323, PT-7421 (PE!); Keenan et al. 5467 (K!); Kerr 1006 (P!)
475	*Dendrobium thyrsiflorum* Rchb. f.	Mt. Popa, Mandalay	Xiaohua Jin et al. PT-5347 (PE!), Khin Myo Htwe 103 (spirit collection-MBK, TNS)
476	*Dendrobium tortile* Lindl.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7319 (PE!); Helfer 5050 (K!)
477	*Dendrobium transparens* Wall.	Bago; Mt. Victoria, Chin; Putao, Kachin; PyinOoLwin (Maymyo), Mandalay; Taunggyi, Shan	Xiaohua Jin et al. PT-2458 (PE!), Ye Lwin Aung PT-7596 (PE!); A. Samuel 13567 (K!); Daun 8 (K!); Cooper 6090 (E!)
478	*Dendrobium treutleri* (Hook.f.) Schuit. & Adams	Putao, Kachin	Kate Armstrong 1918 (NY!); Kingdon-Ward 21446 (BM!)
479	*Dendrobium trigonopus* Rchb. f.	Recorded from Myanmar	s.coll. s.n. (K!)
480	*Dendrobium unicum* Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
481	*Dendrobium venustum* Teijsm. & Binn.	Mt. Popa & PyinOoLwin (Maymyo), Mandalay	A. Samuel 13562 (K!); J.H. Lace 6262, 6357 (K!); Tanaka et al. 036163 (MBK)
482	*Dendrobium virgineum* Rchb. f.	Reported from Myanmar	Kress et al. 2003
483	*Dendrobium wardianum* Warner	Chin, Rakhine	Kingdon-Ward 21778 (BM!)
484	*Dendrobium wattii* (Hook. f.) Rchb. f.	Mt. Victoria, Chin	Ye Lwin Aung PT-7475 (PE!); Kimnach B - 16 (US)
485	*Dendrobium wightii* A.D. Hawkes & A.H. Heller	Sagaing	Kress et al. 2003
486	*Dendrobium williamsonii* Day & Rchb. f.	Black Rock, Myitkyina & Putao, Kachin; Pyin Oo Lwin, Mandalay; Upper Myanmar	Ye Lwin Aung PT-7135, PT-7028, PT-7133, PT-7137, PT-7155 (PE!); Forrest 26608 (K!), (E!) & (US); Kermode 17330 (K!); Kingdon-Ward 6659 (K!); Tha Hla 1942 (RAF!); Kingdon-Ward 20771 (BM!)
487	*Dendrobium xanthophlebium* Lindl.	Mon, Tanintharyi	Kress et al. 2003
488	*Dendrochilum longifolium* Rchb. f.	Kachin, "Birma: Bhamo"	Rchb.f. 13763 W
489	*Dendrochilum pallidiflavens* Blume	Tanintharyi	Kress et al. 2003
490	*Dendrolirium laniceps* (Rchb.f.) Schuit., Y.P.Ng & H.A.Pedersen	Kyaikkahmi (Amherst), Mon	Lace 5594 (E!)
491	*Dendrolirium lasiopetalum* (Willd.) S.C.Chen & J.J.Wood	Putao, Kachin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-5277 (PE!), Ye Lwin Aung PT-7098, PT-7229, PT-7230, PT-7092, PT-7185, PT-7234, PT-7243, PT-7332, PT-7442, PT-7454 (PE!)
492	*Dendrolirium tomentosum (*J.Koenig) S.C.Chen & J.J.Wood	Bago, Tanintharyi	Abdul Huk s.n. (BM!)
493	*Dickasonia vernicosa* L.O.Williams	Kyaukkut Chaung, Falam & Haka, Chin	Venning 4 & 5 (K!); F.G. Dickason 7377 & 7524 (K!), 8576 (K!) & (AMES!) & (US); Daun 13 (K!)
494	*Didymoplexis pallens* Griff.	Mandalay; YePhyu, Tanintharyi	Ye Lwin Aung PT-7338 (PE!)

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495	*Dienia cylindrostachya* Lindl.	Chin	Kingdon-Ward 9758a (BM!); Matsumoto 053614 (MBK), Mu Mu Aung et al. 092798 (MBK), Fujikawa et al. 094517 (MBK), Fujikawa et al. 094853 (MBK), Thet Yu Nwe TY 61 (RAF)
496	*Dienia ophrydis* (Koenig) Seidenf.	Mt. Popa, Mandalay; NyaungShwe, Shan	Xiaohua Jin et al. PT-5080 (PE!); Kingdon-Ward 12791 (BM!); Tanaka et al. 036192 (TNS); Khin Myo Htwe 43 (spirit collection-TNS)
497	*Diglyphosa latifolia* Blume	Putao, Kachin	Xiaohua Jin et al. PT-5236 (PE!)
498	***Dilochia subsessilis* (Rolfe) S. Thomas**	Recorded from Myanmar	s.coll. s.n. (K!)
499	*Diplomeris hirsuta* (Lindl.) Lindl.	Putao, Kachin	Kingdon-Ward 13089 (BM!)
500	*Diplomeris pulchella* D. Don	Kachin; Mandalay; Upper Chidwin, Sagaing	Boxall s.n. (K!); Toppin 4226 (E!); Rogers 1024 (E!); Kingdon-Ward 1926 (E!); Keenan et al. 3984 (E!); Kingdon-Ward 9030 (BM!)
501	*Diploprora championii* Hook. f.	Putao, Kachin; Tanintharyi	Xiaohua Jin et al. PT-ET 1323, PT-ET 1379 (PE!)
502	*Diploprora truncata* Rolfe ex Downie	Chin	Srisanga et al. 97741 (US)
503	*Disperis neilgherrensis* Wight	Ywangan, Taunggyi, Shan	Kang et al. 2019 [photographic record from Shan State]
504	*Epipactis flava* Seidenf.	Pyin Oo Lwin (Maymyo), Mandalay; Muse, Shan	H. Collett s.n. (K!); F.G. Dickason 6122 (Holotype: AMES)
505	*Epipactis helleborine* (L.) Crantz	Mandalay	Kress et al. 2003
506	*Epipactis mairei* Schltr.	Upper Myanmar	Kingdon-Ward 1667 (E!)
507	*Epipactis royleana* Lindl.	Upper Myanmar	Farrer 1078 (E!)
508	*Epipogium aphyllum* Sw.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
509	*Epipogium roseum* (D. Don) Lindl.	Mt. Popa, Mandalay; Mt. Victoria, Kanpetlet, Chin; Putao, Kachin	Xiaohua Jin et al. PT-6483 & PT-6938 (PE!); Cooper 5951A (E!); Kuroiwa et al. 051335 MBK
510	*Eria albiflora* Rolfe	Putao, Kachin	Ye Lwin Aung PT-7055, PT-7090, PT-7101 (PE!)
511	*Eria clausa* King & Pantl.	Putao, Kachin	Ye Lwin Aung PT-7084 (PE!)
512	*Eria coronaria* (Lindl.) Rchb. f.	Mt. Victoria & Haka, Chin	Ye Lwin Aung PT-7525 (PE!); Venning 54 (K!)
513	*Eria javanica* (Sw.) Blume	Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7262A, PT-7314 (PE!)
514	*Eria laniceps* Rchb. f.	Tanintharyi	Kress et al. 2003
515	*Eria scabrilinguis* Lindl.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7353 (PE!)
516	***Eria sicaria* Lindl.**	Tanintharyi	Kress et al. 2003
517	*Eria vittata* Lindl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
518	*Eriodes barbata* (Lindl.) Rolfe	Reported from Myanmar	Kress et al. 2003
519	*Erythrodes blumei* (Lindl.) Schltr.	Putao, Kachin	Xiaohua Jin et al. PT-5354 (PE!)
520	*Erythrodes hirsuta* (Griff.) Ormerod	Chin	Kress et al. 2003
521	*Erythrorchis altissima* (Blume) Blume	YePhyu, Tanintharyi	Ye Lwin Aung PT-7268 (PE!)

No.	Species	Local distribution	Specimen citations
522	*Eulophia andamanensis* Rchb. f.	Mon; Tanintharyi; Mt. Popa, Mandalay	Khin Myo Htwe 9 (spirit collection-MBK, TNS), Khin Myo Htwe 035063 (MBK)
523	*Eulophia bicallosa* (D. Don) P.F. Hunt & Summerh.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	Kress et al. 2003
524	*Eulophia bracteosa* Lindl.	Tanintharyi	Kress et al. 2003
525	*Eulophia dabia* (D. Don) Hochr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
526	*Eulophia flava* (Lindl.) Hook. f.	PyinOoLwin (Maymyo), Mandalay; Lwelin loihonmein Taung & Taunggyi Reserve, Shan	Maung Po Khant 16310 & 16319 (E!); Lace s.n. (E!)
527	*Eulophia graminea* Lindl.	Kachin; Tanintharyi; Mt. Popa, Mandalay	Khin Myo Htwe 44, 100 (spirit collection-TNS)
528	*Eulophia herbacea* Lindl.	Chin; Kachin; Magway; PyinOoLwin (Maymyo), Mandalay; Sagaing; Lwelin lymonmein Taung & Taunggyi Reserve, Shan	Khan 24 (K!); English 160 (E!); Lace s.n. (E!); Maung Po Khant 16307 & 16315 (E!); Abdul Kholil s.n. (BM!)
529	*Eulophia macrobulbon* (Parish & Rchb. f.) Hook. f.	Kachin; Mt. Victoria & Mindat, Chin; Mon	Cooper 6077 (E!); Kingdon-Ward 22186 (BM!)
530	*Eulophia nuda* Lindl.	Bago; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Mon; Lwelin Lymon Mein Taung & Taunggyi Reserve, Shan; Tanintharyi	Maung Po Khant 16305 & 16317 (E!); Lace s.n. (E!); Prazer s.n. (E!); Kingdon-Ward s.n. (E!); Kingdon-Ward 22228 & 22207 (BM!); Khin Myo Htwe 107 (spirit collection-MBK)
531	*Eulophia promensis* Lindl.	Hmaing-Yee, Shan; Bago	Maung Po Khant 16352 (E!)
532	*Eulophia pulchra* (Thouars) Lindl.	Reported from Myanmar	Kress et al. 2003
533	*Eulophia sooi* Chun & Tang ex Chen	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
534	*Eulophia zollingeri* (Rchb. f.) J.J.Sm.	Mt. Popa, Mandalay	Tanaka et al. 036244 (MBK)
535	*Eulophia siamensis* Rolfe ex Downie	Mt. Victoria, Chin	X.H. Jin 24553 (PE!)
536	*Galearis spathulata* (Lindl.) Hunt	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
537	*Galearis tschiliensis* (Schltr.) P.J.Cribb, S.W.Gale & R.M.Bateman	Valley of Dichu, Kachin	F.K.W. 7197 (K!)
538	*Galearis wardii* (W.W. Sm.) Hunt	Nogmung, Kachin; Seinghku taung, Northern Myanmar	Kingdon-Ward 7007 (K!), Kingdon-Ward 9678 (BM)
539	*Galeola lindleyana* Rchb. f.	Putao, Kachin; Chin	Xiaohua Jin et al. PT-2293 (PE!); Forrest 26846 & 29734 (E!); Farrer 1107 (E!)
540	*Galeola nudifolia* Lour.	Mon, Tanintharyi	Kress et al. 2003
541	*Gastrochilus acutifolius* (Lindl.) Kuntze	Reported from Myanmar	Kress et al. 2003
542	*Gastrochilus bellinus* (Rchb. f.) Kuntze	Recorded from Myanmar	s.coll. s.n. (E!)
543	*Gastrochilus calceolaris* D. Don	Putao, Kachin; Chin; Rakhine; Tanintharyi; Yangon	Xiaohua Jin et al. PT-6800 (PE!)
544	*Gastrochilus distichus* (Lindl.) Kuntze	Mt. Victoria, Chin; Kachin	Xiaohua Jin et al. PT-5397 (PE!), Ye Lwin Aung PT-7478 (PE!); Unwin 3068 (E!); Kingdon-Ward 21930 (BM!)
545	*Gastrochilus intermedius* (Griff. ex Lindl.) Kuntze	Putao, Kachin; Tanintharyi	Xiaohua Jin et al. PT-6917 (PE!)
546	*Gastrochilus obliquus* (Lindl.) Kuntze	Putao, Kachin; Kyaukme, Shan	Kate Armstrong 2282 & 3077 (NY!); McMillen 144 (US); Wallich 7304 (AMES!)

No.	Species	Local distribution	Specimen citations
547	***Gastrochilus pechei* Schltr.**	Mawlamyaing (Moulmein), Mon; Tanintharyi	Peché 40811 (W!); s.coll. s.n. (K!)
548	*Gastrochilus platycalcaratus* (Rolfe) Schltr.	Upper Myanmar	Sander & Sono 100-09 (K!); s.coll. s.n. (K!)
549	*Gastrochilus pseudodistichus* (King & Pantl.) Schltr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
550	*Gastrochilus sukhakulii* Seidenf.	Reported from Myanmar	Kress et al. 2003
551	*Gastrodia elata* Blume	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
552	***Gastrodia kachinensis* X.H.Jin & L.A.Ye**	Hponkanrazi Wildlife Sanctuary, Putao Township, Kachin State	Xiaohua Jin et al. PT -6897 (Putao expedition team 6897) (Holotype, PE!)
553	*Gastrodia menghaiensis* Z.H.Tsi & S.C.Chen	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
554	***Gastrodia putaoensis* X.H.Jin**	Hkakaborazi National Park, Putao District, Kachin State	Xiaohua Jin et al. PT-2275 (holotype: PE!; isotypes: PE!, IBSC!)
555	*Geodorum densiflorum* (Lam.) Schltr.	Mt. ZweKaBin, Kayin; Bago; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-2566 (PE!); Kingdon-Ward 17464 (NY!); Tanaka et al. 020328 (MBK)
556	*Geodorum eulophioides* Schltr.	Mt. Popa, Mandalay	Khin Myo Htwe 55 (spirit collection-TNS), Tsujita 036208 (spirit collection-TNS)
557	*Geodorum recurvum* (Roxb.) Alston	Kachin; Mt. Popa, Mandalay; Shan	Mokim s.n. (BM!); Tanaka et al. 020437 (MBK); Khin Myo Htwe 41 & 42 (spirit collection-TNS); Khin Myo Htwe 109 (spirit collection-MBK, TNS)
558	*Geodorum siamense* Rolfe ex Downie	Upper Myanmar	Forrest 9172 (E!); Rogers s.n. (E!)
559	*Geodorum terrestre* (L.) Garay	PyinOoLwin (Maymyo), Mandalay; Moulmein, Mon	Parish 180 & 275 (K!); Lace s.n. (E!)
560	*Goodyera foliosa* (Lindl.) Benth. ex C.B.Clarke	Mountain at the East of Fort Hertz, Putao, Kachin	Xiaohua Jin et al. PT-ET 835, PT-ET 841, PT-ET 569, PT-ET 530, PT-2220 (PE!); Kate Armstrong 2094 (NY!); Griffith s.n. (K!); s.coll. s.n. (K!); Kingdon-Ward 10138 & 13271 (BM!)
561	*Goodyera fumata* Thwaites	Keng Tung, Shan	Robertson 306 (K!)
562	*Goodyera fusca* (Lindl.) Hook.f.	Northeast Upper Myanmar	Forrest 27452 (K!) & (E!) & (BM!)
563	*Goodyera hemsleyana* King & Pantl.	Chipwi, Kachin	Kingdon-Ward 1897 (E!)
564	*Goodyera marginata* Lindl.	Recorded from Myanmar	Kingdon-Ward 1879 (E!)
565	***Goodyera myanmarica* Ormerod & C.S.Kumar**	Mountains at the East of Fort Hertz, Putao Township, Kachin State	Kingdon-Ward 7368 (holotype, K)
566	*Goodyera pendula* Maxim.	Putao, Kachin	Xiaohua Jin et al. PT-ET 842 & PT-2287 (PE!)
567	*Goodyera procera* Hook.	Bago; Chin; Putao, Kachin; Shan	Xiaohua Jin et al. PT-6401 (PE!); Kingdon-Ward 24127 (E!); Kingdon-Ward 20593 & 11239 (BM!)

No.	Species	Local distribution	Specimen citations
568	*Goodyera repens* (L.) R.Br.	Putao, Kachin	Xiaohua Jin et al. PT-ET 863, PT-2181 (PE!); Kingdon-Ward 13407 & 13161 (BM!)
569	*Goodyera schlechtendaliana* Rchb. f.	Putao, Kachin	Kate Armstrong 1943 (NY!)
570	*Goodyera viridiflora* (Blume) Lindl. ex Dietr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
571	*Grammatophyllum speciosum* Blume	Tanintharyi	Griffith 5318 (P!)
572	*Grosourdya appendiculata* (Blume) Rchb. f.	Reported from Myanmar	Kress et al. 2003
573	*Gymnadenia orchidis* Lindl.	Upper Myanmar	Farrer 1118 (E!); Kingdon-Ward 3294 (E!)
574	*Habenaria acuifera* Wall.	Chin; Shan; Tanintharyi	MacGregor 814 (E!); Prazer 169 (BM!)
575	*Habenaria aitchisonii* Rchb. f.	Recorded from Myanmar	s.coll. s.n. (E!)
576	*Habenaria arietina* Hook. f.	Chin, Shan	MacGregor 817 (E!)
577	*Habenaria avana* Hook. f.	Reported from Myanmar	Kress et al. 2003
578	*Habenaria chlorina* Parish & Rchb. f.	Yangon; Moulmein, Mon	Parish 124 & 245 (K!)
579	*Habenaria commelinifolia* Wall.	Kachin; Shan; Yangon	MacGregor 690 (E!); Mokim 131 (US)
580	***Habenaria corticicola* W.W. Sm.**	Reported from Myanmar	Kress et al. 2003
581	*Habenaria corymbosa* Parish & Rchb. f.	Recorded from Myanmar	Parish 329 (K!)
582	*Habenaria delavayi* Finet	Reported from Myanmar	Kress et al. 2003
583	*Habenaria dentata* (Sw.) Schltr.	Chin; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Kalaw, Shan	Xiaohua Jin et al. PT-5114 (PE!); Lace 4322 (E!); MacGregor 815 (E!); Keenan et al. 1582 (E!); Kingdon-Ward 3556 (E!); Roger 648 (E!); Kingdon-Ward 22707 (BM!); Khin Myo Htwe 71 (spirit collection-MBK, TNS)
584	*Habenaria dentirostrata* Tang & F.T. Wang	Taunggyigon Reserve, Meikhtila, Mandalay	Maung Tha Myaing 263 (K!) & (E!)
585	*Habenaria digitata* Lindl.	Mt. Popa, Mandalay; Tanintharyi	Khin Myo Htwe 50 (spirit collection-TNS)
586	*Habenaria diphylla* (Nimmo) Dalzell	Shan; Dawei (Tavoy), Tanintharyi	MacGregor 681 (E!); Keenan et al. 933, 758 & 905 (E!)
587	***Habenaria ditricha* Hook. f.**	Putao, Kachin; Moulmein, Mon	Lobb 350 (K!); Kate Armstrong 1649 (NY!)
588	*Habenaria fulva* Tang & F.T. Wang	Reported from Myanmar	Kress et al. 2003
589	*Habenaria furcifera* Lindl.	Chin, Yangon	Kress et al. 2003
590	*Habenaria humidicola* Rolfe	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
591	*Habenaria intermedia* D. Don	Chin	U Mg Gale-2 & U Chit Ko Ko 5595 (RAF), Yasuda 060067 (MBK), Tanaka & Yukawa 081134 (MBK), Tanaka & Yukawa 081279, 081398 (MBK), Mu Mu Aung et al. 092340 (MBK)
592	*Habenaria limprichtii* Schltr.	Recorded from Myanmar	Kingdon-Ward 1668 (E!)
593	*Habenaria lindleyana* Steud.	Reported from Myanmar	Kress et al. 2003
594	***Habenaria linearis* King & Pantl.**	Reported from Myanmar	Kress et al. 2003
595	*Habenaria linguella* Lindl.	Loilem District, Shan State	Robertson 7 (K)

No.	Species	Local distribution	Specimen citations
596	*Habenaria lucida* Wall. ex Lindl.	Bago, Mon, Tanintharyi, Yangon, Mt. Popa of Mandalay Region	Murata et al. 021000 (MBK), Khin Myo Htwe 61 (spirit collection-TNS)
597	*Habenaria malintana* (Blanco) Merr.	Mon, Tanintharyi, Mt. Popa of Mandalay Region	Tanaka et al. 020764 (MBK)
598	*Habenaria malleifera* Hook. f.	Reported from Myanmar	Kress et al. 2003
599	*Habenaria mandersii* Collett & Hemsl.	Upper Myanmar	Manders s.n. (K!)
600	*Habenaria marginata* Colebr.	Inle, Shan	Robertson 428 (K!)
601	***Habenaria massoniana* King & Pantl.**	Reported from Myanmar	Kress et al. 2003
602	*Habenaria medioflexa* Turrill	Mt. Popa, Mandalay	Tanaka et al. 020761 (MBK, TNS)
603	***Habenaria mientienensis* Tang & F.T. Wang**	Sakangyi, Mandalay	Mya 3658 (K!)
604	*Habenaria myriotricha* Gagnep.	Dawei (Tavoy), Tanintharyi	Keenan et al. 771, 887, 1379 & 841 (E!)
605	*Habenaria pantlingiana* Kraenzl.	Mindat, Chin; Shan	Kingdon-Ward 22580 (BM!); Seo et al. 100743 (MBK)
606	*Habenaria pectinata* D. Don	Mindat, Chin; Mandalay	Kingdon-Ward 22357 (BM!)
607	*Habenaria plurifoliata* Tang & F.T.Wang	Putao, Kachin	Xiaohua Jin Jin-14581 (PE!)
608	***Habenaria prazeri* King & Pantl.**	Reported from Myanmar	Kress et al. 2003
609	*Habenaria reflexa* Blume	Mt. Popa, Mandalay	Khin Myo Htwe 67 (spirit collection-MBK)
610	*Habenaria reniformis* (D.Don) Hook.f.	Kyaukpadaung Township, Mandalay Region	Saw Lwin et al. MPO 020 (SING)
611	*Habenaria rhodocheila* Hance	Mindat & Falam, Chin; Pyin Oo Lwin (Maymyo), Mogok & Mt. Popa, Mandalay	Rodger 201 (K!); Kingdon-Ward 22700 (BM!); Daun 98 (K); Samuel 13582 (K); Khin Myo Htwe 024088A (MBK)
612	*Habenaria rostrata* Wall. ex Lindl.	Bago, Tanintharyi	Wallich s.n. (GH!) & (P!)
613	***Habenaria shweliensis* W.W. Sm. & Banerji**	Mogok, Mandalay	Rodger 387 (K!); Lace s.n. (E!)
614	***Habenaria spatulifolia* Parish & Rchb. f.**	Tanintharyi	Parish 217 (K!)
615	*Habenaria stenopetala* Lindl.	Mt. Popa, Mandalay	Khin Myo Htwe 66 (spirit collection-TNS)
616	*Habenaria tonkinensis* Seidenf.	Putao, Kachin	Xiaohua Jin et al. PT-2545 (PE!)
617	*Habenaria trichosantha* Wall.	Mon	Kress et al. 2003
618	***Habenaria triquetra* Rolfe**	Reported from Myanmar	Kress et al. 2003
619	*Habenaria vidua* Parish & Rchb. f.	Mon, Tanintharyi	Parish 223 (K!)
620	*Habenaria viridiflora* (Rottler ex Sw.) Lindl.	Mt. Popa, Mandalay	Kress et al. 2003
621	***Habenaria yomensis* Gage**	Reported from Myanmar	Kress et al. 2003
622	*Habenaria yuana* Tang & Wang	Mt. Victoria, Chin; Mt. Popa, Mandalay	Tanaka & Yukawa 081279 (MBK), Khin Myo Htwe 65 (spirit collection-TNS)
623	*Hemipilia calophylla* Parish & Rchb. f.	Putao, Kachin; PyinOoLwin (Maymyo), Mandalay; Gokteik, Lashio, Shan; Moulmein, Mon	Xiaohua Jin et al. PT-2569 (PE!); s.coll. 13507 (K!); J.H. Lace s.n. (K!); Parish 348 (K!); Kingdon-Ward 22358 (BM!)
624	*Hemipilia cordifolia* Lindl.	Mt. Victoria & Haka, Chin; Shan	Venning 18 (K!); Cooper 6048 (E!)

No.	Species	Local distribution	Specimen citations
625	*Hemipilia limprichtii* Schltr.	PyinOoLwin (Maymyo), Mandalay	R.C.F. Swinhoe 67 (K!)
626	*Herminium edgeworthii* (Hook.f. ex Collett) X.H.Jin, Schuit., Raskoti & Lu Q.Huang	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
627	*Herminium elisabethae* (Duthie) Tang & F.T.Wang	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
628	*Herminium fallax* (Lindl.) Hook.f.	Chin	Yasuda 053610A (MBK), Yasuda 060088 (spirit collection-MBK), Yasuda 053613 (MBK, spirit collection MBK), Mu Mu Aung et al. 092824 (MBK), Fujikawa et al. 094119 (MBK)
629	*Herminium forceps* (Finet) Schltr.	Shan	Kilgour et al. m-760 (MBK)
630	*Herminium kamengense* A.N. Rao	Chin	Kress et al. 2003
631	*Herminium lanceum (Thunb. ex Sw.) Vuijk*	Chin; Kachin; Mt. Popa, Mandalay	Ye Lwin Aung PT-7224 (PE!); Forrest 27084 (E!); Farrer 995 (E!); Kingdon-Ward 1662 (E!); Kingdon-Ward 22612 (BM!); Murata et al. 021048 (MBK)
632	*Herminium latilabre* (Lindl.) X.H.Jin, Schuit., Raskoti & Lu Q.Huang	Haka, Chin	Venning 62 (K!); Kingdon-Ward 22671 (BM!)
633	*Herminium mannii* (Rchb.f.) Tang & F.T.Wang	Reported from Myanmar	Kress et al. 2003
634	*Herminium souliei (*Finet) Rolfe	Shan	Seo et al. 100687 (MBK)
635	*Herminium quinquelobum* King & Pantl.	Mt. Victoria, Chin	X.H. Jin 24588 (PE!)
636	*Herpysma longicaulis* Lindl.	Putao, Kachin	Xiaohua Jin et al. PT-ET 215, PT-2075, PT-2263 (PE!); Ye Lwin Aung PT-7039 (PE!); Keenan et al. 3308 (E!); Kate Armstrong 2114 (NY!); Kingdon-Ward 13525 (BM!)
637	*Hetaeria affinis* (Griff.) Seidenf. & Ormerod	Chin; Kachin; Magway; Mandalay; Uyu, Upper Chindwin, Sagaing; Shan; Thaton, Mon	Lulay 9040 (K!); Lace 4606 (K!)
638	*Hetaeria anomala* Lindl.	Recorded from Myanmar	Kingdon-Ward 20633 (BM!)
639	*Hetaeria finlaysoniana* Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
640	*Hetaeria oblongifolia* (Blume) Blume	Tanintharyi	Helfer 464 (K!)
641	*Holcoglossum amesianum* (Rchb. f.) Christenson	Putao, Kachin; Sagaing; Shan; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-5101 (PE!), Khin Myo Htwe 76 (spirit collection-MBK, TNS)
642	*Holcoglossum himalaicum* (Deb, Sengupta & Malick) Aver.	Putao, Kachin; Valley of the Sunghku, Northernmost Myanmar	Xiaohua Jin et al. PT-2101 (PE!); Kingdon-Ward 7620 (K!); Kingdon-Ward 21528 (BM!)
643	*Holcoglossum kimballianum* (Rchb. f.) Garay	Chin; Kachin; Taunggyi & Kalaw, Shan	Xiaohua Jin et al. PT-5099 (PE!); Ye Lwin Aung PT-7599, PT-7600 (PE!); s.coll. s.n. (E!)
644	*Holcoglossum subulifolium* (Rchb. f.) Christenson	Chin, Kachin, Sagaing, Shan	Kress et al. 2003
645	*Lecanorchis javanica* Blume	Putao, Kachin	Xiaohua Jin et al. PT-ET 1185 B (PE!)
646	*Lecanorchis nigricans* Honda	Putao, Kachin	Ye Lwin Aung PT-7151 (PE!)

No.	Species	Local distribution	Specimen citations
647	*Lecanorchis sikkimensis* Pearce & Cribb	Putao, Kachin	Xiaohua Jin et al. PT-2091, PT-2109 (PE!)
648	*Liparis barbata* Lindl.	Lawa, 85.30 km west of Myitkyina & Putao, Kachin	Xiaohua Jin et al. PT-6953 (PE!); H.S.M. Lee 6284 (K!)
649	*Liparis bistriata* Parish & Rchb. f.	Putao & Myitkyina, Kachin; Tanintharyi	Ye Lwin Aung PT-7074 (PE!); Su Koe 10109 (K!); Parish 80 (K!)
650	*Liparis bootanensis* Griff.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7352 (PE!); Parish 233 (K!)
651	*Liparis cespitosa* (Lam.) Lindl.	Putao, Kachin; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-ET 567 (PE!); Ye Lwin Aung PT-7266, PT-7089 (PE!); Kingdon-Ward 3338 & 1771 (E!)
652	*Liparis chapaensis* Gagnep.	Reported from Myanmar	Kress et al. 2003
653	*Liparis condylobulbon* Rchb. f.	Mon	Kress et al. 2003
654	*Liparis deflexa* Hook. f.	Falam & Mindat, Chin; Upper Chindwin, Sagaing	Daun 92 (K!); Lace 4301 (K!) & (E!); Abdul Huk s.n. (K!); Kingdon-Ward 22563 (BM!)
655	*Liparis distans* C.B.Clarke	border regions of Putao and Nogmung Townships, Kachin State	Xiaohua Jin et al. PT-5270 (PE!), Kurzweil H & Saw Lwin KL 2460 (herbarium of Myanmar Floriculturist Association)
656	*Liparis downii* Ridl.	Reported from Myanmar	Kress et al. 2003
657	*Liparis elliptica* Wight	Putao, Kachin	Xiaohua Jin et al. PT-6481 (PE!); Kingdon-Ward 9174, 9127 & 10178 (BM!)
658	***Liparis forrestii* Rolfe**	Reported from Myanmar	Kress et al. 2003
659	*Liparis grossa* Rchb. f.	Reported from Myanmar	Kress et al. 2003
660	*Liparis jovispluvii* Parish & Rchb. f.	Mindat, Chin; Mon; Paungdaw Power station, Tanintharyi	Keenan et al. 885 (K!) & (E!); Parish 323 (K!); Kingdon-Ward 22517 & 22466 (BM!)
661	*Liparis lacerata* Ridl.	Tanintharyi	Griffith 5073 (K!)
662	*Liparis luteola* Lindl.	Chin, Kachin, Magway, Mandalay, Mon, Sagaing, Shan, Tanintharyi	Kress et al. 2003
663	*Liparis mannii* Rchb.f.	Putao & Tanai Townships, Kachin State	Xiaohua Jin et al. PT-6295 (PE!); Murata et al. 041223 (MBK)
664	*Liparis nervosa* (Thunb.) Lindl.	Putao, Kachin; Magway; Mon; Shan; Tanintharyi	Ye Lwin Aung PT-7125, PT-7145 (PE!); s.coll. 01007 (K!);
665	*Liparis odorata* (Willd.) Lindl.	Mindat, Chin; Kachin; Mandalay; Sagaing; Lwelin Hlaing Hokmein taung, Shan; Tanintharyi	Swinhoe 58 (K!); Mokim 23 (K!) & (BM!) & (US); Parish 317 (K!); Maung Po Khant 16327 & 16350 (E!); Kingdon-Ward 22516 & 22517 (BM!)
666	*Liparis petiolata* (D. Don) P.F. Hunt & Summerh.	Chipwi Township, Kachin State	Kingdon-Ward 1838 (E!)
667	*Liparis plantaginea* Lindl.	Nogmung or Putao Township, Kachin State	Kress et al. 2003
668	***Liparis popaensis* X.H.Jin, A.T.Mu & L.A.Ye**	Mt. Popa, Mandalay	Xiaohua Jin et al. 19984 (holotype, PE!; isotype, RAF!)
669	*Liparis regnieri* Finet	Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Upper Myanmar	Tsujita et al. 036188 (spirit collection-TNS); J.H. Lace s.n. (K!); D. Burlee s.n. (K!); s.coll. 13576 (K!)

No.	Species	Local distribution	Specimen citations
670	*Liparis resupinata* Ridl	Waingmaw Township, Kachin State	Stephen Lasi Bawk Naw BW 32 (herbarium of the Myanmar Floriculturist Association)
671	*Liparis siamensis* Rolfe ex Downie	Mt. Popa, Mandalay	Ye Lwin Aung PT-7225 (PE!)
672	***Liparis stenoglossa* Parish & Rchb. f.**	Recorded from Myanmar	Parish 154 (K!)
673	*Liparis stricklandiana* Rchb.f.	Putao, Kachin	Ye Lwin Aung PT-7016, PT-7075, PT-7083 (PE!)
674	*Liparis torta* Hook. f.	Reported from Myanmar	Kress et al. 2003
675	*Liparis tschangii* Schltr.	Lwelin Hlaing Hokmein taung, Shan; Pyay, Bago	Maung Po Khant 16326 (E!); Sugawara et al. 036384 (MBK)
676	*Liparis viridiflora* (Blume) Lindl.	Ayeyarwaddy; Zamani Reserve, Bago; Putao, Kachin; Kayah; Kayin; Mandalay; Mon; Hkamti, Sagaing; Shan; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-5261 (PE!); Ye Lwin Aung PT-7173, PT-7176, PT-7262, PT-7340, PT-7013 (PE!); Lace s.n. (E!); Kate Armstrong 2230 & 3193 (NY!); Kingdon-Ward 288 (NY!); Egerod B-109 (US)
677	*Ludisia discolor* (Ker Gawl.) Lindl.	Reported from Myanmar	Kress et al. 2003
678	***Luisia amesiana* Rolfe**	Shan	Garden Collector 583 (K!)
679	*Luisia brachystachys* Blume	Mt. Victoria, Chin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma	Ye Lwin Aung PT-7385, PT-7489, PT-7543 (PE!); Batten s.n. (BM!)
680	***Luisia cantharis* Rolfe**	PyinOoLwin (Maymyo), Mandalay; Shan	Bogg B.G. 8 (K!); s.coll. s.n. (K!)
681	*Luisia filiformis* Hook.f.	Mt. Victoria, Chin; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7422, PT-7568 (PE!)
682	*Luisia hancockii* Rolfe	Putao, Kachin; Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7399, PT-7057 (PE!)
683	*Luisia macrotis* Rchb.f.	Mt. Popa, Mandalay	Khin Myo Htwe 26 (spirit collection-TNS)
684	*Luisia magniflora* Tsi & Chen	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
685	***Luisia primulina* Parish & Rchb. f.**	Moulmein, Mon; Tanintharyi	Peche s.n. (K!)
686	*Luisia psyche* Rchb. f.	Mon; Tanintharyi; Mt. Popa, Mandalay	Maxwell JF 98- 1303 (L!); s.coll. s.n. (K!); Tanaka et al. 036142 (MBK, spirit collection-TNS), Tsujita et al. 036167 (spirit collection-TNS)
687	*Luisia thailandica* Seidenf.	Reported from Myanmar	Kress et al. 2003
688	*Luisia trichorrhiza* (Hook) Blume	PyinOoLwin (Maymyo), Mandalay	A. Samuel 13558 (K!)
689	*Luisia volucris* Lindl.	Reported from Myanmar	Kress et al. 2003
690	*Luisia zeylanica* Lindl.	Mt. Popa, Mandalay; Bago; Kachin; Tanintharyi; Yangon	Khin Myo Htwe 17 (spirit collection-TNS), Khin Myo Htwe 035060 (MBK), Tanaka et al. 036242 (spirit collection-MBK, TNS) & 036252 (spirit collection-TNS), Khin Myo Htwe 93 (spirit collection-MBK)
691	*Luisia zollingeri* Rchb. f.	Reported from Myanmar	Kress et al. 2003
692	*Malaxis muscifera* (Lindl.) Kuntze	Chin, Tanintharyi	Farrer 1117 (E!); Kingdon-Ward 1769 (E!); Kingdon-Ward 9758 (BM!)

No.	Species	Local distribution	Specimen citations
693	*Malaxis versicolor* (Lindl.) Abeywickr.	Reported from Myanmar	Kress et al. 2003
694	*Micropera obtusa* (Lindl.) Tang & F.T. Wang	Putao, Kachin; Mon; Tanintharyi	Ye Lwin Aung PT-7053 (PE!)
695	*Micropera pallida* (Roxb.) Lindl.	Putao, Kachin; Tanintharyi	Xiaohua Jin et al. PT-2072, PT-2378 (PE!); A.F.G. Kerr 01000 (K!) & (P!)
696	*Micropera rostrata* (Roxb.) N.P. Balakr.	Reported from Myanmar	Kress et al. 2003
697	***Micropera secunda* (Rolfe) T. Tang & F.T. Wang**	Recorded from Myanmar	s.coll. s.n. (K!)
698	*Micropera thailandica* (Seidenf. & Smitinand) Garay	YePhyu, Tanintharyi	Saw Lwin et al. TNRO 61 (SING, SING [spirit], herbarium of Myanmar Floriculturist Association)
699	*Microsaccus griffithii* (Parish & Rchb. f.) Seidenf.	Reported from Myanmar	Kress et al. 2003
700	*Mycaranthes floribunda* (D.Don) S.C.Chen & J.J.Wood	Putao, Kachin; Naga hill, Sagaing; Mandalay	Xiaohua Jin et al. PT-2069 (PE!), Ye Lwin Aung PT-7103, PT-7126 (PE!); D. Prain 67 (K!); Kingdon-Ward 10208 (BM!)
701	*Mycaranthes oblitterata* Blume	Putao, Kachin	Ye Lwin Aung PT-7081 (PE!)
702	*Mycaranthes pannea* (Lindl.) S.C.Chen & J.J.Wood	Putao, Kachin; Mt. Victoria, Chin; Upper Myanmar; Tanintharyi	Xiaohua Jin et al. PT-2049 (PE!), Ye Lwin Aung PT-7049, PT-7121, PT-7183, PT-7191, PT-7566 (PE!); Daun 67 (K!); G. Forrest 25121 (K!)
703	*Myrmechis drymoglossifolia* Hayata	Putao, Kachin	Xiaohua Jin et al. PT-2096 & PT-2224 (PE!)
704	*Myrmechis pumila* (Hook.f.) Tang & Wang	Laktang, Putao, Kachin	Kingdon-Ward 3337 & 1722 (E!); Kingdon-Ward 21107 (BM!)
705	*Neogyna gardneriana* (Lindl.) Rchb.f.	Putao, Kachin	Xiaohua Jin et al. PT-ET 1026 (PE!); s.coll. s.n. (E!); Kingdon-Ward 9109 (BM!)
706	*Neottia dentata* (King & Pantl.) Szlach.	Tama Bum, North Triangle of Kachin State	Kingdon-Ward 21058 (AMES, BM)
707	***Neottia flabellata* (W.W.Sm.) Szlach.**	Valley of the Chawng-maw-hka, Upper Myanmar	Kingdon-Ward 3414 (E!) & (BM!); Kingdon-Ward 21085 (BM!)
708	*Neottia karoana* Szlach.	Putao & Nogmung, Kachin	Xiaohua Jin et al. PT-2122, PT-2223 (PE!), Kingdon-Ward 9961 (AMES), Kingdon-Ward 3359 (E)
709	*Neottia longicaulis* (King & Pantl.) Szlach.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
710	*Neottia pinetorum* (Lindl.) Szlach.	Chipwi Township, Kachin State	Kingdon-Ward 1631 & 1652 (E!)
711	***Neottia unguiculata* (W.W.Sm.) Szlach.**	Hpimaw Pass & Laktang, Kachin	Kingdon-Ward 3350 & 1875 (E!)
712	*Nephelaphyllum cordifolium* (Lindl.) Blume	Nogmung Township, Kachin State	Kingdon-Ward 7314 (K)
713	*Nephelaphyllum pulchrum* Blume	Kachin	Keenan et al. 3015 (E!)
714	*Nephelaphyllum tenuiflorum* Blume	Putao, Kachin	Ye Lwin Aung PT-7120 (PE!)

No.	Species	Local distribution	Specimen citations
715	*Nervilia concolor* (Blume) Schltr.	Mt. Popa, Mandalay	Kingdon-Ward 22208 (BM!); Than Than Aye & Khin Myo Htwe 020725 (MBK), Khin Myo Htwe 024044 (MBK)
716	*Nervilia juliana* (Roxb.) Schltr.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
717	*Nervilia khasiana* (King & Pantl.) Schltr.	Reported from Myanmar	Kress et al. 2003
718	*Nervilia macroglossa* (Hook. f.) Schltr.	Kachin	Kress et al. 2003
719	*Nervilia maculata* (Parish & Rchb. f.) Schltr.	PyinOoLwin (Maymyo), Mandalay; Mon; Tanintharyi	Parish 165 (K!); Rodger 572 (E!)
720	*Nervilia plicata* (Andrews) Schltr.	Mt. Zwekabin, Kayin; Mandalay; Mon; Tanintharyi	Xiaohua Jin et al. PT-2565 (PE!); Kingdon-Ward 486 (NY!); Kingdon-Ward 22166 (BM!)
721	*Oberonia acaulis* Griff.	Putao, Kachin; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-2028, PT-5252 (PE!); Ye Lwin Aung PT-7347 (PE!); Kingdon-Ward 1862 (E!)
722	*Oberonia angustifolia* Lindl.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7344 (PE!)
723	*Oberonia anthropophora* Lindl.	Putao, Kachin; Mt. Victoria, Chin; Dawei (Tavoy), Tanintharyi	Xiaohua Jin et al. PT-5220 (PE!); Ye Lwin Aung PT-7066, PT-7079, PT-7102 (PE!); Keenan et al. 1457 (E!)
724	*Oberonia bantaengensis* J.J.Sm.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7289 (PE!)
725	*Oberonia brachystachys* Lindl.	Tanintharyi	s.coll. s.n. (GH!)
726	*Oberonia brunoniana* Wight	Reported from Myanmar	Kress et al. 2003
727	*Oberonia caulescens* Lindl.	Valley of Dichu, Kachin	Kingdon-Ward 7169 (K!); Kingdon-Ward 22783 (BM!)
728	*Oberonia cavaleriei* Finet	Chin, Mon	Kress et al. 2003
729	*Oberonia ensiformis* Lindl.	Mt. Popa & Headwater of Satthwa Chaung, Mandalay	Maung Hla 3638 (K!); Khin Myo Htwe 74 (spirit collection-TNS)
730	*Oberonia evrardii* Gagnep.	Shan	MacGregor 822 (E!)
731	*Oberonia falcata* King & Pantl.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7282 (PE!)
732	*Oberonia falconeri* Hook. f.	Mt. Victoria, Chin; Alaungdaw Kathapa National Park, Sagaing; PyinOoLwin (Maymyo), Mandalay	Ye Lwin Aung PT-7406, PT-7514 (PE!); A. Samuel 13516 (K!)
733	*Oberonia ferruginea* Parish	Putao, Kachin; Mandalay; Mon; Tanintharyi	Xiaohua Jin et al. PT-2379 (PE!); s.coll. 288 (K!)
734	*Oberonia forcipata* Lindl.	Mt. Victoria, Chin	Ye Lwin Aung PT-7511 (PE!)
735	*Oberonia gammiei* King & Pantl.	Mt. Victoria, Chin	Ye Lwin Aung PT-7510 (PE!)
736	*Oberonia griffithiana* Lindl.	Putao, Kachin; Bago; Mon; Tanintharyi	Xiaohua Jin et al. PT-2259 (PE!); s.coll. 826 (K!); Griffith 5090 (K!)
737	*Oberonia helferi* Hook.f.	Tanintharyi	Helfer 5088 (K!)
738	*Oberonia heliophila* Rchb.f.	YePhyu, Tanintharyi	Ye Lwin Aung PT-7343 (PE!)
739	*Oberonia insectifera* Hook.f.	Mt. Victoria, Chin	Ye Lwin Aung PT-7513 (PE!)
740	*Oberonia jenkinsiana* Griff. ex Lindl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
741	*Oberonia lycopodioides* (Koenig) Ormerod	Tanintharyi	Rottler s.n. (K!)
742	*Oberonia mannii* Hook. f.	Putao, Kachin	Xiaohua Jin et al. PT-2107, PT-2278 (PE!), Ye Lwin Aung PT-7023 (PE!)
743	*Oberonia maxima* Parish	Mon; Alaungdaw Kathapa National Park, Sagaing; Tanintharyi	Ye Lwin Aung PT-7446 (PE!); Parish 287 (K!)

No.	Species	Local distribution	Specimen citations
744	*Oberonia mucronata* (D. Don) Ormerod & Seidenf.	Mon, Shan, Tanintharyi	Kress et al. 2003
745	*Oberonia obcordata* Lindl.	Putao Township, Waingmaw Township, Kachin State	Kurzweil, H. & Saw Lwin KL 2664 (SING), Stephen Lasi Bawk Naw BW 8 (RAF, herbarium of the Myanmar Floriculturist Association).
746	*Oberonia pachyrachis* Rchb.f. ex Hook.f.	Mt. Victoria, Chin	Ye Lwin Aung PT-7512 (PE!)
747	*Oberonia pyrulifera* Lindl.	Chin	Kress et al. 2003
748	*Oberonia rufilabris* Lindl.	Mon, Tanintharyi	Griffith s.n. (P!); s.coll. s.n. (E!)
749	*Oberonia seidenfadenii* (H.J.Su) Ormerod	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7414 (PE!)
750	*Odontochilus clarkei* Hook.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
751	*Odontochilus crispus* (Lindl.) Hook.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
752	*Odontochilus elwesii* Clarke ex Hook.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
753	*Odontochilus grandiflorus* (Lindl.) Benth. ex Hook.f.	Putao, Kachin	Ye Lwin Aung PT-7062 (PE!)
754	*Odontochilus lanceolatus* (Lindl.) Blume	Myitkyina & Putao, Kachin	Kaulback 75 & 404 (BM!); Kingdon-Ward 13062 & 21255 (BM!)
755	*Odontochilus poilanei* (Gagnep.) Ormerod	Putao, Kachin	Ye Lwin Aung PT-7063 (PE!)
756	***Odontochilus putaoensis* X.H. Jin, L.A. Ye & A.T. Mu**	Hponkanrazi Wildlife Sanctuary, Putao Township, Kachin State	Xiaohua Jin et al. PT-ET 959 (Holotype, PE!)
757	*Odontochilus tortus* King & Pantl.	Kachin	Kingdon-Ward 21255 (BM!)
758	***Oreorchis aurantiaca* Pearce & Gibbs**	Kachin	Kingdon-Ward 13334 (BM!)
759	*Oreorchis discigera* W.W. Sm.	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	Kingdon-Ward 1640 (E!) & (BM!)
760	*Oreorchis foliosa* (Lindl.) Lindl.	Kachin	Kingdon-Ward 9596 (BM!)
761	*Oreorchis micrantha* Lindl.	Recorded from Myanmar	Forrest 26809 (E!); Kingdon-Ward 1633 (E!)
762	*Oreorchis oligantha* Schltr.	Nogmung Township, Kachin State	Kingdon-Ward 7076 (K)
763	*Otochilus albus* Lindl.	Putao, Kachin; Chin; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-ET 1038 (PE!); Ye Lwin Aung PT-7300, PT-7301 (PE!); Keenan et al. 3556 (E!)
764	*Otochilus fusca* Lindl.	Putao, Kachin; Chin; Kyaikkami (Amherst), Mon	Ye Lwin Aung PT-7085, PT-7097, PT-7109, PT-7154, PT-7207 (PE!); Forrest 26566 (E!) & (US); Kingdon-Ward 22095 (E!) & (BM!); Lace 5648 (E!); Keenan et al. 3816 (E!)
765	*Otochilus lancilabius* Seidenf.	Putao, Kachin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma	Ye Lwin Aung PT-7374 (PE!); Xiaohua Jin et al. PT-ET 574 (PE!); Kate Armstrong 1917 (NY!)
766	*Otochilus porrectus* Lindl.	Mt. Victoria, Chin; YePhyu, Tanintharyi	Ye Lwin Aung PT-7345, PT-7520, PT-7521, PT-7522 (PE!); Kingdon-Ward 9081 & 22245 (BM!)
767	*Oxystophyllum carnosum* Blume	Mon, Tanintharyi	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
768	*Pachystoma pubescens* Blume	Myitkyina, Kachin	Lace 5237 (E!); Kingdon-Ward 21786 (BM!)
769	*Panisea apiculata* Lindl.	Mon, Tanintharyi	Kress et al. 2003
770	*Panisea demissa* (D. Don) Pfitzer	Recorded from Myanmar	Kingdon-Ward 21682 (BM!)
771	*Panisea distelidia* Lund	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
772	*Panisea tricallosa* Rolfe	Putao, Kachin; Mt. Victoria, Chin	Ye Lwin Aung PT-7479 (PE!), Kurzweil & Lwin 2442 (SING [spirit]), Kurzweil & Lwin 2573 (SING)
773	*Panisea uniflora* (Lindl.) Lindl.	Mon; Mt. Popa, Mandalay; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; YePhyu, Tanintharyi	Ye Lwin Aung PT-7284, PT-7349, PT-7371, PT-7379 (PE!), Tanaka et al. 036190 (MBK, TNS), Tanaka et al. 036185 (spirit collection-TNS)
774	*Panisea yunnanensis* S.C.Chen & Z.H.Tsi	Mt. Victoria, Chin	Ye Lwin Aung PT-7547 (PE!)
775	*Paphiopedilum bellatulum* Pfitzer	Meikhtila, Mandalay	Prazer s.n. (K!); Lace s.n. (E!)
776	*Paphiopedilum callosum* (Rchb.f.) Stein	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
777	*Paphiopedilum charlesworthii* (Rolfe) Pfitzer	Shan, Yangon	s.coll. s.n. (K!)
778	*Paphiopedilum concolor* (Bateman) Pfitzer	Kayin; Kyaikkami (Amherst), Mon; Shan; Tanintharyi	Parish 57 (K!); Bogg B.G. 20 (K!)
779	*Paphiopedilum godefroyae* (Godef.) Pfitzer	Bago, Kayah, Kayin, Mon, Rakhine, Tanintharyi, Yangon	Kress et al. 2003
780	*Paphiopedilum hirsutissimum* (Lindl.) Pfitzer	Reported from Myanmar	Kress et al. 2003
781	*Paphiopedilum insigne* (Wall.) Pfitzer	Chin, Kachin, Mandalay, Sagaing, Shan	Kress et al. 2003
782	***Paphiopedilum myanmaricum* Koop., Iamwir. & S.Laohap.**	Southern Myanmar	Koopowitz et al. 2017
783	*Paphiopedilum niveum* (Rchb.) Pfitzer	Reported from Myanmar	Kress et al. 2003
784	*Paphiopedilum parishii* (Rchb.) Pfitzer	Moulmein, Mon; Kalaw, Shan	Parish 198 (K!); Maymyo Botanic Garden 13512 (K!)
785	*Paphiopedilum spicerianum* (Rchb. f.) Pfitzer	Chin, Kachin	Keenan et al. 3994 (K!) & (E!)
786	*Paphiopedilum tigrinum* Koop. & Haseg.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
787	*Paphiopedilum villosum* (Lindl.) Pfitzer	Mt. Victoria, Chin; Kachin; Moulmein & Kyaikkami (Amherst), Mon; Sagaing; Tanintharyi	Ye Lwin Aung PT-7526 (PE!); Lobb 179 (K!); Parish 92 (K!); J.H. Lace 5645 (K!) & (E!); Kingdon-Ward 33 (NY!)
788	*Paphiopedilum wardii* Summerh.	Chin; Putao, Kachin; Mandalay; Sagaing	Xiaohua Jin et al. PT-6388 (PE!); Kingdon Ward 9070 (K!) & (BM!)
789	*Papilionanthe biswasiana* (Ghose & Mukerjee) Garay	Putao, Kachin	Xiaohua Jin et al. PT-6136 (PE!); Kingdon-Ward 21903 (E!); Kingdon-Ward 21903 (BM!)
790	***Papilionanthe sillemiana* (Rchb. f.) Garay**	Reported from Myanmar	Kress et al. 2003
791	*Papilionanthe teres* (Roxb.) Schltr.	Mt. Victoria, Chin; thaton, Mon; YePhyu, Tanintharyi	Xiaohua Jin et al. PT-5179 (PE!); Ye Lwin Aung PT-7239, PT-7326 (PE!); Lace s.n. (E!)
792	*Papilionanthe uniflora* (Lindl.) Garay	Reported from Myanmar	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
793	*Papilionanthe vandarum* (Rchb. f.) Garay	Chin	Srisanga et al. 97605 (US)
794	*Pecteilis hawkesiana* (King & Pantl.) Sathish Kumar	Upper Myanmar	Prazer s.n. (K!)
795	*Pecteilis henryi* Schltr.	Naunghkio, Shan	Lace 4854 (K!) & (E!)
796	*Pecteilis ophiocephala* (W.W.Sm.) Ormerod	Laktang, Kachin State	Kingdon-Ward 3336 (E!);
797	*Pecteilis susannae* (L.) Raf.	Kachin; Lwelin Loiyang Main Taung & Kyay Si ManSan, Shan; Mt. Popa, Mandalay	Lace 67 (E!); Maung Po Khant 16320 & 16345 (E!); Mokim 91 (E!); Kingdon-Ward 22695 (BM!); Murata et al. 020761 (MBK)
798	*Pelatantheria ctenoglossum* Ridl.	ALaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7416 (PE!)
799	*Pelatantheria insectifera* (Rchb. f.) Ridl.	Bago, Tanintharyi	Kress et al. 2003
800	*Pelatantheria rivesii* (Guillaumin) Tang & F.T.Wang	ALaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7411, PT-7420, PT-7426 (PE!)
801	*Peristylus affinis* (D. Don) Seidenf.	PyinOoLwin (Maymyo), Mandalay	English 160 (E!) & Lace 3227 (E!)
802	*Peristylus constrictus* (Lindl.) Lindl.	Kachin; Chin; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Sagaing; Shan; Mon; Dawei (Tavoy), Tanintharyi	Swinhoe 45 (K!); Lace 4907(E!); Keenan et al. 574 & 712 (E!); Mokim 14 & 130 (E!) & (US); Rodger 616 (E!); Kaulback 251 (E!); Maung Po Khant 16313 (E!); Tanaka et al. 020246 (MBK); Khin Myo Htwe 68 (spirit collection-TNS)
803	*Peristylus densus* (Lindl.) Santap. & Kapad.	Haka, Chin; Loilan, Shan; PyinOoLwin (Maymyo), Mandalay; Moulmein, Mon; Tanintharyi	Venning 58 (K!); Robertson 380 (K!); Lobb 363 (K!); Lace 3227 (K!); MacGregor 821 (E!)
804	*Peristylus goodyeroides* (D. Don) Lindl.	Mt. Zwekabin, Kayin; Shan; Chin; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Yangon; Dawei (Tavoy), Tanintharyi	Xiaohua Jin et al. PT-2567 (PE!); Robertson 5 (K!); Daun 93 (K!); Keenan et al. 593 (K!); Lace 4907 & 5297 (E!)
805	*Peristylus gracilis* Blume	Reported from Myanmar	Kress et al. 2003
806	*Peristylus lacertifer* (Lindl.) J.J. Sm.	Tanintharyi	Keenan et al. 811, 1028 & 1814 (E!)
807	*Peristylus parishii* Rchb. f.	Mt. Popa, Mandalay; Shan; Mon	Parish 216 (K!); MacGregor 6802 (E!); Tanaka et al. 036191 (MBK, spirit collection-TNS)
808	*Peristylus prainii* (Hook. f.) Krzl.	Chin; Kachin; MongPaw Loihka, Shan; PyinOoLwin (Maymyo), Mandalay; Sagaing; Tanintharyi; Yangon; Munghoo & Delu valley, Upper Myanmar	Robertson 361 (K!); Swinhoe 50 (K!); Pantling 167 (K!); Kingdon-Ward 8532 (K!); Lace 3227 (E!)
809	*Peristylus tentaculatus* (Lindl.) J.J. Sm.	Reported from Myanmar	Kress et al. 2003
810	*Peristylus tipulifer* (Parish & Rchb. f.) Mukerjee	Dawei (Tavoy), Tanintharyi	Keenan et al. 1191, 1192, 1177, 886 & 985 (E!); Kingdon-Ward 13102 (BM!)
811	*Phaius flavus* (Blume) Lindl.	Upper Myanmar	Kingdon-Ward 1739 (E!)
812	*Phaius mishmensis* (Lindl. & Paxton) Rchb. f.	Chin; Putao, Kachin; Mandalay; Sagaing	Xiaohua Jin et al. PT-ET 1185 A, PT-ET 250 (PE!); Boxall s.n. (K!)

No.	Species	Local distribution	Specimen citations
813	*Phaius nanus* Hook.f.	Myitkyina, Kachin	Lace 5236 (E!)
814	*Phaius takeoi* (Hayata) Su	Taunggyi, Shan State	Nyan Tun s.n. (SING)
815	*Phaius tankervilleae* (Aiton) Blume	Khaiyang, Upper Myanmar	Kingdon-Ward 17324 (NY!); Griffith 5292 (P!)
816	*Phaius wallichii* Lindl.	Mt. Popa, Mandalay	Kingdon-Ward 11315 (BM!); Khin Myo Htwe 29 (spirit collection-TNS)
817	*Phalaenopsis cornu-cervi* (Breda) Blume & Rchb. f.	Mandalay, Tanintharyi, Yangon	Mokim 640 (BM!)
818	*Phalaenopsis deliciosa* (Rchb. f.) Sweet	YePhyu, Tanintharyi	Ye Lwin Aung PT-7312 (PE!)
819	*Phalaenopsis difformis* (Wall. ex Lindl.) Kocyan & Schuit.	Putao, Kachin; Mt. Victoria, Chin; PyinOoLwin (Maymyo), Mandalay; Shan; Hkamti, Sagaing; Mon; Dawei (Tavoy), Tanintharyi	Xiaohua Jin et al. PT-5256 (PE!); C.E.P 6155 (K!); Keenan et al. 973 (E!); Kingdon-Ward 1561 (E!); Cooper 6085 (E!); Kate Armstrong 2716 (NY!)
820	*Phalaenopsis hygrochila* J.M.H.Shaw	Mt. Victoria, Chin; Alaungdaw Kathapa National Park, Sagaing; Taunggyi, Shan	Ye Lwin Aung PT-7400, PT-7560, PT-7597 (PE!); s.coll. s.n. (E!)
821	*Phalaenopsis kunstleri* Hook.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
822	*Phalaenopsis lobbii* (Rchb.) Sweet	Nampakom Drainage, Upper Chindwin; Tanintharyi	Rule(?) 5777 (K!)
823	*Phalaenopsis lowii* Rchb. f.	Mon, Tanintharyi	Parish 125 (AMES!); s.coll. s.n. (AMES!)
824	*Phalaenopsis mannii* Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
825	***Phalaenopsis natmataungensis* (T.Yukawa, Nob.Tanaka & J.Murata) Dalstrom & Ormerod**	Mt. Victoria, Chin	Yukawa et al. 029689 (Holotype: TNS; Isotype: MBK, TI)
826	*Phalaenopsis parishii* Rchb.f.	Tanintharyi	Griffith 5236 (K!); Parish 110 (AMES)
827	*Phalaenopsis pulcherrima* (Lindl.) J.J. Sm.	Reported from Myanmar	Kress et al. 2003
828	*Phalaenopsis stobartiana* Rchb. f.	Putao, Kachin	Xiaohua Jin et al. PT-2093 (PE!)
829	*Phalaenopsis sumatrana* Korth. & Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
830	*Phalaenopsis taenialis* (Lindl.) Christenson & U.C. Pradhan	Reported from Myanmar	Kress et al. 2003
831	***Pholidota advena* Parish & Rchb. f.**	Mon; Dawei (Tavoy), Tanintharyi	Parish 296 (K!); Keenan et al. 5348 (E!)
832	*Pholidota aidiolepis* Seidenf. & de Vogel	Putao, Kachin	Ye Lwin Aung PT-7058 (PE!)
833	*Pholidota articulata* Lindl.	Putao, Kachin; Mt. Victoria, Chin; Mt. Popa, Mandalay; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Taunggyi, Shan; Dawei (Tavoy), Tanintharyi	Ye Lwin Aung PT-7069, PT-7086, PT-7138, PT-7386, PT-7533, PT-7548, PT-7549, PT-7550, PT-7581, PT-7582, PT-7583, PT-7534 (PE!); Lugard s.n. (K!); Hooker s.n. (K!); Clarke 11810 (K!); Griffith 5045 (K!); Keenan et al. 1896 (E!); Khin Myo Htwe 24 (spirit collection-TNS), Khin Myo Htwe 45 (MBK), Tanaka et al. 036158 (MBK)

No.	Species	Local distribution	Specimen citations
834	*Pholidota chinensis* Lindl.	below Laugyang (Hlawgaw), Myitkyina, Kachin	Lulay 10016 (K!)
835	*Pholidota convallariae* (Parish & Rchb. f.) Hook. f.	Putao, Kachin; Mt. Victoria, Chin; Mandalay; Mulayit & W. Dawna, Kayin; Mon; Tanintharyi	Xiaohua Jin et al. PT-5271 (PE!); F.G. Dickason 7479, 8442 & 8602 (K!); R.C.F. Swinhoe 101 & R 119 (K!)
836	*Pholidota imbricata* Lindl.	Putao, Kachin; Mt. Victoria, Chin; Mt. Popa, Mandalay; Sagaing; Shan; YePhyu, Tanintharyi; Yangon	Xiaohua Jin et al. PT-ET 132 (PE!); Ye Lwin Aung PT-7292, PT-7336, PT-7365, PT-7529 (PE!); Egerod B-20 (US); Rock 7457 (US); Khin Myo Htwe 69 (spirit collection-MBK, TNS)
837	*Pholidota missionariorum* Gagnep.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
838	*Pholidota pallida* Lindl.	Kyaikkahmi (Amherst), Mon	Kingdon-Ward 20946 (BM!); Lace s.n. (E!)
839	*Pholidota protracta* Hook. f.	Putao, Kachin; Sagaing	Xiaohua Jin et al. PT-2261, PT-2262 (PE!); Swinhoe K 75 (K!); Kingdon-Ward 21426 (BM!)
840	*Pholidota recurva* Lindl.	Putao, Kachin; Mt. Victoria, Chin; Paungdaw Power Station, Dawei (Tavoy), Tanintharyi	Xiaohua Jin et al. PT-5276, PT-5382 (PE!), Ye Lwin Aung PT-7017, PT-7108, PT-7122, PT-7574, PT-7078 (PE!); Keenan et al. 5389 (K!) & (E!)
841	*Pholidota rubra* Lindl.	Chin, Kachin, Mandalay; Sagaing; Kyaikkami (Amherst), Mon	Xiaohua Jin et al. PT-5253, PT-5343 (PE!); Ye Lwin Aung PT-7019 (PE!); Lace s.n. (E!); Kingdon-Ward 10179 & 13509 (BM!)
842	*Pinalia acervata* (Lindl.) Kuntze	Chin, Mandalay, Tanintharyi	Daun 37 (K!); Forrest 176 (E!)
843	*Pinalia affinis* (Griff.) Ormerod	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
844	*Pinalia amica* (Rchb.f.) Kuntze	Mt. Victoria, Chin; Kachin; Alaungdaw Kathapa National Park, Sagaing; Tanintharyi	Ye Lwin Aung PT-7429, PT-7504, PT-7507, PT-7430, PT-7431, PT-7559 (PE!); R.C.F. Swinhoe K 74 (K!); Kingdon-Ward 1557 (E!)
845	*Pinalia apertiflora* (Summerh.) A.N.Rao	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
846	*Pinalia bicolor* (Lindl.) Kuntze	Mt. Victoria, Chin	Ye Lwin Aung PT-7505 (PE!)
847	*Pinalia bractescens* (Lindl.) Kuntze	Bhamo, Kachin; Mandalay; Tanintharyi	Swinhoe 20 & 87 (K!); McMillen 248 (NY!) & (US)
848	***Pinalia brownei* (Braid) Ormerod**	Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Chin	Ye Lwin Aung PT-7444, PT-7466 (PE!); s.coll. s.n. (K!)
849	*Pinalia concolor* (E.C.Parish & Rchb.f.) Kuntze	Putao, Kachin; Kayin; Mt. Popa, Mandalay; Alaungdaw Kathapa National Park, Sagaing; Taunggyi, Shan; Tanintharyi	Xiaohua Jin et al. PT-5258 (PE!), Ye Lwin Aung PT-7443, PT-7459, PT-7460, PT-7461, PT-7462, PT-7465, PT-7467, PT-7468, PT-7470, PT-7471, PT-7472, PT-7046, PT-7232, PT-7233, PT-7235, PT-7592, PT-7593 (PE!)
850	***Pinalia dasypus* (Rchb.f.) Kuntze**	Upper Myanmar; Tanintharyi	Forrest 26606 (E!); s.n. (K!)
851	*Pinalia densa* (Ridl.) W.Suarez & Cootes	Tanintharyi	Kress et al. 2003

No.	Species	Local distribution	Specimen citations
852	*Pinalia eriopsidobulbon* (E.C.Parish & Rchb.f.) Kuntze	Mt. Victoria & Haka, Chin; Mt. Popa, Mandalay; Mon; Alaungdaw Kathapa National Park, Sagaing; Tanintharyi	Ye Lwin Aung PT-7408, PT-7432, PT-7433, PT-7434, PT-7435, PT-7464, PT-7469, PT-7508, PT-7567 (PE!); Venning 17 (K!); Parish 281 (K!); C.E. Parkinson 2459 (K!); R.C.F. Swinhoe 56 (K!)
853	*Pinalia excavata* (Lindl.) Kuntze	Mt. Victoria, Chin	Cooper 6088 (E!)
854	*Pinalia floribunda* (Lindl.) Kuntze	Dawei (Tavoy), Tanintharyi	Keenan et al. 5021 (E!)
855	*Pinalia globulifera* (Seidenf.) A.N. Rao	Putao, Kachin; Mt. Popa, Mandalay	Ye Lwin Aung PT-7011, PT-7012, PT-7022, PT-7037 (PE!)
856	*Pinalia graminifolia* (Lindl.) Kuntze	Upper Myanmar; Kachin	Forrest 26955 & 27242 (K!) & (E!) & (US); Farrer 1109 (E!); Kingdon-Ward 1822 (E!); Forrest 24920 (NY!)
857	*Pinalia lineoligera* (Rchb.f.) Ormerod	Mogok, Mandalay	Kress et al. 2003
858	*Pinalia merguensis* Kuntze	YePhyu & Myeik (Mergui), Tanintharyi	Ye Lwin Aung PT-7250, PT-7257, PT-7258 (PE!); Griffith 1034, 5120 & 5381 (K!); Parish 52 (K!)
859	*Pinalia myristiciformis* (Hook.) Kuntze	Mt. Victoria, Chin; West Dawna, Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7541, PT-7251 (PE!); Bogg B.G. 6 (K!); Parish 113 (K!)
860	*Pinalia mysorensis* (Lindl.) Kuntze	Ayeyarwaddy, Rakhine, Tanintharyi, Yangon	Kress et al. 2003
861	*Pinalia obesa* (Lindl.) Kuntze	Bago; Thaton & Kyaikkami (Amherst), Mon; Tanintharyi	Swinhoe 81 (K!); Lace 5595 (K!) & (E!)
862	*Pinalia ovata* (Lindl.) W. Suarez & Cootes	Mt. Victoria, Chin	Ye Lwin Aung PT-7506 (PE!)
863	*Pinalia pachyphylla* (Aver.) S.C.Chen & J.J.Wood	Putao, Kachin	Xiaohua Jin et al. PT-6173, PT-6934 (PE!)
864	*Pinalia praecox* (Aver.) Schuit., Y.P.Ng & H.A.Pedersen	Putao, Kachin	Xiaohua Jin et al. PT-6779 (PE!)
865	*Pinalia pumila* (Lindl.) Kuntze	Mon, Tanintharyi	Kress et al. 2003
866	***Pinalia rimannii* (Rchb.f.) Kuntze**	Reported from Myanmar	Kress et al. 2003
867	***Pinalia shanensis* (King & Pantl.) Ormerod**	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
868	***Pinalia shiuyingiana* Ormerod & Wood**	Hkrang Hka, Kachin State	Kingdon-Ward 20970 (Holotype: AMES; Isotype: BM[photograph])
869	*Pinalia spicata* (D.Don) S.C.Chen & J.J.Wood	Putao, Kachin; Bago; Chin; PyinOoLwin (Maymyo), Mandalay; Tanintharyi	Xiaohua Jin et al. PT-5355 (PE!); Bogg B.G. 9 (K!); Kingdon-Ward 1847 (E!)
870	*Pinalia stricta* (Lindl.) Kuntze	Putao, Kachin; Mon; Sagaing; Tanintharyi	Ye Lwin Aung PT-7072, PT-7104 (PE!)
871	*Pinalia sutepensis* (Rolfe ex Downie) Schuit., Y.P.Ng & H.A.Pedersen	Mt. Popa, Mandalay	R.C.F. Swinhoe 114 (K!); Khin Myo Htwe 46 (spirit collection-TNS), Tsujita et al. 036172, 036175 (spirit collection-TNS)
872	*Pinalia tenuiflora* (Ridl.) J.J.Wood	Mon, Tanintharyi	Kress et al. 2003
873	*Pinalia trilophota* (Lindl. ex Jackson) Ormerod	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
874	*Pinalia xanthocheila* (Ridl.) Suarez & Cootes	Recorded from Myanmar	s.n. (K!)
875	*Platanthera angustilabris* Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014

No.	Species	Local distribution	Specimen citations
876	*Platanthera bakeriana* (King & Pantl.) Kraenzl.	Adung valley, Putao, Kachin	Kingdon Ward 9806 (AMES), Kingdon Ward 9931 (AMES); Kingdon-Ward 9931 (BM!)
877	*Platanthera bhutanica* K.Inoue	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
878	*Platanthera calceoliformis* (W.W.Sm.) X.H.Jin, Schuit. & W.T.Jin	Putao, Kachin	Xiaohua Jin et al. PT-2176, PT-2182 (PE!)
879	*Platanthera dulongensis* X.H.Jin & Efimov	Putao, Kachin	Xiaohua Jin et al. PT-2222 (PE!)
880	*Platanthera leptocaulon* (Hook.f.) Soó	Putao, Kachin	Kingdon-Ward 9911 (BM!)
881	***Platanthera longibracteata* Lindl.**	Reported from Myanmar	Kress et al. 2003
882	*Platanthera minutiflora* Schltr.	Putao, Kachin	Kingdon-Ward 9713 & 9803 (BM!)
883	*Platanthera nematocaulon* (Hook.f.) Kraenzl.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
884	*Platanthera orbicularis* (Hook.f.) X.H.Jin, Schuit. & Raskoti	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
885	*Platanthera pachycaulon* (Hook.f.) Soó	Adung valley, Putao, Kachin	Kingdon Ward 9918 (AMES) & (BM!)
886	*Platanthera roseotincta* (W.W. Sm.) Tang & Wang	Kachin	Forrest 26959 (K!) & (E!) & (BM!) & (P!); Kingdon-Ward 3376 (E!); Forrest 25036 (E!); Farrer 1150 (E!); Kingdon-Ward 9764 & 9834 (BM!)
887	*Platanthera stenantha* (Hook.f.) Soo	Putao, Kachin	Forrest 25092 (E!); Farrer 1245 (E!); Kingdon-Ward 1874 (E!); Kingdon-Ward 21458 (BM!)
888	*Platanthera superantha* (J.J.Wood) X.H.Jin, Schuit., Raskoti & Lu Q.Huang	Upper Myanmar; Kachin	Farrer 1125 (E!); Kingdon-Ward 1816 (E!)
889	*Platanthera uniformis* Tang & F.T.Wang	Laktang & Putao, Kachin	Farrer 1910 (E!); Kingdon-Ward 3566 & 1902 (E!); Kate Armstrong 1969 (NY!)
890	*Platanthera urceolata* (Hook.f.) Bateman	Putao, Kachin; valley of Seinghku, Upper Myanmar	Xiaohua Jin et al. PT-2225 (PE!); Kingdon-Ward 7524 (K!); Farrer 1314 (E!); Kingdon-Ward 21427 (E!); Kingdon-Ward 9949, 21427 & 13445 (BM!)
891	*Pleione albiflora* Cribb & C.Z. Tang	Reported from Myanmar	Kress et al. 2003
892	*Pleione forrestii* Schltr.	Chin, Kachin, Sagaing, Shan	Forrest 26656 (NY!) & (BM!) & (P!); Kingdon-Ward 443 (NY!)
893	*Pleione grandiflora* (Rolfe) Rolfe	Recorded from Myanmar	Rock 7512 (US)
894	*Pleione hookeriana* (Lindl.) B.S. Williams	Reported from Myanmar	Kress et al. 2003
895	*Pleione humilis* (J.E. Sm.) D. Don	Putao, Kachin; Mt. Victoria, Chin	Xiaohua Jin et al. PT-ET 862, PT-2120, PT-2265 (PE!); Ye Lwin Aung PT-7515 (PE!); Kingdon-Ward 21966 (BM!)
896	*Pleione limprichtii* Schltr.	Chin	Kress et al. 2003
897	*Pleione maculata* (Lindl.) Lindl.	Putao, Kachin; Chin; Yangon	Keenan et al. 3367 (E!); Kate Armstrong 2172 (NY!); Kingdon-Ward 21515 (BM!)

No.	Species	Local distribution	Specimen citations
898	*Pleione praecox* (J.E. Sm.) D. Don	Putao, Kachin; Mt. Victoria, Chin	Xiaohua Jin et al. PT-5205 (PE!); Ye Lwin Aung PT-7490 (PE!); Kate Armstrong 1910 (NY!); s.coll. s.n. (E!); Kingdon-Ward 21508 (BM!)
899	*Pleione scopulorum* W.W. Sm.	Putao, Kachin	Xiaohua Jin et al. 10951 (PE!); Kingdon-Ward 9541 & 21065 (BM!)
900	*Pleione yunnanensis* (Rolfe) Rolfe	Kachin	Farrer 849 (E!)
901	*Podochilus cultratus* Lindl.	Putao, Kachin; Mon; Tanintharyi	Xiaohua Jin et al. PT-ET 135 (PE!), Xiaohua Jin et al. PT-5350 (PE!)
902	*Podochilus khasianus* Hook. f.	Putao, Kachin; Bago; Mon	Xiaohua Jin et al. PT-ET 1233, PT-5249 (PE!), Ye Lwin Aung PT-7172 (PE!)
903	*Podochilus lucescens* Blume	Tanintharyi	Kerr 1004 (P!)
904	*Podochilus microphyllus* Lindl.	Tanintharyi	Kress et al. 2003
905	*Pogonia yunnanensis* Finet	Nogmung, Kachin	Kingdon-Ward 9766 (BM!)
906	*Polystachya concreta* (Jacq.) Garay & Sweet	Mt. Popa, Mandalay	Tanaka et al. 036162 (MBK)
907	*Pomatocalpa diffusum* Breda	Recorded from Myanmar	Griffith 5235 (P!)
908	*Pomatocalpa spicatum* Breda, Kuhl & Hasselt	Tanintharyi	Kress et al. 2003
909	*Ponerorchis chusua* (D.Don) Soó	Myitkyina, Kachin; Seinghku taung, Northern Myanmar	Kingdon-Ward 7060 & 7230 (K!); Naw Mu Pa 17425 (K!); Farrer 1119 (E!); Kingdon-Ward 3448 (E!); Kingdon-Ward 9835 (BM!)
910	*Ponerorchis monantha* (Finet) X.H. Jin, Schuit. & W.T. Jin	Kachin	Kingdon-Ward 21604 (AMES)
911	*Ponerorchis puberula* (King & Pantl.) Verm.	Putao, Kachin	Kingdon-Ward 9826 & 21064 (BM!)
912	*Ponerorchis secundiflora* (Kraenzl.) X.H.Jin, Schuit. & W.T.Jin	Recorded from Myanmar	Kingdon-Ward 9978 (AMES!)
913	*Ponerorchis tibetica* (Schltr.) X.H.Jin, Schuit. & W.T.Jin	Kachin	Forrest 26907 & 24656 (E!) & (US); Forrest 26907 (P!)
914	*Porpax conica* (Summerh.) Schuit., Y.P.Ng & H.A.Pedersen	Recorded from Myanmar	Parkinson 5288 (AMES)
915	*Porpax dickasonii* (Ormerod) Schuit., Y.P.Ng & H.A.Pedersen	Haka District, Chin State	F.G. Dickason 7359 (Holotype: AMES)
916	*Porpax elwesii* (Rchb.f.) Rolfe	Thet Kal Kwet, YePhyu, Tanintharyi	Tanaka et al. MY1731 & MY1732 (RAF, TNS)
917	*Porpax extinctoria* (Lindl.) Schuit., Y.P.Ng & H.A.Pedersen	Mon; Tanintharyi	R.C.F. Swinhoe R 114 (K!)
918	*Porpax gigantea* Deori	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
919	*Porpax lacei* (Summerh.) Schuit., Y.P.Ng & H.A.Pedersen	Dawna Range, Kyaikkami (Amherst), Mon	Lace 4751 (K!) & (E!)
920	*Porpax meirax* (N.E. Br.) King & Pantl.	Mon, Tanintharyi	Kress et al. 2003
921	*Porpax muscicola* (Lindl.) Schuit., Y.P.Ng & H.A.Pedersen	Tanintharyi	Kress et al. 2003
922	*Porpax parishii* (Lindl. & Rchb.f.) Rolfe	Mon, Tanintharyi	Kress et al. 2003
923	*Porpax pusilla* (Griff.) Schuit., Y.P.Ng & H.A.Pedersen	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014

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924	*Porpax summerhayesiana* (A.D.Hawkes & A.H.Heller) Schuit., Y.P.Ng & H.A.Pedersen	Recorded from Myanmar	Kress et al. 2003
925	*Porpax ustulata* (Parish & Rchb. f.) Rolfe	Putao, Kachin; Mon; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-2042 (PE!), Parish 62 (K!); Tanaka et al. 036155 (MBK), Tanaka et al. 036187 (MBK, spirit collection-TNS)
926	*Pteroceras compressum* (Blume) Holtt.	Sagaing, Tanintharyi	Kress et al. 2003
927	*Pteroceras leopardinum* (Parish & Rchb. f.) Seidenf. & Smitin.	Mon, Tanintharyi	Parish 269 (K!)
928	*Pteroceras teres* (Blume) Holttum	Mon, Tanintharyi	Kress et al. 2003
929	*Renanthera coccinea* Lour.	Chin; Alaungdaw Kathapa National Park, Sagaing; YePhyu, Tanintharyi	Ye Lwin Aung PT-7320, PT-7436 (PE!)
930	***Renanthera hennisiana* Schltr.**	Reported from Myanmar	Kress et al. 2003
931	*Renanthera imschootiana* Rolfe	Mindat, Chin; Mandalay	Kingdon-Ward 22182 (BM!)
932	*Renanthera isosepala* Holttum	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
933	***Renanthera pulchella* Rolfe**	Recorded from Myanmar	Peeters s.n. (K!)
934	*Rhomboda abbreviata* (Lindl.) Ormerod	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
935	*Rhomboda moulmeinensis* (Parish & Rchb. f.) Ormerod	Moulmein, Mon; Tanintharyi	Parish 237 (K!); Lobb s.n. (K!)
936	***Rhomboda wardii* Ormerod**	Kachin	Kingdon-Ward 12889 (BM!)
937	*Rhynchostylis gigantea* Ridley	Mt. Victoria, Chin; Mt. Popa, Mandalay; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; Alaungdaw Kathapa National Park, Sagaing; Kalaw, Shan	Xiaohua Jin et al. PT-5113 (PE!); Ye Lwin Aung PT-7391, PT-7425, PT-7427, PT-7571 (PE!); Lace s.n. (E!); White 245 (US); Khin Myo Htwe 72 (spirit collection-MBK, TNS), Tanaka et al. 036139 (MBK)
938	*Rhynchostylis retusa* Blume	Mt. Popa & PyinOoLwin (Maymyo), Mandalay; YePhyu, Tanintharyi	Ye Lwin Aung PT-7246 (PE!); Lace s.n. (E!); Kaulback 249 (BM!); Mokim 6 (P!) & (US); Kurz 3243 (US); Khin Myo Htwe 032884 (MBK); Tanaka 036102 (MBK, spirit collection-TNS); Tanaka et al. 036139 (MBK, spirit collection-TNS)
939	*Risleya atropurpurea* King & Pantl.	Upper Myanmar	Kingdon-Ward 1780 (E!)
940	*Robiquetia pachyphylla* (Rchb. f.) Garay	Recorded from Myanmar	s.coll. s.n. (K!)
941	*Robiquetia spathulata* (Blume) J.J. Sm.	Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7355 (PE!)
942	*Robiquetia succisa* (Lindl.) Seidenf. & Garay	Reported from Myanmar	Kress et al. 2003
943	*Saccolabiopsis pusilla* (Lindl.) Seidenf. & Garay	Reported from Myanmar	Kress et al. 2003
944	*Sarcoglyphis flava* (Hook. f.) Garay	Mon, Tanintharyi	Kress et al. 2003
945	*Sarcoglyphis mirabilis* (Rchb. f.) Garay	Reported from Myanmar	Kress et al. 2003
946	*Sarcoglyphis smithiana* (Kerr) Seidenf.	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7424 (PE!)

No.	Species	Local distribution	Specimen citations
947	*Satyrium nepalense* D. Don	Mt. Victoria, Chin; Shan; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-5221 (PE!); Kingdon-Ward 1870 (E!); Farrer 1261 (E!); Maung Gale 9164 (E!)
948	*Schoenorchis fragrans* (Parish & Rchb. f.) Seidenf. & Smitin.	Mon, Tanintharyi	Kress et al. 2003
949	*Schoenorchis gemmata* (Lindl.) J.J. Sm.	Putao, Kachin	Xiaohua Jin et al. PT-2081 (PE!); Forrest 26607 (E!) & (US); Kingdon-Ward 1556 (E!)
950	*Seidenfadenia mitrata* (Rchb.f.) Garay	Tanintharyi	Kress et al. 2003
951	*Sirindhornia monophylla* (Collett & Hemsl.) H.A.Pedersen & Suksathan	Chin; Kachin; Magway; Mandalay; Sagaing; Nawngtaya, Shan	Collett s.n. (K!); Collett 766 (CAL)
952	*Smitinandia helferi* (Hook. f.) Garay	Mon, Tanintharyi	Kress et al. 2003
953	*Smitinandia micrantha* (Lindl.) Holtt.	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7439 (PE!)
954	*Spathoglottis affinis* de Vriese	Mt. Popa, Mandalay; Dawei (Tavoy), Tanintharyi; Rakhine	Keenan et al. 929 (E!); Murata et al. 021040 (MBK, TNS)
955	*Spathoglottis hardingiana* Parish & Rchb.f.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
956	*Spathoglottis plicata* Blume	Mt. Popa, Mandalay	Khin Myo Htwe 4 (spirit collection-TNS), Tanaka et al. 036160 (MBK)
957	*Spathoglottis pubescens* Lindl.	Bago; Chin; Kachin; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Rakhine; Shan; Tanintharyi	Ye Lwin Aung PT-7237, PT-7238 (PE!); Farrer 1262 (E!); Lace 5515 (E!); MacGregor 819 & 820 (E!); Kingdon-Ward 1848 (E!); Kingdon-Ward 22567 (BM!); Belcher 628 & 816 (US)
958	*Spiranthes sinensis* (Pers.) Ames	Putao & Sumpra Bum, Kachin; Mindat, Chin	Xiaohua Jin et al. PT-ET 988 (PE!); Lace 3141 (E!); Kingdon-Ward 1735 & 22035 (E!); Kingdon-Ward 22848, 22656 & 22035 (BM!)
959	*Stereochilus erinaceus* (Rchb. f.) Garay	Mon, Tanintharyi	Kress et al. 2003
960	*Stereochilus hirtus* Lindl.	Tanintharyi	Kress et al. 2003
961	***Stereochilus laxus* (Rchb. f.) Garay**	Tanintharyi	Kress et al. 2003
962	*Stereosandra javanica* Blume	YePhyu, Tanintharyi	Saw Lwin et al. TNRO 5 (SING, SING [spirit])
963	*Stichorkis gibbosa* (Finet) Wood	Mon, Tanintharyi	Kress et al. 2003
964	*Strongyleria pannea (Lindl.)* Schuit., Y.P.Ng & H.A.Pedersen	PyinOoLwin (Maymyo), Mandalay; Mt. Victoria, Chin	Forrest 25121 & 27028 (E!) & (NY!) & (BM!) & (US); Kingdon-Ward 1552 (E!); Cooper 6087 (E!); s.n. (K!)
965	*Taeniophyllum glandulosum* Blume	InnDawGyi Wildlife Sanctuary, Kachin State	Kurzweil & Lwin 2790 (SING spirit)
966	***Tainia hennisiana* (Schltr.) P.F.Hunt**	Reported from Myanmar	Kress et al. 2003
967	*Tainia latifolia* (Lindl.) Rchb. f.	Chin; Putao, Kachin; Mandalay; Sagaing; Upper Chindwin	Xiaohua Jin et al. PT-2106 (PE!), Ye Lwin Aung PT-7142 (PE!); Glin 5761 (K!); Parish 253 (K!); Keenan et al. 3429 (E!)

No.	Species	Local distribution	Specimen citations
968	*Tainia minor* Hook.f.	Laktang, Kachin	Kingdon-Ward 3229 (E!); Kingdon-Ward 20938 (BM!)
969	*Tainia wrayana* (Hook.f.) J.J.Sm.	Reported from Myanmar	Kress et al. 2003
970	*Thecostele alata* (Roxb.) Parish & Rchb. f.	Mon, Tanintharyi	Kress et al. 2003
971	*Thelasis carinata* (Blume) Rchb. f.	Reported from Myanmar	Kress et al. 2003
972	*Thelasis khasiana* Hook.f.	Putao, Kachin	Xiaohua Jin et al. PT-5274 (PE!), Ye Lwin Aung PT-7065, PT-7077, PT-7095, PT-7110 (PE!)
973	*Thelasis micrantha* (Brongn.) J.J. Sm.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
974	*Thelasis perpusilla* (C.S.P.Parish & Rchb.f.) Schuit.	Hpa-an, Kayin; Mon; Tanintharyi; Pyu Kyoon, Bago; Mandalay	Xiaohua Jin et al. PT-2552 (PE!); R.C. Swinhoe 22 (K!); Brandis s.n. (K!)
975	*Thelasis pygmaea* (Griff.) Lindl.	Chin, Mon, Tanintharyi	Kress et al. 2003
976	*Thrixspermum calceolus* (Lindl.) Rchb. f.	Reported from Myanmar	Kress et al. 2003
977	*Thrixspermum centipeda* Lour.	Putao, Kachin; Dawei (Tavoy), Tanintharyi	Xiaohua Jin et al. PT-ET 1322 (PE!); Keenan et al. 5450 (E!)
978	*Thrixspermum merguense* (Hook. f.) Kuntze	Mon; YePhyu, Tanintharyi	Ye Lwin Aung PT-7348 (PE!)
979	*Thrixspermum scortechinii* (Hook. f.) Ridl.	Mon	Kress et al. 2003
980	*Thrixspermum trichoglottis* (Hook. f.) Kuntze	YePhyu, Tanintharyi	Ye Lwin Aung PT-7329 (PE!)
981	*Thunia alba* Rchb. f.	Mt. Victoria & Mindat, Chin; Putao, Kachin; Mt. Popa, Mandalay; Rakhine; Kalaw, Shan; YePhyu, Tanintharyi; Mon	Xiaohua Jin et al. PT-ET 109 (PE!), Xiaohua Jin et al. PT-5116 (PE!); Ye Lwin Aung PT-7010, PT-7288 (PE!); Cooper 6068 (E!); Kingdon-Ward 22320 (BM!); Khin Myo Htwe 40 (spirit collection-TNS)
982	*Thunia bensoniae* Hook. f.	Chin, Mon	Kress et al. 2003
983	***Thunia brymeriana* Rolfe**	Recorded from Myanmar	s.coll. s.n. (K!)
984	***Thunia candidissima* Rchb. f.**	Reported from Myanmar	Kress et al. 2003
985	*Thunia pulchra* Rchb.f.	Putao, Kachin; Mon	Qiang Liu 455 (HITBC!); Parish 5 & 199 (K!)
986	*Thuniopsis cleistogama* L.Li, D.P.Ye & Shi J.Li	Mt. Popa, Mandalay; Kanpetlet, Chin	Cho et al. MM-0507 (HHU); Kang et al. 2019 [photographic record from Chin State]
987	*Tipularia josephi* Rchb.f. ex Lindl.	Kachin	Kingdon-Ward 12991 & 13242 (BM!)
988	*Trachoma coarctatum* (King & Pantl.) Garay	Reported from Myanmar	Kress et al. 2003
989	*Trichoglottis bipunctata* (Parish & Rchb. f.) Tang & F.T. Wang	Mon, Tanintharyi	Kress et al. 2003
990	*Trichoglottis dawsoniana* Rchb.f.	Mon, Tanintharyi	Kress et al. 2003
991	*Trichoglottis fasciata* Rchb.f.	Tanintharyi	Kress et al. 2003
992	*Trichoglottis ramosa* (Lindl.) Senghas	Mt. Popa, Mandalay	Khin Myo Htwe 15 (spirit collection-TNS)
993	*Trichoglottis ventricularis* Kocyan & Schuit.	Reported from Myanmar	Kress et al. 2003
994	*Trichotosia aurea* (Ridl.) Carr	Putao, Kachin	Ye Lwin Aung PT-7146 (PE!)

No.	Species	Local distribution	Specimen citations
995	*Trichotosia crassicaulis* (Hook.f.) Kraenzl.	Putao, Kachin	Xiaohua Jin et al. PT-2400 (PE!)
996	*Trichotosia dasyphylla* (Parish & Rchb. f.) Krzl.	Mt. Victoria, Chin; Bago; Tanintharyi	Ye Lwin Aung PT-7569 (PE!); Kurz 1432 (K!)
997	*Trichotosia pauciflora* Blume	Tanintharyi	Kress et al. 2003
998	*Trichotosia pulvinata* (Lindl.) Krzl.	Putao, Kachin; Bago; Tanintharyi	Xiaohua Jin et al. PT-5345 (PE!)
999	*Trichotosia rotundifolia* (Ridl.) Krzl.	Mon, Tanintharyi	Kress et al. 2003
1000	*Trichotosia velutina* (Lodd. ex Lindl.) Krzl.	Tanintharyi	Kress et al. 2003
1001	*Trichotosia vestita* (Wall. ex Lindl.) Kraenzl.	Tanintharyi	Kress et al. 2003
1002	*Tropidia angulosa* Blume	Putao, Kachin; Sagaing; Tanintharyi	Xiaohua Jin et al. PT-2094 (PE!); McMillen 130 (US); Belcher B-C-956 (US)
1003	*Tropidia curculigoides* Lindl.	Putao, Kachin; Mt. Popa, Mandalay	Xiaohua Jin et al. PT-ET 1378, PT-ET 458 (PE!), Than Than Aye & Khin Myo Htwe 020642 (MBK), Murata et al. 020892 (MBK), Than Than Aye & Khin Myo Htwe 021361 (MBK, TNS)
1004	*Tuberolabium elobe (Seidenf.)* Seidenf.	Putao, Kachin	Xiaohua Jin et al. PT-ET 245 (PE!)
1005	*Uncifera obtusifolia* Lindl.	Putao, Kachin; YePhyu, Tanintharyi	Ye Lwin Aung PT-7304, PT-7027, PT-7032, PT-7168 (PE!)
1006	***Uncifera verrucosa* Summerh.**	Recorded from Myanmar	Kingdon-Ward 21171 (BM!)
1007	*Vanda ampullacea* (Roxb.) L.M.Gardiner	Falam, Chin; Mandalay; Mon	Daun 20 (K!); Swinhoe 44 (K!); Kurz 328 (BM!)
1008	*Vanda bensonii* Bateman	Mt. Victoria & Haka, Chin; Bago; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Mon; Alaungdaw Kathapa National Park, Sagaing; Tanintharyi	Ye Lwin Aung PT-7395, PT-7415, PT-7428, PT-7570 (PE!); Benson s.n. (K!); Venning 51 (K!); Lace s.n. (E!); Kingdon-Ward 21803 (BM!); Khin Myo Htwe 12 (spirit collection-TNS); Tanaka et al. 036152 (MBK)
1009	*Vanda brunnea* Rchb. f.	Falam, Chin; Putao, Kachin; Mt. Popa, Mandalay; Shan	Xiaohua Jin et al. PT-5346 (PE!), Daun 3 (K!); Khin Myo Htwe 97 (spirit collection-MBK), Khin Myo Htwe 16 (spirit collection-TNS)
1010	*Vanda coerulea* Griff. ex Lindl.	Chin; Kachin; PyinOoLwin (Maymyo), Mandalay; Shan; Yangon	Bogg B (K!); Lace s.n. (E!)
1011	*Vanda coerulescens* Griff.	Pyay (Prome), Bago; Falam, Chin; Kachin; Mt. Popa & PyinOoLwin (Maymyo), Mandalay; Alaungdaw Kathapa National Park, Sagaing; Shan	Ye Lwin Aung PT-7397, PT-7412, PT-7419, PT-7437 (PE!); Benson s.n. (K!); Collett 544 (K!); Daun 24 (K!); Samuel 13523 & 13559 (K!); Forrest 7450 (E!); Khin Myo Htwe 81 (spirit collection-MBK) & 89 (spirit collection-TNS)
1012	*Vanda cristata* Lindl.	Putao, Kachin; Paunglaung Creek, Nay Pyi Taw-Shan Yoma; YePhyu, Tanintharyi	Ye Lwin Aung PT-7322, PT-7372, PT-7373 (PE!); Xiaohua Jin et al. PT-6869 (PE!)

No.	Species	Local distribution	Specimen citations
1013	*Vanda curvifolia* (Lindl.) L.M.Gardiner	Bago; Mandalay; Yangon; Dawei (Tavoy), Tanintharyi	Griffith s.n. (K!); Mokim 454 (BM!) & (P!)
1014	*Vanda denisoniana* Benson & Rchb. f.	Reported from Myanmar	Kress et al. 2003
1015	*Vanda flabellata* (Rolfe ex Downie) Christenson	Taunggyi, Shan State	Ye Lwin Aung PT-7598 (PE!)
1016	*Vanda garayi* (Christenson) L.M.Gardiner	Alaungdaw Kathapa National Park, Sagaing	Ye Lwin Aung PT-7410 (PE!)
1017	*Vanda liouvillei* Finet	Mt. Popa, Mandalay	s.coll. s.n. (K!); Khin Myo Htwe 035062 (MBK), Khin Myo Htwe 6 (spirit collection-TNS), Khin Myo Htwe 20 (spirit collection-TNS), Khin Htwe 106 (spirit collection-MBK, TNS)
1018	***Vanda longitepala* D.L.Roberts, L.M.Gardiner & Mote**	Myitkyina District, Kachin State	Kermode 17331 (Holotype: K!)
1019	*Vanda petersiana* Schltr.	Reported from Myanmar	Kress et al. 2003
1020	*Vanda rubra* (Lindl.) L.M.Gardiner	Recorded from Myanmar	Griffith s.n. (P!)
1021	*Vanda tessellata* Hook. ex G. Don	Chin, Tanintharyi	Kress et al. 2003
1022	*Vanda testacea* (Lindl.) Rchb. f.	Mt. Popa, Mandalay; Bago; Mon; Rakhine; Tanintharyi	Khin Myo Htwe 79 (spirit collection-MBK), Khin Myo Htwe 78 & 83 (spirit collection-MBK, TNS), Khin Myo Htwe 82 (spirit collection-MBK, TNS)
1023	***Vanda vipanii* Rchb. f.**	Falam, Chin; Taunggyi, Shan	Kingdon-Ward 22961 (BM!); Abdul Khalil s.n. (BM!); s.coll. s.n. (K!)
1024	*Vandopsis gigantea* (Lindl.) Pfitzer	Reported from Myanmar	Kress et al. 2003
1025	***Vandopsis shanica* (Phillimore & W.W. Sm.) Garay**	Reported from Myanmar	Kress et al. 2003
1026	*Vandopsis undulata* (Lindl.) J.J.Sm.	Recorded from Myanmar	Forrest 13729 (E!)
1027	*Vanilla aphylla* Blume	Recorded from Myanmar	Parish 286 (K!)
1028	*Vanilla planifolia* Andrews	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
1029	*Vanilla siamensis* Rolfe ex Downie	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
1030	*Vrydagzynea albida* (Blume) Blume	Reported from Myanmar	Kress et al. 2003
1031	*Vrydagzynea nuda* Blume	Putao, Kachin	Xiaohua Jin et al. PT-6469 (PE!)
1032	*Zeuxine affinis* (Lindl.) Trimen	Mt. Popa, Mandalay	Kingdon-Ward 21758 (BM!); s.coll. s.n. (E!); Akiyama et al. 030199 (MBK); Ohi-Toma 035001 (MBK)
1033	*Zeuxine flava* (Lindl.) Benth.	Myitkyina, Kachin; Kanpetlet, Chin; Kalaw, Shan; Mt. Popa, Mandalay; Tanintharyi	Dickason 8448 (K!); Kermode 16609 (K!)
1034	*Zeuxine goodyeroides* Lindl.	Bago; Dawna range, Kayin	Lace 4606 (E!)
1035	*Zeuxine gracilis* (Breda) Blume	Mon, Tanintharyi	Kress et al. 2003
1036	*Zeuxine longilabris* (Lindl.) Trimen	Galon Reserve, Katha, Sagaing	Lace s.n. (E!)
1037	*Zeuxine membranacea* Lindl.	Mogok, Mandalay	Lace 5070 (E!)
1038	*Zeuxine nervosa* (Wall. ex Lindl.) Trimen	Hpa-an or Myawaddy District, Kayin State	Burkill 24458 p.p. (K)
1039	*Zeuxine parvifolia* (Ridl.) Seidenf.	Listed as occurrence in Myanmar	Kurzweil and Lwin 2014
1040	*Zeuxine strateumatica* (L.) Schltr.	PyinOoLwin (Maymyo), Mandalay; Shan	Swinhoe s.n. (K!); White 206 & 207 (US)

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Notes on the genus *Gastrochilus* (Orchidaceae) in Myanmar

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Abstract

Myanmar is known for its high species richness of genus *Gastrochilus*; however, most of them lack proper information for taxonomic revision. During four years of field investigation in Myanmar, two new distributional records were encountered, namely, *G. arunachalensis* and *G. corymbosus* and one species, i.e. *G. pechei* was rediscovered after its original description. The three species were not easy to interpret from the available original descriptions and types due to severely shrunk or poorly preserved specimens. Therefore, we hereby present more detailed illustrations and updated descriptions for these species, based on freshly collected materials.

Keywords

Orchidaceae, *Gastrochilus*, taxonomy, Myanmar

Introduction

The genus *Gastrochilus* D. Don was established in 1825 (Epidendroideae; Vandeae; Aeridinae) and is characterised by saccate hypochile of the lip, a distinct epichile on the front of the saccate hypochile, two porate and globose pollinia borne on a slender stipe

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and a short axillary inflorescence, often with brightly coloured flowers (Christenson 1985; Seidenfaden 1988; Tsi 1996).

This genus includes around 62 species distributed from Andamans, Sri Lanka, India and the Himalayas eastwards to southern China, Indochina and southern Japan and southwards to the Philippines and Indonesia, of which many species are narrow endemics and there is a major centre of diversity in the South-East Asian archipelago (Chen et al. 2009; Kumar et al. 2014; Govaerts et al. 2016; Liu et al. 2016, 2019; Raskoti 2016; Averyanov et al. 2018; Liu and Gao 2018). According to the latest references, there are 9 species of *Gastrochilus* distributed in Myanmar (Kress et al. 2003; Kurzweil and Lwin 2014), but these are only known from very few, sometimes single, specimens or over-simplified descriptions.

During our field investigations in Myanmar since 2015, a total of eight species of *Gastrochilus* were discovered, of which two species were new records for Myanmar and *G. pechei* (Rchb.f.) Kuntze was collected more than 125 years after its first description in 1891 (Kuntze 1891). These three species are illustrated or recorded only from the type specimens and some of the key morphological characters were hard to interpret due to severely shrunk or poorly preserved specimens. Therefore, we hereby present more detailed colour illustrations and updated descriptions of these species based on fresh materials.

Materials and method

Morphological observations of these species were based on living plants and 2–3 fertile specimens (kept in the herbaria of HITBC) or illustrations in original published papers (Das and Chanda 1988; Rao 1992). All morphological measurements were done by using a vernier calliper.

Taxonomic treatment

Gastrochilus arunachalensis **Nageswara Rao, (1992: 723)**
Figure 1

Type. INDIA. West Kameng Distinct, tropical rain forest, about 150 m a.s.l., epiphytic on tree trunks. A. N. Rao *24220* (holotype: Orchid Herbarium, Tipi!)

Description. Epiphytic herbs. Stem, erect, 4.0 cm long and 1.0 cm in diameter, with 3–4 leaves. Leaves nearly basal, distichous, oblong, 8.0–15.0 × 1.7–2.3 cm, slightly fleshy or leathery, apex obtuse and unequally 2-lobed. 1–4 inflorescences from base of stem, sub-umbellate, often 8–10-flowered; peduncle straight, 1–2 cm, stout, with 2 cupular sheaths. Flower yellow or yellow green, with dark brown or purplish spots. Sepals similar, oblanceolate, 6.8–7.0 × 3.2–3.5 mm, base contracted, apex obtuse. Petals oblanceolate, 6.2–6.5 × 2.3–2.5 mm, apex obtuse. Lip with an epichile and a saccate hypochile; epichile triangular, 2.5–3.0 × 5.4–6.0 mm, fleshy, adaxially glabrous, with a central cushion, margin irregularly fimbriate or erose, apex

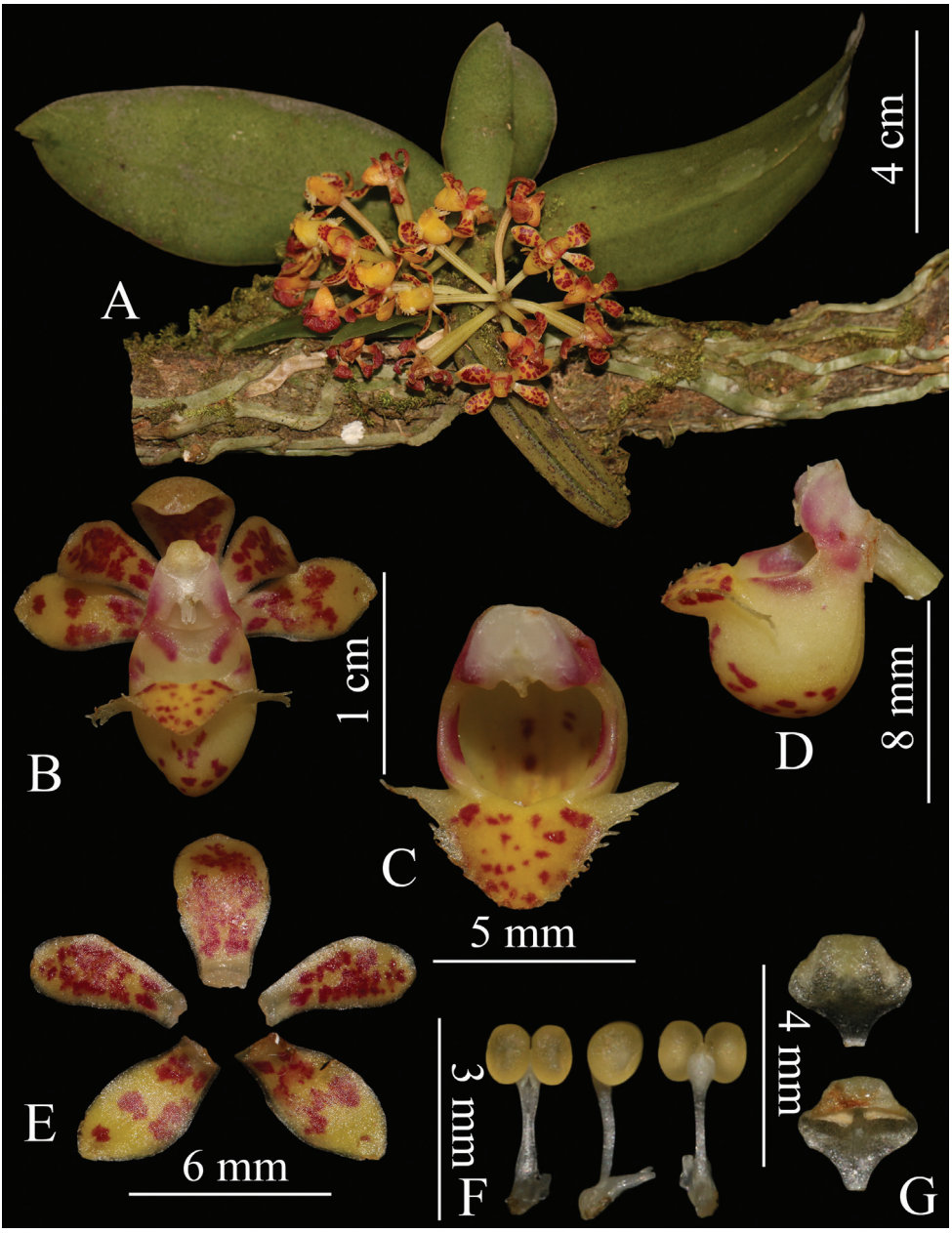

Figure 1. *Gastrochilus arunachalensis* **A** habitat **B** front view of flower **C** front view of labellum and column **D** lateral view of labellum and column **E** sepals and petals; **F.** pollinarium **G** anther cap.

rounded; hypochile cupular, ca. 6 mm tall, ca. 4 mm in diameter, white tinged with pale yellow at bottom, outside with 3 ridges. Column ca. 4 mm, stout; rostellum deeply 2–lobed; pollinia 2, ca. 1.0 mm in diam.; stipe elongate, ca. 2.0 mm; anther cap nearly subglobose, apex narrowed into a beak. Fruit cylindrical, ridged, 5–6 cm in length, 1.2–1.4 cm in diameter.

Phenology. Flowering occurs in October and November.

Distribution and habitat. *Gastrochilus arunachalensis* is previously known only from India and this is the first record from Myanmar (Putao county, Kachin state). It is epiphytic on the trunk of riparian trees in tropical rainforest in Myanmar or mixed deciduous tropical forest in India.

Additional specimens examined. MYANMAR. Kachin State. Putao County, Wasadam village, tropical forest, 750 m a.s.l., epiphyte on the trunk of riparian trees, 14 Sep 2016, *Qiang Liu 408* (HITBC!). Kachin State. Putao County, Malirun village, tropical forest, 600 m a.s.l., epiphyte on the trunk of riparian trees, 29 Nov 2017, *Yun-Hong Tan M2965* (HITBC!).

Note. *Gastrochilus arunachalensis* is an interesting species that was only known from the type specimen until recently, the key morphological characters of flowers being hard to interpret (Rao 1992). Now that fresh material has been collected in north Myanmar, a detailed description of the species, including the leaf and flower colour, leaf apex shape and features of pollinia, anther cap and rostellum, are provided here. Morphologically, it is closely related to *G. pechei* in having the sub-triangular epichile of the lip and hypochile of the lip laterally not compressed. However, it can be easily distinguished from the latter by the small stature of the plant (leaves less than 15 cm), green or yellow green flowers, oblanceolate sepals and petals, epichile triangular without central cushion (Kuntze 1891; Rao 1992).

Gastrochilus corymbosus A.P. Das & Chanda (1988: 401)

Figure 2

Type. INDIA. Jalapahar, Darjeeling (West Bengal), about 2200 m a.s.l., epiphytic on tree trunks. 29 Oct 1982, A.P. Das 823 (holotype: CAL!)

Description. Epiphytic pendulous herb. Stem often branched, pendulous and usually 8.0–15.0 cm long with 0.4–0.5 cm internodes. Leaves distichous, blade oblong or falcate-lanceolate, 2.0–4.0 × 0.4–0.9 cm, apex acute and unequally 2-lobed. Inflorescence corymb, 4–6-flowered; peduncle 1.2–1.3 cm, upper part broader, lower part with 2 cupular sheaths with purple-red spots; floral bracts ovate-triangular, ca. 3.0 , membranous; pedicle and ovary yellow-green with purple-red spots, 1.0–1.2 cm long. Flowers yellowish or yellow, with purple blotches; epichile of lip white with sparse purple spots. Dorsal sepal oblong-elliptic, concave, 5.0–6.5 × 3.6–4.5 mm, apex obtuse; lateral sepal similar to dorsal sepal, 6.2–6.5× 3.2–4.0 mm, apex obtuse; petals sub-obovate, 5.5–6.5 × 3.5–4.2 mm, apex rounded. Lip with distinct partition between wide epichile and a saccate hypochile; epichile reniform, 4.0–4.9 × 8.0–9.0 mm, adaxially glabrous, with a slightly diamond-shaped central cushion covered with small brown spots and 2 conic calli near base, margin entire or slightly denticulate, emarginate at apex; hypochile cupular, laterally compressed, 7.2–7.8 mm tall, 5.8–6.2 mm in

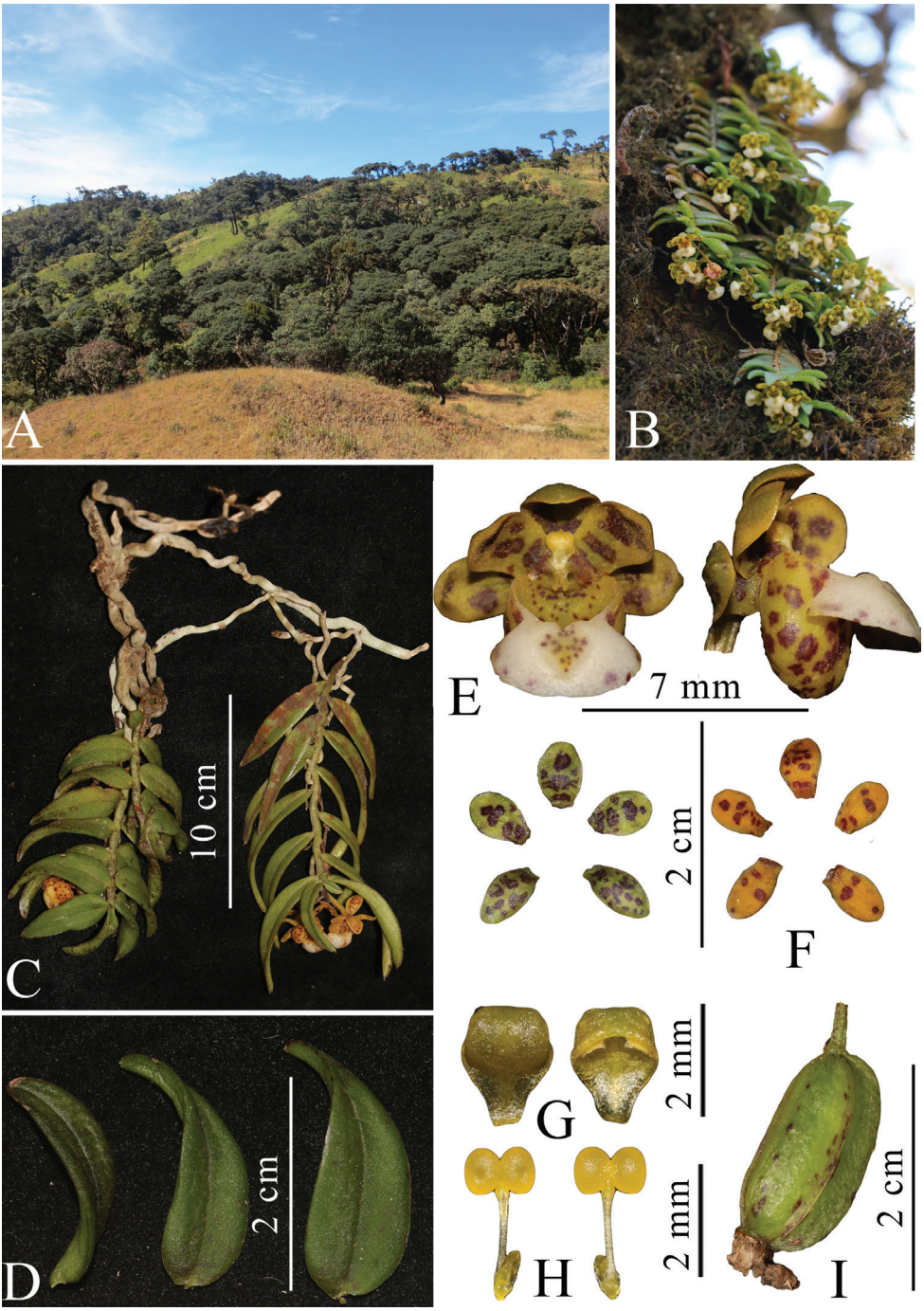

Figure 2. *Gastrochilus corymbosus* **A, B** habitat **C** plant **D** leaf **E** front and lateral view of flower **F** sepals and petals **G** anther cap **H** pollinarium **I** fruit.

diameter, apex rounded. Column stout densely with purple spots, ca. 2 mm; anther cap galeate with recurved acuminate apex, 2.0 × 2.2 mm; pollinia 2, ca. 1.0 mm in diam.; stipe elongate, ca. 2.0 mm; rostellum bilobed with acuminate apex. Capsules cylindrical with 3 ridges, ca. 2.0 × 1.2 cm.

Phenology. Flowering occurs in April to October.

Distribution and habitat. *Gastrochilus corymbosus* is previously only known from the India and this is the first time that it has been recorded in the Natma Taung (Mt. Victoria) National Park, Chin State, Myanmar. It was found growing as an epiphyte on the tree trunks in a *Rhododendron* forest, which is dominated by *Rhododendron protistum* var. *giganteum* (Forrest) D.F. Chamberlain.

Additional specimens examined. MYANMAR. Chin State. Natma Taung (Mt. Victoria) National Park, 2750 m a.s.l., epiphyte on the trunk of Alpine Rhododendron forests, 9 Jan 2017, *Qiang Liu 414* (HITBC!). Natma Taung (Mt.Victoria) National Park, 2900 m a.s.l., epiphyte on the trunk of Alpine Rhododendron forests, 30 Apr 2017, *Yun-Hong Tan M1271* (HITBC!).

Note. Only a single specimen and illustration of this species previously existed, on which the original description was based (Das and Chanda 1988). Foliar and floral characteristics were not described in sufficient detail in the original description, due to the extremely poor state of the preserved specimen and it was not possible to conduct a detailed study on this species. Now that fresh material has become available, a detailed description of the species has been provided here. On the basis of the long and pendulous stem, *G. corymbosus* can be placed in section *Microphyllae* (Tsi 1996). This species exhibits great variation between populations in leaf shape from falcate-lanceolate to oblong (Figure 2 C). Morphologically, it shows a close affinity to *G. distichus* (Lindley) Kuntze, but differs from the latter by having much shorter (less than 15 cm) and stout stem, apex of leaf unequally 2-lobed without awns, inflorescences corymb with 4–6-flowers, epichile of lip with a slightly diamond shaped central cushion, margin entire or slightly denticulate, emarginate at apex (Das and Chanda 1988; Chen et al. 2009).

Gastrochilus pechei **(Reichenbach f.) Kuntze (1891: 661)**

Figure 3

Saccolabium pechei Reichenbach f. (1889: 447) (Basionym)

Type. MYANMAR. s. coll., s. n. (Holotype: K!)

Description. Epiphytic herbs. Stem 1.0–1.5 cm, stout, with 4–5 leaves. Leaves nearly basal, distichous, oblong, 15–20 × 3.5–4.5 cm, slightly fleshy or leathery, apex obtuse and unequally 2-lobed. Inflorescences 1–4, from base of stem, sub-umbellate, often 4–6-flowered; peduncle straight, 1.5–2.5 cm, stout, with 2 cupular sheaths. Flower with yellow sepals and petals and white labellum, all dense with purplish spots. Sepals similar, spatulate, 11.8–12.5 × 4.2–5.4 mm, base contracted, apex obtuse. Petals spatulate, 11.5–11.7 × 4.0–4.2 mm, apex obtuse. Lip with an epichile and a saccate hypochile; epichile subtriangular, 5.0–5.2 × 15.1–15.4 mm, fleshy, adaxially glabrous,

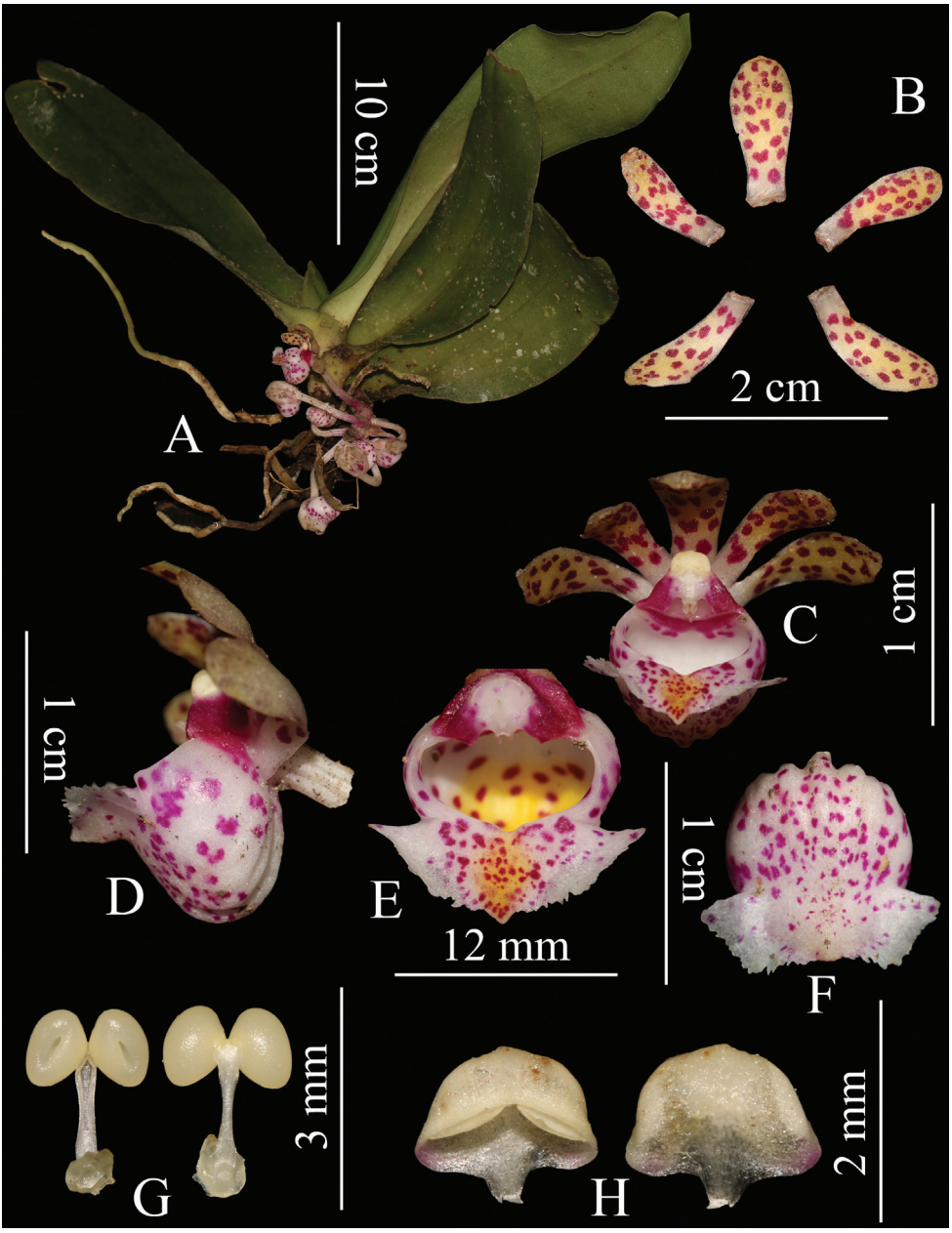

Figure 3. *Gastrochilus pechei* **A** plant **B** sepals and petals **C** front view of flower **D** lateral view of flower **E** adaxial labellum **F** abaxial labellum **G** pollinarium **H** anther cap.

with a central cushion with a yellow blotch, margin irregularly erose, apex acute; hypochile subglobose, ca. 8 mm tall, ca. 8.4 mm in diameter, white tinged with yellow at bottom, outside with 5 ridges. Column ca. 3 mm, stout; rostellum deeply 2–lobed; pollinia 2, ca. 1.2 mm in diam.; stipe elongate, ca. 1.5 mm; anther cap nearly subglobose, apex narrowed into a beak.

Phenology. Flowering occurs in August and September.

Distribution and habitat. *Gastrochilus pechei* was originally recorded from Myanmar without detailed information about locality. Here in the manuscript, we have confirmed the occurrence of this species in north Myanmar in the Naungmeng town, Putao county, Kachin state. It was growing epiphytically on the trunk of riparian trees in tropical rainforest which is dominated by *Dipterocarpus obtusifolius* Teijsm. ex Miq. (Dipterocarpaceae).

Additional specimens examined. MYANMAR. Kachin State. Putao County, Naungmeng town, tropical forest, 700–800 m a.s.l., epiphyte on the trunk of riparian trees, 8 August 2017, *Qiang Liu 470* (HITBC!).

Note. *Gastrochilus pechei* was only known from the type specimen until recently and, because this specimen was poorly preserved and severely shrunk, the key morphological characters of this species, such as flower colour and shape, were hard to interpret. As far as we can tell, there had been no subsequent collections of this species since 1889. Now that fresh material has become available, a detailed description of the species, including the plant and flower characters and information of distributed location, habitat and altitude, can be provided here. Morphologically, it shows a close affinity to *G. obliquus*, *G. somai* and *G. arunachalensis*. However, it differs from *G. obliquus* by having the slightly irregularly erose margin on the epichile, apex of epichile acute and subglobose hypochile (significantly lacerate or erose on epichile margin, apex of epichile obtuse and subglobose-cucullate and laterally compressed hypochile in *G. obliquus*) (Chen et al. 2009); from *G. somai*, it can be differentiated on being a large plant (leaves 15–20 × 3.5–4.5 cm), yellow sepals and petals and white labellum, all densely covered with purplish spots (smaller plant (3.5–4.2 × 1.2–1.7 cm), yellow-green sepals and petals without purplish spots and white labellum with yellow blotch on the centre of the epichile in *G. somai*) (Jin et al. 2010); from *G. arunachalensis*, by having spathulate sepals and petals, sub-triangular epichile with central cushion and subglobose hypochile (oblanceolate sepals and petals, triangular epichile without central cushion and cupular hypochile in *G. arunachalensis*) (Rao 1992).

Discussion. The orchid flora of Myanmar is highly diverse but poorly known due to very few comprehensive studies. According to our current knowledge, about 800 orchid species are distributed in Myanmar (Kurzweil and Lwin 2014), but this is probably an underestimate. Many new distribution records and new species have been published in the last few years (Aung et al. 2017; Liu et al. 2017, 2018; Yang et al. 2017; Aung and Jin 2018, Zhou et al. 2018).

Although the genus of *Gastrochius* is small, it is easy to be confused with other taxa of Aeridinae when it is without flowers and is also difficult to be identified within species even during the flowering period. So, many species may be misidentified as other taxa. Meanwhile, Myanmar lies in southeast Asia, with the northern part bordering with southwest China and India and the southern part connecting with Thailand, all of these regions being rich in species of *Gastrochilus*. Therefore, we believe that more and more species of *Gastrochilu*s will be found when undertaking further field investigations and systematic studies.

Key to the species of *Gastrochilus* D. Don in Myanmar

1 Hypochile strongly dorsiventrally compressed from middle to tip, subtruncate and concave at tip ..... ***G. platycalcaratus***
– Hypochile subglobose or cupular, not dorsiventrally compressed **2**
2 Hypochile subglobose and laterally compressed..... ***G. obliquus***
– Hypochile subglobose or cupular, not compressed **3**
3 Stem erect **4**
– Stem pendulous **5**
4 Sepals and petals oblanceolate, epichile triangular without central cushion, epichile margin irregularly fimbriate or erose ..... ***G. arunachalensis***
– Sepals and petals spatulate, epichile subtriangular with central cushion, epichile margin lacerate or erose..... ***G. pechei***
5 Epichile densely haired adaxially and with a cavity at base..... **6**
– Epichile glabrous without cavity at base **7**
6 Flowers size 2–3 cm in diam., hypochile subconic or subglobose ..... ***G. bellinus***
– Flowers size 1–1.8 cm in diam., hypochile galeate..... ***G. calceolaris***
7 Stem stout and leaf over 5 cm in length **8**
– Stem slender and leaf less 3 cm in length..... **9**
8 Flower large (1.8–2.0 cm in diam.) and epichile margin entire..... ***G. acutifolius***
– Flower small (0.6–0.8 cm in diam.) and epichile margin erose or irregular toothed ..... ***G. intermedius***
9 Epichile sub-elliptic, without central cushion and conic calli.... ***G. pseododistichus***
– Epichile sub-orbicular, with a central cushion, base with 2 conic calli **10**
10 Short (less than 15 cm) and stout stem, leaf apex unequally 2-lobed without awns, inflorescences corymb with 4–6-flowered ..... ***G. corymbosus***
– Long (more than 30 cm) and slender stem, leaf apex with 2 or 3 awns, inflorescences subumbellate with 2–4-flowered..... ***G. distichus***

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Bulbophyllum papuaense (Orchidaceae), a new species from Indonesia

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Abstract

A new species, *Bulbophyllum papuaense*, was described and illustrated from Indonesia. *Bulbophyllum papuaense* is similar to *Bulbophyllum tortuosum* and *B. muscohaerens* but differs from them by having rhizome and pseudobulbs covered with papillose scales, caudate and ciliate petals, linear and ciliate lip.

Keywords

Bulbophyllum, Indonesia, new species, Orchidaceae

Introduction

Bulbophyllum is among the largest genera of angiosperm, composed of more than 2200 species and widely distributed in tropical and subtropical regions throughout Africa, Asia, and the South Americas (Lindley 1830, Pearce and Cribb 2002, Seidenfaden 1979, 1992, Chen and Vermeulen 2009, Gravendeel and Vermeulen 2014, Chase et al. 2015, Govaerts et al. 2019, Vermeulen and O'Byrne 2011). *Bulbophyllum* is usually characterized by its creeping or pendent rhizomes with 1-internoded pseudobulbs, apex of pseudobulb with one or two non-sheathing leaves, inflorescences arising from nodes the rhizome, lateral sepals and column foot forming mentum, and waxy pollinia (Gravendeel and Vermeulen 2014).

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Papua is the largest tropical island in the world and has a rich flora. It is estimated that there are 2869 orchid species in Papua (Ormerod 2017), most of which are endemic in Papua. For example, there are about 647 species in 36 sections of *Bulbophyllum* in New Guinea, out of which 590 species are endemic (Ormerod 2017). Most of these species are distributed in tropical montane forest (Ormerod 2017). During our fieldwork in montane forest in West Papua, Indonesia, in August 2016, a new species of *Bulbophyllum* was discovered and is described below.

Taxonomy

Bulbophyllum papuaense **X.H.Jin, sp. nov.**
urn:lsid:ipni.org:names:77204197-1
Figures 1–3

Type. Indonesia. West Papua, Mokwan, Arfak Mountains, 1700–1900 m, August 16, 2016, Xiaohua Jin 17434 (holotype, BO; isotype, PE).

Diagnosis. *Bulbophyllum papuaense* is close to *Bulbophyllum tortuosum* and *B. muscohaerens* but differs from them by having rhizome and pseudobulbs covered with papillose scales, caudate and ciliate petals, linear and ciliate lip which curve at the tip.

Description. Epiphytic herb. Rhizome slender, creeping or pending with spreading roots, ca. 0.4 mm in diameter, brown, warty. Pseudobulbs elliptic, fleshy, ad-pressed to the stem, ca. 2.2 × 1.0 mm, with a long membranous sheath at base, usually 1-leaved. Leaf ca. 14 × 6.0 mm, elliptic to oval, entire, middle vein concave, apex mucronate, subsessile, young leaves green then turning reddish purple. Inflorescence solitary, usually 1-flowered, peduncle slender and short, ca. 1 mm long, base covered with long bract. Bracts tubular at base and caudate, 3–5 mm long. Flowers small, reddish purple, lateral sepals connate along their margins, together forming a somewhat boat-shaped structure, ca. 4.2 × 3.0 mm, margins entire, ciliolate in the proximal 1/2 from the base; median sepal oblong, apex attenuate to acuminate, ca. 5.5 × 2.0 mm, margin entire with obvious ciliate, 3-veined; petals much smaller than sepals, triangular and caudate, ca. 2.7 mm long, 1-veined, ciliate, apex contract to linear (caudate) and nearly 3 times as long as the basal part, margins with minutely white hairs; lip linear, recurved, dark reddish purple, ca. 2.6 mm long, with short white hairs, apex slightly widened with long and white hairs, a small triangular protuberance at base. Column white, including stelidia ca. 1.2 mm long, stelidia triangular, ca. 0.2 mm long, acute, with triangular and acute tooth along the upper margin; column foot 1 mm long; mentum cylindric, conspicuous, ca. 1 × 0.5 mm; pollinia 2.

Ecology. *Bulbophyllum papuaense* was discovered in broad-leaved, evergreen montane forest in Mokwan, West Papua. *Bulbophyllum papuaense* is epiphytic on trunks or shrub in humid and shady areas in montane forest. Plants are tiny and grow usually with moss. Our observation indicated that it was in full bloom in August. *Bulbophyllum papuaense* is only known from the type locality.

Conservation status. The tropical montane rain forest is well protected in Mokwan region. However, the rain forest is very difficult to reach due to poor transportation. Our

Figure 1. Habit of *Bulbophyllum papuaense*.

Figure 2. Close-up of flowers of *Bulbophyllum papuaense*.

examination in BO and Herbarium of Universitas Papua (Manokwari) did not find other collections of this species. Therefore, this new species is currently considered as DD.

Etymology. The name derives from the Papua, where the new species was discovered.

Taxonomic notes. *Bulbophyllum papuaense* belongs to sect. *Oxysepala* which is often characterized by 1-flowered inflorescence, lateral sepals connate, basal node of pedicel near at same level with the attachment of floral bract (Vermeulen et al. 2015). *Bulbophyllum papuaense* is a distinctive species in sect. *Oxysepala* and easily differs from its relatives by its morphological characters, such as the rhizome with warty scales, caudate and ciliate petals, linear lip recurve and with white hairs.

Key to *Bulbophyllum papuaense* and its alliance

1 Lateral sepals forming a boated-shaped structure by the adherence of their lower margins **2**

– Lateral sepals free from each other adherent along their lower margins forming a boated-shaped structure ..... ***B. leptoglossum***

2 Rhizome elongate, pseudobulbs well-spaced along the rhizome **3**

– Rhizome short, pseudobulbs clustered ..... ***B. aberrans***

3 lip less than 0.5 mm wide, ration length/width about 10 ..... **4**

– lip more than 0.5 mm wide, ration length/width about 2 ..... ***B. tortuosum***

4 petals ciliate and caudate, lip ciliate along the margin and curve at tip ..... ***B. papuaense***

– petal (elliptic-) ovate, margin entire, lip ciliate at base ..... ***B. muscohaerens***

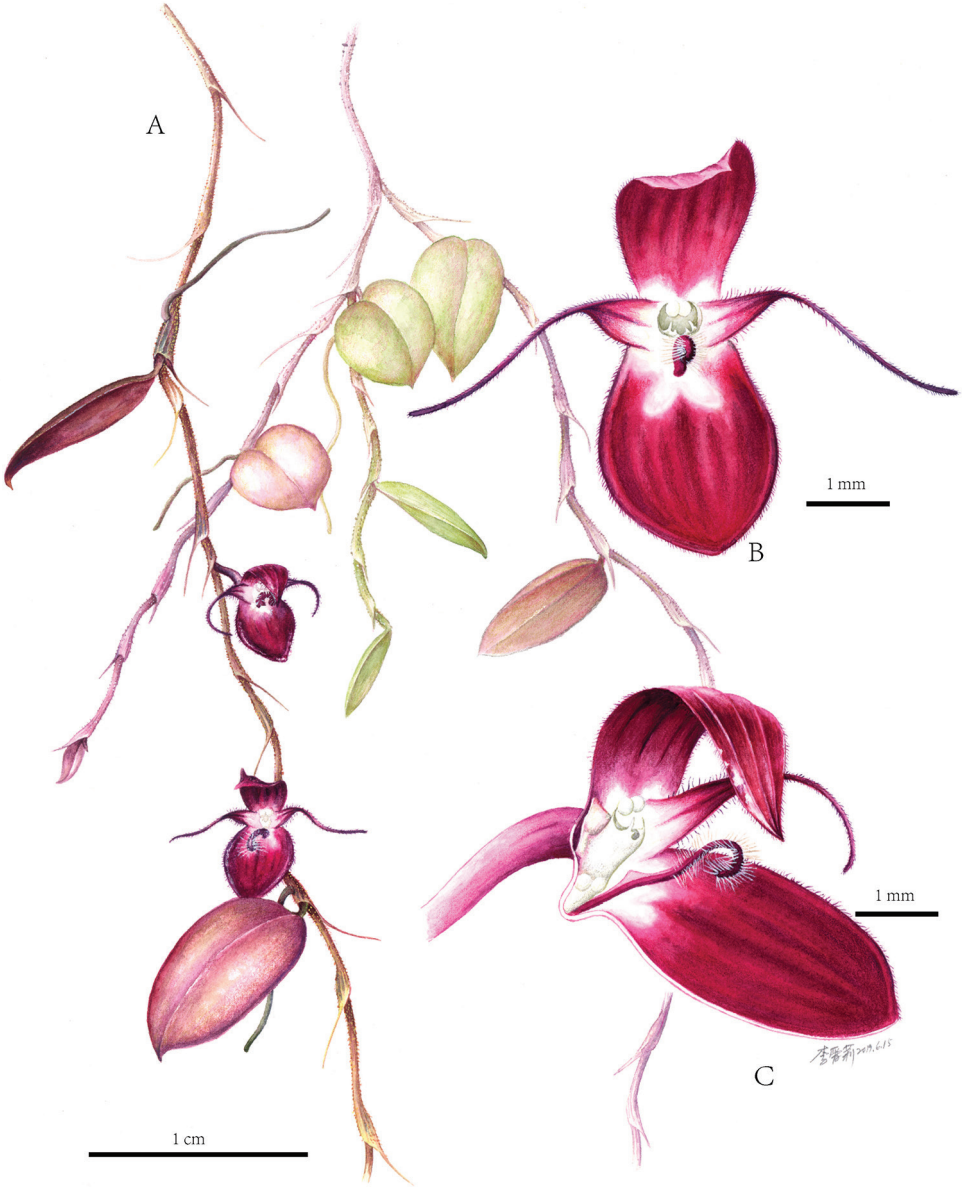

Figure 3. Color drawing of *Bulbophyllum papuaense* **A** Plants **B** front view of flower **C** lateral view of flower.

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RESEARCH ARTICLE

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A new species of *Zingiber* (Zingiberaceae) from Natma Taung National Park, Chin State, Myanmar

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Abstract

Zingiber natmataungense S.S.Zhou & R.Li (Zingiberaceae), a new species from Natma Taung National Park, Chin State, Myanmar, is described and illustrated. The new species is morphologically similar to *Z. yunnanense*, but differs by: leaf blade abaxially light green, glabrous, ligule sparsely pubescent, ca. 2–3 mm, bracts glabrous; calyx white 20–21 × 3.2–3.5 mm, glabrous, apex obviously 3-toothed; corolla tube white, ca. 3.9–4.1 cm, labellum lateral lobes, ca. 1.5–1.7 × 0.6–0.7 cm; stamen with sparse pubescent, filament white, glabrous, 1–2 mm; anther connective appendage yellowish proximally, purplish distally; ovary white, sparsely white pubescent, epigynous glands, ca. 6–7 mm long, tapered, apex whorled, yellow. This new species is also similar to *Z. teres*, but has a different flower colour.

Keywords

Zingiber new species, Myanmar, Taxonomy, Zingiberaceae

Introduction

Zingiberaceae is a pantropical and subtropical family, but with most species distributed in South and Southeast Asia. Zingiberaceae consist of about 50 genera and 1300 species. There are about 100 to 150 species in *Zingiber*, out of which 42 occur in China (Wu and Larsen 2000). Plants of the genus *Zingiber* are widely used throughout the

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world as foods and as herbal remedies in various traditional healing systems because of their wide range of bioactivities (Sharifi-Rad et al. 2017). In the last decade, one new genus and several new species of Zingiberaceae have been described from Myanmar (Kress et al. 2010; Gowda et al. 2012; Ding et al. 2018; Tanaka and Aung 2019). Two new species of *Zingiber* were reported recently from the west and northwest of Myanmar (Aung et al. 2017; Tanaka and Aung 2017). Plant diversity in Myanmar has certainly been underestimated so far and there is an urgent need for both botanical exploration and plant conservation (Jin et al. 2018).

Since 2014, cooperation between the Ministry of Natural Resources and Environmental Conservation in Myanmar and the Chinese Academy of Sciences (CAS) has resulted in more than ten joint biodiversity investigations in northern and western Myanmar by researchers from the Forest Department of Myanmar and CAS institutions. During our investigations from October 2016 to July 2019, in Natma Taung National Park, Chin State, western Myanmar, a new species of *Zingiber* was discovered and is described as follows.

Materials and methods

According to the published method (Stearn 1983), the morphological description of the new species was prepared from living plants and five dried herbarium specimens (HITBC: herbarium of Xishuangbanna Tropical Botanical Garden, the Chinese Academy of Science). Measurements were made using a vernier caliper. Herbarium and fresh specimens of *Zingiber yunnanense* (KUN: herbaria of Kunming Institute of Botany, the Chinese Academy of Science, Specimen number No.0833231 or No.0833232) and *Zingiber teres* (KUN, Specimen number No. 0833210) were also examined.

Taxonomy

Zingiber natmataungense **S.S.Zhou & R.Li, sp. nov.**
urn:lsid:ipni.org:names:77204198-1
Fig. 1

Diagnosis. *Zingiber natmataungense* is similar to *Zingiber yunnanense* S. Q. Tong & X. Z. Liu (Tong and Liu 1991; Wu and Chen 1997), but differs from it by leaf blade abaxially light green, ligule sparse pubescent, bracts glabrous; calyx white and glabrous, apex obviously 3-toothed; lateral lobes, ca. 1.5–1.7 × 0.6–0.7 cm; stamen with sparse pubescence, filament white and glabrous, 1–2 mm; anther connective appendage yellowish proximally, purplish distally; ovary white with sparse white pubescence; epigynous glands tapering, yellow. This new species also shows some morphological affinities with *Z. teres* S. Q. Tong & Y. M. Xia (Tong and Xia 1987), but differs from it by corolla tube white, ca. 3.9–4.1 cm; central lobe white; lateral lobes white, 28–30 × 4–5 mm; labellum central lobe white, apex undulate and lobed, purplish-spotted at base, 28–29 × 16–18 mm. (Fig. 2).

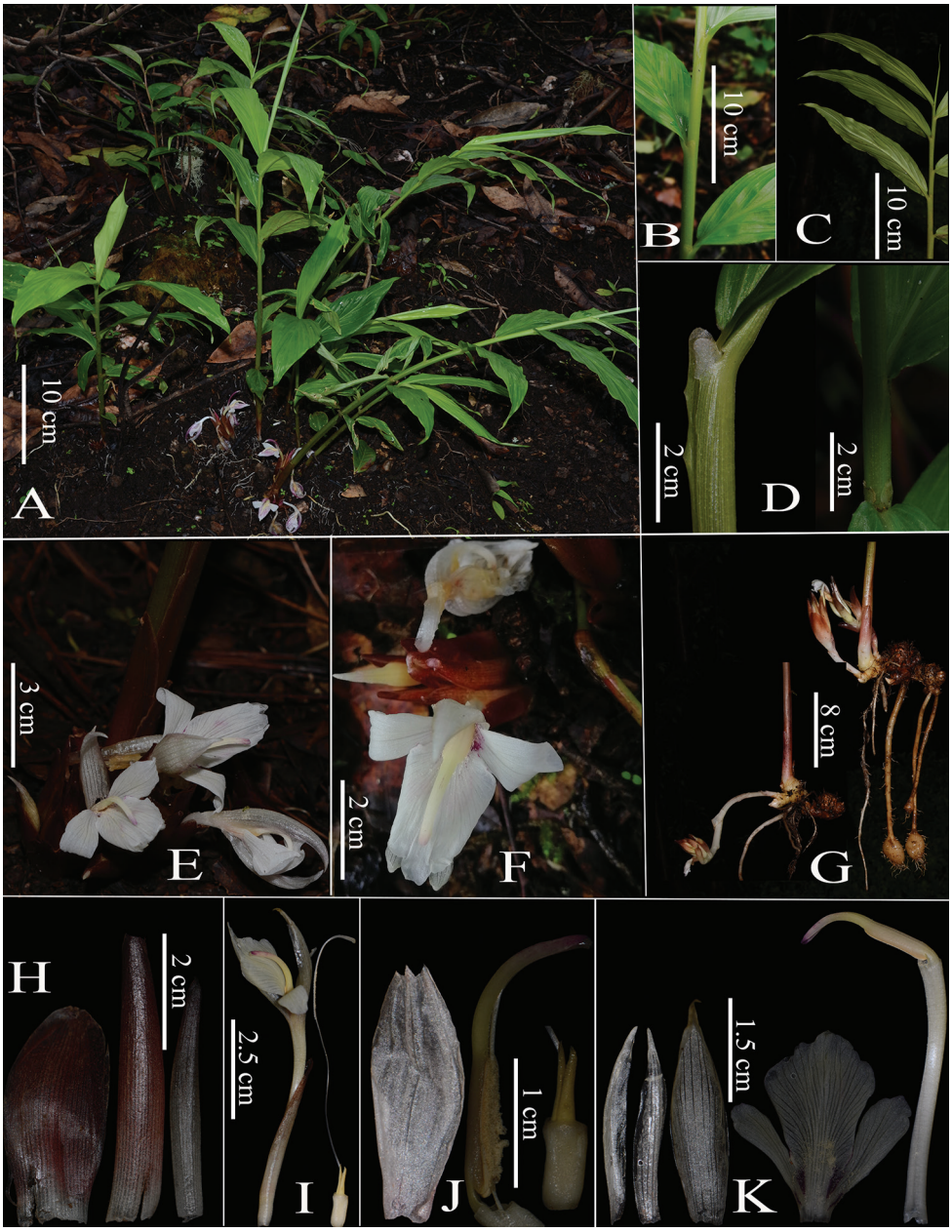

Figure 1. *Zingiber natmataungense* S.S.Zhou & R.Li, sp. nov. **A** habitat **B–D** pseudostem and detail of ligules **E** inflorescence **F** flower **G** inflorescence and rhizome **H** bract **I** flower and style **J** calyx and detail of ovary with epigynous glands and anther **K** dissection (from left): corolla lobes and labellum, floral tube with anther in side view.

Type. Myanmar. Chin State. Natma Taung (Mt. Victoria) National Park, under evergreen broad-leaved forest in tropical montane forest, 1900–2000 m alt., 9 July 2019, Shi Shun-Zhou 15828 (holotype: HITBC!, Herb. Bar. Code No. 169318; isotype: RAF!).

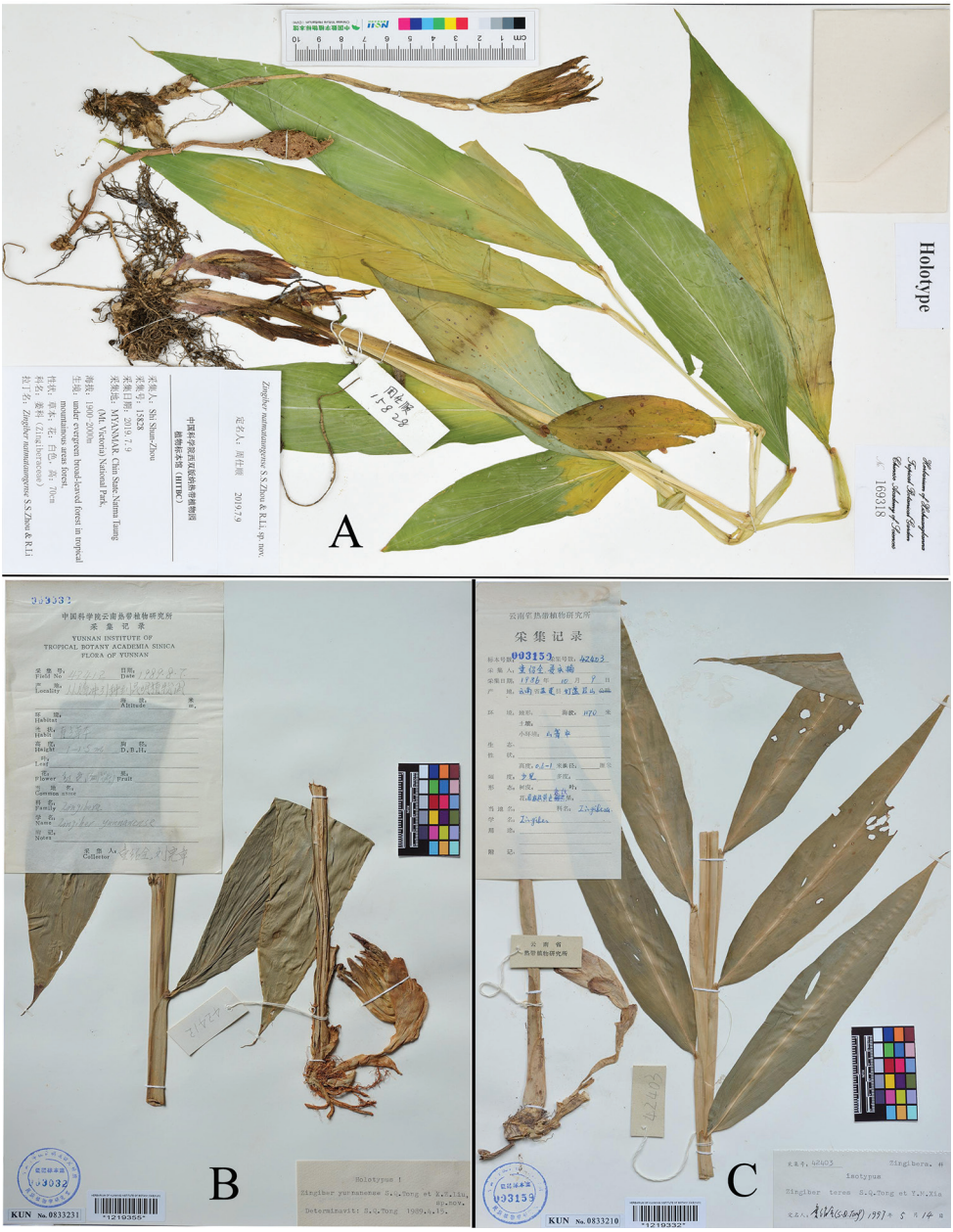

Figure 2. A Holotype of *Zingiber natmataungense* S.S.Zhou & R.Li, sp. nov (S.S. Zhou. 15828, HITBC Acc. No. 169318) **B** holotype of *Z. yunnanense* S.Q.Tong et X.Z.Liu (Tong, S.Q. & Liu, X.Z. 42412, KUN Acc. No. 0833231) **C** isotype of *Z. teres* S.Q.Tong et Y.M.Xia (Tong, S.Q. & Xia, Y.M. 42403, KUN Acc. No. 0833210).

Description. Pseudostems 50–80 cm, base with purplish-red sheaths. Rhizome yellow, aromatic. Leaves subsessile, ligule 2-lobed, 2–3 mm, sparsely pubescent; leaf blade green, abaxially light green, lanceolate or narrowly, ca. 5–25 × 3–5 cm, glabrous,

Table 1. Diagnostic morphological characters of *Zingiber natmataungense*, *Z. yunnanense* and *Z. teres*.

Characters	*Zingiber natmataungense*	*Zingiber yunnanense*	*Zingiber teres*
Leaf blade	abaxially light green, glabrous	abaxially purplish-red on basal leaves, sparsely hairy	glabrous except sparsely puberulent along mid-vein abaxially
Ligule	sparsely pubescent, ca. 2–3 mm	densely pubescent, 4–7 mm	pubescent, 2–4 mm
Bracts	glabrous	slightly hairy	glabrous except red pubescent at acute or acuminate apex
Calyx	white 20–21 × 3.2–3.5 mm, glabrous, apex obscurely 3-toothed	white with red base and apex, ca. 10 mm, sparsely hairy, apex truncate	apex obscurely 3-toothed, 14–16 mm
Corolla tube	white, ca. 3.9–4.1 cm	white with red apex, ca. 3.7 cm	yellow, ca. 4–5 cm
Central lobe	White, 31–33 × 8–9 mm	red with slightly yellowish-green base, ca. 33 × 13 mm	yellow, 26–30 × 9–10 mm
Lateral lobes	White, 28–30 × 4–5 mm	red with slightly yellowish-green base, ca. 33 × 13 mm	yellow, 20–22 × 5–7 mm
Labellum central lobe	white, apex undulate and lobed, purplish- spotted at base, 28–29 × 16–18 mm	white with purple lines, elliptic, ca. 28 × 17 mm	purple with yellow stripes, apex acuminate, 18–20 × 11–13 mm
Labellum Lateral lobes	ca. 1.5–1.7 × 0.6–0.7 cm	ca. 0.7 × 0.45 cm	small
Stamen	sparsely pubescent,	glabrous	glabrous
Filament	white, glabrous, 1–2 mm	no filament	no filament
Anther connective appendage	yellowish proximally, purplish distally, 14–16 mm	purplish, 2-cleft ca. 15 mm	yellow proximally, purple distally, ca. 10 mm
Ovary	sparsely white pubescent	densely white pubescent	densely white pubescent
Epigynous glands	yellow, ca. 6–7 mm, tapered, apex whorled	white, ca. 5 mm, linear	white, ca. 4 mm, linear

base cuneate, apex acuminate or caudate. Inflorescences radical, ellipsoid, ca. 5–6 × 2–3.5 cm, ellipsoid or narrow ellipsoid; peduncle embedded in ground, 3–16 cm; bracts glabrous, outer ones purple, elliptic, apex blunt, ca. 4–4.2 × 2–2.3 cm, inner ones purple, purplish at base, long ellipsoid or lanceolate, ca. 4.5–5.0 × 1.3–1.7 cm; bracteoles white, purplish-spotted at apex, white at base, tubular, 43–45 × 4.5–5 mm. Calyx white 20–21 × 3.2–3.5 mm, apex obviously 3-toothed, glabrous. Corolla tube white, glabrous, ca. 3.9–4.1 cm; central lobe white with apex caudate-acuminate, ca. 3.1–3.3 × 0.8–0.9 cm; lateral lobes with acuminate apex, 2.8–3.0 × 0.4–0.5 cm. Labellum white, glabrous, apex undulate and lobed, purplish plaque at base; central lobe obovate, ca. 2.8–2.9 × 1.6–1.8 cm; lateral ones oblanceolate, ca. 1.5–1.7 × 0.6–0.7 cm. Stamen with sparse pubescence, ca. 2.4–2.6 cm; filament white, glabrous,1–2 mm; anther yellowish, ca. 1–1.1 cm; connective appendage yellowish proximally, purplish distally, ca. 1.4–1.6 cm. Ovary white, sparsely white pubescent; style white, glabrous, stigma slightly thicker than style, white, ostiole front facing, ciliate. Epigynous glands 2, ca. 6–7 mm tapered, apex whorled, yellow. Fruit unknown.

Etymology. The new species is named after Natma Taung National Park, Chin State, Myanmar, where it was discovered in a vast area of monsoon forest.

Phenology. Flowering from July to August.

Distribution and habitat. *Zingiber natmataungense* is only known from the type locality. It is a terrestrial plant in monsoon forest dominated by *Castanopsis tribuloides* (Smith)

A. de Candolle (Fagaceae) and *Nyssa javanica* (Blume) Wangerin (Nyssaceae) and narrowly distributed from 1900 m to 2000 m alt. It has been used as a traditional medicine by local Chin people, who cover wounds with freshly crushed rhizomes and also apply it as a substitution for common ginger to treat coughs by drinking water in which it has been boiled.

Critical note. The new species most resembles *Zingiber yunnanense* and *Z. teres*. Detailed morphological differences between the two species are given in Table 1.

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Taxonomic studies on *Amomum* Roxburgh s.l. (Zingiberaceae) in Myanmar II: one new species and five new records for the flora of Myanmar

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Abstract

In the course of a study of *Amomum* s.l. (Zingiberaceae) in Myanmar, *Amomum schistocalyx* Y.H. Tan & H.B. Ding, from Htamanti Wildlife Sanctuary, Sangaing Region of Northern Myanmar is described and illustrated as new to science here. Five taxa: *A. yingjiangense* S.Q. Tong & Y.M. Xia, *A. carnosum* V.P. Thomas & M. Sabu, *A. tibeticum* (T.L. Wu & S.J. Chen) X.E. Ye, L. Bai & N.H. Xia, *Lanxangia scarlatina* (H.T. Tsai & P.S. Chen) M.F. Newman & Škorničk, and *Meistera yunnanensis* (S.Q. Tong) Škorničk. & M.F. Newman, are newly recorded from Myanmar. The photographic illustrations, the distributions, and voucher specimens for each species are provided.

Keywords

Kachin State, *Lanxangia*, *Meistera*, Putao District, Sangaing Region

Introduction

Amomum s.l. (Roxburgh 1820: 75) is the second largest genus in the family Zingiberaceae with about 150–180 species (Xia et al. 2004; Thomas et al. 2016). It is distributed from the Himalayas throughout Southeast Asia to northern Australia and extends into the central Pacific (Tripathi and Prakash 1999; Xia et al. 2004; Kaewsri

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and Paisooksantivatana 2007), the centre of endemism being the forests of Southeast Asia (Droop and Newman 2014). Based on molecular phylogenetic analyses by De Boer et al. (2018), *Amomum* s.l. are now categorised into seven monophyletic genera, namely *Amomum* s.s., *Conamomum* Ridley (1899: 121), *Meistera* Giseke (1792: 205), *Wurfbainia* Giseke (1792: 206), *Epiamomum* A.D. Poulsen & Škorničková (De Boer et al. 2018: 22), *Lanxangia* M.F. Newman & Škorničková (De Boer et al. 2018: 23) and *Sundamomum* A.D. Poulsen & M.F. Newman (De Boer et al. 2018: 27).

According to this new treatment, the Myanmar species previously classified in *Amomum* s.l. are now categorised into three genera, namely *Amomum* s.s. (7 species: *A. dealbatum* Roxb., *A. robertsonii* Craib, *A. sericeum* Roxb., *A. subulatum* Roxb., *A. erythranthum* Y.H. Tan & H.B. Ding, *A. ampliflorum* Y.H. Tan & H.B. Ding, *A. pauciflorum* Baker), *Meistera* (2 species: *M. aculeata* (Roxb.) Škorničk. & M.F. Newman, *M. koenigii* (J.F.Gmel.) Škorničk. & M.F. Newman) and *Wurfbainia* (4 species: *W. aromatica* (Roxb.) Škorničk. & A.D. Poulsen, *W. gramine*a (Wall. ex Baker) Škorničk. & A.D. Poulsen, *W. villosa* (Lour.) Škorničk. & A.D.Poulsen, *W. microcarpa* (C.F. Liang & D. Fang) Škorničk. & A.D. Poulsen) (Kress et al. 2003; De Boer et al. 2018; Ding et al. 2019). In the course of a study of *Amomum* s.l. (Zingiberaceae) in Myanmar, one new species, *A. schistocalyx* Y.H. Tan & H.B. Ding, is described and illustrated as new to science here. Five taxa: *A. yingjiangense* S.Q. Tong & Y.M. Xia, *A. carnosum* V.P. Thomas & M. Sabu, *A. tibeticum* (T.L. Wu & S.J. Chen) X.E. Ye, L. Bai & N.H. Xia, *L. scarlatina* (H.T. Tsai & P.S. Chen) M.F. Newman & Škorničk, and *M. yunnanensis* (S.Q. Tong) Škorničk. & M.F. Newman, are newly recorded from Myanmar here. As a result, the total number of *Amomum* s.l. recorded in Myanmar is presently raised to 19. The number of species occurring in Myanmar is still too small. Further extensive fieldwork would reveal much more species diversity of Myanmar *Amomum* s.l.

Taxonomic treatment

***Amomum schistocalyx* Y.H.Tan & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204200-1
Fig. 1

Diagnosis. *Amomum schistocalyx* Y.H. Tan & H.B. Ding is similar to *A. putrescens* D. Fang (1978: 51) in having lax inflorescence, similar yellow flowers, non-tubular bracteoles and green fruits, but can be distinguished by its leaves abaxially densely appressed silvery pubescent (vs. glabrous leaves), 2-cleft ligule (vs. entire ligule), non-tubular calyx (vs. tubular calyx), epigynous glands 2 mm (vs. 5 mm).

Type. Myanmar. Sangaing Region, Hkamti District, near Htamanti village. 95°22'40.42"E, 25°22'32.40"N; 135 m elev., 3 June 2019, *Y.H. Tan & H.B. Ding M5785* (holotype: HITBC!; isotypes: RAF!).

Description. Clump-forming herb, 1.0–2.0 m tall. Pseudostem with 2–7 leaves per pseudostem, swollen at base, greenish yellow or brownish yellow; ligule ovate,

Figure 1. *Amomum schistocalyx* Y.H.Tan & H.B.Ding, sp. nov. **A** habit **B** leaf blade abaxially **C, D** ligule **E** pseudostem **F** flowers (front view) **G** flowers (back view) and showing non-tubular calyx (even when flower budding) **H** inflorescence **I** infructescence **J** single flower **K** single fruit **L** cross section of fruit **M** bracteole **N** calyx **O** dorsal corolla lobe **P** lateral corolla lobes **Q** labellum with floral tube and lateral staminodes **R** stamen with stigma and style (back view) **S** stamen with stigma and style (front view) **T** ovary with pedicel **U** epigynous glands. Photographed by H.B. Ding.

2-lobed to middle or bottom, 2.0–4.0 cm long, yellowish brown, membranous, fragile, pubescent, apex acute; petiole 2.0–7.0 cm; leaf blade adaxially green, abaxially silvery, elliptic to oblong-lanceolate, 17–50 × 6–10 cm, adaxially glabrous, abaxially densely appressed silvery pubescent, base attenuate, apex caudate. Inflorescence radical, 5.0–18.0 cm, arising from the rhizome, one inflorescences per pseudostem, peduncle 4.0–10.0 cm, reddish-brown, flowering part obpyramidal, 3.6–5.5 × 3.5–4.5 cm, lax with rachis visible between bracts, sterile bracts ovate, 1.6–2.7 × 1.5–2.0, yellowish brown, membranous; fertile bracts (bracteoles), non-tubular, lanceolate, 1.5–2.5 × 0.3–0.5 cm, yellowish brown, membranous, striate then soon rotting, subtending a single flower. Flowers 3.2–4.0 cm, yellow. Calyx non-tubular, split to bottom (even when flower budding), 1.0–1.5 × 0.3–0.6 cm, apex 3-toothed, membranous, yellowish brown, pubescent. Floral tube 1.0–1.2 cm long, ca. 0.4 cm wide at mouth, pale yellow, glabrous; dorsal corolla lobe oblong or ovate, 1.5–1.7 × 0.5–0.7 cm, brownish yellow and reddish towards apex, apex cucullate with a 1–2 mm long cusp, margin ciliate; lateral corolla lobes oblong, 1.5–1.7 × 0.4–0.5 cm, white towards base and brownish yellow at apex, apex rounded, margin ciliate. Labellum spreading, with red at claw, dull brownish yellow at middle and margin, obovate, entire, 1.9–2.3 × 1.0–1.2 cm, margin crisped, prominently veined, dentate, glabrous, adaxial surface pilose at base. Lateral staminodes lanceolate, adaxial surface red towards base and brownish yellow at apex, abaxial surface brownish yellow, 3–4 mm. Stamen 1.2–1.7 cm long, filament 0.4–0.7 × 0.2–0.3 cm, red at base, brownish yellow at apex, pubescent, connective pubescent, brownish yellow, anther thecae oblong, 0.7–0.9 cm long, creamy-white, dehiscing throughout their length, anther crest semi-lunar or inconspicuous trilobed, ca. 7 × 2 mm, brownish yellow, membranous, margin dentate. Epigynous glands two, oblate, ca. 2 × 1 mm, creamy, glabrous. Ovary ellipsoid, ca. 6 × 3 mm, villous; style ca. 2.7 cm long, puberulous; stigma cup-shaped, white, mouth ciliate. Infructescence up to 40 cm long, usually with 1–7 fruits reaching maturity. Capsule ovoid, 3.0–3.5 × 2.7–3.0 cm, 9-winged, green, at apex with persistent pubescent calyx, wings straight, stalk 5–7 mm.

Phenology. Flowering maybe in April–June and fruiting in May–July.

Distribution. Known only from the type locality, beside the Chindwin River, Hkamti District, Sangaing Region, Myanmar.

Ecology. On the riverside at an elevation of 100–150 m in tropical forest.

Etymology. The specific epithet '*schistocalyx*' refers to the non-tubular, dehiscent calyx.

Conservation status. LC. This species is locally common. Populations in Htamanti Wildlife Sanctuary are well protected. The populations near Htamanti village are not in a protected area but the populations are robust. So we treat this species as of Least Concern (IUCN 2017).

Affinities. *Amomum schistocalyx* Y.H. Tan & H.B. Ding shares similar characters with *A. putrescens* but differs in many characters, such as leaves (abaxially densely appressed silvery pubescent vs. abaxially glabrous, respectively), ligule (2-cleft vs. entire, respectively), calyx (non-tubular vs. tubular, respectively), labellum (red at claw, dull brownish yellow at middle and margin vs. almost pure yellow, respectively), lateral staminodes (lanceolate, adaxial surface red towards base and brownish yellow at apex, abaxial surface brownish yellow vs. tooth like, red, respectively) and epigynous glands (2 mm vs. 5 mm, respectively).

Additional specimens examined (paratypes). Myanmar. Sangaing Region, Hkamti District, Htamanti Wildlife Sanctuary, near Nam E Zu, Camp 1. 95°28'20.56"E, 25°32'13.42"N, 141 m elev., 20 May 2019, fruiting, *B. Yang*, *H.B. Ding & X.D. Zeng M5158* (HITBC!; RAF!); Sangaing Region, Hkamti District, Htamanti Wildlife Sanctuary, near Nam E Zu, Camp 2. 95°31'34.08"E, 25°30'40.15"N, 143 m elev., 25 May 2019, fruiting, *Y.H. Tan, M. Deng, B. Yang, H.B. Ding & X.D. Zeng M5374* (HITBC!; RAF!).

New records for Myanmar

Amomum yingjiangense S.Q. Tong & Y.M. Xia

Fig. 2

Amomum yingjiangense S.Q. Tong & Y.M. Xia in Acta Bot. Yunnan. 10(2): 210. 1988; S.Q. Tong in C.Y. Wu (ed.), Fl. Yunnan. 8: 622. 1997; T.L. Wu & K. Larsen in C.Y. Wu & P.H. Raven (eds), Fl. China 24: 349. 2000; De Boer et al. in Taxon 67(1): 20. 2018. Type: China, Yunnan Province, Dehong Dai and Jingpo Autonomous Prefecture, Yingjiang County, Xima Town, Huoshigou Village, 1740 m elev., 8 August 1983, *S.Q. Tong & C.J. Liao 24870* (holotype: HITBC081571!)

Description. Clump-forming herb, 1–1.5 m tall, 3–7 pseudostems per clump. Pseudostem with 2–7 leaves per pseudostem, swollen and brownish yellow at base, greenish yellow towards apex; ligule ovate, entire, apex rounded, sometimes truncate or praemorse because of fragile, 5–13 mm long, densely brownish pubescent; petiole absent to 4 cm, densely brownish pubescent; leaf blade adaxially dark green, abaxially green, elliptic to narrowly elliptic, 35–65 × 5–11 cm, adaxially pubescent, abaxially densely brownish pubescent, base cuneate or attenuate, apex caudate. Inflorescence radical, 10–17 cm, arising from the rhizome, 1 inflorescences per pseudostem, peduncle short, 2–4 cm, reddish-brown, flowering part obovoid, ca. 11 × 10 cm, sterile bracts ovate, 2.5–5.5 × 2.0–4.5, reddish brown, carneous, fragile; bracteoles, non-tubular, lanceolate, 3.0–3.5 × 0.5–0.8 cm, reddish brown, carneous, fragile, subtending 1–2 flowers. Flowers 5–6 cm, white or pinkish orange. Calyx tubular, 2.3–3.0 × 0.5–0.9 cm, apex 3-toothed, membranous, white or pinkish orange, pubescent. Floral tube 2.3–2.7 cm long, ca. 0.5 cm wide at mouth, white or pinkish orange, pubescent; dorsal corolla lobe oblong, 2.2–2.5 × 0.8–1.0 cm, white or pinkish orange, hooded at apex, obtuse, ciliate; lateral corolla lobes oblong, 2.0–2.5 × 0.5–0.8 cm, white or pinkish orange, apex rounded, ciliate. Labellum spreading, obovate, white or pinkish orange with reddish stripe (by reddish dots) radiating towards apex, 2.5–3.0 × 1.5–2.0 cm, apex trilobed or inconspicuous trilobed, margin crisped or dentate, prominently veined, adaxial surface pilose at base. Lateral staminodes ovate, sometimes dentate, adaxial surface reddish, abaxial surface white or pinkish orange, 5–7 mm. Stamen 2.0–2.3 cm long, filament ca. 8 × 3 mm, white or pinkish orange, pubescent, connective pubescent, white or pinkish orange, anther thecae oblong, ca. 1.0 cm long, brownish yellow,

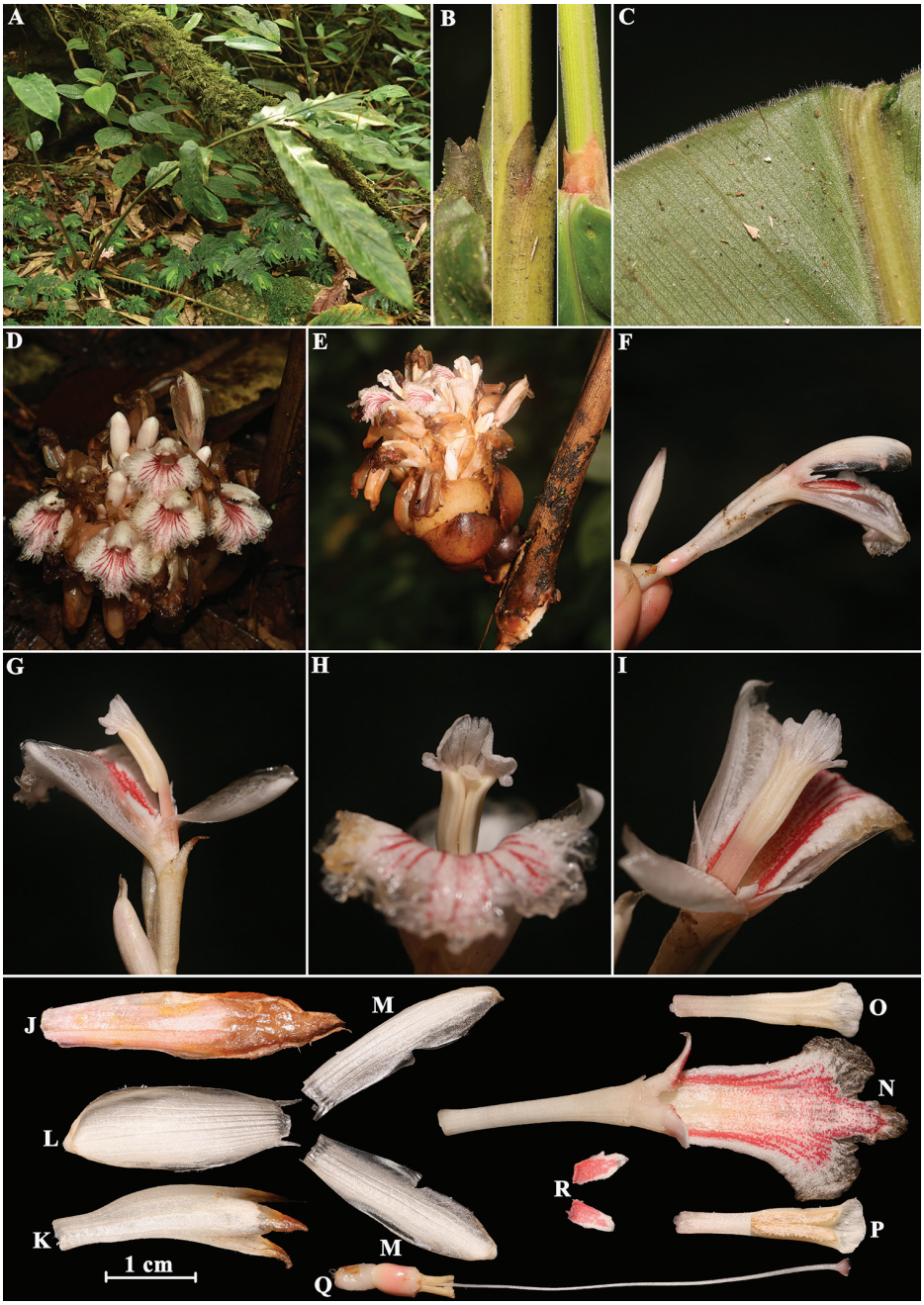

Figure 2. *Amomum yingjiangense* S.Q. Tong & Y.M. Xia **A** habit **B** ligule **C** leaf blade abaxially **D** inflorescence (front view) **E** inflorescence (side view) **F** flower (side view) **G** flower showing lateral staminodes **H** single flower showing anther crest (front view) **I** single flower showing stamen (back view) **J** bracteole **K** calyx **L** dorsal corolla lobe **M** lateral corolla lobes **N** labellum with floral tube and lateral staminodes **O** stamen (back view) **P** stamen (front view) **Q** ovary with epigynous glands, style and stigma **R** lateral staminodes. Photographed by H.B. Ding.

Figure 3. *Amomum carnosum* V.P. Thomas & M. Sabu **A** habit **B** single leaf (back view) **C** leaf blade abaxially **D** ligule **E** rhizome **F** basal part of plant showing inflorescences **G** single flower (side view) **H** single flower (back view) **I** single flower (front view) **J** calyx **K** dorsal corolla lobe **L** lateral corolla lobes **M** floral tube **N** labellum **O** stamen with lateral staminodes (front view) **P** stamen with lateral staminodes (back view) **Q** ovary with epigynous glands **R** style and stigma **S** young fruit with peduncle **T** cross section of fruit. Photographed by H.B. Ding.

dehiscing throughout their length, anther crest reniform or inconspicuous trilobed, ca. 7 × 3 mm, apex crenate or entire, white or pinkish orange, membranous. Epigynous glands 2, cylindrical, ca. 4 × 1 mm, creamy, glabrous. Ovary ellipsoid, ca. 5 × 3 mm, reddish brown, glabrous; style ca. 5.0 cm long, white, glabrous; stigma cup-shaped, reddish brown, mouth ciliate. Capsule not seen.

Specimens examined. Myanmar, Kachin state, Putao district, Pannandin, top of mountain, understory herbs in tropical rain forest, 27°42'15.06"N, 97°52'57.88"E, 1769 m elev., flowering, 9 June 2018, *Myanmar Exped. M4262* (HITBC!; RAF!).

Distribution. China, Myanmar.

Note. This species was originally described by Tong and Xia (1988) from fruiting material only and recorded as endemic to China (Tong 1997, Wu and Larsen 2000). In Ye (2018), he re-described the species with flowering material from the type locality. Here, we also provide a description from Myanmar.

Amomum carnosum V.P. Thomas & M. Sabu

Fig. 3

Amomum carnosum V.P. Thomas & M. Sabu in Kew Bull. 67: 549. 2012; De Boer et al. in Taxon 67(1): 19. 2018. Type: India, Nagaland, Tuensang Distr., Noklak, 20 May 2007, *Thomas & Muhammed Nissar 103698* (holotype: CALI).

Specimens examined. MYANMAR, Kachin state, Putao district, Upper Shankhaung to Wasandum, understory herbs in tropical rain forest, 27°27'15"N, 97°14'50"E, 1007 m elev., 17 June 2018, *Myanmar Exped. M4626* (HITBC!; RAF!).

Distribution. India, Myanmar.

Note. *Amomum carnosum* was first described by Thomas et al. (2012) and recorded as endemic to Nagaland, India. The species is similar to *A. maximum* (Roxburgh 1810: 344) in having a bifid membranous ligule, white flowers, but differs in its diffuse, low stoloniferous herb, 30–45 cm tall, leaves 2–3 per shoot, 3-lobed labellum, lamina elliptic and glabrous. In our collection from Myanmar, *Myanmar Exped. M4626* matches well with Thomas's type in its morphological structure (Thomas et al. 2012). However, it differs in the slightly floral structure and having non-3-lobed labellum. Considering the floral structure of *Amomum* s.l. is easy to tear and corrupt in the rainy season, we consider that the accurate description of *Amomum carnosum* requires further observation and collection of field individuals.

Amomum tibeticum (T.L. Wu & S.J. Chen) X.E. Ye, L. Bai & N.H. Xia

Fig. 4

Amomum tibeticum (T.L. Wu & S.J. Chen) X.E. Ye, L. Bai & N.H. Xia in Ye et al. Plant Syst. Evol. 304(9): 1174. 2018; –*Hornstedtia tibetica* T.L. Wu & S.J. Chen in Acta Phytotax. Sin. 16(3): 39. 1978; T.L. Wu & S.J. Chen, in T.L. Wu (ed.) Fl.

Reipubl. Popularis Sin. 16(2): 136. 1981; T.L. Wu & K. Larsen, in C.Y. Wu & P.H. Raven (eds) Fl. China. 24: 358. 2000; –*Hornstedtia arunachalensis* S. Tripathi & V. Prakash, Nordic J. Bot. 19: 329. 1999. Lectotype (designated by Ye et al. 2018, pg. 1174): China. Xizang Province: Medog County, Beibeng Township (previously District), 810 m elev., 11 August 1974, *Qingzang expedition 74-1913* (PE00075268).

Specimens examined. Myanmar, Kachin state, Putao district, Upper Shankhaung to Wasandum, understory herbs in tropical rain forest, 27°27'15"N, 97°14'50"E, 992 m elev., 17 June 2018, *Myanmar Exped. M4630* (HITBC!; RAF!); Kachin state, Putao district, Shinsanku, 27°39'56.90"N, 97°53'28.81"E, 990 m elev., 10 June 2018, *Myanmar Exped. M4288* (HITBC!; RAF!); Kachin state, Putao district, Naung Maung township, Khasanku village, 27°39'35"N, 97°37'21"E, 1024 m elev., 13 June 2018, *Myanmar Exped. M4457* (HITBC!; RAF!).

Distribution. China, India (Ye et al. 2018), Myanmar.

Note. This was originally described by Wu and Chen (1978) based on a collection from Medog County, Xizang (Tibet), China. It was placed in the genus *Hornstedtia* Retz., presumably due to the radical fusiform inflorescences covered with rigid involucral bracts enclosing oblong and smooth fruits, and pointed out that it was close to *H. affinis* Ridl. (Wu and Chen 1981). But on the basis of morphological study of flowering material originating at the type locality, the species is a member of *Amomum* s.s. (Ye et al. 2018).

Lanxangia scarlatina (H.T. Tsai & P.S. Chen) M.F. Newman & Škorničk

Fig. 5

Lanxangia scarlatina (H.T. Tsai & P.S. Chen) M.F. Newman & Škorničk in De Boer et al. Taxon 67(1): 24. 2018; –*Amomum scarlatinum* H.T. Tsai & P.S. Chen in Acta Phytotax. Sin. 17(4): 90 1979; H.T. Tsai & P.S. Chen in T.L. Wu (ed.), Fl. Reipubl. Popularis Sin. 16(2): 121. 1981; S.Q. Tong in C.Y. Wu (ed.), Fl. Yunnan. 8: 639. 1997; T.L. Wu & K. Larsen in C.Y. Wu & P.H. Raven (eds), Fl. China 24: 350. 2000. Type: China, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Jinghong City, Dadugang Township, Guanping forestry farm, 900 m elev., *J.H. Zhang 18445* (holotype: HITBC048529!).

Specimens examined. Myanmar, Kachin state, Putao district, around Gathu village, understory herbs in tropical rain forest, 27°28'17.39"N, 97°57'06.58"E, 575 m elev., 1 June 2018, *Myanmar Exped. M3897* (HITBC!; RAF!); Kachin state, Putao district, from Gathu village to Tongwang Cave, understory herbs in tropical rain forest, 27°28'14.58"N, 97°57'01.01"E, 581 m elev., 3 June 2018, *Myanmar Exped. M3995* (HITBC!; RAF!).

Distribution. China, Myanmar.

Note. This was originally described by Tsai and Chen (1979) based on a collection from Dadugang Township, Jinghong City, Yunnan Province, China. It was placed in the genus *Amomum* s.l., but on the basis of morphological study, the species is a member of *Lanxangia* (De Boer et al. 2018). It is a new generic record for the country.

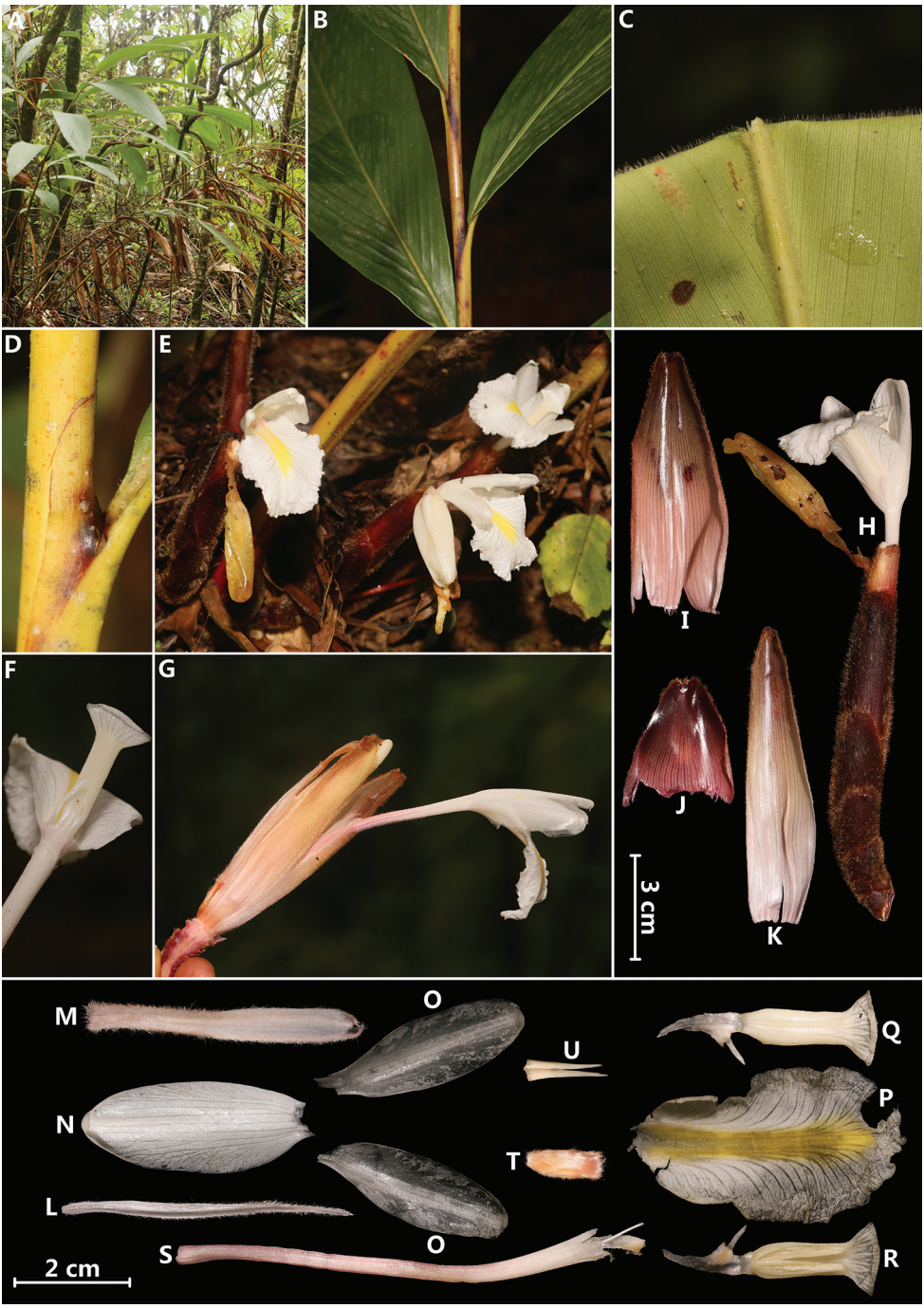

Figure 4. *Amomum tibeticum* (T.L. Wu & S.J. Chen) X.E. Ye, L. Bai & N.H. Xia **A** habit **B** pseudostem **C** leaf blade abaxially **D** ligule **E** inflorescences (front view) **F** single flower showing stamen (back view) **G** inflorescence (inner view) **H** inflorescence (side view) **I, J** sterile bracts **K** bract **L** bracteole **M** calyx **N** dorsal corolla lobe **O** lateral corolla lobes **P** labellum **Q** stamen with lateral staminode (back view) **R** stamen with lateral staminode (front view) **S** floral tube with style **T** ovary **U** epigynous glands. Photographed by H.B. Ding.

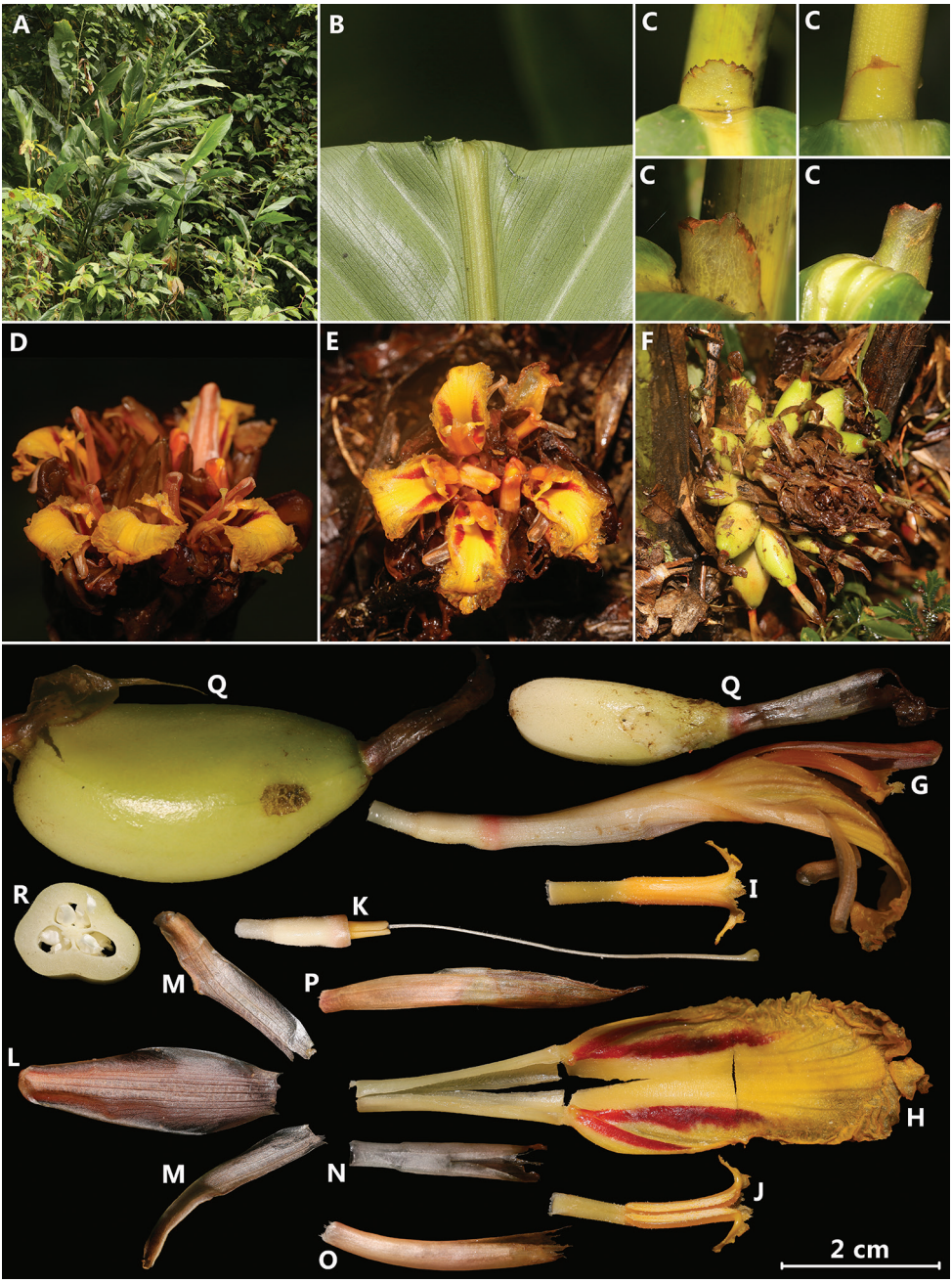

Figure 5. *Lanxangia scarlatina* (H.T. Tsai & P.S. Chen) M.F. Newman & Škorničk **A** habit **B** leaf blade abaxially **C** ligule **D** inflorescence (side view) **E** inflorescence (front view) **F** infructescences **G** single flower **H** labellum with floral tube **I** stamen (back view) **J** stamen (front view) **K** ovary with epigynous glands, style and stigma **L** dorsal corolla lobe **M** lateral corolla lobes **N** calyx **O** bracteole **P** bract **Q** single fruit **R** cross section of fruit. Photographed by H.B. Ding.

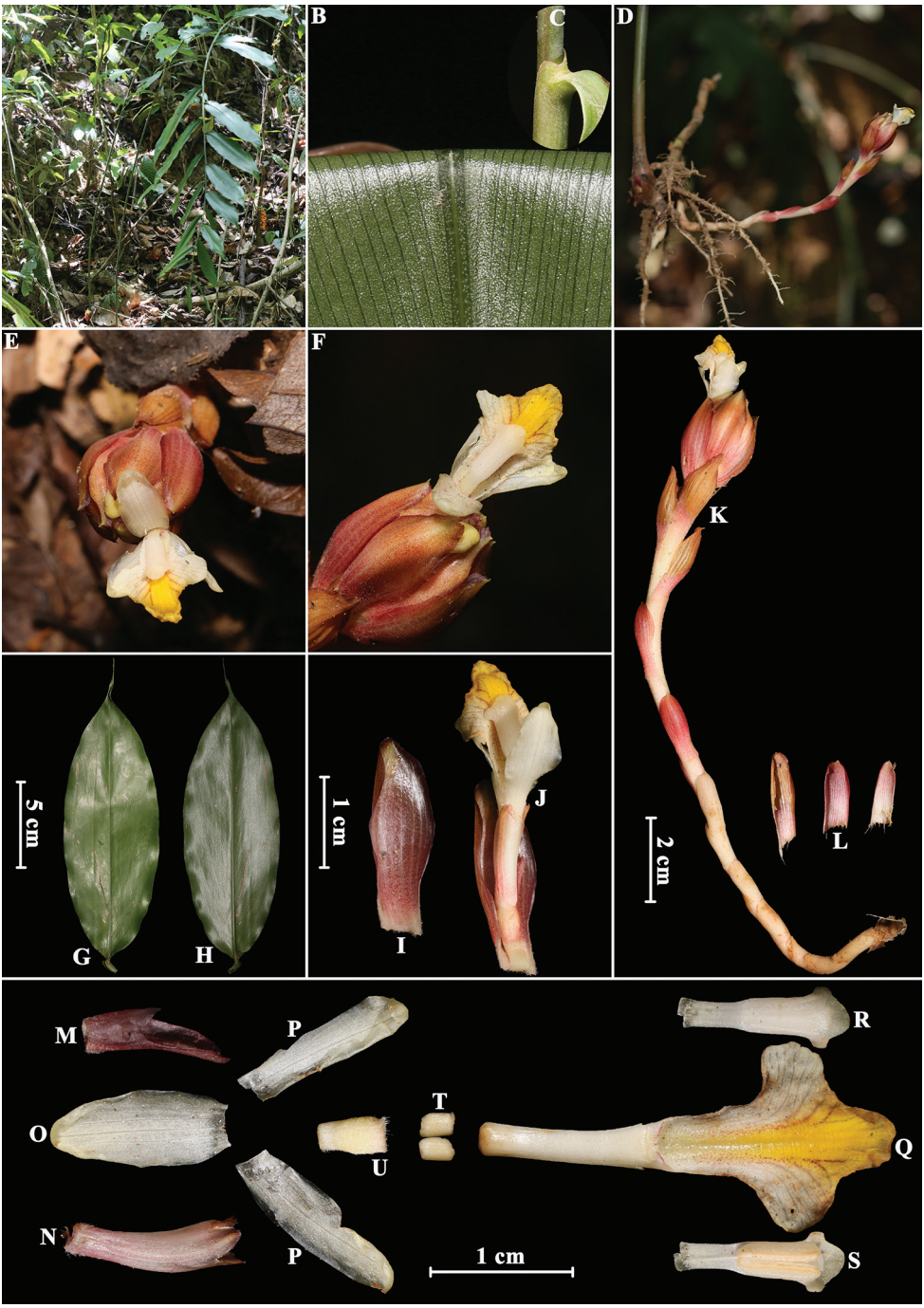

Figure 6. *Meistera yunnanensis* (S.Q. Tong) Škorniček. & M.F. Newman **A** habit **B** leaf blade abaxially **C** ligule **D** basal part of plant showing inflorescences **E** inflorescence **F** single flower (front view) **G** single leaf (front view) **H** single leaf (back view) **I** bract **J** single flower (side view) **K** inflorescence (side view) **L** sterile bracts **M** bracteole **N** calyx **O** dorsal corolla lobe **P** lateral corolla lobes **Q** labellum with floral tube **R** stamen (back view) **S** stamen (front view) **T** epigynous glands **U** ovary. Photographed by H.B. Ding.

***Meistera yunnanensis* (S.Q. Tong) Škorničk. & M.F. Newman**
Fig. 6

Meistera yunnanensis (S.Q. Tong) Škorničk. & M.F. Newman in De Boer et al. Taxon 67(1): 27. 2018; –*Amomum yunnanense* S.Q. Tong in Acta Bot. Yunnan. 12(2): 151. 1990; S.Q. Tong in C.Y. Wu (ed.), Fl. Yunnan. 8: 632. 1997; T.L. Wu & K. Larsen in C.Y. Wu & P.H. Raven (eds), Fl. China 24: 353. 2000. Type: China, Yunnan Province, Dehong Dai and Jingpo Autonomous Prefecture, Ruili county-level City, Mengxiu Township, Guangren, 1200 m elev., 25 July 1983, *S.Q. Tong & C.J. Liao 24832* (holotype: KUN1219275).

Specimens examined. Myanmar, Sangaing Region, Hkamti District, Htamanti Wildlife Sanctuary, near Nam E Zu Camp 2, 25°30'05.35"N, 95°32'41.50"E, 193 m elev., 27 May 2019, *Myanmar Exped. M5515* (HITBC!; RAF!); Sangaing Region, Hkamti District, Homalin Township, just outside Htamanthi Wildlife Sanctuary, Nam Sa Bi Village Management Area, 25°18'53.50"N, 95°21'08.40"E, 216 m elev., 27 September 2016, *Kate et al. 1631* (NY02654996!).

Distribution. China, India, Myanmar.

Note. This was originally described Tong (1990) based on a collection from Dehong Dai and Jingpo Autonomous Prefecture, Yunnan Province, China. It was placed in the genus *Amomum* s.l, but on the basis of morphological study, the species is a member of *Meistera* (De Boer et al. 2018).

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RESEARCH ARTICLE

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A new species and two new combinations of *Monolophus* (Zingiberaceae) from Indo-Burma

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Abstract

Monolophus odontochilus Y.H.Tan & H.B.Ding, a new species from Northern Myanmar, is described and illustrated. The new species is morphologically similar to *M. linearis*, but differs by having elliptic to oblong leaves (vs. linear-lanceolate to lanceolate), bilobed ligules (vs. entire), purely white corolla (vs. pinkish white), semi-orbicular crenate labellum (vs. trilobed). In addition, a diagnostic key to the new species of *Monolophus* and its closely related non-yellow flowered species is provided. New combinations are proposed here for *Caulokaempferia phokhamii* Picheans. & Douangde. and *C. wongsuwaniae* Picheans. & Douangde. from Laos.

Keywords

Caulokaempferia phokhamii, *Caulokaempferia wongsuwaniae*, Kachin State, Putao District

Introduction

The genus *Monolophus* was first described by Wallich (1832) and included three species with references to earlier publications in 1820, 1829; and was recognised by Endlicher (1837), followed by Steudel (1841), Horaninov (1862), Pfeiffer (1874), Wu and

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Chen (1978). But for a very long time it was treated under *Caulokaempferia* K. Larsen (1964). Recently, the genus *Monolophus* was reinstated by Mood et al. (2014) with 22 new combinations. So far, the genus consists of 33 species (Larsen and Smith 1972; Larsen 1973, 2002; Larsen et al. 2004; Larsen and Jenjittikul 2004; Suksathan and Triboun 2004; Picheansoonthon and Mokkamul 2006; Ngamriabsakul 2008; Picheansoonthon et al. 2008; Picheansoonthon and Koonterm 2008; Tiyaworanant 2010; Chaturvedi et al. 2012; Roy and Barbhuiya 2013; Intharapichai et al. 2014; Mood et al. 2014; Phokham et al. 2015a, b; Sangnark et al. 2016; Veldkamp 2016; Bhaumik et al. 2017; Barbhuiya et al. 2018; Douangdeuane et al. 2019) from the Himalayas to South East Asia. There are two distinct groups, the yellow-flowered species (~28 taxa) that are distributed in Thailand and adjacent countries and the other non-yellow-flowered species (purple, red-purple, pink and white) (~5 taxa) which are localized in Eastern Himalaya (Bhaumik et al. 2017).

During our field work from May to June in 2018, some interesting specimens of *Monolophus* were found in Putao, Kachin state. Based on the detailed examination of the morphological characters of our material and morphologically similar species, we draw a conclusion that those specimens of *Monolophus* collected in Myanmar belong to a species new to science, *Monolophus odontochilus* Y.H.Tan & H.B.Ding, which is described here along with illustrations.

Material and methods

Measurements and morphological character assessments of the new species have been examined based on fresh materials and dried specimens. It has been compared with the morphologically similar species by affinities inferred using descriptions (Wallich 1820, 1832; Chaturvedi et al. 2012; Roy and Barbhuiya 2013) and type specimens in herbaria (K, L, E). Protologues and images of type specimens and dried herbarium specimens were gathered from JSTOR Global Plants (http://plants.jstor.org).

Taxonomic treatment

Monolophus odontochilus **Y.H.Tan & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204203-1
Figure 1

Diagnosis. *Monolophus odontochilus* is morphologically similar to *M. linearis* (Wall.) Wall. from India in having white flowers with yellow blotch at the base of the labellum, but differs by having elliptic to oblong leaves (vs. linear-lanceolate to lanceolate leaves), bilobed ligules (vs. entire ligules), semi-orbicular crenate labellum (vs. trilobed labellum) and purely white corolla (vs. pinkish white corolla).

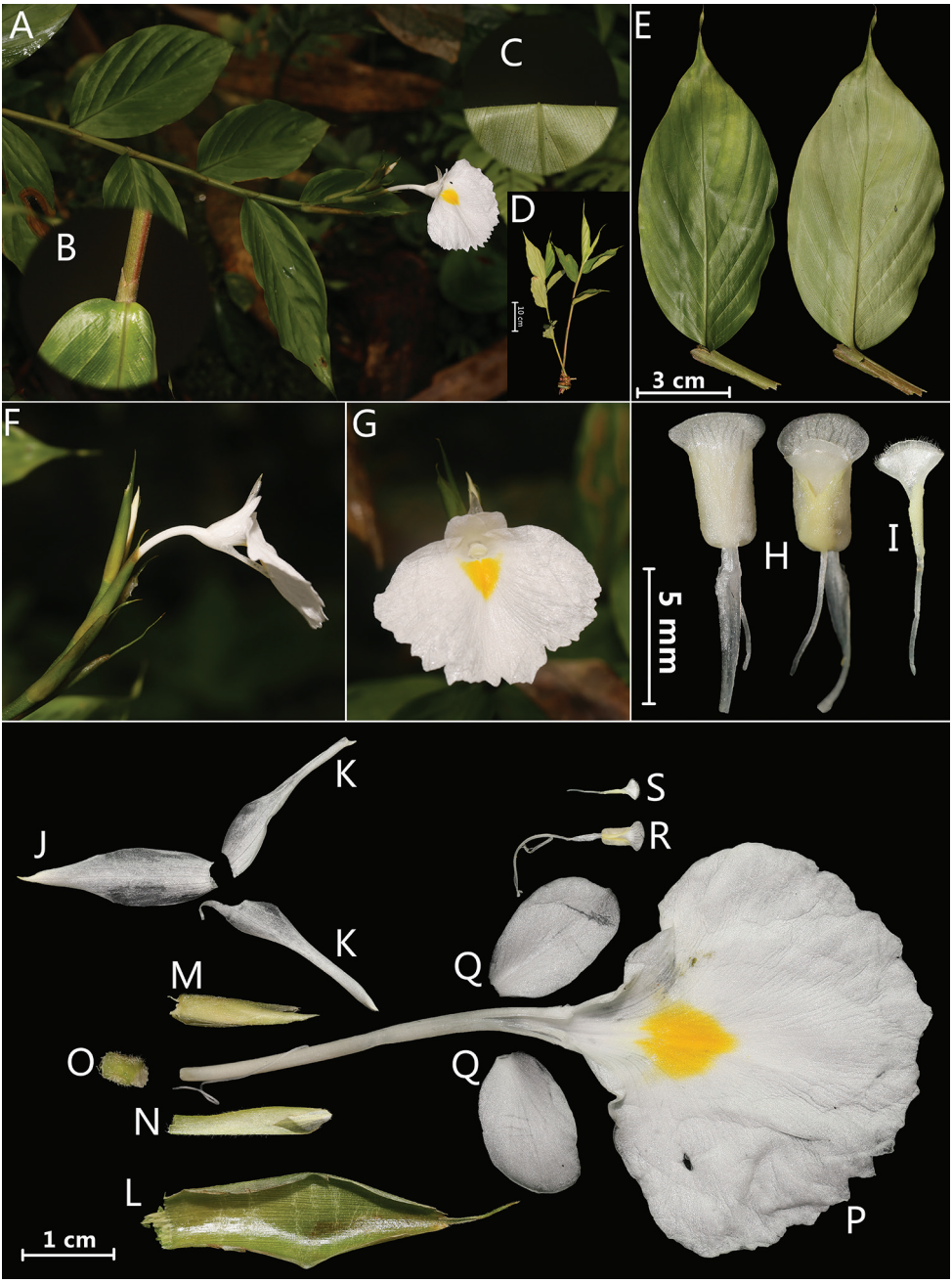

Figure 1. *Monolophus odontochilus* Y.H. Tan & H.B. Ding, sp. nov. **A** habitat **B** ligule **C** leaf blade abaxially **D** habit **E** single leaf (adaxially and abaxially) **F** flower (side view) **G** flower (front view) **H** anther with stigma and crest (front and back view) **I** stigma **J** dorsal corolla lobe **K** lateral corolla lobes **L** bracts **M** bracteoles and young flower **N** calyx **O** ovary **P** labellum and floral tube **Q** lateral staminodes **R** stamen and stigma **S** ovary with style. Photographed by H.B.Ding

Type. Myanmar. Kachin State: Putao District, Gathu Village. 27°29'07.23"N, 97°58'19.49"E, 643 m, 01 June 2018, *Y.H.Tan*, *B.Yang*, *H.B.Ding*, *X.D.Zeng*, *M.B.Maw and H.L.Neing M3886* (holotype: HITBC!, isotypes: RAF!).

Description. Perennial herbs, rhizome short; pseudostem erect, leafy 50–70 cm long. ***Leaves*** 5–13, sub-sessile, elliptic to oblong, 10.2–14 × 3.0–5.0 cm, base cuneate, apex caudate to 2.0 cm long, margins entire, adaxial surface dark green, glabrous, abaxially light green, pubescent; ***ligule*** membranous, 6–8 mm long, hairy, apex unequally bilobed. ***Inflorescences*** terminal, 5–7 cm long, rachis glabrous; ***flowers*** white with yellow blotch at the base of the labellum; ***bracts*** 4–6, along rachis, distichous, oblong, 3.5–4.0 × 1.0–1.3 cm, greenish, outer surface pubescent, base truncate, apex cuspidate to 0.8 cm, 2-flowered; ***bracteoles*** membranous, lanceolate, ca. 1.5 × 0.8 cm, pubescent, rounded; ***calyx*** tubular, 1.3–1.4 × 0.3–0.4 cm, pubescent, greenish, split 6–7 mm down one side, apex acute; ***floral tube*** 4.3–4.5 cm, ca. 3.5 mm wide at mouth, white, glabrous; ***dorsal corolla lobe*** lanceolate, 2.2–2.3 × 0.6–0.7 cm, white, glabrous, hooded at apex, apical cusp ca. 2 mm long; ***lateral corolla lobes*** similar to dorsal lobe, narrower, 2.0–2.1 × 0.3–0.4 cm, hooded at apex, apical cusp ca. 1 mm long; ***lateral staminodes*** elliptic, 1.5–1.6 × 0.9–1.0 cm, white, apex rounded; ***labellum*** semi-orbicular, 4.4–4.8 × 3.2–3.6 cm, white with yellow spot at base, margin crenate; ***anther*** 4–5 mm long; ***anther crest*** flabellate, 2–3 × 4–5 mm, white, apex entire; ***stigma*** funnel-shaped, inserted between anther sac, margin raised on both ends, ciliate; ***ovary*** oblong, 3–4 mm long, pubescent, 3-locular.

Phenology. Flowering in May to June. Fruit not seen.

Etymology. The species epithet '*odontochilus*' refers to the crenate labellum.

Distribution and habitat. *Monolophus odontochilus* is endemic to Kachin State, Northern Myanmar, only known from its type locality, Gathu Village, Putao District. It grows in humid environments or along streams of tropical rain forest at an elevation of 550–750 m.

Conservation status. This new species appears to be restricted to a very moist habitat in Gathu Village, Putao District, Kachin State, Northern Myanmar. According to our observations in the field, the two known populations are composed of about 50 mature individuals in each. Overall, however, the species has been deemed to be Data Deficient (DD) following IUCN Red list Categories and Criteria (IUCN 2017). Further field surveys in northern Myanmar are needed to gain more information on its distribution.

Affinities. *Monolophus odontochilus* is morphologically similar to *M. linearis* (Wall.) Wall. (Wallich 1820, 1832) in having white flowers with a yellow blotch at the base of the labellum. After comparison with specimens and descriptions in literature (Chaturvedi et al. 2012; Roy and Barbhuiya 2013), it was found that *M. odontochilus* can be distinguished from *M. linearis*, even on the basis of its vegetative characters: e.g. *Monolophus odontochilus* has unequally bilobed ligule (vs. entire ligule, respectively), longer calyx (1.3–1.4 cm vs. 0.8–0.9 cm, respectively), bigger lateral staminodes (1.5–1.6 × 0.9–1.0 cm vs. ca. 1.0 × 0.7 cm, respectively). *Monolophus odontochilus*, furthermore,

differs in having elliptic to oblong leaves (10.2–14 × 3–5 cm), margin crenate labellum (non-trilobed) and purely white corolla. *Monolophu linearis* has linear lanceolate leaves (1.5–6.5 × 0.5–1 cm), trilobed labellum and pinkish white corolla. A diagnostic key to the new species of *Monolophus* and its closely related species is provided.

A diagnostic key to the non-yellow flowered of *Monolophus* is given below

1 Flowers completely pink **2**
– Flowers usually white, if corolla and lateral staminodes pink then labellum white **3**
2 All leaves sessile, blade to 2.8 cm broad, ligule absent or indistinct ..... ***M. suksathanii***
– At least upper leaves petiolate, blade 2.5–4 cm broad, ligule distinct..... ***M. secundus***
3 Labellum completely white, without yellow blotch ..... ***M. sikkimensis***
– Labellum white with yellow blotch **4**
4 Corolla completely white ..... ***M. odontochilus***
– Corolla pink to purple-pink..... **5**
5 Leaf blades linear-lanceolate to lanceolate, labellum trilobed..... ***M. linearis***
– Leaf blades oblong to oblong-elliptic, labellum entire ..... ***M. arunachalensis***

New combinations

Mood et al. (2014) have argued that the generic name *Caulokaempferia* is a superfluous name of genus *Monolophus*. A proposal to conserve *Caulokaempferia* by Intharapichai et al. (2014) has not yet been considered by the appropriate committee. Therefore, in our opinion, *Monolophus* is valid and the name *Caulokaempferia* must be rejected. Recently, Douangdeuane et al. (2019) described two new species under *Caulokaempferia* from Laos, which are transferred here to *Monolophus*.

***Monolophus phokhamii* (Picheans. & Douangde.) Y.H.Tan & H.B.Ding, comb. nov.**
urn:lsid:ipni.org:names:77204204-1

Basionym. *Caulokaempferia phokhamii* Picheans. & Douangde. in Douangdeuane et al., Pak. J. Bot. 51(1): 235. 2019.

Type. Lao PDR. Vientiane Province, Hin Herb District, Phou Meut-Phou Kiykon Forest Conservation, Ban Hoiuy Dokmai (Hoiuy Dokmai Waterfall), 18°42'58.20"N, 102°22'20.94"E, 270 m, 26 August 2014, *CP260814-1* (holotype: BK, isotypes: MSU).

Monolophus wongsuwaniae **(Picheans. & Douangde.) Y.H.Tan & H.B.Ding, comb. nov.**
urn:lsid:ipni.org:names:77204205-1

Basionym. *Caulokaempferia wongsuwaniae* Picheans. & Douangde. in Douangdeuane et al., Pak. J. Bot. 51(1): 237. 2019.

Type. Lao PDR. Bolikhamxai Province, Mueang Tha Pabad District, Nam Tok Tad Mangkorn, 18°25'59.82"N, 103°12'32.64"E, 200 m, 20 September 2014, *CP200914-1* (holotype: BK, isotypes: MSU).

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RESEARCH ARTICLE

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Khoonmengia honbaensis, a new genus and species of temperate bamboo (Poaceae, Bambusoideae) from central-southern Vietnam

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Abstract

A new genus of Arundinarieae, *Khoonmengia*, is established to accommodate a unique new bamboo species, *K. honbaensis*, from central-southern Vietnam. The morphological features, habitats and distribution of *Khoonmengia* and related genera, i.e. *Ampelocalamus* and *Hsuehochloa*, are compared. The characters of its scrambling habit, internodes with brownish green dots, conspicuous nodes swollen at one side, elliptic buds wholly sunken into culm, extravaginal branching pattern, mid-culm branch complement with one central dominant branch elongating to reiterate the culm accompanied by several lateral slender branches, swollen culm sheath base with a distinctive zone of transverse wrinkles, synflorescence composed of only one spikelet, single or several to many synflorescences arranged into a raceme or panicle terminal on leafy branches, purple anthers and nut-like caryopsis with hardened pericarp and loosely adherent lemma and palea distinguish *K. honbaensis* from morphologically similar taxa. In order to investigate the phylogenetic position of this unknown bamboo, molecular phylogenetic analyses based on the nuclear gene GBSSI were also conducted, and the results proved that *K. honbaensis* is definitely a member of Arundinarieae with an isolated position, which also indicated that this species could not be assigned to any of the already described genera and supported the establishment of the new genus.

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Keywords
Arundinarieae, morphology, phylogeny, scrambling bamboos, synflorescence

Introduction

Bamboos, including a single evolutionary radiation of 1,642 species in the grass family Poaceae, subfamily Bambusoideae, are important components in tropical to warm temperate forests (Vorontsova et al. 2016). Bambusoideae is classified into two tribes of woody bamboos (the tropical Bambuseae and the temperate Arundinarieae) and one tribe of herbaceous bamboos (the Olyreae) (Soreng et al. 2015). The Arundinarieae are the temperate woody bamboos, a diverse clade of 31 genera and ca. 546 species, with the center of diversity in East Asia (ca. 430 species), distributed primarily in forests of the northern temperate zone, but also in some high elevation tropical regions (BPG 2012; Clark et al. 2015). Arundinarieae is not only a taxonomically difficult group of bamboos, but also a troublesome one in molecular phylogenetics (Yang et al. 2013). Previous phylogenetic studies mainly based on plastid DNA divided Arundinarieae into twelve lineages, but the phylogenetic relationships among many clades were not well resolved (Zeng et al. 2010; Zhang et al. 2012; Ma et al. 2014; Attigala et al. 2016). Some analyses also revealed many inconsistencies between the plastid and the nuclear gene trees (Zhang et al. 2012; Yang et al. 2013). For example, *Ampelocalamus actinotrichus* had an affinity with individuals of *Chimonocalamus* in the plastid phylogeny (Zeng et al. 2010), rather than other taxa of *Ampelocalamus*. However, in the nuclear gene phylogenies, this species formed a clade with the congeneric taxa (Yang et al. 2013). These results implied that the nuclear genome and the plastid genome may have different evolutionary trajectories (Zhang et al. 2012; Yang et al. 2013). The most recent study based on phylogenetic analyses with RAD-seq data identified eight major lineages in Arundinarieae with strong support, which conflicts with earlier studies (Wang et al. 2017).

During an investigation of the bamboos in Hon Ba Nature Reserve, Khanh Hoa Province of central-southern Vietnam in October 2017, an unusual bamboo with unicaespitose habit, scandent stems, pachymorph rhizomes and semelauctant inflorescences on leafy flowering branches caught our attention. This species was misidentified as *Bambusa tulda* Roxb. during the background survey of Hon Ba Nature Reserve (Lee et al. 2014). The semelauctant inflorescence is a relatively rare condition in the Bambuseae. After closer examination, we found that it has three stamens and two stigmas. By its habit and floral characters, it should be a member of the tribe Arundinarieae. In Vietnam, only five clambering genera, i.e. *Melocalamus* Benth., *Maclurochloa* K. M. Wong, *Nianhochloa* H. N. Nguyen & V. T. Tran, *Cochinchinochloa* H. N. Nguyen & V. T. Tran and *Yersinochloa* H. N. Nguyen & V. T. Tran, are currently recognized, but all of these genera belong to Bambuseae (Wong 1993; Tran et al. 2013). In Southeast Asia, many other genera also have climbing or clambering culm

habits, such as *Holttumochloa* K. M. Wong, *Kinabaluchloa* K. M. Wong, *Dinochloa* Büse, *Racemobambos* Holttum, *Chloothamnus* Büse, etc. However, none of these genera belong to Arundinarieae either. There are only two genera belonging to Arundinarieae in subtropical Asia, i.e. *Ampelocalamus* S. L. Chen, T. H. Wen & G. Y. Sheng and *Hsuehochloa* D. Z. Li & Y. X. Zhang, which have a combination of morphological characters including scandent stems, semelauctant inflorescences, three stamens and two stigmas (Chen et al. 1981; Zhang et al. 2018). However, this unknown bamboo has some both reproductive and vegetative characters that are different from these two subtropical genera (see Table 1).

The nuclear gene GBSSI (granule-bound starch synthase I) occurs as a single copy in Poaceae and was often used in recent phylogenetic studies on woody bamboos (Zhang et al. 2012; Goh et al. 2013; Yang et al. 2013). Zhang et al. (2012) showed that the phylogeny based on GBSSI was better resolved at the generic level than the plastid phylogeny. Therefore, in order to investigate the phylogenetic position of this unknown bamboo, we conducted molecular phylogenetic analyses of Asian Arundinarieae based on GBSSI.

Materials and methods

Sampling and morphological study

Samples of this putative new species were collected for morphological and molecular phylogenetic studies from the only known population in Hon Ba Nature Reserve, Khanh Hoa Province, central-southern Vietnam during our field investigation in Oct. 2017. Photographs were taken with a CANON EOS 60D camera and dried flowers were dissected and examined under an Olympus SZX16 Microscope; line drawings and descriptions were made by reference to dried specimens.

DNA amplification and sequencing

Total genomic DNA was isolated from silica gel-dried leaf material using the Plant Genomic DNA Extraction Kit (Tiangen, Beijing, China), following the manufacturer's instructions. The nuclear GBSSI sequence was amplified following the protocol used in Zeng et al. (2010). All PCR were performed in 25 μL volumes with a SensoQuest Labcycler 48 Gradient. A fragment from this unknown species was successfully sequenced by the DNA sequencing facility at Sangon Biotech (China). Automated sequencing output was checked visually for correct automated base-calling. Sequences were aligned using Bioedit v7.2.0 (Hall 1999) and adjusted manually where necessary. The newly obtained sequence has been deposited in Genbank.

In addition, sequences from the other 42 taxon representing nearly all known genera of Arundinarieae and outgroups, mainly following prior studies (Zeng et al. 2010;

Table 1. Comparison of morphological characters, distributions and habitats of *Khoonmengia*, *Hsuehochloa* and *Ampelocalamus.*

	Khoonmengia	***Hsuehochloa***	***Ampelocalamus***
Habit	Scrambling	Pendulous or procumbent	Scrambling
Branching pattern	Extravaginal	Extravaginal	Transferring
Nodes	Swollen at one side	Nearly flat	Swollen at one side
Mid-culm branch complement	One central dominant branch accompanied by 1–4 lateral slender ones	3–7 branches, subequal	Several to numerous branches, subequal, or one or three dominant branches accompanied by numerous slender ones
Bud	Elliptic, wholly sunken into culm	Elliptic, wholly sunken into culm	Ovate to broad ovate, not sunken or only base sunken into culm
Culm sheath base	Swollen, with a distinctive zone of transverse wrinkles	Flat, without a distinctive zone of transverse wrinkles	Usually swollen, without a distinctive zone of transverse wrinkles
Culm sheath auricles	Absent	Present, falcate, amplexicaul	Absent or present
Culm sheath oral setae	Absent	Present, radiate	Absent or present
Presence of dots on culm	With brownish green dots	Without dots	Without dots
Leaf auricles and oral setae	Absent	Present	Absent or present
Synflorescence	Composed of only one spikelet, single or several to many synflorescences arranged into a raceme or panicle on leafy flowering branches	Racemose, composed of 1 or few spikelets, single synflorescence on leafy flowering branches	Paniculate, composed of many spikelets, on leafy or leafless flowering branches
Glumes	(0–)1–2	Unknown	2
Number of florets per spikelet	7–9	5	2–7
Anther color	Purple	Purple	Yellow
Caryopsis	Nut-like, with hardened pericarp and loosely adherent lemma and palea	Unknown	Grain-like, without hardened pericarp and with closely adherent lemma and palea
Distribution	Central-southern Vietnam	Southwest China (Guizhou)	South and Southwest China (Gansu, Chongqing, Sichuan, Guizhou, Yunnan, Hainan)
Habitat	Granite montane, alt. 1500 m	Limestone montane, alt. 500–950 m	Limestone, granite or basalt montane, alt. 200–1800 m

Zhang et al. 2012; Yang et al. 2013; Attigala et al. 2016), were downloaded from the NCBI Genbank database (http://www.ncbi.nlm.nih.gov/genbank/) (Table 2). *Bonia amplexicaulis* (L. C. Chia, H. L. Fung & Y. L. Yang) N. H. Xia, *Neomicrocalamus prainii* (Gamble) Keng f., and *Bambusa ventricosa* McClure of the tribe Bambuseae were chosen as outgroups based on prior studies (Zeng et al. 2010; Zhang et al. 2012).

Phylogenetic analyses

Gaps were coded as present or absent using the simple indel coding method (Simmons and Ochoterena 2000). The best-fitting models were selected using jModeltest v2.1.4 under the Akaike Information Criterion (AIC) (Darriba et al. 2012). The model used for the GBSSI in this study was TrNef+G.

Table 2. Voucher information and GenBank accession numbers for taxa used in this study.

Taxon	Voucher no.	Source	GenBank accession no. (GBSSI)
Acidosasa chinensis C. D. Chu & C. S. Chao ex Keng. f.	Zhang 08035 (KUN)	Guangdong, China	JN132035
Acidosasa chienouensis (T. H. Wen) C. S. Chao & T. H. Wen	Zhang 08065 (KUN)	Fujian, China	JN132043
Ampelocalamus actinotrichus (Merr. & Chun) S. L. Chen, T. H. Wen & G. Y. Sheng	Zeng and Zhang 06054 (KUN)	Hainan, China	KM264660
Arundinaria gigantea (Walter) Muhl.	Zhang US1025 (KUN)	Arkansas, United States	JN131985
Arundinaria tecta (Walter) Muhl.	Triplett 173 (ISC)	South Carolina, United States	JN131988
Bambusa ventricosa McClure	Zhang KMBG09 (KUN)	Yunnan, China	JN131925
Bashania abietina T. P. Yi & L. Yang	Zhang 07092 (KUN)	Sichuan, China	JN132004
Bonia amplexicaulis (L. C. Chia, H. L. Fung & Y. L. Yang) N. H. Xia	Zeng and Zhang SB5 (KUN)	Yunnan, China	JN131926
Brachystachyum densiflorum (Rendle) Keng	Zeng and Zhang 06174 (KUN)	Zhejiang, China	JN131957
Chimonobambusa macrophylla (Hsueh & T. P. Yi) T. H. Wen & Ohrnb	Zhang 07091 (KUN)	Sichuan, China	JN131980
Chimonocalamus montanus Hsueh & T. P. Yi	Zhang 07057 (KUN)	Yunnan, China	JN132029
Chimonocalamus pallens Hsueh & T. P. Yi	Zhang 07071 (KUN)	Yunnan, China	JN132060
Drepanostachyum ampullare (T. P. Yi) Demoly	GLM 081860 (KUN)	Xizang, China	JN132079
Drepanostachyum hookerianum (Munro) Keng f.	DZL 199903 (KUN)	Kew, Britain	AF445165
Fargesia decurvata J. L. Lu	Zhang 07087 (KUN)	Hubei, China	JN131937
Fargesia fungosa T. P. Yi	Zhang 07048 (KUN)	Yunnan, China	JN131982
Fargesia nitida (Mitford) Keng f. & T. P. Yi	Zhang KMBG10 (KUN)	Sichuan, China	JN131941
Ferrocalamus strictus Hsueh & Keng f.	Zeng and Zhang SB1 (KUN)	Yunnan, China	JN132090
Gaoligongshania megalothyrsa (Hand.-Mazz.) D. Z. Li, Hsueh & N. H. Xia	JRX 9401 (KUN)	Yunnan, China	JN131945
Gelidocalamus rutilans T. H. Wen	Zeng and Zhang 06183 (KUN)	Zhejiang, China	JN131967
Himalayacalamus falconeri (Munro) Keng f.	GLM 081524 (KUN)	Xizang, China	JN132078
Hsuehochloa calcarea (C. D. Chu & C. S. Chao) D. Z. Li & Y. X. Zhang	Zhen-Hua Guo 013 (KUN)	GenBank	KM264662
Indocalamus sinicus (Hance) Nakai	Zeng and Zhang 06081 (KUN)	GenBank	JN131939
Indocalamus wilsonii (Rendel) C. S. Chao & C. D. Chu	Zeng and SD Zhang 07119 (KUN)	GenBank	JN131928
Indosasa crassiflora McClure	Zhang 07014 (KUN)	GenBank	JN132069
Khoonmengia honbaensis N. H. Xia, Y. H. Tong & X. R. Zheng	BVN2017048 (IBSC)	Vietnam	MN521458
Neomicrocalamus prainii (Gamble) Keng f.	LL07236 (KUN)	Xizang, China	JN131921
Oldeania alpina (K. Schum.) Stapleton	Triplett and Clark (2010), ZHZ200101 (KUN)	Locality unkown	AF445171
Oligostachyum sulcatum Z. P. Wang & G. H. Ye	Zhang 07024 (KUN)	Guangxi, China	JN131987
Ampelocalamus loudianensis T. P. Yi & R. S. Wang	MPF10052 (KUN)	Guizhou, China	KM264663
Ampelocalamus melicoideus Keng f.	MPF10142 (KUN)	Chongqing, China	KM264667
Ampelocalamus microphyllus Hsueh & T. P. Yi	MPF10123 (KUN)	Chongqing, China	KM264665
Ampelocalamus patellaris (Gamble) Stapleton	Zhang 07075 (KUN)	Yunnan, China	AF445163
Ampelocalamus scandens Hsueh & W. D. Li	Zhen-Hua Guo 013 (KUN)	Yunnan, China	AF445164
Phyllostachys edulis (Carriere) Houzeau	Zhang KMBG04 (KUN)	Yunnan, China	JN132018
Pleioblastus gramineus (Bean) Nakai	Zhang and Zeng 06157 (KUN)	Zhejiang, China	JN131990
Pleioblastus juxianensis T. H. Wen, C. Y. Yao & S. Y. Chen	Zhang and Zeng 06136 (KUN)	Zhejiang, China	JN132037
Pseudosasa japonica (Sieb. & Zucc.) Makino	Zhang 07023 (KUN)	Guangxi, China	JN132010
Sasa senanensis Rehder	Triplett 146 (KUN)	Tennessee, United States	JN132068
Sinobambusa tootsik (Sieb.) Makino	Zhang and Zeng 06090 (KUN)	Guangdong, China	JN132015
Thamnocalamus spathiflorus (Trin.) Munro	GLM 081775 (KUN)	Xizang, China	JN132083
Yushania basihirsuta (McClure) Z. P. Wang & G. H. Ye	Zeng and Zhang 06108 (KUN)	Hunan, China	JN131961
Yushania brevipaniculata (Hand.-Mazz.) T. P. Yi	Zhang 08005 (KUN)	Sichuan, China	JN131933

Phylogenetic analyses were conducted with PAUP*v.4.0b10, MrBayes 3.2.5 (Ronquist et al. 2012) and GARLI 2.0 (Zwickl 2006). MP analyses were conducted using PAUP*v.4.0b10 (Swofford 2003). Heuristic searches were performed with 1000 homogeneity replicates, tree-bisection-reconnection (TBR) branch swapping, MULTREES option off, and random addition of sequences with 1000 replicates.

ML analyses were conducted using GARLI 2.0 (Zwickl 2006), with 1000 bootstrap replicates. 50% majority-rule consensus tree was constructed using PAUP*4.0b10.

BI analyses were conducted using MrBayes 3.2.5 (Ronquist et al. 2012). The runs were conducted starting with random trees, consisting of a single cold chain and three heated chains, with the temperature set to 0.1. The Markov chain Monte Carlo (MCMC) chains were run for 10 million generations and sampled trees every 1000 generations for the GBSSI gene data set. A 50% majority-rule consensus tree was constructed from the remaining trees, yielding the posterior probability (PP) values for each clade.

Results

A total of 1414 characters were included in the maximum parsimony (MP) analyses matrix, of which 133 characters were parsimony-informative, 238 variable characters were parsimony-uninformative and 843 characters were constant. The strict consensus tree for the 234 most parsimonious trees (tree length = 531; CI = 0.787; RI = 0.675; RC = 0.532) is shown in Fig. 1. The results of the MP, BI and ML analyses were almost identical except for slight position changes of some species (not shown). PP (posterior probabilities), MPBS (maximum parsimony bootstrap support) and MLBS (maximum likelihood bootstrap support) were included on the strict consensus tree from MP analyses. PP< 0.95 and MPBS/MLBS < 70% were considered as lacking support for a clade.

In the current study, the monophyly of the temperate woody bamboo clade was strongly supported, with 100% MPBS, 100% MLBS and 1.00 PP. Our putative new species was nested in the monophyletic clade of Arundinarieae. However, the phylogenetic relationships among groups of temperate woody bamboos were not resolved in this study.

Taxonomic treatment

Khoonmengia **N.H.Xia, Y.H.Tong & X.R.Zheng, gen. nov.**
urn:lsid:ipni.org:names:77204206-1

Type. *Khoonmengia honbaensis* N.H.Xia, Y.H.Tong & X.R.Zheng.

Diagnosis. *Khoonmengia* resembles *Hsuehochloa* and *Ampelocalamus* in having pachymorph and short-necked rhizomes, florets with 3 stamens and 2 stigmas, but differs

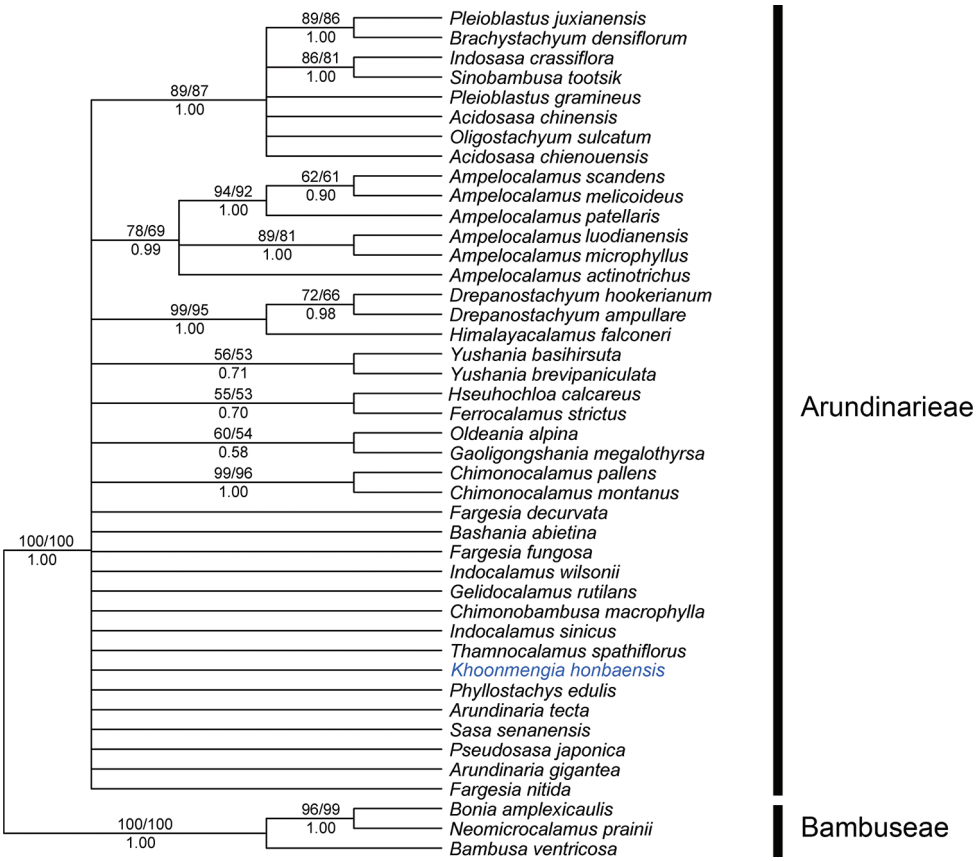

Figure 1. The strict consensus of 234 equally most parsimonious trees based on the partial GBSSI gene. Numbers below branches indicate posterior probability of Bayesian Analysis, and numbers above branches indicate bootstrap values of MP and ML.

from the former by its scrambling habit, nodes swollen at one side, mid-culm branch complement with one central dominant branch elongating to reiterate the culm accompanied by 1–4 lateral slender branches, swollen culm sheath base with a distinctive zone of transverse wrinkles, culm and leaf sheaths without auricle or oral setae, and single or several to many synflorescences arranged into a raceme or panicle, and can be distinguished from the latter by extravaginal branching pattern, buds wholly sunken into culm, culm sheath base with a distinctive zone of transverse wrinkles, synflorescence composed of only one spikelet, purple anthers and nut-like caryopsis with hardened pericarp and loosely adherent lemma and palea.

Description. Shrubby bamboo. Rhizomes pachymorph, short-necked. Culms unicaespitose, erect at lower part, distally scrambling; internodes terete, with dense brownish green dots; nodes conspicuous, swollen at one side. Buds elliptic, wholly sunken into culm. Branches extravaginal, often solitary at lower part of culm, and usually with one central dominant branch elongating to reiterate the culm and 1–4

lateral slender ones in the middle part of culm. Culm sheaths persistent, basally swollen, with a distinctive zone of transverse wrinkles; auricles and oral setae absent; blade reflexed; ligule convex. Foliage leaves without auricles and oral setae; ligules convex. Synflorescence semelauctant, composed of only one spikelet subtended by one or several sheath-like bracts, single or several to many synflorescences arranged into a raceme or panicle which is terminal on leafy branches; spikelets with 8–9 florets. Glumes (0-)1–2. Palea slightly shorter than lemma. Lodicules 3. Stamens 3, filaments free, anthers purple. Styles 2, free, stigmas 2, plumose. Caryopsis nut-like, with a hardened pericarp and loosely adherent lemma and palea, apex with 2 persistent style bases.

Khoonmengia honbaensis **N.H.Xia, Y.H.Tong & X.R.Zheng, sp. nov.**
urn:lsid:ipni.org:names:77204207-1

Type. Vietnam, Khanh Hoa, Hon Ba Nature Reserve, 1500 m, 17 October 2017, N. H. Xia et al. BVN2017048 (holotype, IBSC!; isotypes, SING!, VNM!).

Description. Culms erect at lower part, distally scrambling, 2–4(-10) m long; internodes terete, 20–32 cm long, 4–6 mm in diam., initially light purple, becoming gray-green, with dense brownish green dots turning black when dry; nodes conspicuous, swollen at one side, lower margin ciliate, supranodal ridge inconspicuous, internodes glabrous. Buds elliptic, wholly sunken into culm. Branches extravaginal, often solitary at lower part of culm, and usually with one central dominant branch elongating to reiterate the culm and 1–4 lateral slender ones in the middle part of culm, lateral branches 10–25 cm long. Culm sheaths persistent, leathery, glossy, initially light purple, 8–9.5 cm long, abaxially with distinct veins, basally swollen, with a distinctive zone of transverse wrinkles; auricles and oral setae absent; blade reflexed, lanceolate, 6–9 cm long, glabrous, deciduous; ligule convex, ca. 2 mm high, glabrous. Leaves 3–8 per ultimate branch; leaf sheaths glabrous; auricles and oral setae absent; ligules convex, ca. 2 mm high; blades elliptic-lanceolate, 10–20 × 1–2.5 cm, glabrous both sides except margin ciliate at the base when young, secondary veins 3–5 pairs, transverse veins distinct. Synflorescence semelauctant, composed of only one spikelet subtended by one or several sheath-like bracts, single or several to many synflorescences arranged into a raceme or panicle which is terminal on leafy branches; spikelets 4–7 cm long, florets 8–9. Glumes (0-)1–2, ovate, ca. 10 × 3 mm, apex acute, glabrous, 11-veined. Rachilla segments flat, ca. 6 mm, glabrous, apex inflated. Lemma ovate-lanceolate, 12–13 × 5 mm, glabrous, 13-veined, apex acute with a mucro; palea slightly shorter than lemma, 11–12 × 2–3 mm, 2-keeled, keels ciliolate, apex with excurrent keel vein, 3-veined between keels and 2-veined outside keels, veins inconspicuous; lodicules 3, ovate, membranous, 3–5 × 1.5–2 mm, ciliolate, apex acuminate; stamens 3, filaments white, free, anthers tinged purplish when young, then becoming purple, ca. 7 mm long; ovary ovoid, 1 mm long, glabrous; styles 2, free, ca. 1 mm long, stigmas plumose,

ca. 3 mm long. Caryopsis nut-like, with a hardened pericarp and loosely adherent lemma and palea, dark brown, fusiform, 8–9 × ca. 3 mm, apex with 2 persistent style bases.

Etymology. *Khoonmengia* is named in honor of Dr. Khoon Meng Wong, a renowned botanist who has studied the bamboos and other plant groups of Southeast Asia for more than 35 years. The specific epithet is named after Hon Ba Nature Reserve, the type locality of this species.

Distribution and habitat. This species was only found in the type locality, i.e. Hon Ba Nature Reserve, Khanh Hoa Province of Vietnam. It occurs in high mountain broadleaved forests at an elevation of ca. 1500 m.

Additional specimen examined (paratype): VIETNAM, Khanh Hoa, Hon Ba Nature Reserve, 12°06'39.2"N, 108°56'47.2"E, C. Y. Lee et al. HIKK370 (HN!).

Discussion

Morphological analysis (Table 1) revealed that this unknown bamboo owns several unique vegetative and reproductive characters that are different from the two closely related genera, i.e. *Ampelocalamus* and *Hsuehochloa*, such as culm with brownish green dots (Figs 2F, 5A), swollen culm sheath base with a distinctive zone of transverse wrinkles (Fig. 5A), synflorescence composed of solitary spikelet, single (Figs 2J–K, 3B, 4H) or several to many synflorescences arranged into a raceme or panicle (Figs 3A, 4G) terminal on leafy flowering branches, and nut-like caryopsis with loosely adherent lemma and palea (Fig. 3J). The nut-like bamboo caryopsis is different from the usual grain-like one by the hardened pericarp, and is reported only in some species of Bambuseae such as *Cephalostachyum pallidum* Munro, *Dendrocalamus membranaceus* Munro and *D. strictus* Nees before (Yu et al. 1993). Thus, the nut-like caryopsis type seems very rare in Arundinarieae. Our unknown bamboo species is also different from *Ampelocalamus* in the extravaginal branching pattern (vs. transferring), elliptic buds wholly sunken into culm (vs. ovate to broad ovate, not sunken or only base sunken into culm) (Fig. 6), and purple anthers (vs. yellow). For these three important generic characters, *Hsuehochloa* is the same as our unknown bamboo, which makes us infer that the closest genus to *Khoonmengia* may be *Hsuehochloa*. Although some important characters of *Hsuehochloa* such as number of glume, caryopsis type, are still unknown, besides the differences mentioned above, our unknown bamboo species can be further distinguished from *Hsuehochloa* by its scrambling habit (vs. pendulous or procumbent, not scrambling, according to the third author's field observation), nodes swollen at one side (vs. flat, Fig. 5B), mid-culm branch complement with one central dominant branch elongating to reiterate the culm accompanied by 1–4 lateral slender branches (vs. subequal 3–7 branches), and culm and leaf sheath auricle or oral setae absent (vs. present). Moreover, *Hsuehochloa* grows on the limestone mountain, while the unknown species grows in granitic montane broadleaved forests. More detailed comparisons of

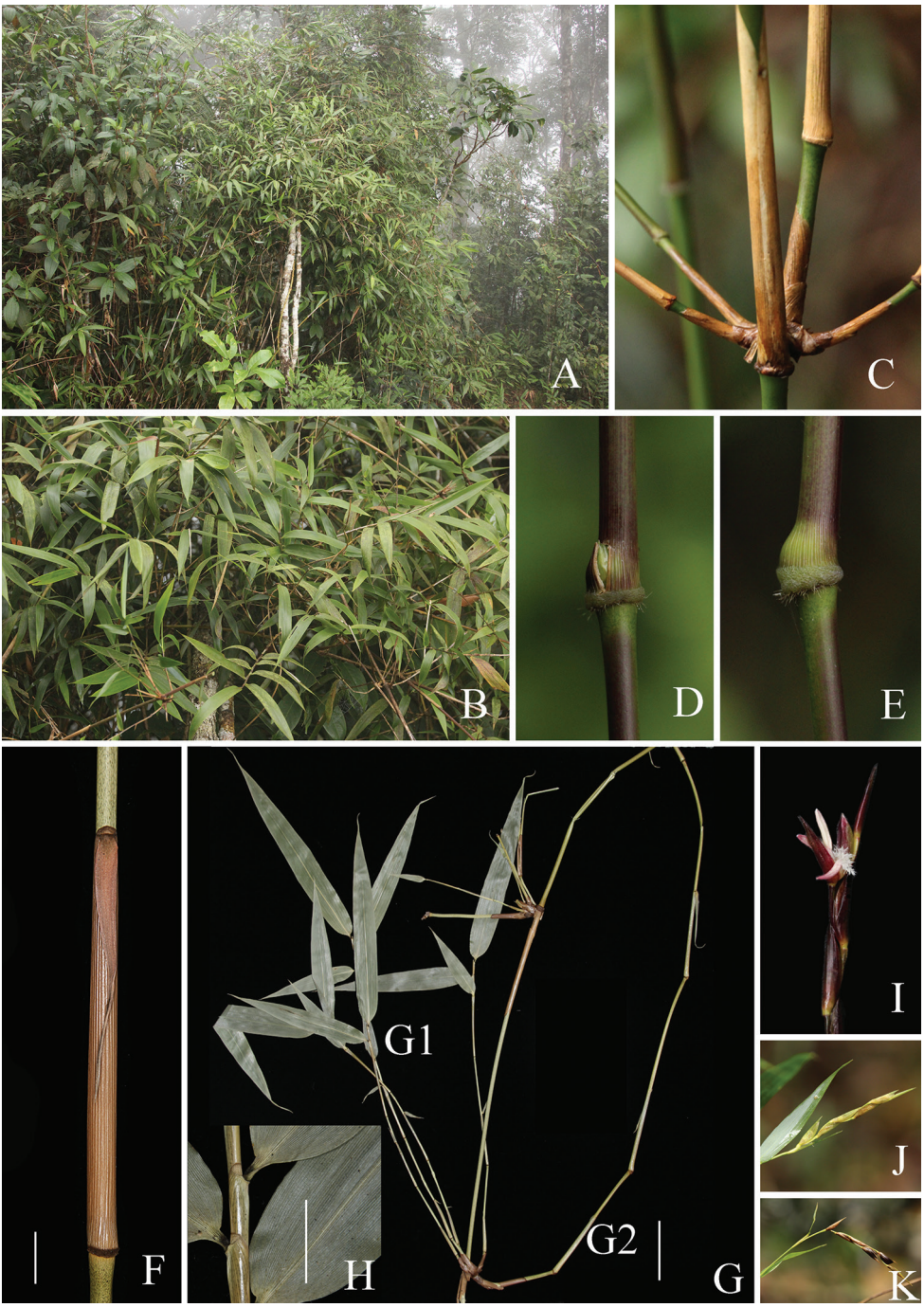

Figure 2. *Khoonmengia honbaensis* **A** habit **B** leafy branches **C** branch complement **D** node with buds breaking out of the culm sheath base **E** node with bud inside the intact culm sheath **F** culm sheath **G** leafy branches at culm apex (G1 Slender branches, G2 Dominant branch) **H** leaf sheath **I** florets **J** synflorescence composed of only one spikelet **K** infructescence (**F, G, H** from N. H. Xia et al. BVN2017048). Scale bars: 1 cm (**F, H**); 5 cm (**G**).

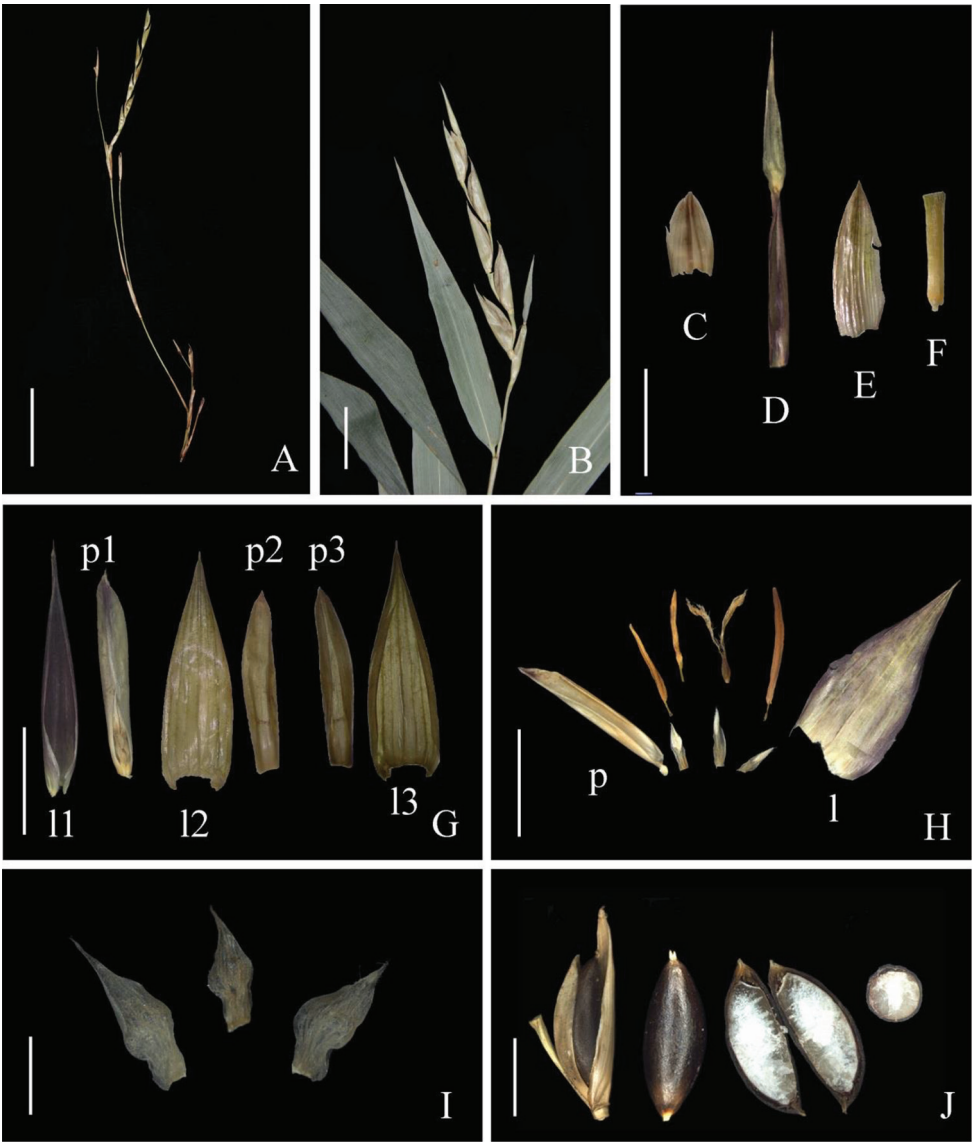

Figure 3. *Khoonmengia honbaensis* **A** many synflorescences arranged into a panicle (leaf flowering branch not shown) **B** single synflorescence composed of only one spikelet subtended by a sheath-like bract terminal on leaf flowering branch **C** prophyll **D** sheath-like bract **E** glume **F** rachilla segment **G** lemmas & paleas **H** dissection of one floret showing lemma, palea, 3 stamens, gynoecium with 2 stigmas and 3 lodicules **I** lodicules **J** nut-like caryopsis (leftmost, within its lemma and palea, and second from left, detached) and when sectioned vertically (third from left) and transversely (rightmost). (l = lemma, p = palea). Scale bars: 2 cm (**A**); 1 cm (**B**); 5 mm (**C–H, J**); 2 mm (**I**).

these genera are summarized in Table 1. The GBSSI phylogeny revealed that our putative new species is definitely a member of Arundinarieae with an isolated position, which indicated that this species could not be assigned to any of the already

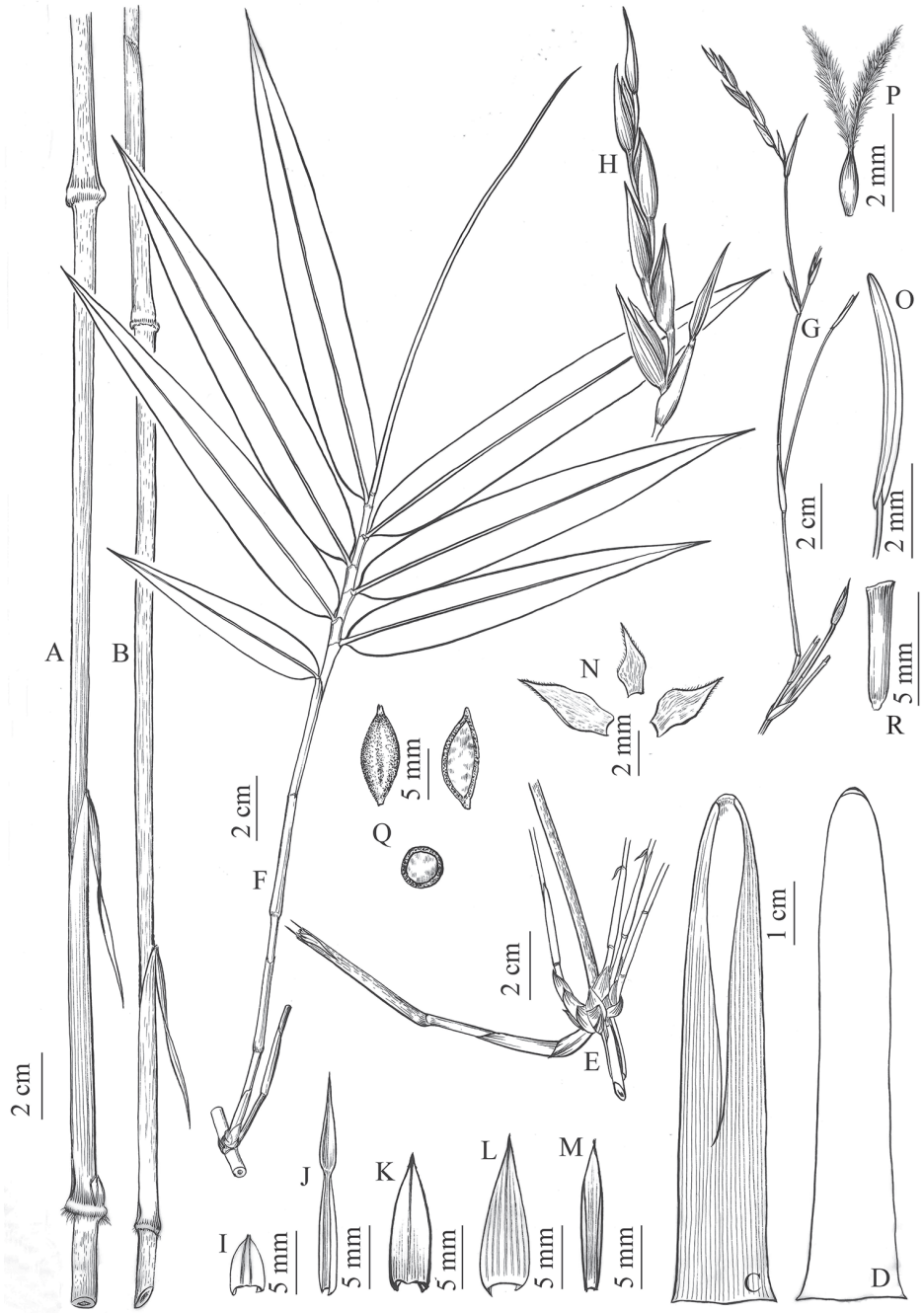

Figure 4. *Khoonmengia honbaensis* **A, B** culm nodes and internodes with sheaths **C** culm sheath, abaxial view **D** culm sheath, adaxial view **E** branch complement **F** leafy branch **G** synflorescences arranged into a panicle **H** synflorescence composed of only one spikelet subtended by a sheath-like bract **I** prophyll **J** sheath-like bract **K** glume **L** lemma **M** palea **N** lodicules **O** stamen **P** pistil **Q** caryopsis and its vertical and cross sections **R** rachilla segment (From N. H. Xia et al. BVN2017048).

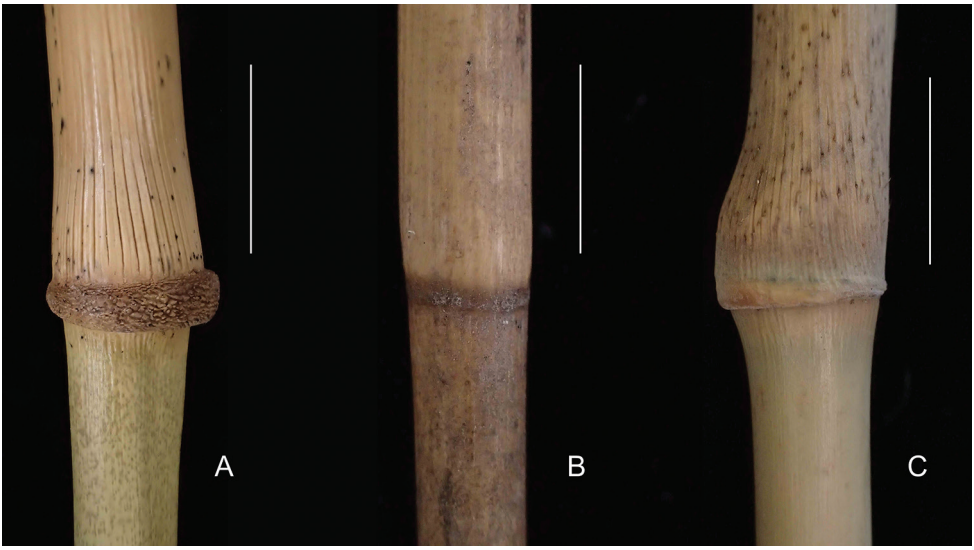

Figure 5. Comparison of culm leaf sheath bases **A** *Khoonmengia honbaensis*, showing swollen culm leaf sheath base with a distinctive zone of transverse wrinkles (From N. H. Xia et al. BVN2017048) **B** *Hsuehochloa calcarea*, showing flat and smooth culm leaf sheath base (From Y. Y. Zhang zyy-030, IBSC) **C** *Ampelocalamus actinotrichus*, showing slightly swollen and nearly smooth culm leaf sheath base (From N. H. Xia et al. HN-025, IBSC). Scale bars: 1 cm (**A, C**); 5 mm (**B**).

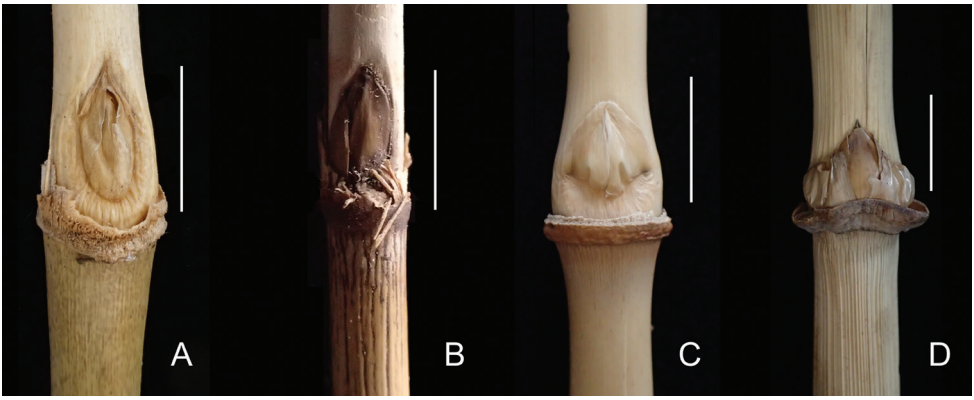

Figure 6. Comparison of buds **A** *Khoonmengia honbaensis*, showing elliptic bud wholly sunken into culm (From N. H. Xia et al. BVN2017048) **B** *Hsuehochloa calcarea*, showing elliptic bud wholly sunken into culm (From Y. Y. Zhang zyy-030, IBSC) **C** *Ampelocalamus actinotrichus*, showing ovate bud with the base sunken into culm (From N. H. Xia et al. HN-025, IBSC) **D** *Ampelocalamus melicoideus*, showing broad ovate bud not sunken into culm (From Y. Y. Zhang zyy-033, IBSC). Scale bars: 1 cm (**A, C, D**); 5 mm (**B**).

described genera. Based on the above analysis of morphology, molecular phylogenetic relationships and habitat, we propose to establish a new genus to accommodate this unknown bamboo.

Acknowledgments

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RESEARCH ARTICLE

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Schizostachyum dakrongense (Poaceae, Bambusoideae), a new species from Dakrong Nature Reserve, Vietnam

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Abstract

Schizostachyum dakrongense is a new species of woody bamboo from Dakrong Nature Reserve, Quang Tri Province, central Vietnam. It is closely related to *S. hainanense* but differs by its pseudospikelets having terminal rachilla segments with ciliate margin and 6 bracts; culm sheath with the base of the outer margin having a slight projection below its point of attachment at the node, as well as sheath blades usually less than half as long as the culm sheath proper; and leaf blades pale-puberulent and sparsely pilosulous on the abaxial surface. The new species is described and illustrated here.

Keywords

Asia, Melocanninae, morphology, taxonomy, woody bamboos

Introduction

Schizostachyum Nees, which was established by Nees von Esenbeck in 1829, is a genus of subtribe Melocanninae (Poaceae, Bambusoideae) (Nees von Esenbeck 1829; BPG 2012). It is widely distributed in tropical and subtropical southeastern Asia (Wong 1995; Widjaja 1997; Ohrnberger 1999; Xia and Stapleton 2006). This genus is closely related

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to several later genera: *Teinostachyum* Munro, *Neohouzeaua* A. Camus, *Dendrochloa* Parkinson, *Leptocanna* Chia & H.L. Fung, *Cephalostachyum* Munro, and *Pseudostachyum* Munro so that there are different opinions about generic delimitation (Munro 1868; McClure 1935; Holttum 1946; Dransfield 1983; Xia 1993; Yang et al. 2007; Vorontsova et al. 2016). One opinion, suggested by Xia, is that *Teinostachyum*, *Neohouzeaua*, *Dendrochloa*, and *Leptocanna* should be combined with *Schizostachyum*, and both *Cephalostachyum* and *Pseudostachyum* should be recognized as a separate genus (Xia 1993). Molecular evidence has supported this suggestion (Yang et al 2007; Zhou et al 2017).

The first species of *Schizostachyum* in Vietnam was discovered by Balansa, who reported *S. zollingeri* Steud. (Balansa 1890). E.G. Camus also recorded this species in his monograph (Camus 1913). Several years later, E.G. Camus and A. Camus found another species of *Schizostachyum* in Vietnam, namely *S. aciculare* Gamble (Camus and Camus 1923). In 1942, McClure recorded two further species, *S. pseudolima* McClure and *S. hainanense* Merr. ex McClure (McClure 1942). Besides the above-mentioned four species, Pham recorded another seven species of *Schizostachyum* bamboo in Vietnam (Pham 2000). In the Bamboos of Vietnam, Nguyen increased this number to sixteen, with many undescribed species (Nguyen 2006). But after systematically researching Vietnam *Schizostachyum*, Tran (2011) thought that six species previously determined as *Schizostachyum* were in fact misidentifications. In his revision, he followed Xia's concept and recognized that there were fifteen species of *Schizostachyum* in Vietnam, including several undescribed ones. Up to now, he has published 4 new species of Vietnam *Schizostachyum*, namely *S. ninhthuanense* N.H. Xia, V.T. Tran & H.N. Nguyen, *S. yalyense* N.H. Xia, V.T. Tran & H.N. Nguyen, *S. nghianum* N.H. Xia & V.T. Tran, and *S. langbianense* V.T. Tran, N.H. Xia & H.N. Nguyen (Tran et al. 2010, 2013, 2016).

Dakrong Nature Reserve is located in Quang Tri province, central Vietnam. The main terrain of the reserve includes low ranges that are part of the Annamite Mountains. With a tropical monsoon climate, the average annual temperature of this area is 22–24 °C and the average annual precipitation is 2500–3000 mm. There are large areas of lowland forest in the reserve. These forests are located in a zone of overlap between the tropical Indo-Pacific/Sunda and subtropical/temperate China floristic regions. Consequently, this area shows high species richness and diversity (Trai et al. 1999). About 1053 species of plants are recorded for the 40,253 ha area (CRES 2005).

During a field survey in Dakrong Nature Reserve in November 2018, we collected a flowering bamboo which appeared similar to *S. hainanense*. But after further study, we confirmed that it is an undescribed species characterized by a ciliate margin in the terminal rachilla segment of the pseudospikelet and the base of the culm sheath's outer margin developing a slight projection below the point of attachment at the node.

Materials and methods

Material from this new species was collected from the type locality. Flowers were dissected under an Olympus-SZX16 microscope and photomicrographs microphotos were taken with a Qimaging MicroPublisher 3.3 RTV instrument. Morphological

comparisons were based on characters recorded in the relevant literature including protologues, as well as a study of type specimens. The type specimens, photos and living plants were used for describing this new species.

Taxonomic treatment

Schizostachyum dakrongense **N.H.Xia, Z.Y.Cai, Y.H.Tong & T.C.Vu, sp. nov.**
urn:lsid:ipni.org:names:77204209-1
Figures 1, 2

Type. Vietnam. Quang Tri Province: Dakrong Nature Reserve, 16°37'16.80"N, 106°52'1.80"E, alt. ca. 200m, 15 Nov. 2018, *N.H. Xia et al* BVN20181114 (holotype: IBSC!; isotype: VNMN!).

Diagnosis. This new species resembles *Schizostachyum hainanense* in having culm sheaths with an asymmetrically concave apex and well-developed oral setae. However, *S. dakrongense* differs from *S. hainanense* in its pseudospikelets having a terminal rachilla segment with ciliate margin, and 6 bracts; the base of the culm sheath outer margin with a slight projection below its point of attachment; culm sheath blades that are usually less than half as long as the sheath proper; pale-puberulent and sparsely pilosulous leaf blade abaxial surfaces.

Description. Culms erect, apex pendulous, 6–8 m tall, ca. 1.5 cm in diameter; internodes ca. 40 cm long, slightly siliceous and scabrous, with sparse white hairs, sometimes with white waxy powder, with an especially conspicuous white-powdery and brown-yellow setaceous zone ca. 1 cm wide just below each node; walls 1–2 mm thick. Culm sheaths up to 23 cm long, dark brown, covered with white powder and appressed brown hairs, margins sparsely ciliate, apex asymmetric, concave (ca. 9 mm deep), base of outer margin with a slight projection below point of attachment; auricles absent; oral setae well-developed, up to 20 mm or longer; ligule up to ca. 1 mm long, fringes of margin ca. 10 mm long; culm sheath blade narrowly lanceolate, reflexed, entire, usually less than half as long as culm sheath, adaxial side covered with dense white and brown hairs, especially at the base. Branches numerous and subequal, 30–50 cm long. Foliage leaves complements with 6–10 leaves; leaf blades oblong-lanceolate or linear-lanceolate, 10–21 cm long, 1.3–3.7 cm wide, adaxial surface slightly scabrous, abaxial surface pale-puberulent and sparsely pilosulous; sheaths 3–8 cm long, glabrous; auricles absent; oral setae well developed, pale, 10–15 mm long; ligule up to ca. 0.5 mm long, margin fimbriate. Pseudospikelets with 1 floret, clustered on leafy flowering branches, fusiform, ca. 20 mm long; prophylls ca. 2.5 mm long, ovate-lanceolate or triangular, apex acute or emarginate, abaxial surface glabrous or hairy; bracts (5–)6, ovate or ovate-lanceolate, apex emarginate, obtuse to acute or mucronate, abaxial surface glabrous or hairy, margin ciliate or not, the lowest bract without buds in its axils, the top two each with a bud in their axils, the middle ones with a bud in their axil or not; glumes absent; rachilla ca. 1 mm long, terminal segment enlarged, disciform, margin ciliate; lemma ca. 12 mm long, ovate-lanceolate, involute, apex acuminate mucronate, many-veined, margins ciliate or not; palea ca. 15 mm, strongly involute, upper portion

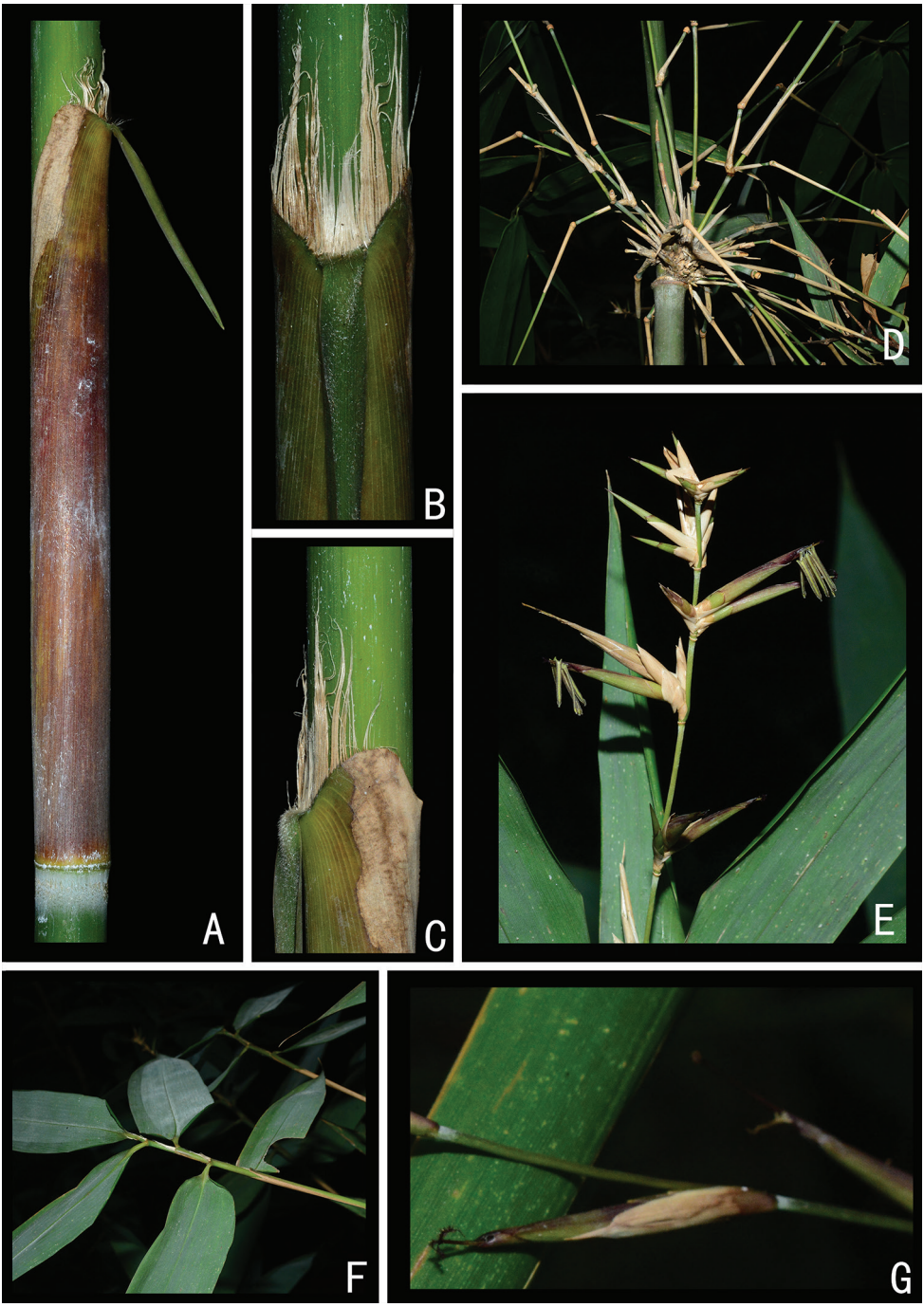

Figure 1. Morphological character of *S. dakrongense* sp. nov. **A** Culm sheath **B, C** apex of culm sheath **D** branches **E** pseudospikelets and anthers **F** foliage blades **G** pseudospikelets and stigmas.

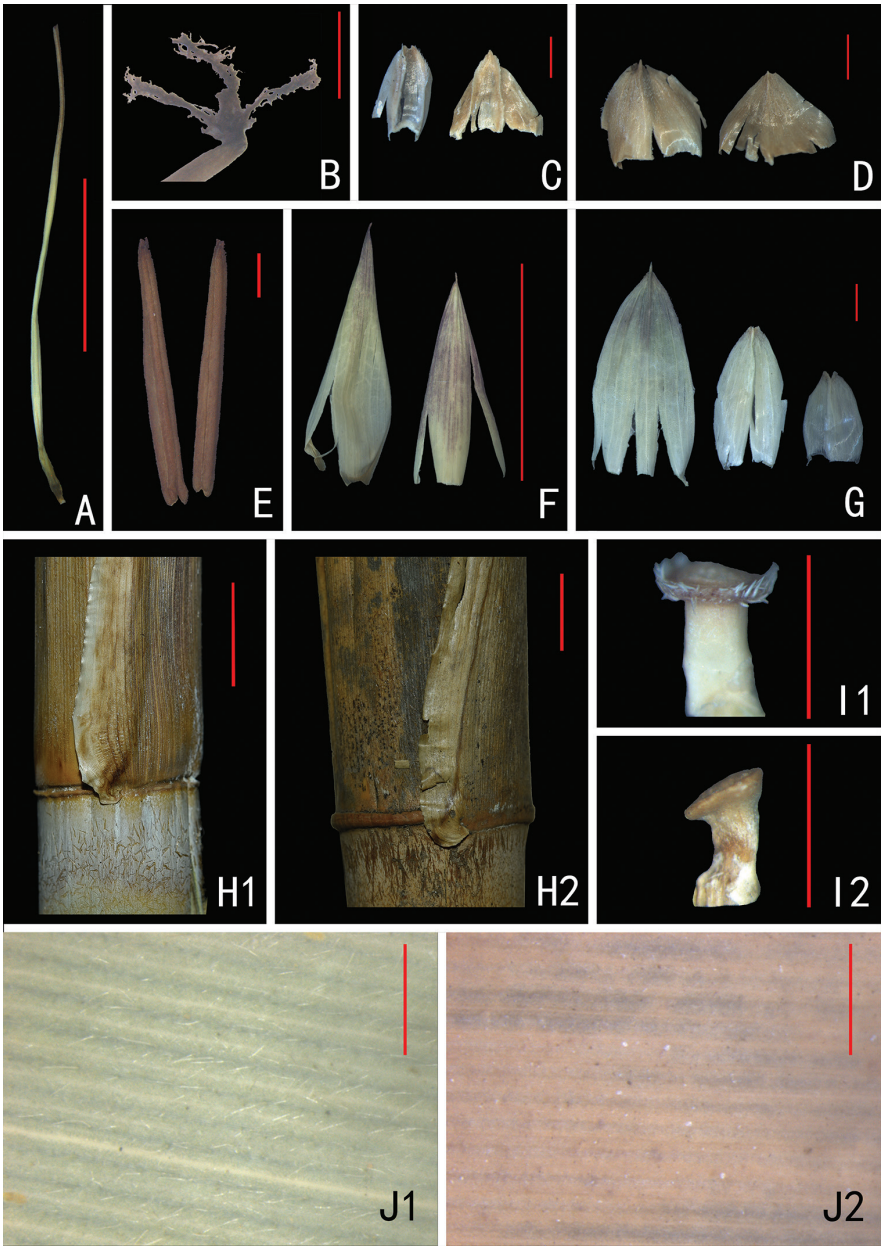

Figure 2. Morphological character of *S. dakrongense* sp. nov. and comparisons between *S. dakrongense* and *S. hainanense*. **A** Ovary and style **B** stigmas **C** prophylls **D, G** bracts **E** stamens **F** Palea (left) and Lemma (right) **H1** base of culm sheath outer margin of *S. dakrongense* **H2** base of culm sheath outer margin of *S. hainanense* **I1** rachilla of *S. dakrongense* with ciliate margin **I2** rachilla of *S. hainanense* with glabrous margin **J1** Leaf abaxial surface of *S. dakrongense* pale-puberulent and sparsely pilosulous **J2** leaf abaxial surface of *S. hainanense* glabrous. Scale bars: 1 cm (**A, F, H1, H2**); 1 mm (**B–E, G, I1, I2, J1, J2**).

Table 1. Morphological comparisons of *S. dakrongense* with *S. hainanense*.

Characters	*S. dakrongense*	*S. hainanense*
Culm	6–8 m tall, ca. 1.5 cm in diameter	8–20(–30) m tall, ca. 4 cm in diameter
Internodes	ca. 40 cm long	75 cm long or more
sheath blade	usually less than half as long as sheath	usually more than half as long as sheath
Base of culm sheath outer margin	With a slight projection below point of attachment	With a conspicuous semi-circular projection below point of attachment
Leaf abaxial surface	pale-puberulent and sparsely pilosulous	glabrous
Bracts	(5–)6	3–4
Rachilla terminal segment	margin ciliate	glabrous

indurate, lower portion soft, apex mucronate; lodicules absent; filaments white, ca. 13 mm long, free, anthers ca. 6 mm long, brownish yellow; ovary ovoid, glabrous, style ca. 15 mm long, stigmas 3, purple, ca. 1.5 mm long, plumose. Fruit unknown.

Etymology. The species epithet "dakrongense" refers to the type locality: Dakrong Nature Reserve, Quang Tri Province, Vietnam.

Phenology. New shoots are found from summer to autumn.

Distribution and habit. According to our investigations and the available data, *S. dakrongense* is only distributed in Dakrong Nature Reserve. It commonly occurs in evergreen forest at an elevation of ca. 200 m, together with *Eurycoma longifolia* Jack, *Ficus hirta* var. *roxburghii* King, *Archidendron occultatum* (Gagnep.) I.C. Nielsen, and a species of *Ochna*.

Conservation status. The species is found in a protected area, so its environment appears to be relatively stable. It is locally common. However, the area of distribution is less than 400 km^2. According to International Union for Conservation of Nature (IUCN) Red List categories and criteria, this species should be treated as Endangered (EN) (IUCN 2012).

Acknowledgments

We would like to thank Mr. Ngyuen Van Dat, Mr. Nguyen Van Minh and the staff in Dakrong Nature Reserve for their assistance during field work. The study was supported by the National Natural Science Foundation of China (Grants 31670196), Regional International Cooperation Project of Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences (Grants 2016CASSEABRIQG008) and Provincial Science and Technology Planning Project of Guangdong (Grants 2017A030303061).

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RESEARCH ARTICLE

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An updated checklist of *Begonia* (Begoniaceae) in Laos, with two new species and five new records

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Abstract

Two new species of *Begonia* L. (Begoniaceae), *B. laotica* (sect. *Parvibegonia*) and *B. hypoleuca* (sect. *Reichenheimia*), from north Laos are described and illustrated. *Begonia augustinei*, *B. dryadis*, *B. lancangensis*, *B. sizemoreae* and *B. sillentensis* subsp. *mengyangensis* were newly recorded taxa in Laos. Furthermore, an updated checklist of *Begonia* of Laos is also compiled.

Keywords

sect. *Parvibegonia*, sect. *Reichenheimia*, taxonomy, new records

Introduction

Begonia Linnaeus (1753: 1056) is the sixth largest genera of angiosperms and the number of accepted species of *Begonia* currently stands at 1947 (Hughes et al. 2015) and is likely to rise to well over 2000 (Moonlight et al. 2018; Tian et al. 2018). According to

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the annotated checklist of south east Asia *Begonia* by Hughes (2008) and recent taxonomic publications (Hughes 2007; Newman et al. 2007; De Wilde et al. 2011; Averyanov and Nguyen 2012; Souvannakhoummane et al. 2016, 2018; Yang et al. 2018; Averyanov et al. 2019), 19 species of *Begonia* have been described from Laos, so far.

As part of the botanical inventory of China-Laos transboundary biodiversity conservation, we carried out floristic surveys in the Phou Hin Phee National Biodiversity Conservation Area, Oudomxay Province, the Nam Ha National Biodiversity Conservation Area in Luang Namtha Province and the Phou Dean Din National Bio-Diversity Park, Phongsaly Province of northern Laos. During the fieldwork from 2018 to 2019, some interesting species of *Begonia* have been collected. After reviewing the literature and herbarium specimens, we described and illustrated two species as new to science and five species as new records for the flora of Laos. We provided an updated total of 26 species for the *Begonia* flora of Laos.

Begonia laotica is classified under *B.* sect. *Parvibegonia* A. de Candolle (1859: 136) according to its small and tuberous habitat, axile placentation, 2-locular ovary, 2 styles and fruit with 3 unequal wings (Doorenbos et al. 1998; Moonlight et al. 2018). *Begonia hypoleuca* belongs to *B.* sect. *Reichenheimia* (Klotzsch, 1855: 174) A. de Candolle (1864: 385), based on the morphological characteristics, including 2 tepals in male flowers, axile and entire placentation, 3-locular ovary, 3 styles and fruit with 3 wings (Doorenbos et al. 1998; Moonlight et al. 2018).

Material and methods

Measurements and morphological character assessments of the new species have been examined, based on fresh materials and dried specimens. They have been compared with morphologically similar species by affinities inferred using descriptions (Ku et al. 2007; Camfield and Hughes 2018) and type specimens in herbaria (BM, E, K, B, KUN, P, HITBC, YUNU, LE and FOF). Protologues and images of type specimens were gathered from JSTOR Global Plants (http://plants.jstor.org).

Taxonomic treatments

Begonia laotica **Y.H.Tan & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204211-1
Figure 1

sect. *Parvibegonia* A. de Candolle

Diagnosis. The new species is mostly similar to *B. josephii* A. de Candolle (1859: 126) in its peltate, stemless, tuberous habit, but significantly differs by fleshy reddish bristles at the petiole apex (vs. without), ovary 2-locular (vs. 3-locular) and styles 2 (vs. 3).

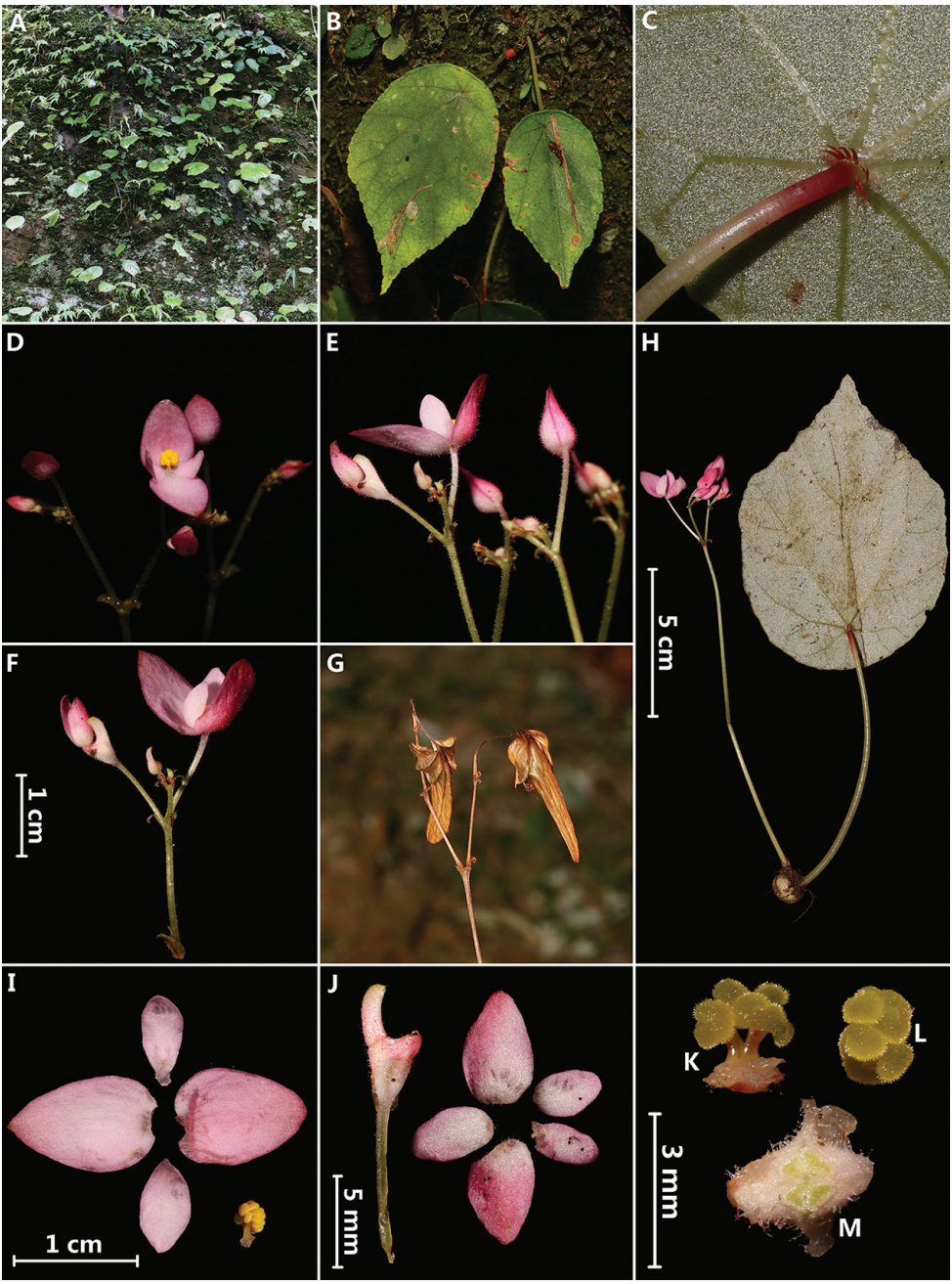

Figure 1. *Begonia laotica* Y.H.Tan & H.B.Ding, sp. nov. **A** habitat **B** leaf blade adaxially **C** leaf blade abaxially (showing fleshy reddish bristles at the petiole apex) **D** flowers (front view) **E** flowers (lateral view) **F** inflorescence **G** mature fruits **H** habit **I** staminate flower **J** pistillate flower (young) **K** stamens (lateral view) **L** stamens (front view) **M** cross section of ovary. Photographed by H.B. Ding.

Type. Laos. Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, 20°43'18.69"N, 102°08'47.97"E. 1378 m elev., 25 October 2018, flowering, *Y.H. Tan & H.B. Ding L0827* (holotype: HITBC!; isotypes: HNL!).

Description. Monoecious herb, stemless, tuberous, 18–25 cm high, tuber small, subglobose, 12–15 mm in diameter. ***Stipule*:** broadly lanceolate, 2–3 mm long, membranous, sparsely glandular hairy, margin fringed by hairs, deciduous. ***Leaf*: *petiole*** 6–15 cm long, glabrous or sparsely puberulous; blade ovate, nearly symmetric, 9.2–13.5 × 5.8–11 cm, peltate, base rounded, apex acuminate, margin slightly denticulate, with sparse short hairs, upper surface green, glabrous, lower surface paler, venation palmate-pinnate, tomentose on the veins, fleshy reddish bristles at the petiole apex, thinly succulent in life, thinly papery when dried. ***Inflorescence*:** axillary, terminal cyme; peduncle puberulent, 7.2–10.9 cm long, branching 2–3 times; bracts narrowly ovate, ca. 4.0 × 2.5 mm, membranous, reddish line along the middle, slightly glandular hairy, margin fringed by glandular hairs. ***Staminate flower*:** pedicel 1.1–1.8 cm, membranous, covered with glandular hairs, tepals 4, pink, unequal, outer 2, ovate, 10–13 × 7–17 mm, glandular hairs on the outer surface, margin entire, inner 2, elliptic, 7–10 × 2–4 mm, glabrous, margin entire; stamens 15–20, anther obovate, ca. 1 mm. ***Pistillate flower*** (young): pedicel 0.9–1.2 cm long, membranous, glandular hairy, tepals 5, pink, unequal, outer 2, ovate, 4–6 × 3–4 mm, inner 2, elliptic, 3–5 × 1–3 mm, glandular hairs on the outer surface, especially at the base; ***ovary*** 2-locular, placentae axial, placentae 2 per locule, ***styles*** 2, stigmas bifid with twisted bands, highly convolute, golden yellow. ***Capsule*** nodding, obovate, pinkish tomentose, unequally 3-winged, abaxial wing oblong, ca. 13 mm long, lateral wings shorter, ca. 3 mm long.

Phenology. Flowering in October–November and fruiting in December.

Distribution. Endemic to the type locality, Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, Laos.

Ecology. Restricted to the shaded base of limestone cliff at ca. 1378 m elevation.

Etymology. The specific epithet '*laotica*' refers to the type locality in Laos.

Conservation status. Data Deficient (DD) (IUCN 2017). The new species was only collected from the limestone cliff of Hin Phee National Biodiversity Conservation Area. Due to its remote habitat, we suggested that the species may not suffer from strong human disturbance. According to the available information, we proposed the preliminary conservation status of this new species as Data Deficient (DD) (IUCN 2017).

Notes. *Begonia laotica* is phenotypically most similar to *B. josephii* in its tuberous habit, ovate and peltate leaves, but it can easily be distinguished by its glabrous upper leaf surface (vs. hispid all over), fleshy reddish bristles at the petiole apex (vs. without), bracts narrowly ovate and fringed by glandular hairs (vs. lanceolate and glabrous), male flowers pedicels with glandular hair (vs. glabrous), outer tepals ovate (vs. broadly obovate), inner tepals elliptic (vs. spathulate), anther obovate (vs. ellipsoid), female flowers pedicels with sparsely glandular hair (vs. glabrous), glandular hair on the outer surface (vs. glabrous), ovary 2-locular (vs. 3-locular) and styles 2 (vs. 3). This new species also shares similar characteristics with *B. subperfoliata* Parish ex Kurz (1873: 81) in tuberous habit and peltate leaves, but it can easily be distinguished by its ovary 2-locular (vs. 3-locular) and styles 2 (vs. 3).

Begonia hypoleuca **Y.H.Tan & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204213-1
Figure 2

sect. *Reichenheimia* (Klotzsch) A. de Candolle

Diagnosis. The new species is mostly similar to *B. henryi* Hemsley (1887: 322), but differs by its glabrous leaves, petiole with linear red dots and pubescent, slightly denticulate leaf margin and fewer stamens.

Type. Laos. Luang Namtha Province, Nam Ha National Biodiversity Conservation Area, Nam O. Village, 20°04'48.16"N, 101°06'58.46"E. 656 m elev., 24 October 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng L0792* (holotype: HITBC!).

Description. Monoecious herb, stemless, tuber small, globose with fibrous roots, 10–13 mm in diameter. ***Stipule*****:** caducous. ***Leaf*****:** petiole 7–10 cm long, succulent, with reddish linear dots, sparsely pubescent or subglabrous. ***Blade*** slightly triangular ovate or broadly ovate, 6–12 × 5–8.5 cm, base cordate, apex acuminate, margin slightly denticulate, upper surface green, lower surface paler or silver, glabrous, venation palmate-pinnate, midrib pale green, lateral veins 4–6 pairs. ***Inflorescence*** axillary, cymose, peduncle ca. 6 cm long, reddish, glabrous, branching 2–4 times, 2–6 male flowers, ca. 2 pistillate flowers, bracts caducous, ca. 2 × 1 mm. ***Staminate flower*****:** pedicel 1.0–1.2 cm long, membranous, reddish at the basal part and pink, glabrous, tepals 2, pink, margin entire, glabrous on both surfaces, broadly ovate, 12 × 10 mm, apex acute, base rounded; stamens 10–15, filaments 1.5–2 mm long, anthers 1–1.5 mm, ellipsoid, yellow. ***Pistillate flower*****:** pedicle ca. 1.8 cm long, reddish to pink, tepals unknown, ***ovary*** 3-locular, placentae axial, entire, ***styles*** 3. ***Capsule*** pale green, nodding, ellipsoid, dorsal wing enlarged, 7–10 mm long, two lateral wings, smaller, 2–3 mm long.

Phenology. Flowering and fruiting in October–November.

Distribution. The species is known only from the type locality, Luang Namtha Province, Nam Ha National Biodiversity Conservation Area, Laos.

Ecology. The species was collected on shaded moist limestone rock surfaces of stone forest at 656 m elevation.

Etymology. The specific epithet '*hypoleuca*' refers to the lower surface of its paler or silver leaf.

Conservation status. Data Deficient (DD). *Begonia hypoleuca* has been collected on only one occasion from the type locality. However, the type locality is located in the Nam Ha National Biodiversity Conservation Area and we did not discover any strong pressure on the species. Thus, the species preliminarily has been assigned in the Data Deficient (DD) category as being appropriate according to the guidelines for using the IUCN Red List Categories and Criteria (IUCN 2017).

Notes. *Begonia hypoleuca* is most similar in morphological characteristics to *B. henryi* Hemsl. under the section *Reichenheimia*. It can, however, be distinguished by the following characteristics, including reddish linear red dots on petiole (vs. without), sparsely pubescent on petiole (vs. brown villous), slightly denticulate leaf margin (vs. crenate), glabrous leaves (vs. pubescent), leaf upper surface green (vs. green with dark green patches), lower surface

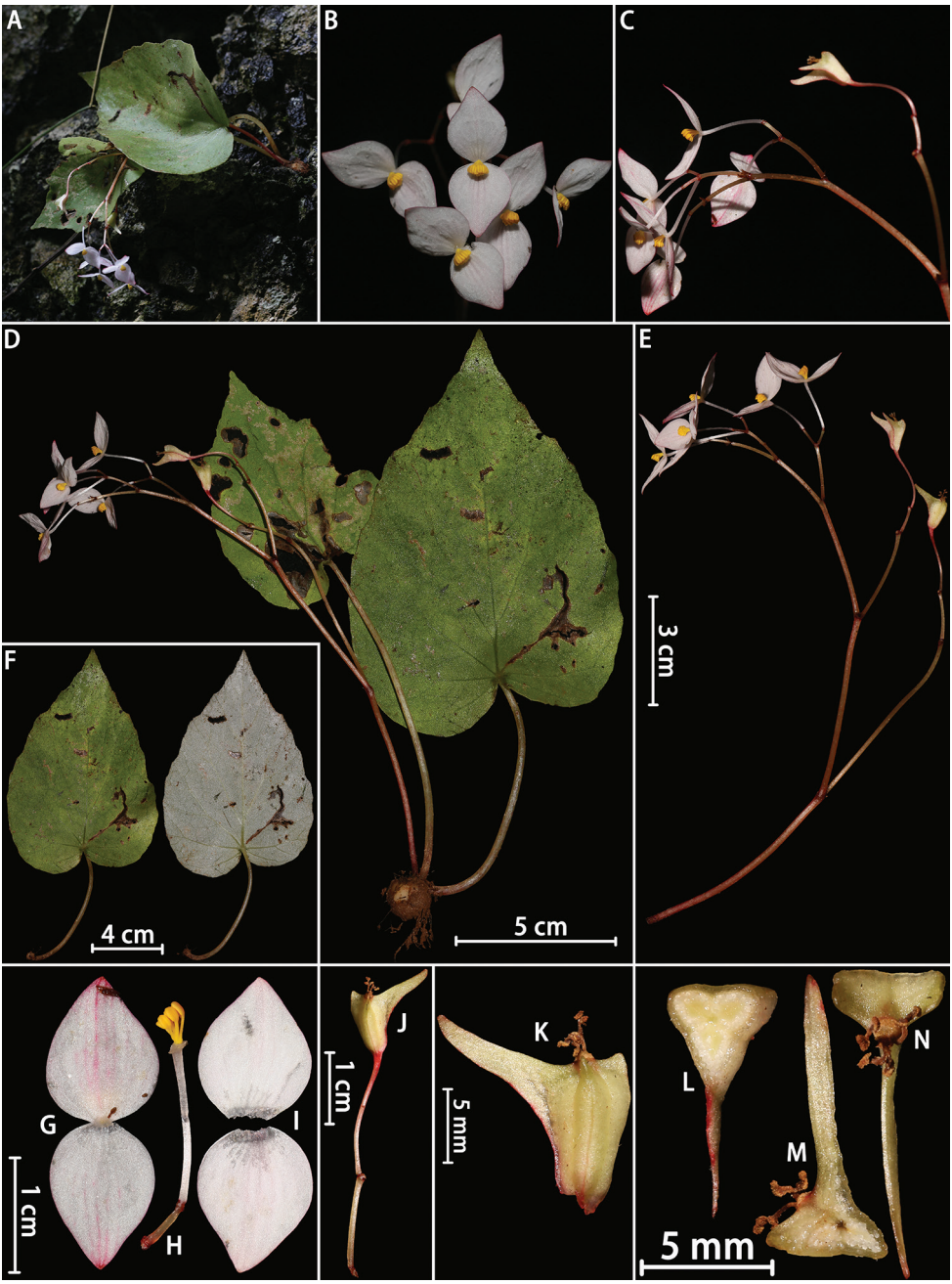

Figure 2. *Begonia hypoleuca* Y.H.Tan & H.B.Ding, sp. nov. **A** habitat **B** flowers (front view) **C** flowers (lateral view) **D** habit **E** inflorescence **F** leaves **G** tepals of staminate flower (back view) **H** stamens with peduncle **I** tepals of staminate flower (front view) **J** mature fruit with peduncle **K** mature fruit **L–N** serial cross sections of ovary. Photographed by H.B. Ding.

pale green (vs. pale green with reddish patches), male flower tepals broadly ovate (vs. oblate-orbicular), apex acute (vs. rounded), stamens number fewer 10–15 (vs. up to 30).

New records for Laos

Begonia augustinei **Hemsley**
Figure 3 A–E

Begonia augustinei Hemsley, Gard. Chron 3 (28): 286. 1900; T.C. Ku in T.L. Wu (ed.), Fl. Reipubl. Popularis Sin. 52(1): 256. 1999; S.H. Huang & Y.M. Shui in C.Y. Wu (ed.), Fl Yunnan. 12: 213. 2006; T.C. Ku et al. in C.Y. Wu & P.H. Raven (eds), Fl. China 13: 163. 2007. Type: China, Yunnan Province, Simao, *A. Henry 12333A* (holotype: B100365120!).

Specimens examined. Laos. Luang Namtha Province, Nam Ha National Biodiversity Conservation Area, Near Nalan Neua Village, 20°49'54.92"N, 101°19'24.85"E. 646 m elev., 13 October 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng L0687* (HITBC; HNL); Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, 20°43'30.86"N, 102°08'42.39"E. 1288 m elev., 25 October 2018, *Y.H. Tan & H.B. Ding L0819* (HITBC; HNL); Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, 20°43'23.74"N, 102°08'42.84"E. 1224 m elev., 25 October 2018, *Y.H. Tan & H.B. Ding L0822* (HITBC).

Distribution. China, Laos.

Note. This species is characterised by elongate rhizomes, extremely asymmetric leaves, base cordate to deeply cordate, margin irregularly serrulate (Hemsley 1900; Ku 1999; Huang and Shui 2006; Ku et al. 2007).

Begonia dryadis **Irmscher**
Figure 3 F–K

Begonia dryadis Irmscher, Not. Bot. Gard. Edinb. 21(1): 41. 1951; T.C. Ku in T.L. Wu (ed.), Fl. Reipubl. Popularis Sin. 52(1): 246. 1999; S.H. Huang & Y.M. Shui in C.Y. Wu (ed.), Fl Yunnan. 12: 215. 2006; T.C. Ku et al. in C.Y. Wu & P.H. Raven (eds), Fl. China 13: 171. 2007. Type: China, Yunnan Province, Kuen-ger, Che-li Hsien, 1100 m elev., October 1936, *C.W. Wang 79349* (holotype: KUN0370809).

Specimens examined. Laos. Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, 20°43'18.52"N, 102°08'47.16"E. 1368 m elev.,

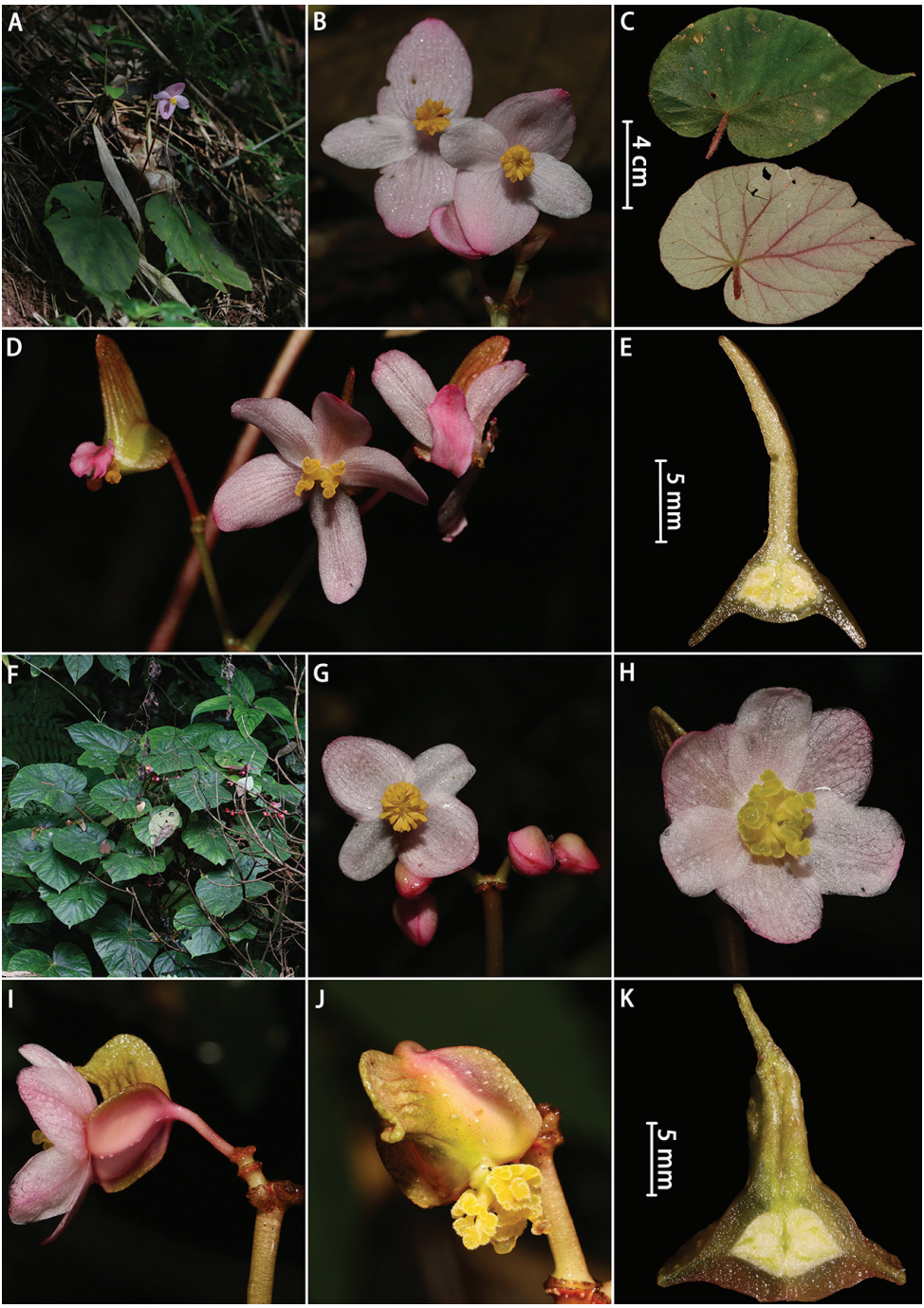

Figure 3. A–E *Begonia augustinei* Hemsley: **A** habitat **B** staminate flowers (front view) **C** leaf blade (adaxially and abaxially) **D** pistillate flowers **E** cross section of ovary **F–K** *Begonia dryadis* Irmscher: **F** habitat **G** staminate flowers (front view) **H** pistillate flower (front view) **I** pistillate flower (lateral view) **J** fruit **K** cross section of ovary. Photographed by H.B. Ding.

30 March 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng L0356* (HITBC; HNL); Oudomxay Province, Maung Xai, Phou Hin Phee National Biodiversity Conservation Area, 20°43'18.74"N, 102°08'47.84"E. 1364 m elev., 25 October 2018, *Y.H. Tan & H.B. Ding L0815* (HITBC).

Distribution. Chian, Laos.

Note. This species was first discovered and reported in the forest understorey, by streams in a valley of South Yunnan, China. The discovery of this species in Laos shows the geographical linkage between two type localities. The species is differentiated from the allied species by its short, stout rhizome and the presence of cauline leaves. (Irmscher 1951; Ku 1999; Huang and Shui 2006; Ku et al. 2007).

Begonia lancangensis **S.H. Huang**
Figure 4 A–C

Begonia lancangensis S.H. Huang, Acta Bot. Yunnan. 21(1): 13. 1999; S.H. Huang & Y.M. Shui in C.Y. Wu (ed.), Fl Yunnan. 12: 230. 2006; T.C. Ku et al. in C.Y. Wu & P.H. Raven (eds), Fl. China 13: 181. 2007. Type: China, Yunnan Province, Lancang Xian, Fazhan He, 1600 m elev., 1995, *Huang Suhua 95001* (holotype: YUNU).

Specimens examined. Laos. Luang Namtha Province, Nam Ha National Biodiversity Conservation Area, Near Na Lun Village, 20°50'39.62"N, 101°19'41.46"E. 687 m elev., 23 March 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng L0055* (HITBC).

Distribution. China, Laos.

Note. The species is characterised by its dioecious and erect stems with ovate or ovate-oblong leaves and fleshy berry-like fruits (Shui and Huang 1999, Ku et al. 2007). Additionally, *B. handelii* Irmscher (Irmscher 1921: 24) and *B. acetosella* Craib (Craib 1912: 153) have been discovered in the same locality. We suspect that this species may be a natural hybrid species of them.

Begonia sizemoreae **Kiew**
Figure 4 D–F

Begonia sizemoreae Kiew, in Gard. Bull. Singapore 56: 95. 2004; Kiew R. in Adansonia sér. 3, 29(2): 234. 2007. Type: Vietnam, Ba Vi National Park, Ha Tay Province, ca. 80 km west of Hanoi, Accession No. 20020399 cult. in Singapore Botanic Gardens ex Palm Hammock Orchid Estate, Miami, U.S.A. *R. Kiew 5304* (holotype: SING, isotype: HN).

Specimens examined. Laos. Phongsaly Province, Phou Dean Din National Bio-Diversity Park, 21°46'02.39"N, 102°31'28.58"E. 1111 m elev., 8 April 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng L0559* (HITBC).

Figure 4. A–C *Begonia lancangensis* S.H. Huang: **A** habitat **B** staminate flower (front view) **C** staminate flower (back view) **D–F** *Begonia sizemoreae* Kiew: **D** habitat **E** staminate flower **F** pistillate flower **G–I** *Begonia silletensis* (A. DC.) C.B. Clarke subsp. *mengyangensis* M.C. Tebbitt & K.-Y. Guan: **G** habitat **H** inflorescence **I** staminate flower (front view). Photographed by H.B. Ding and Y.H. Tan.

Distribution. Vietnam, Laos.

Note. *Begonia sizemoreae* was originally described in north Vietnam. Now, its distribution in Laos has been confirmed. This species is very similar to *B. rex* Putz. (Putzey 1857: 141) from Assam, India, in its leaf shape, fine variegated leaves and flower structure, but it is distinct in its leaf margin with very hairy upper surface of the lamina with hairs 5–10 mm long and its conspicuous deep crimson tertiary venation in the centre and outer part of the lower leaf surface (Kiew 2004, 2007).

***Begonia silletensis* subsp. *mengyangensis* M.C. Tebbitt & K.Y. Guan**
Figure 4 G–I

Begonia silletensis (A. DC.) C.B. Clarke subsp. *mengyangensis* M.C. Tebbitt & K.-Y. Guan, Novon 12(1): 134. 2002; T.C. Ku et al. in C.Y. Wu & P.H. Raven (eds), Fl. China 13: 198. 2007. Type: China, Yunnan Province, Xishuangbanna, on the way from Puwen to Mengyang, at the bottom of valley in a wet area on the slope facing N, dense forest, 21 April 1957, *Sino-Soviet Union expedition 9633* (holotype KUN0533687!).

Specimens examined. Laos. Luang Namtha Province, Nam Ha National Biodiversity Conservation Area, Near Na Lun Village, 20°50'34.97"N, 101°20'05.69"E. 632 m elev., 23 March 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding & X.D. Zeng* L0095 (HITBC; HNL).

Distribution. India, China, Bangladesh, Myanmar and Laos.

Note. The species is characterised by its dioecious and prostrate stems with large broad leaves and fleshy berry-like fruits (Tebbitt and Guan 2002; Ku et al. 2007).

An updated checklist of *Begonia* species in Laos

Begonia sect. *Diploclinium*
Begonia adscendens C.B. Clarke
Laos: Champasak: *J.K. Munzinger 250* (L, P).
Begonia hinnamnoensis Souvann & Lanors
Laos: Khammouan: *Lamxay et al. HNN227* (holotype HNL, isotypes FOF, E, SING).
Begonia khammouanensis Souvann. & Lamxay
Laos: Khammouan: *Lamxay et al. HNN138* (holotype HNL, isotypes FOF, E, SING).
Begonia modestiflora Kurz
Laos: Bassac: *Maxwell 97-1081* (L); Me-Kong: *C. Threl 2239* (BM, P).
Begonia tatianae Aver.
Laos: Khammouan: *L. Averyanov*, *AL 820b.1* (holotype LE01049623), *L. Averyanov et al. AL820b* (paratype LE01049002).
Begonia viscosa Aver. et H.Q. Nguyen
Laos: Vientiane: *L. Averyanov*, *P.V. The*, *CPC2438* (holotype LE, isotype CPC).

Begonia sect. *Jackia*
Begonia cladotricha M.Hughes
Laos: Khammouan: *M.F. Newman et al. LAO985* (holotype E).

Begonia sect. *Parvibegonia*
Begonia integrifolia Dalzell
Laos: Champasak: *J.F. Maxwell 97-1150* (CMU, L), *C. Thorel 2226* (P[2]); *C. Thorel 2226A*(P[2]).
Begonia laotica Y.H. Tan & H.B. Ding
Laos: Oudomxay: *Y.H. Tan*, *H.B. Ding L0827* (holotype HITBC!, isotypes HNL!).
Begonia namkadingensis C.-J. Yang, Souladeth & Tagane
Laos: Bolikhamxay: *Tagane S. et al. L1202* (holotype FOF, isotypes HAST, HNL, KYO), *Tagane S. et al. L960* (FOF, KYO, TAI).
Begonia procridifolia Wall. ex A.DC.
Laos: *A.F.G. Kerr 21188* (K, P).

Begonia sect. *Petermannia*
Begonia lamxayiana Souvann
Laos: Bolikhamxay: *V. Lamxay et al. VL2198* (holotype HNL).

Begonia sect. *Platycentrum*
Begonia acetosella Craib
Laos: *E. Poilane 20721* (P); Luang Namtha: *Tan et al. L0050* (HITBC!, HNL!), *Tan et al.* L0083 (HITBC!); Oudomxay: *Tan et al.* L0202 (HITBC!, HNL!).
Begonia augustinei Hemsl
Laos: Luang Namtha: *Tan et al. L0687* (HITBC; HNL); Oudomxay: *Tan et al. L0819* (HITBC; HNL), *Tan et al. L0822* (HITBC).
Begonia dryadis Irmsch
Laos: Oudomxay: *Tan et al. L0356* (HITBC; HNL), *Tan et al. L0815* (HITBC).
Begonia handelii var. ***handelii*** Irmsch.
Laos: Luang Namtha: *L.J. Ahnby 129* (E), *Tan et al. L0061* (HITBC; HNL); Phongsaly: *Tan et al. L0502* (HITBC).
Begonia handelii var. ***prostrata*** (Irmsch.) Tebbitt
Laos: Xiangkhoang: *A.F.G. Kerr 21772* (K).
Begonia lancangensis S.H. Huang
Laos: Luang Namtha: *Tan et al. L0055* (HITBC).
Begonia palmata D. Don
Laos: Houaphan: *E. Poilane 1938* (P), *E. Poilane 2002* (P); Khammouan: *M.F. Newman LAO1429* (E); Xiangkhoang: J. Delacour (P).
Begonia quadripetiolata Aver. et H. Q. Nguyen
Laos: Vientiane: *L. Averyanov et al. LA-VN1510/1* (holotype LE01049395, isotype LE01049479).
Begonia sizemoreae Kiew
Laos: Phongsaly: *Tan et al. L0559* (HITBC).

Begonia siamensis Gagnep.
Laos: Attapu: *F.J. Harmand 1387* (P); Phongsaly: *Tan et al. L0476* (HITBC; HNL), *Tan et al. L0416* (HITBC).
Begonia silletensis subsp. ***mengyangensis*** M.C. Tebbitt & K.Y. Guan
Laos: Luang Namtha: *Tan et al. L0095* (HITBC; HNL).

Begonia sect. *Reichengeimia*
Begonia hymenophylla Gagnep.
Laos: Champasak: *C. Thorel 2358* (P), *C. Thorel* 2958 (P).
Begonia hypoleuca Y.H. Tan & H.B. Ding
Laos: Luang Namtha: *Tan et al. L0792* (holotype HITBC!).

Begonis sect. *Tetraphila*
Begonia afromigrata J.J. de Wilde
Laos: Muang Awn: *Kerr 20938* (BM, K, L); Vientiane: *Rodda*, *Simonsson MR106* (TO), *Rodda*, *Simonsson MR107* (FI).

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Taxonomic studies on *Begonia* (Begoniaceae) in Myanmar I: three new species and supplementary description of *Begonia rheophytica* from Northern Myanmar

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Abstract

Three new species of *Begonia* (*B. chenii*, *B. putaoensis* and *B. crassitepala*) belonging to *Begonia* section *Platycentrum* and a supplementary description of *B. rheophytica* with a detailed description of female flowers from Putao, Kachin State, Northern Myanmar, are described and illustrated. All the new species are endemic to Northern Myanmar and can be easily distinguished from other species among the section *Platycentrum*. A detailed description, photographs, habitat, distribution and a comparison with the most related allied species for all new species are provided.

Keywords

Kachin State, Sect. *Platycentrum*, Putao District, Sect. *Sphenanthera*

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Introduction

Begonia Linnaeus (1753: 1056) (Begoniaceae) is one of the largest genera of angiosperm in the world, comprising more than 1900 species (Hughes et al. 2015), currently divided into 70 sections (Moonlight et al. 2018). The genus consists of herbs or lianas and is distributed throughout the tropical and subtropical regions of the world (Doorenbos et al. 1998; Moonlight et al. 2018). It has around 959 species and 19 recognized sections in Asia with the bulk occurring in Southeast Asia (Doorenbos et al. 1998; Shui et al. 2002; Ku et al. 2007; Hughes 2008; Moonlight et al. 2018). According to a recent updated checklist of *Begonia* from Myanmar by Hughes et al. (2019), 73 species of *Begonia* have been recorded from Myanmar.

During floristic surveys of northern Myanmar from 2016 to 2018, some interesting *Begonia* specimens were collected. After conducting a detailed examination of the morphological characteristics of the collected material, reviewing the type specimens and taxonomic publications, the authors have confirmed that the specimen of *Begonia* collected from northern Myanmar belong to species new to science, which are described and illustrated below.

Historically, based on the characters of axial placentation, 3 or 4-locular ovary, berry-like and wingless fruit, *Begonia chenii* should belong to *Begonia* sect. *Sphenanthera* (Hasskarl 1856: 139) Warburg (1894: 141). However, the recent molecular research result showed that *B.* sect. *Sphenanthera* was included in *B.* sect. *Platycentrum* (Klotzsch 1855: 243) A. DC. (1859: 134) (Moonlight et al. 2018). As the result, *Begonia chenii*, *B.putaoensis* and *B.crassitepala* belong to *B.* sect. *Platycentrum* in the present report.

Material and methods

Measurements and morphological character assessments of the new species have been examined based on fresh materials and dried specimens. They have been compared with morphologically similar species by affinities inferred using descriptions (Ku et al. 2007, Camfield and Hughes 2018) and type specimens in herbaria (BM, E, K, NYBG, KUN, PE, HITBC and RAF). Protologues and images of type specimens were gathered from JSTOR Global Plants (http://plants.jstor.org).

Taxonomic treatments

***Begonia chenii* Y.H.Tan, M.B.Maw & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204214-1
Figure 1

Diagnosis. *Begonia chenii* Y.H. Tan, M.B. Maw & H.B. Ding is mostly similar to *B. mariachristinae* Wahlsteen (2018: 1) in lanceolate-ovate leaves with silver patches or

Figure 1. *Begonia chenii* Y.H.Tan, M.B.Maw & H.B.Ding, sp. nov. (photographed by H.B. Ding and Y.H. Tan) **A** habitat **B** leaves (back view) **C** inflorescence **D** staminate flower showing 6 tepals **E** pistillate flower **F** infructescence showing monoecious **G** infructescence showing stigmas **H** staminate flower showing variation of 4, 5, 6 tepals **I** tepals of staminate flower **J** androecium **K** tepals of pistillate flower **L** ovary and stigma **M** ovary (3-winged) **N** ovary (4-winged) **O–P** serial cross section of ovary (locules 4) **Q** serial cross section of ovary (locules 4 and wingless) **R** serial cross section of ovary (locules 3).

dots on the upper surface, but significantly differs by stipules slightly pilose (*vs.* glabrous), petiole densely reddish pilose (*vs.* sparsely puberulous), 6 (rarely 4 or 7) tepals of female flower (*vs*. 4 tepals) and red, 3 or 4 locular ovary (*vs*. green, 2 locular).

Type. Myanmar. Kachin State: Putao District, on the way from Putao to Upper Shankhaung, in tropical rain forest, 27°25'36.87"N, 97°16'13.56"E, 512 m, 4 May 2017, *Y.H. Tan*, *B. Yang*, *H.B. Ding*, *X.D. Zeng*, *M.B. Maw & T.S. Tin M1378* (holotype: HITBC!; isotypes: RAF!).

Description. Perennial herb, dioecious or rarely monoecious, lacking rhizome or tuber. **Stem** erect, 40–60 cm tall, reddish brown, densely white pilose, internode 2–11 cm long, branching. **Stipule** persistent, ovate, 1–15 × 3–5 mm, papery, keeled, apex cuspidate (1–4 mm), margin entire, slightly pilose. **Leaf** alternate, petiole 1.5–3 cm long, reddish-brown, densely reddish pilose; **blade** asymmetric, lanceolate-ovate, 8–11 × 2.5–4 cm, apex attenuate, base oblique, margin serrate and with reddish hispid, venation palmate-pinnate, 5–6 pairs of veins; **upper surface** green or dark green with white patches and dots between the veins, bright green shot with metallic blue depending on the angle of the light, especially on young leaves, sparsely reddish hispid, especially along the midrib and lateral veins; **lower surface** deep red or deep red with light green areas both margin linings, scattered reddish hispid and densely along the midrib and lateral veins. **Inflorescence** axillary, flower solitary or in a simple cyme, pendulous; **bract** persistent, ovate to narrow lanceolate, 4–8 × 2–3 mm. **Staminate flower:** pedicel 0.8–1.1 cm, reddish, glabrous or sparsely pilose; tepals 4 (rarely 5 or 6), reddish with white margins, unequal, inner 2 (rarely 3), ovate, 7–1 × 6–1 mm, glabrous, outer 2 (rarely 3), ovate, 7–9 × 7–1 mm, reddish or whitish pilose on the outer surface, margin entire; androecium actinomorphic, stamens numerous, filament free, anther oblong, golden yellow. **Pistillate flower:** pedicel 0.6–0.8 cm, tepals 6 (rarely 4 or 7), unequal, inner 3, elliptic, 8–10 × 3–4 mm, pink to white, glabrous, outer 3, ovate or elliptic, 7–11 × 5–7 mm, reddish or whitish pilose on outer surface; ovary red, slightly or densely pilose on the surface, triangular or rhomboid winged, 3–5 × 2–5 mm, placentation axillary, locules 3 or 4, placentae 2 per locule; styles 3, fused at base, stigma bifid with twisted bands, highly convolute, yellow or golden yellow. **Fruit** berry-like, red, reddish or whitish pilose, triangular, rhomboid (8–15 × 6–9 mm) or suboblate (8–15 mm in diam.), 3 or 4 horned, rarely wingless.

Phenology. Flowering from April to May; fruiting from May to June.

Distribution. The species is only known from the type locality, Putao District, Kachin State, Northern Myanmar.

Ecology. The species grows in the moist shaded environment of tropical rain forest, elevation about 512 m.

Etymology. The species epithet "*chenii*" is named after Professor Chen Jin, the director of Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences, who gave us the opportunity to study the Myanmar flora, which led to the discovery of this new species.

Conservation status. Data Deficient (DD). *Begonia chenii* was collected along the path on the way from Putao to Upper Shankhaung where any signs of major anthropogenic disturbance were noticed in the type locality. However, further explorations

Table 1. Comparison of key morphological characters of *Begonia chenii* and *B. mariachristinae*.

Attributes	*B. chenii*	*B. mariachristinae*
Stem	40–60 cm tall, reddish brown densely white pilose	40–60 cm tall dark red to maroon, hairs
Stipules	persistent, slightly pilose	persistent, glabrous
Petiole	1.5–3 cm long, densely reddish pilose	1–5 cm long, sparsely puberulous
Leaves	lanceolate-ovate, 8–11 × 2.5–4 cm	lanceolate-ovate 6–11.5 × 2.5–4.5 cm
Upper surface	sparsely reddish hispid especially along the midrib and lateral veins	slightly reddish hispid
Lower surface	scattered reddish hispid and densely along the midrib and lateral veins	slightly hairy along midrib
Male flower	tepals 4 (rarely 5 or 6) reddish with white linings	tepals 4 pink or white
Female flower	tepals 6 (rarely 4 or 7) pink to white	tepals 4 pink or white
Ovary	locules 3 or 4 red, slightly or densely pilose	locules 2 green, hispid
Style	3	2 (or 3)

are needed for a proper assessment of conservation due to insufficient information on its distribution and population status. Therefore, the species has been preliminarily assigned to Data Deficient (DD) category according to The Guidelines for Using The IUCN Red List Categories and Criteria (IUCN 2017).

Additional specimens examined (paratypes). Myanmar. Kachin State: Putao District, Upper Shankhaung, in tropical montane forest, 27°25'36.87"N, 97°16'13.56"E, 512 m, 4 May 2017, *Y.H. Tan*, *B. Yang*, *H.B. Ding*, *X.D. Zeng*, *M.B. Maw & T.S. Tin M1379* (HITBC!); Kachin State: Putao District, Upper Shankhaung, 27°25'35"N, 97°16'14"E, 500 m, 29 April 2016, *Y.H. Tan & S.S. Zhou M201627* (HITBC!); Kachin State: Putao District, Upper Shankhaung, 27°25'34"N, 97°16'13"E, 520 m, 7 May 2017, *S.S. Zhou & X.D. Zeng M2030* (HITBC!; RAF!)

Affinities. *Begonia chenii* is morphologically similar to *B. mariachristinae*. But it can be easily distinguished in having 3 or 4 locules (*vs.* 2 locules). See Table 1 for detailed comparison of *B. chenii* with morphologically allied species.

***Begonia putaoensis* Y.H.Tan, M.B.Maw & H.B.Ding, sp. nov.**
urn:lsid:ipni.org:names:77204216-1
Figures 2–3

Diagnosis. *Begonia putaoensis* Y.H. Tan, M.B. Maw & H.B. Ding is morphologically similar to *B. scintillans* Dunn (1920: 111) in rhizomatous creeping habit and dark green ovate leaves with silver or white area on the upper surface, but it can be easily distinguished by the following characters: sparsely pubescent adaxially leaf (*vs.* densely strigose) and glabrous capsule (*vs.* red villose).

Type. Myanmar. Kachin State: Putao District, on the way from Camp 2 to Camp 3 along Putao to Madwel, on moist rocky slope in tropical rain forest, 27°39'35"N, 97°22'30"E, 505 m, 29 November 2017, *Y.H. Tan*, *B. Yang*, *H.B. Ding*, *X.D. Zeng*, *M.B. Maw & P.K. Linn M2923* (holotype: HITBC!; isotypes: RAF!).

Description. Perennial herb, monoecious, 10–25 cm tall. **Rhizome** creeping with adventitious roots, sometimes branched, 3–30 cm long, 5–12 mm thick, reddish brown, densely pubescent or rusty villous, internode short, 3–8 mm long. **Stipule** tri-

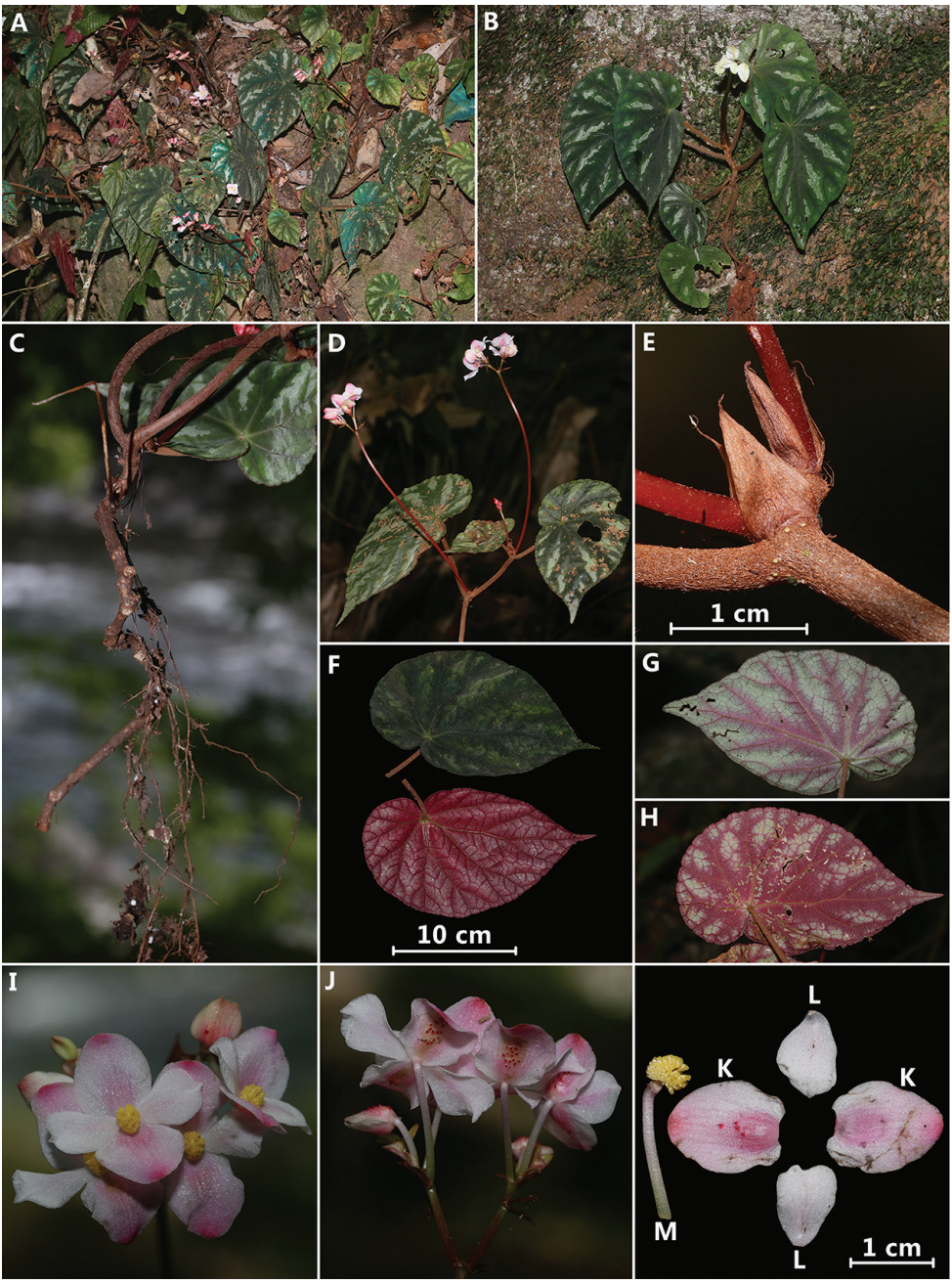

Figure 2. *Begonia putaoensis* Y.H.Tan, M.B.Maw & H.B.Ding, sp. nov. (wild, photographed by H.B. Ding) **A–B** habitat **C** rhizome **D** inflorescence **E** stipule on stem **F–H** single leaf (front and back view) **I** flowers (front view) **J** flowers (back view) **K** outer tepals of male flower (back view) **L** inner tepals of male flower (back view) **M** androecium with pedicel.

angular, 6–12 × 5–6 mm, apex cuspidate (3–5 mm), margin entire, rusty colored, densely rusty tomentose on both surfaces, persistent; **petiole** scarlet red to crimson, cylindrical, 3–15 cm long, densely rusty tomentose. **Blade** ovate to widely ovate, 6.5–15 cm long, 6–11cm wide, asymmetric, adaxially dark green with gray or light-green areas, slightly pubescent, abaxially light-green, deep red along veins, rarely entirely dark red or red with light-green areas, slightly pubescent, rusty villous on the veins; base cordate, apex acuminate to attenuate, margin sinuate, with sparse hairs; venation palmate, 7–9 veined, adaxial slightly impressed, abaxial distinctly prominent. **Inflorescence** axillary, sub-corymb, erect, branching 2–3 times, 7–19 cm long. Primary peduncle 5.5–14.5 cm long, densely rusty tomentose, dark red, secondary 0.6–1.5 cm long; bract ovate to lanceolate or obovate, 8–13 × 3–7 mm, glabrous, apex acute, margin entire, sometimes with ciliate, 2–10 flowers per inflorescence, male flowers open earlier at the same node. **Staminate flower:** pedicel white or pink, glabrous, 0.9–3.7 cm long, tepals 4, rarely 6, outer 2 (or 3) larger, pink, ovate to suborbicular, 1.3–1.8 × 1.1–2.1 cm, glabrous or abaxially strigose; inner 2 (rarely 3), smaller, white-pinkish, ovate or obovate, 9–17 × 7–11 mm., glabrous; **androecium** 4–6 mm long, 5–7 mm in diameter; **stamens** numerous, filaments ca. 1.7 mm long, anthers yellow, obovate, nearly 1.2 mm long, apex obtuse. **Pistillate flower:** pedicel dark red, glabrous, 2.6–3.3 cm long, tepals 5, rarely 6, outer 3, larger, pink, ovate, 14–16 × 1–13 mm, inner 2 (rarely 3), smaller, white-pinkish, ovate to suborbicular, 12–16 × 8–11 mm; **ovary** glabrous, 2-loculed, placentae axillary, placentae 2 per locule, **styles** 2 or 3, fused at base, stigma bifid with twisted bands, highly convolute, yellow or golden yellow. **Capsule** nodding, ovoid, glabrous, unequally 3-winged; abaxial wing nearly round-rectangular, 13–17 mm broad, lateral wings shorter, 2.5–3.0 mm broad.

Phenology. Flowering from November to December; fruiting from December to February.

Distribution. The species is known from the single locality in Putao District, Kachin State, Northern Myanmar.

Ecology. The species grows on moist rocky slopes of tropical montane forest, elevation 500–900 m.

Etymology. The species epithet refers to the type locality of the species, Putao District, Kachin State, Northern Myanmar.

Conservation status. Data Deficient (DD). The species might not confront strong human pressures because of the remoteness of its type locality. But we cannot assess the species' risk of extinction due to lack of data. Therefore, the species is temporarily assigned a status Data Deficient (DD) according to The Guidelines for Using The IUCN Red List Categories and Criteria (IUCN 2017).

Affinities. *Begonia putaoensis* is mostly similar in morphological characters to *B. scintillans* and *B. annulata* K. Koch (1857: 76) under the sect. *Platycentrum*. But it can be easily distinguished from *B. scintillans* in having shorter internode 0.3–0.8 cm long (*vs.* 3–5 cm long), sparsely pubescent leaf lamina (*vs.* densely hairy) and

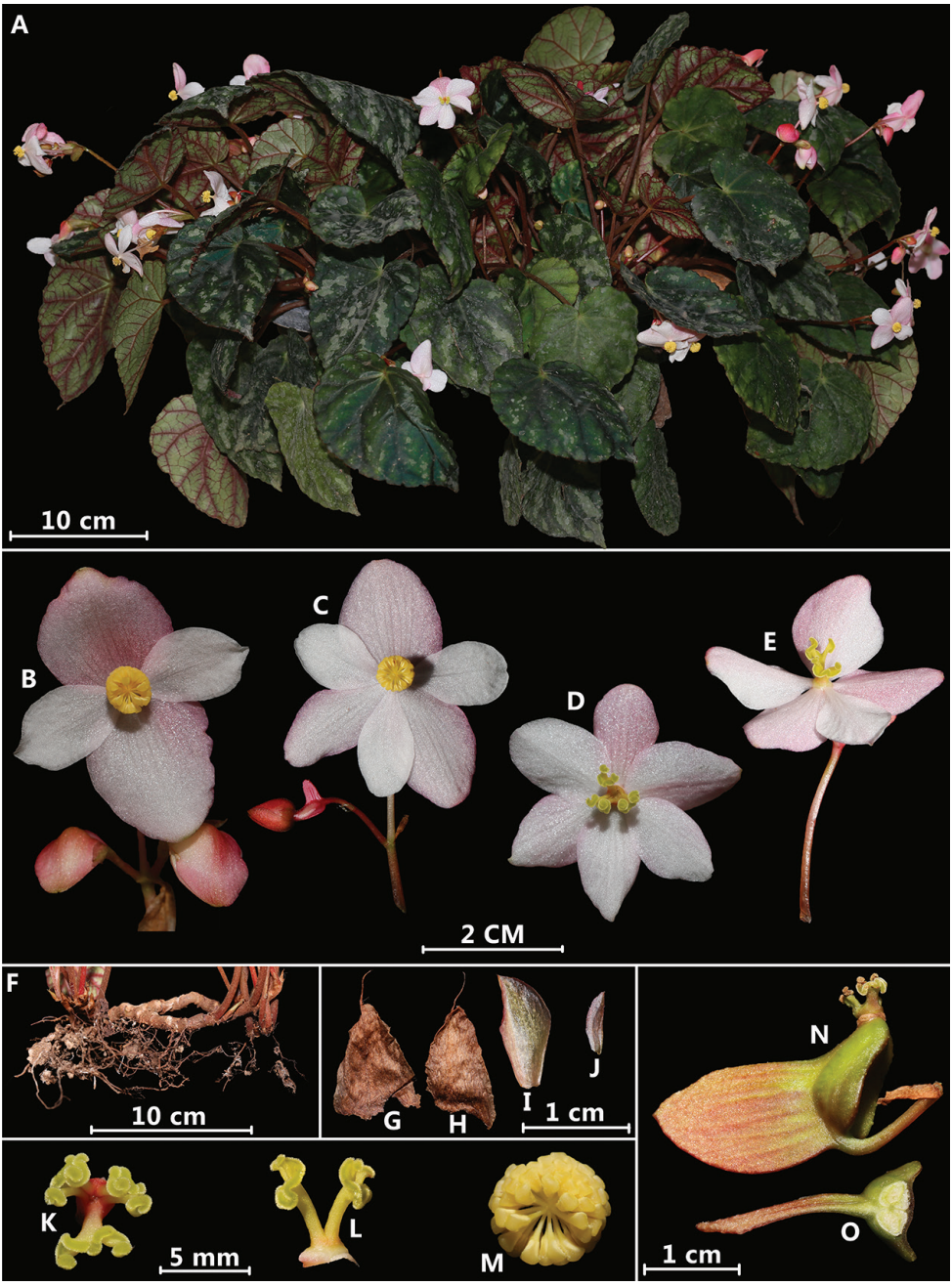

Figure 3. *Begonia putaoensis* Y.H.Tan, M.B.Maw & H.B.Ding, sp. nov. (cultivated plants, photographed by H.B. Ding) **A** habit **B** staminate flower showing 4 tepals **C** staminate flower showing 6 tepals **D** pistillate flower showing 6 tepals and 3 styles **E** pistillate flower showing 5 tepals and 2 styles **F** rhizome **G** stipule (back view) **H** stipule (front view) **I** bract **J** uppermost bract **K** stigma (3, front view) **L** stigma (2, side view) **M** androecium (front view) **N** fruit with unequal wings **O** serial cross section of ovary.

Table 2. Comparison of key morphological characters of *Begonia putaoensis*, *B. scintillans* and *B. annulata*.

Attributes	*B. putaoensis*	*B. scintillans*	*B. annulata*
Habit	rhizomatous, creeping 15–25 cm tall	rhizomatous, creeping 7–15 cm tall	rhizomatous, erect 15–30 cm tall
Internode	short, 0.3–0.8 cm long	3–5 cm long	0.7–1.5 cm long
Stipule	triangular, 6–12 × 5–6 mm densely rusty tomentose on both surfaces	lanceolate, 6–11 × 4–6 mm villose on outer surface	lanceolate, 4 –13 × 2 – 6 mm tomentose on outer surface
Leaf	ovate to widely ovate 6.5–15 × 6–11cm	ovate-orbicular 4.5–10 × 3.5–7 cm	ovate 9–15 × 5–10 cm
Upper surface	dark green with silver or light green areas sparsely pubescent	dark green with small silver spots, densely strigose	dark green with white/silver bands slightly tomentose or strigose
Lower surface	light green, deep red along veins entire dark-red or red with light green area slightly pubescent, rusty villous on the veins	red, densely red tomentose	red and green, strigose
Staminate flower	tepals 4 (rarely 6), pink or white-pinkish	tepals 4, coral pink	tepals 4, white to pink
Pistillate flower	tepals 5 (rarely 6), glabrous pink or white-pinkish	tepals 4–5, coral pink, pilose on outer surface	tepals 4–5, white to pale pink, puberulous on outer surface to glabrous
Style	2 or 3	3	2
Capsule	ovoid, glabrous, 3-winged longest one round-rectangular 13–17 mm broad	obovoid, red villose, 3-winged longest one rounded oblong 4–6 mm broad	ellipsoid, tomentose, 3-winged longest one rounded oblong 5–9 mm broad

glabrous capsule (*vs.* red villose). It differs from *B. annulata* through having the following characteristics: rhizomatous creeping (*vs.* rhizomatous erect) and dark green with silver or light green area on upper surface of leaf (*vs.* dark green with silver or white bands). See Table 2 for detailed comparison of *B. putaoensis* with morphologically allied species.

Additional specimens examined (paratypes). Myanmar. Kachin State: Putao District, near around Camp 5, along Putao to Madwel, on moist rocky slopes in tropical rain forest, 27°43'59.51"N, 97°22'52.27"E, 873 m, 3 December 2017, *Y.H. Tan*, *B. Yang*, *H.B. Ding*, *X.D. Zeng*, *M.B. Maw & P.K. Linn M3168* (HITBC!; RAF!); MYANMAR. Kachin State: Putao District. Voucher from the cultivated plant in the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, 12 November 2018, *H.B. Ding XTBG-0050* (HITBC!).

***Begonia crassitepala* Y.H.Tan & M.B.Maw, sp. nov.**
urn:lsid:ipni.org:names:77204217-1
Figure 4

Diagnosis. *Begonia crassitepala* Y.H. Tan & M.B. Maw is morphologically similar to *B. dryadis* Irmscher (1951: 41) in ovate to broadly ovate leaf, but it can be distinguished by its stem and petiole having white prickles (*vs.* puberulous), adaxially leaf having densely pinkish or grey hirsute (*vs.* subglabrous), abaxially outer 2 tepals of pistillate flower and ovary having reddish or whitish succulent strigose and tuberculate (*vs.* puberulous).

Figure 4. *Begonia crassitepala* Y.H.Tan & M.B.Maw, sp. nov. (photographed by H.B. Ding) **A** habit **B** inflorescence **C** stipule and stem (showing the whitish soft spine-like hairs) **D** rhizome **E** single leaf (front view) **F** single leaf (back view) **G** hirsute leaf margins **H** flowers (front view staminate flower) **I** staminate flower (back view) **J** dried fruits **K** pistillate flower (front view) **M** staminate flower showing 4 tepals **N** pistillate flower (side view) **L** capsule and cross section of ovary.

Type. Myanmar, Kachin State, Putao District, on the way from Ratbaw to Alanga, 27°17'13.73"N, 97°44'24.28"E, 836 m, 15 June 2018, *Y.H. Tan*, *B. Yang*, *H.B. Ding*, *X.D. Zeng*, *M.B. Maw & H.L. Naing M4495* (holotype: HITBC!; isotypes: RAF!).

Description. Perennial herb, monoecious, rhizomatous. **Stem** erect, 40–60 cm tall, reddish, densely rusty wooly tomentose, and sparsely covered by whitish soft spine-like hairs, internodes 1–2 cm long. **Stipule** lanceolate, 1–1.3 × 0.3–0.5 cm, slightly or densely rusty tomentose, deciduous. **Leaf** petiole 4.5–15 cm, densely rusty tomentose, slightly whitish stiff hairs; **blade** ovate to broadly ovate, base cordate with overlapping lobes, 12–20 × 15–19.5 cm, asymmetric, adaxiall**y** green, densely pinkish or grey hirsute, abaxially green, rusty puberulous, venation palmate-pinnate, densely rusty wooly tomentose along midrib and veins, margin denticulate, reddish hirsute along the margin, apex acuminate. **Inflorescence** nearly terminal, cymose, peduncle 4.4–6.0 cm long, reddish, slightly rusty wooly tomentose and whitish soft spine-like hairs. **Staminate flower:** pedicel 1.8–2.5 cm long, whitish villose, tepals 4, unequal, outer 2, ovate, 2.2–2.7 × 2.6–2.8 cm, whitish or pinkish with pink lining, thick, ca. 2 mm, inner 2, smaller, 1.7 × 2.1 cm, whitish or pinkish (sometimes with pinkish lining), densely whitish villose on the outer surface; stamen numerous, ca. 200; filaments ca. 2 mm long, fused at base; anther oblong to elliptic, 1–2 mm long. **Pistillate flower:** pedicel 2.2–2.5 cm, densely whitish or rusty villose, bracteoles absent; tepals 5, equal, obovate, outer 2, 2.0–2.9 × 1.8–2.0 cm, pure white or sometimes with pink lining, densely pinkish or whitish strigose on outer surface, margin entire, inner 3, similar to outer ones but smaller, 1.8–2.1 × 1.6–1.8 cm, ovary 2-locular, placentation axillary, placentae 2 per locule, densely reddish or whitish succulent strigose and tuberculate, styles 2, fused at base, stigma bifid with twisted bands, highly convolute, yellow or golden yellow. **Fruit** berry-like, elliptic, pale green to pink, 3 wings, unequal, with whitish or reddish succulent strigose and tuberculate (especially on wings).

Phenology. Flowering from June–July; fruiting from July–August.

Distribution. Endemic to the type locality, Putao District, Kachin State, Northern Myanmar.

Etymology. The species epithet refers to its thick tepals.

Ecology. In the tropical montane forest up to about 577 m elevation, on the moist soil slope.

Conservation status. Data Deficient (DD). *Begonia crassitepala* have been collected along the roadside from Langsa to Gawlaw village where no signs of major anthropogenic disturbance were noticed. Further exploration is required to access the current range of the species (IUCN 2017).

Additional specimens examined (paratypes). Myanmar. Kachin State: Putao District, along Langsa to Gawlei, tropical montane forest, 27°32'28.94"N, 97°56'36.09"E, 577 m, 2 June 2018, *Myanmar Exped. M3952* (HITBC!; RAF!); Kachin State, Putao District, Gathu to Tongwang Cave, 27°29'53.48"N, 97°58'30.84"E, 664 m, 4 June 2018, *Myanmar Exped. M4008* (HITBC!; RAF!); Kachin State, Putao District, Gathu to Tangsa, 27°28'41.17"N, 97°56'46.40"E, 550 m, 31 May 2018, *Myanmar Exped.*

M3797 (HITBC!; RAF!); Kachin State, Putao District, Putao Township, Maliraing area, buffer zone of Hkakaborazi National Park, between camp 1 and camp 2, 27°38'03.6"N, 97°22'11.2"E, 552 m, 6 November 2016, *Kate et al. 2253* (NY02653741!); Kachin State, Putao District, Naungmung Township, buffer zone of Hkakaborazi National Park, Hill next to Naungmung village, 27°31'02.2"N, 97°50'46.2"E, 845 m, 12 June 2017, *Kate et al. 2880* (NY02653917!); Between N Dung Ga and Ting Pru Ting Sar, 27 August 1953, *Thar Hla & Chit Ko Ko 4447* (RAF!).

Affinities. *Begonia crassitepala* is the most distinct species in the section *Platycentrum* thanks to its thicken tepals and succulent strigose and tuberculate ovary. The new species shares similar characteristics with *B. dryadis* in ovate to broadly ovate leaf and 4 tepals of staminate flower. However, it can be easily distinguished by its stem and petiole having rusty tomentose and whitish soft spine-like hairs (*vs*. puberulous), adaxially leaf having densely pinkish or grey hirsute (*vs.* subglabrous), adaxially outer 2 tepals of pistillate flower having densely pinkish or whitish strigose (*vs.* puberulous), ovary having densely reddish or whitish succulent strigose and tuberculate (*vs.* puberulous).

Begonia rheophytica **M. Hughes, Edinb. J. Bot. 76(2): 2. 2019**
Figure 5

Type. Myanmar. Hills east of the Mali Hka, 2000–3000 ft, xii 1930, *Kingdon-Ward 9067* (holotype: BM000896328; isotypes: BM000896327, NY02652766).

Description. Herb, rhizomatous, firmly rooted to rock. **Rhizome** 2.5–4.0 cm long and 0.5–1.0 cm in diam., internode 0.2–0.7 cm long. **Stipule** reddish brown, eventually deciduous, narrowly triangular, 0.7–1.0 × 0.3–0.5 cm, keeled, margin entire, glabrous. **Leaf** petiole deep red or deep red to green, turns to brown in mature leaves, sparsely or densely white pilose, 4–17 cm in length, deeply grooved above; **blade** symmetric, narrowly lanceolate, 13.4–18.2(–21) × 2.2–4.0 cm, base attenuate, sometimes unequal, margin red, toothed, teeth tipped by a short ciliate, sometimes undulate, apex elongate; adaxially dark green, glabrous; abaxially pale green, veins densely or sparsely white pubescent; venation pinnate, 5–7 pairs of veins, reddish green in young leaves, red in mature leaves. **Inflorescence** axillary, cymose, peduncle erect, 14–20 cm long, reddish green or pale reddish brown, sparsely hairy; **bract** caducous, broadly ovate–triangular (or ovate–lanceolate), 6–8 × 3–5 mm, purplish red to dark yellow-green, margin entire, hairless. **Staminate flower:** pedicel 1.9–2.1 cm, pale pink (or) pinkish white, sparsely hairy; bracteoles ca. 3 mm, narrowly ovate, dark yellow green, margin entire, hairless, soon falling, **tepals** 4, unequal, inner 2, elliptic, 1.4–1.7 × 0.8–1.0 cm, pure white to pinkish, margin entire, outer tepals 2, broadly ovate, 1.1–1.8 × 1.1–1.5 cm, pure white or pinkish, tip rounded, margin entire; androecium actinomorphic; stamens numerous, filaments fused at base; anther golden yellow, narrowly oblong, apex rounded. **Pistillate flower:** pedicels 2–3 cm, reddish or purplish red, hairless; **bracteole** narrowly ovate 6–8 × 3–5 mm, dark yellow green

Figure 5. *Begonia rheophytica* M. Hughes (photographed by H.B. Ding and Y.H. Tan) **A** habitat **B** staminate flower (front view) **C** pistillate flowers **D** inflorescences **E** staminate flowers (front and back view) **F** single leaf (back view) **G** single leaf (front view) **H** pistillate flower **I** ovary with gynoecium, pedicel and bracts **J** ovary with gynoecium **K** bracts **L** pedicel **M** androecium with pedicel **N** tepals of staminate flower **O** tepals of pistillate flower **P** capsule **Q–R** cross section of ovary.

(sometimes crystal white), soon falling; **tepals** 5–6, unequal, outer 2, equal, broadly ovate, tip rounded, 0.7–1.2 × 0.8–1.2 cm, pure white or white to rosy pink, inner 3 or 4, unequal, 3 larger, 0.8–1.2 × 0.7–1.0 cm, elliptic, pure white or pinkish, tip rounded, 1 smaller, ca. 0.8 × 0.3 cm, pure white, crescent, styles 2, free, stigma bifid with twisted bands, greenish yellow, 4–5 mm long, ovary purplish red, ca. 9–15 mm long, 2–4 mm in diam., wings 3, unequal, placentation axile, locules 2, placentae 2 per locule. **Capsule** nodding, 3-winged, unequal, major wing 8–12 mm long, lateral wings 2–3 mm long.

Distribution. Only found in Putao District, Kachin State, Northern Myanmar.

Additional specimens examined. Myanmar, Kachin State, Putao District, Camp 1 to Namti (Camp 2), understory herbs in tropical rain forest, 27°24'36.80"N, 97°39'24.38"E, 801 m, 12 December 2018, *Myanmar Exped. M3427* (HITBC!; RAF!); Kachin State, Putao District, near around Camp 1, understory herbs in tropical rain forest, 27°24'18.70"N, 97°36'24.18"E, 850 m, 11 December 2018, *Myanmar Exped. M3334* (HITBC!; RAF!); Kachin State, Putao District, humid rocks near streams or near caves by waterfall of tropical montane forest, 27°24'46.31"N, 93°39'36.28"E, 808 m, 16 December 2017, *Myanmar Exped. M3747* (HITBC!, RAF!).

Note. This species was originally described by Hughes et al. (2019) from the male flowering plant only. Here, we provide a supplementary description of *B. rheophytica* with a detailed monograph of female flowers from Putao, Kachin State, Northern Myanmar.

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RESEARCH ARTICLE

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Ophiorrhiza monsvictoriae (Rubiaceae, Rubioideae), a new species from Myanmar

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Abstract

A new species, *Ophiorrhiza monsvictoriae* S.S.Zhou & L.D.Duan, discovered at Natma Taung (Mt.Victoria) National Park, Chin State, Myanmar, is described and illustrated. The new species is morphologically similar to *O. dulongensis*, but differs from the latter by its stipules broadly triangular, 2–4 mm long, inflorescence axillary, 1-flowered, bracts lanceolate to subulate, 1–2 mm long, puberulous, calyx pilose, 1–2 mm long, lobes and tube equal length, corolla narrowly funnelform, 15 mm long, puberulous outside.

Keywords

NatmaTaung (Mt. Victoria) National Park, taxonomy, new taxon

Introduction

The genus *Ophiorriza* Linnaeus belongs to the tribe *Ophiorrhizeae* in the subfamily Rubioideae (Bremer and Manen 2000; Duan et al. 2019). It is a notably species-rich, taxonomically complicated genus consisting of 318 species, five varieties and one subspecies and found in wet tropical forests of South-East Asia and extending to Australia, New Guinea and the Pacific islands (Darwin 1976; Chen and Taylor 2011). Approximately 18 species of this genus have been recorded from Myanmar (Kress et al. 2003).

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The Natma Taung (Mt. Victoria) National Park is located in the south-western part of Myanmar. Mount Victoria is the highest mountain in this region and has been regarded as an ecological refugium, offering a temperate zone that is absent from neighboring regions (Tanaka et al. 2010a). Belonging to the world biodiversity research hotspot areas, it is estimated that there are about 2500 vascular plant species on Mt. Victoria and a number of endemic, relict and new species have been found in this area (Cowley 1982; Tanaka et al. 2010b; Zhou et al. 2018; Ding et al. 2019). We carried out field expeditions in this area since 2016, sponsored by the Xishuangbanna Tropical Botanical Garden, CAS, in cooperation with the Forest Department, Ministry of Natural Resources and Environmental Conservation, Myanmar. A new species of *Ophiorrhiza* was discovered and is described below. The new species belongs to *Ophiorrhiza* section *Proliferae* (Lindl.) Pfitzer and Kraenzlin.

Materials and methods

A morphological description (Stearn 1983) of the new species was prepared from living plants and five dried herbarium specimens (HITBC: herbaria of Xishuangbanna Tropical Botanical Garden, the Chinese Academy of Science). Measurements were made using a vernier caliper. Herbarium and fresh specimens of *Ophiorrhiza dulongensis* (KUN: herbaria of Kunming Institute of Botany, the Chinese Academy of Science) (Lo 1990) were examined. The conservation status of the new species was evaluated based on the International Union for Conservation of Nature criteria C (Small population size and decline). We just observed the number of mature individuals in the subpopulation and criteria of C2a [i] is used to evaluate the threatened status (vulnerable) (IUCN Standards and Petitions Subcommittee 2017).

Taxonomy

Ophiorrhiza monsvictoriae **S.S.Zhou & L.D.Duan, sp. nov.**
urn:lsid:ipni.org:names:77204218-1
Fig. 1

Diagnosis. *Ophiorrhiza monsvictoriae* is similar to *Ophiorrhiza dulongensis* H. S. Lo (1990: 27), but differs from it by the principal veins raised on both sides of leaf, stipules broadly triangular, 2–4 mm long, inflorescences axillary, 1-flowered, peduncles puberulous, bracts lanceolate to subulate, 1–2 mm long, puberulous, calyx pilose, 1–2 mm long, lobes and tube equal in length, and corolla narrowly funnelform, 15 mm long, puberulous outside, see Table 1.

Type. MYANMAR. Chin State. Natma Taung (Mt. Victoria) National Park, under evergreen broad-leaved forest in tropical mountainous areas forest, 2500–2600 m, 18 July 2018, Shi Shun-Zhou 15305 (holotype: RAF!; isotype: HITBC!, Herb. Bar. Code No. 169316).

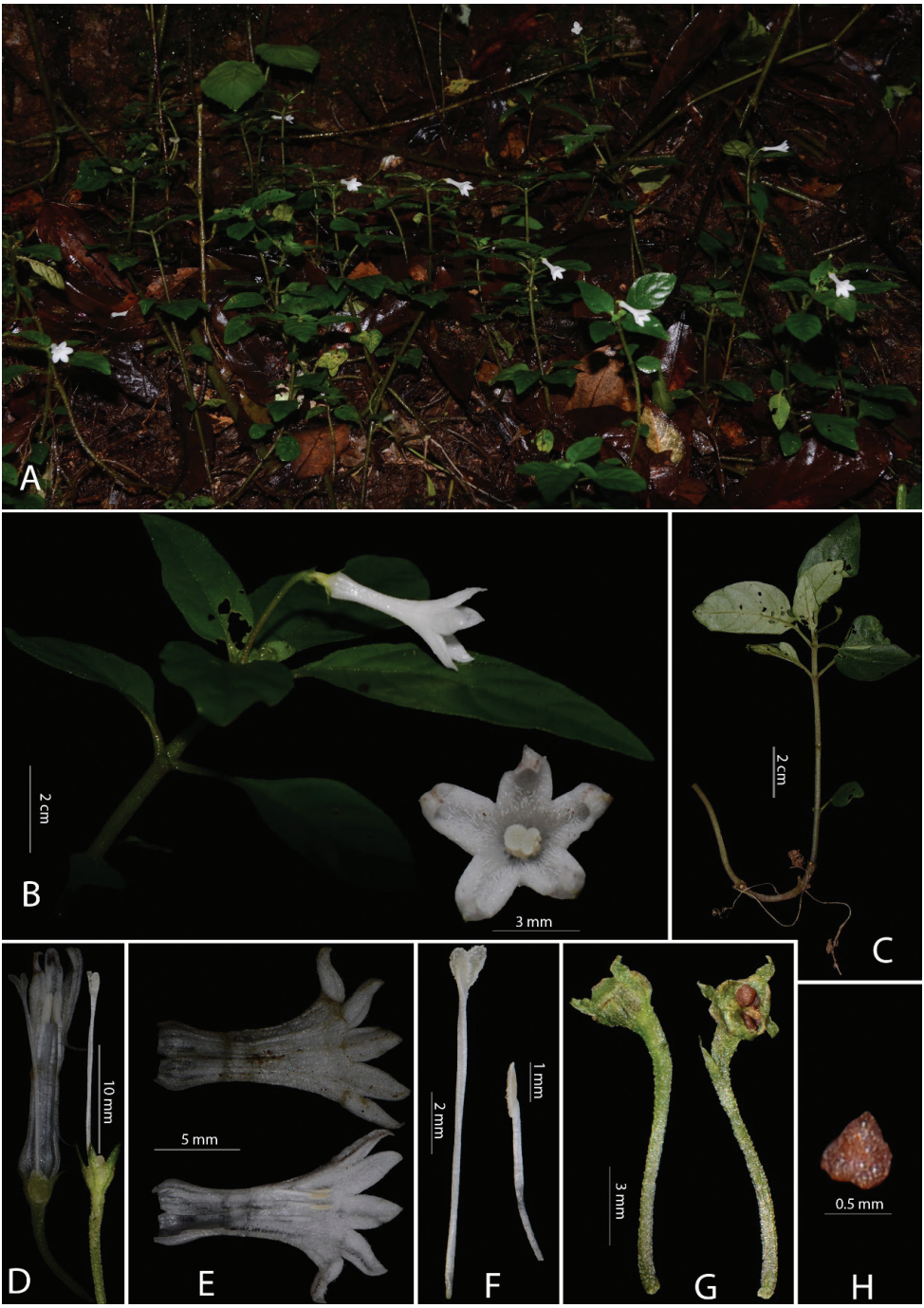

Figure 1. *Ophiorrhiza monsvictoriae* S.S.Zhou & L.D.Duan, sp. nov. **A** Habitat **B** front view of flower and Inflorescence **C** infructescence **D** opened corolla of long styled flower **E** corolla inside and outside **F** stamen and style **G** fruit **H** seed.

Table 1. Diagnostic morphological characters of *Ophiorrhiza dulongensis* and *O. monsvictoriae*.

Characters	*O. dulongensis*	*O. monsvictoriae*
Leaf	principal veins flat on both sides of leaf blade; stipules subulate, 4–6 mm long	principal veins raised on both sides of leaf blade; stipules broadly triangular, 2–4 mm long
Inflorescence	inflorescence fasciculate, 3- or 4-flowered; peduncle glabrous; bracts linear, ca. 1 mm long, glabrous	inflorescence axillary, 1-flowered; peduncle puberulous; bracts lanceolate to subulate, 1–2mm long, puberulous
Flower	calyx puberulent to glabrescent, 3–4 mm long; lobes slightly longer than calyx tube; corolla funnelform, 11 mm long, glabrate outside	calyx pilose,1–2 mm long, lobes and tube equal in length; corolla narrowly funnelform, 15 mm long, puberulous outside

Description. Herbs, creeping to weakly ascending, 15–30 cm tall; stems drying purplish brown, puberulous. Petioles 0.5–1 cm long, puberulous; leaf blade drying membranous to papery, adaxially green, abaxially grayish-green, broadly ovate or elliptic, 2–4 × 1–2.5 cm, adaxially scattered puberulous, abaxially moderately puberulous along principal veins, base obtuse, apex acute; secondary veins 4–5 pairs; stipules broadly triangular, 2–4 mm long, glabrous. Inflorescences axillary, 1-flowered; peduncle puberulous, 6–8 mm long; pedicel ca. 2 mm long, puberulous; macrostylous: bracts lanceolate to subulate, 1–2mm, puberulous. Calyx pilose, 1–2 mm; hypanthium 5-ribbed; lobes lanceolate; lobes and tube equal in length. Corolla white, 15 mm long, narrowly funnelform, puberulous outside, pilose inside; tube densely villous in throat; lobes triangular-lanceolate, 3–3.5 mm long, dorsally ribbed at least in bud. Stamens reaching the tube throat; anthers linear; style reaching the tube mouth; Capsules obcordate, ca. 2 × 4.5 mm.

Etymology. The new species was named after Mountain Victoria, Natma Taung National Park, Chin State, southwestern Myanmar, where it was discovered in a vast area of mountain forest.

Phenology. Flowering in July to August, fruits in August to September.

Distribution and habitat. *Ophiorrhiza monsvictoriae* is only known from the type locality. It is a terrestrial plant that grows in the floating soil on the stone in subtropical evergreen broad-leaved forest, which is dominated by *Lithocarpus xylocarpus* (Kurz) Markg. (Fagaceae).

Conservation status. *Ophiorrhiza monsvictoriae* was collected on Victoria Mountain, Natma Taung National Park, Chin State, South-western Myanmar. However, only one population, consisting of approximately100 individuals, has been discovered so far in the National Park. Other populations may be found with further investigation because the area is legally protected under by the government of Myanmar.

Critical note. The new species most resembles *Ophiorrhiza dulongensis*. Detailed morphological differences between the two species are given in Table 1.

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RESEARCH ARTICLE

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Blumea htamanthii (Asteraceae), a new species from Myanmar

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Abstract

A new species, *Blumea htamanthii* Y.L. Peng, C.X. Yang & Y. Luo from Myanmar is described. The new species is distinguished from *B. bifoliata* by its leaves with short petioles, abaxially purple, leaf blade with papillary hair and sparse multicellular villous, capitula with 1–4 heads, glabrous florets and usually unbranched stems. A key to *Blumea* species in Myanmar is provided.

Keywords

Asteraceae, *Blumea htamanthii*, Myanmar, new species

Introduction

Blumea DC. is one of the largest and most taxonomically difficult genera in the Tribe Inulaceae, which includes approximately 100 species worldwide (Randeria 1960; Anderberg 1991, 1994, 2009; Pornpongrungrueng et al. 2016). Blumea is a monophyletic genus supported by molecular data (Pornpongrungrueng et al. 2007, 2009). *Blumea* is primarily distributed in tropical Asia, Africa and Oceania, while its highest diversity is in tropical Asia (Pornpongrungrueng et al. 2016). With the exception of the most common

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weeds in disturbed habitat, some species of *Blumea* have very narrow distribution areas at the edge of the forest. With the exception of partial revisions of 49 species of *Blumea* throughout the whole world by Randeria (1960) and of 27 species in continental Southeast Asia by Pornpongrungrueng et al. (2016), a whole revision of this genus worldwide is still lacking. Seventeen species were reported from Myanmar (Kress et al. 2003).

Material and methods

During our fieldwork in Myanmar in 2019, we found an undescribed species of *Blumea.* The plant that we collected in the Htamanthi Wildlife Reserve, Sagaing, is easily distinguished from any other taxa of *Blumea* by its specific flowers and leaves, i.e. its basal rosette abaxially purple leaves with papillary hairs and multicellular villous and 1–4 capitula at the ends of the peduncles and unribbed achenes.

Results

***Blumea htamanthii* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov.**
urn:lsid:ipni.org:names:77204219-1
Figs 1–2

Diagnosis. This new species is the most similar to *Blumea bifolia* (Linn.) DC. in its obovate-oblong leaves, reflexed linear phyllaries, flat, alveolate, glabrous receptacles. However, it is distinguished by its leaf blades with papillary hairs and sparse multicellular villous, abaxial purple, 1–4 capitula at the ends of the peduncles and its unribbed achenes.

Type. Myanmar: Htamanthi Wildlife Sanctuary, Hkamti District of Sagaing Region, the cliff near the edges of the forest along the branch river of Chindwin River, elevation 127 m, 25.4948593°N, 95.4319749°E , May 23 2019,Y.L. Peng, C.X. Yang & Y. Luo, SE02614 (Holotype CDBI!, Isotype HITBC!, RAF!).

Description. Annual herbs, herbaceous, 5–25 cm tall. Stems erect, occasionally procumbent, villous with multicellular hairs, leaves basal rosette or sub-basal rosette and a few cauline, petioles 0.2 to 0.3 cm long, at the base of petioles with white pilose hairs, lamina obovate or obovate-oblong, thinly papyraceous, 0.9–3.5 × 0.3–1.2 cm, acute at the apex, base abruptly constricted into winged petiole, margins distantly dentate, villous with multicellular hairs, both surfaces hairy, significantly discoloured, upper surface bright green, leaf blade with papillary hairs and sparse multicellular pilose, multicellular pilose on the veins are dense, lower surface purple, the base of margins serrate, apex acute; inflorescences loose panicles, 3–10 cm long, capitula terminal, rarely axillary, 1–4 heads at the ends of the peduncles, 4–6 mm in diameter, peduncles 5–25 mm long with white pilose hairs; phyllaries herbaceous, slightly longer than the florets, 10–20 mm long, phyllaries in 5 (–6)-seriate, reflexed, outer phyllaries linear, with colleters and pilose hairs, lower part of the inner phyllaries lanceolate, upper part abruptly reduced to a linear tip,

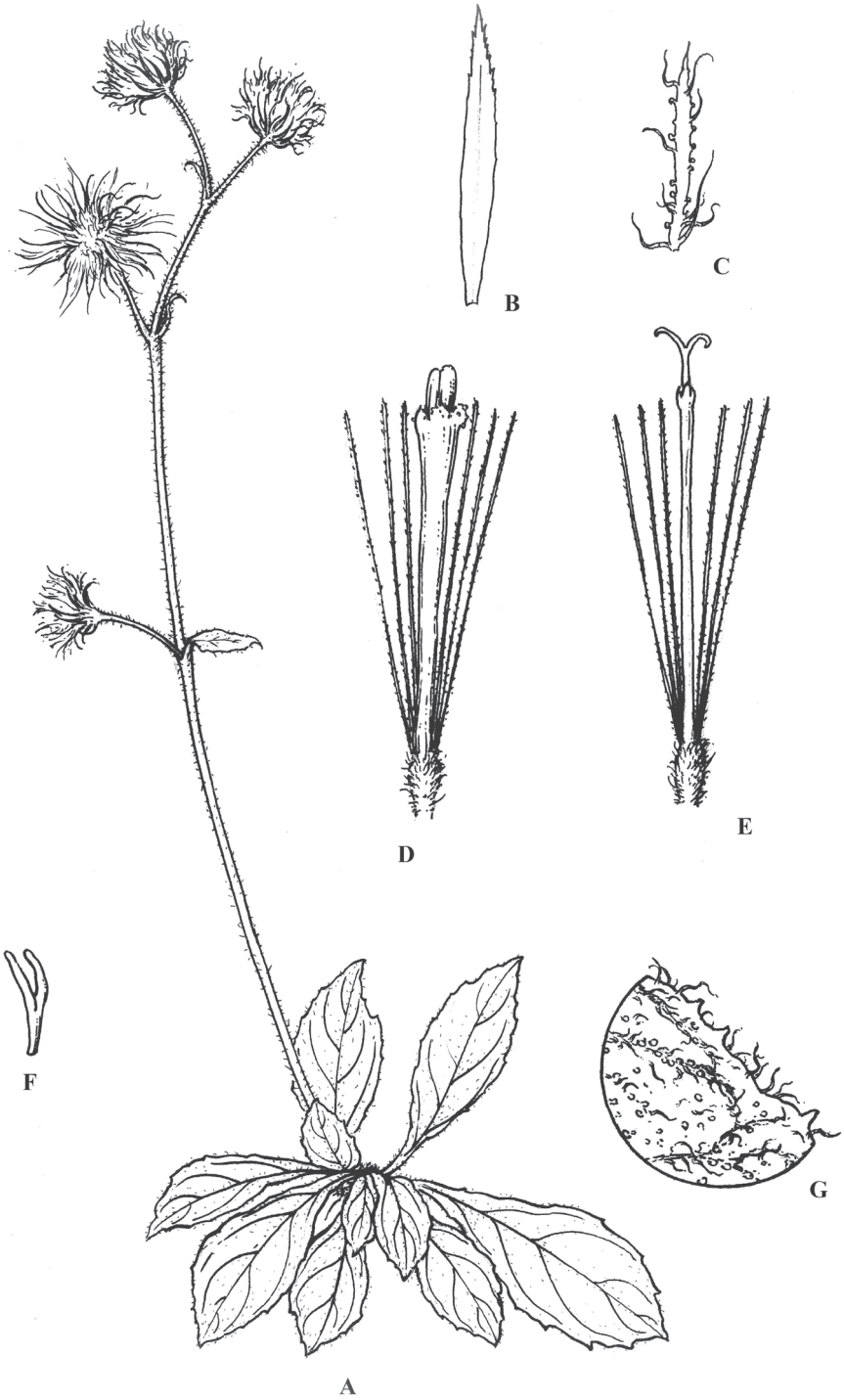

Figure 1. *Blumea htamanthii* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov. **A** habit **B** the inner phyllary **C** the outer phyllary **D** bisexual floret **E** female floret **F** style of bisexual floret **G** magnified part of upper surface of the leaf. Drawings: Jian Gu based on the holotype.

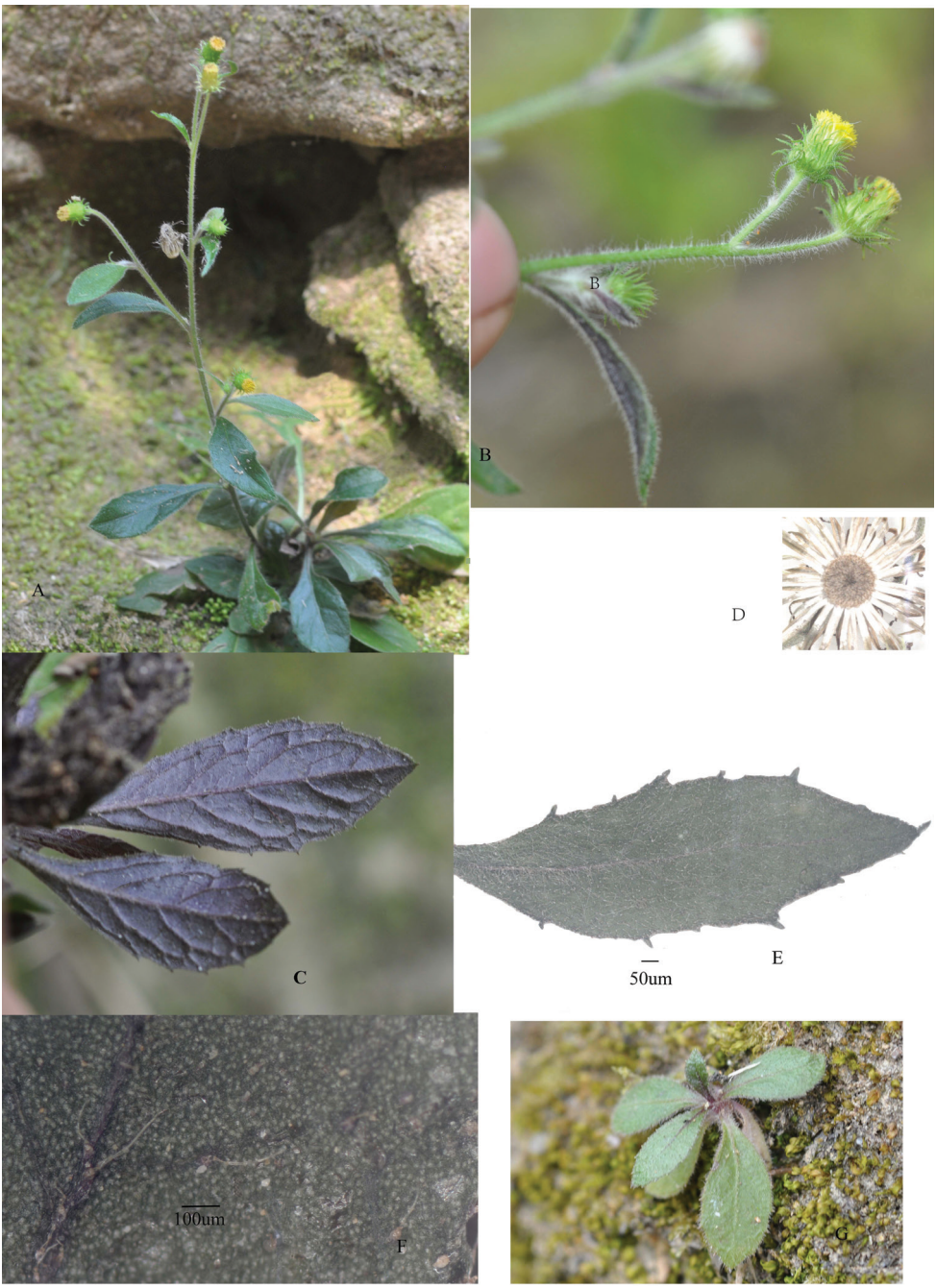

Figure 2. *Blumea htamanthii* Y.L.Peng, C.X.Yang & Y.Luo , sp. nov. in the field and magnified leaves and receptacle **A** the whole plant **B** inflorescences **C** the abaxial surface of the leaf **D** receptacle **E** the upper surface of the leaf **F** magnified part of upper surface of the leaf **G** basal leaves. Photos: Y.L. Peng.

the middle and upper part margin of the inner phyllaries lacerate, with sparse multicellular hairs, receptacle 0.5–1 mm in diameter, flat or slightly convex, alveolate, glabrous. Florets yellow, tubular, glabrous; those of the bisexual florets, corolla tube 3.5–4.5 mm long, with 5 ovate, papillate lobes, styles of the hermaphroditic flowers are wrapped in a slightly longer stamen tube; those of the female florets are filiform, up to 3.5 mm long, with 2 to 3 lobed, corolla tube 1–1.5 mm long. Cypselas pale brown, oblong, pubescent, not ribbed, 0.4–0.6 mm long, pilose; pappus carducous, white, 3–4 mm long.

Etymology. The new specific epithet "htamanthii" refers to the name of the town along the Chindwin River, Hkamti District of Sagaing, Myanmar, where the novel species was discovered.

Phenology. Flowering and fruiting April to June.

Distribution and habitat. Myanmar. Sagaing, Htamanthi; *Blumea htamanthii* is only known from the type collection along the branch river of Chindwin River, growing on the steep rocks near the forest from 66–366 m altitude above mean sea level, 25.4948°–25.5152°N, 95.4319°–95.5268°E in the Htamanthii Nature Reserve.

Additional material examined. 25.4947931°N, 95.4319147°E, elevation 121–129 m, 23 May 2019,Y.L Peng, C.X. Yang &Y. Luo SE02645, SE02694 (CDBI, HITBC, RAF); 25.5132139°N, 95.5269449°E, elevation 36–367 m, 26 May 2019, Y.L. Peng, C.X. Yang & Y. Luo SE02730, SE02731, SE02736 (CDBI, HITBC, RAF); 25.5127053°N, 95.5267582°E, elevation 366 m, 27 May 2019, Y.L Peng, C.X.

Table 1. A list of the morphological differences between *Blumea tamanthii*, *B. bifoliata*, *B. diffusa* and *B. bicolor*.

Characters	*Blumea htamanthii*	*Blumea bifoliata*	*Blumea diffusa*	*Blumea bicolor*
Leaf arrangement patterns	Basal rosette or sub-basal rosette and a few cauline, the cauline ones are all alternate	Mostly cauline, the uppermost pair are subopposite	Basal rosette or sub-basal rosette and a few cauline; the cauline ones are all alternate and amplexicaulous	The lower part of the stem naked, leafless; the leaves mostly aggregated in the middle portion of the stem
Leaf morphology	Petioles 0.2 to 0.3 cm long, lower surface purplish, apex acute, leaf blade obovate or obovate-oblong, villous with papillary hair and sparsely multicellular villous, 0.9–3.5× 0.3–1.2 cm	Sessile, both surfaces green, the apex acute or apiculate, leaf blade oblong or ovate, villous with multicellular hairs and stipitate glands, radical leaves 0.7–3 × 0.4–1.5 cm	Sessile, both surfaces green, the apex acute to apiculate, obovate or rarely oblanceolate, pilose with colleters and multicellular hairs, 2–6 cm × 1.0–2.5 cm wide	Lower surface purplish, apex sharply acuminate, blade oblong elliptic, sparsely pilose with multicellular hairs, 5.5–23.5× 1.3–8.6 cm
Stem	Erect, occasionally procumbent, usually unbranched, pilose with long, white hairs	Erect, branched from the base, ascending or rarely procumbent	Procumbent, stems branched from the base, pilose with long, white hairs	Erect, generally unbranched, puberulous
Capitula	1–4, colleters and pilose on the outer phyllaries, the middle and upper part margin of the inner phyllaries lacerate	1, glands on the phyllaries	1, pilose on the phyllaries	Several formed a lax, terminal panicle, pubescent on the phyllaries
Florets	Glabrous	Sparsely pubescent on the lobes	Glabrous	Bisexual florets pubescent, female florets glabrous
Cypselas	Pilose, not ribbed	Pilose, 6–10-ribbed	Sparsely pilose, 10-ribbed	Ribbed, pubescent

Yang & Y. Luo, SE02769 (CDBI, HITBC, RAF); 25.5128305°N, 95.5268144°E, elevation 366 m, 27 May 2019, SE02770 (CDBI, HITBC, RAF), 25.5133152°N, 95.5262927°E, elevation 340 m, 27 May 2019, Y.L Peng, C.X. Yang & Y. Luo SE02777 (CDBI, HITBC, RAF); 25.5128089°N, 95.5266037°E, elevation 160 m, 27 May 2019, Y.L Peng, C.X. Yang & Y. Luo SE02806, SE02861(CDBI, HITBC, RAF).

Discussion. *Blumea htamanthii* resembles *B. bifoliata* (Linn.) DC. and *B. diffusa* R. Br. ex Benth. in its reflexed linear phyllaries, flat, alveolate, glabrous receptacle and obovate leaves. *Blumea htamanthii* differs from *B. bifoliata* by erect stem and basal bicolour rosette leaves, abaxially purple, with short petioles, leaf blade with papillary hairs and sparse multicellular villous and 1–4 capitula at the ends of the peduncles, achenes not ribbed (vs. leaves sessile, one colour, villous with multicellular hairs and stipitate glands, solitary capitula, achenes 6–10 ribbed) (Table 1). *Blumea htamanthii* differs from *B. diffusa* in erect stems and leaves with short petioles, cauline leaf base not amplexicaulous, and 1–4 capitula at the ends of the peduncles (vs. stems procumbent, leaves sessile, one colour, cauline amplexicaulous, solitary capitula) (Table 1). In addition, *B. bicolor* is endemic in the Philippines with abaxially purple leaves (Merrill 1912, Randeria 1960). However, it is a tall erect herb with leaves aggregated in the middle portion of the stem, leave blade oblong elliptic, 5.5–23.5 × 1.3–8.6 cm and achenes ribbed. Its morphological traits are significantly different from those of *B. htamanthii* (Table 1).

Key to *Blumea* species in Myanmar (including the closely related species ***B. bi**color* in the Philippines and ***B. d**iffusa* in Australia)

1a Plants densely white-woolly **2**
2a Outer phyllaries oblong-lanceolate, acute..... ***Blumea hieraciifolia* (Don) DC.**
2b Outer phyllaries linear and tapering **3**
3a Capitula in large lax panicles; pappus red; corolla lobes of bisexual florets glabrous..... ***Blumea densiflora* DC.**
3b Capitula in compact, spiciform panicles; pappus white; corolla lobes of bisexual florets hairy..... ***Blumea lacera* (Burm. f.) DC.**
1b Plants glabrous or variously pubescent **4**
4a Phyllaries at least the outer phyllaries, oblong-ovate to oblong-lanceolate..... **5**
5a Climber; receptacle densely pubescent; corolla lobes of female florets with multicellular hairs ..... ***Blumea riparia* (Blume) DC.**
5b Erect, receptacle fimbrillate or rarely pilose; corolla lobes of female florets glabrous..... **6**
6a Receptacle fimbrillate or rarely pilose glabrous ..... ***Blumea lanceolaria* (Roxb.) Druce**
6b Receptacle pilose **7**
7a Capitula in narrow panicles..... ***Blumea hirsuta* (Less.) M. R. Almeid**
7b Capitula in large, spreading panicles ..... ***Blumea repanda* (Roxb.) Hand.-Mazz**

4b Phyllaries all linear or linear-lanceolate.....**8**
8a Receptacle fimibrillate.....***Blumea aromatica* DC.**
8b Receptacle glabrous or pilose.....**9**
9a Leaves purplish on abaxial surface.....**10**
10a Height 20–100 cm, the lower part of the stem naked, leafless, mostly aggregated in the middle portion of the stem .....***Blumea bicolor* Merr**
10b Height 5–25 cm, leaves basal rosette or sub-basal rosette and a few cauline..... .....***Blumea htamanthii* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov.**
9b Leaves not purplish on abaxial surface.....**11**
11a Pappus reddish.....***Blumea balsamifera* (L.) DC.**
11b Pappus white.....**12**
12a Capitula solitary, axillary and terminal.....**13**
13a Diffuse herbs; leaves mostly radical, the cauline ones all alternate..... .....***Blumea diffusa* R. Br. ex Benth**
13b Erect herbs; leaves mostly cauline, the uppermost pair subopposite..... .....***Blumea bifoliata* (L.) DC.**
12b Capitula interruptedly spiciform paniculate or loose or dense paniculate.....**14**
14a Inflorescence an interrupted spiciform panicle ....***Blumea fistulosa* (Roxb.) Kurz**
14b Inflorescence a loose or dense paniculate.....**15**
15a Leaves spinous-toothed, stems procumbent.....***Blumea oxyodonta* DC.**
15b Leaves not spinous-toothed, stems erect.....**16**
16a Receptacle minutely pilose.....**17**
17a Leaves not lyrately lobed.....***Blumea adenophora* Franch**
17b Leaves lyrately lobed .....***Blumea sinulata* (Lour.) Merr**
16b Receptacle glabrous.....**18**
18a Achenes ribbed.....**19**
19a Plants more or less glabrate .....***Blumea virens* Wall. ex DC.**
19b Plants pubescent or variously glandular.....***Blumea napifolia* DC.**
18b Achenes subangulate to terete **20**
20a Leaves usually not lobed; corollas purple.....***Blumea axillaris* (Lam.) DC.**
20b Leaves often lyrately lobed; corollas yellow..... ***Blumea lacera* (Burm. f.) DC.**

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RESEARCH ARTICLE

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Ainsliaea daheishanensis (Asteraceae): a new species from China

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Abstract

In this work, we describe a new species, *Ainsliaea daheishanensis* Y.L.Peng, C.X.Yang & Y.Luo, based on morphological traits. The new species was discovered in the mountains of Yunnan, near the border between Myanmar and China. The new species differs from the phenotypically closely-related *Ainsliaea foliosa* Handel-Mazzetti in the morphology of the leaf veins and phyllaries, those having a protruding abaxial reticulate pattern in the lower and median part of stem with white hairs and narrow inner phyllaries. A key to the three closed *Ainsliaea* species occurring in China is provided.

Keywords

Asteraceae, *Ainsliaea daheishanensis*, China, new species

Introduction

Ainsliaea DC., first described by de Candolle (1838), belongs to the subfamily Mutisioideae, tribe Mutisieae. The genus *Ainsliaea* is a monophyletic group as supported by molecular data (Mitsu et al. 2008) and it includes 50 estimated species distributed in Afghanistan, Bangladesh, Bhutan, China, India, Indonesia, Japan, Korea, Myanmar,

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Nepal, Pakistan, Philippines, Thailand and Vietnam (Freire 2007, Gao et al. 2011). In addition, in recent years, new species have been reported in China and Vietnam (Qian 2000, Freire 2002, Wang et al. 2010). China is the centre of diversity for *Ainsliaea*. Forty of them are distributed in China, including 28 endemic species (Wang et al. 2010, Gao et al. 2011). However, some species are restricted only to a very narrow area of Sichuan and Yunnan.

During our fieldwork on the border between China and Myanmar, we found a novel and undescribed species of *Ainsliaea* in the Dahei Mountain in Menglian County. This new species is easily distinguishable from other taxa in the *Ainsliaea* genus by the protruding white hairy reticulate veins on the lower surface of leaves and narrow inner phyllaries. Here, we name it as *A. daheishanensis* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov. and we describe its morphology, based on the living plants in the field and several collections in the herbarium.

New species description

***Ainsliaea daheishanensis* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov.**
urn:lsid:ipni.org:names:77204220-1
Figs 1–3

Diagnosis. This new species is similar to *Ainsliaea foliosa* Handel-Mazzetti and *A. latifolia* (D. Don) Schultz Bipontinus, but it differs from them in its solitary white hairy reticulate veins on the abaxial surface of the lower part of the leaves and on the narrow inner phyllaries.

Type. China: Under oak forest, Yunnan Province: Menglian County, Lafu village, Mountain Dahei, 22.102733°N, 99.40731°E, elevation 2092–2300 m, 14 January 2019, Y.L. Peng & C.X. Yang SE02248 (holotype CDBI!, isotype HITBC!) (Figure 1).

Description. Plants perennial, herbaceous, 60–80 cm tall. Stems erect, unbranched, villous. Leaves alternated in lower to median part of the stem. Petiole 4–6 cm long, large winged, gradually reducing, villous, leaf blades papery, palmate-pinnate veined, ovate to elliptic, 8–10 × 2–4 cm, apex acute, base abruptly constricted into winged petiole, margin obscurely callose-denticulate, slightly discoloured, upper surface green, sparsely strigose, subglabrous palmate-pinnate veined, lower surface pale with evident reticular veins densely covered by thick white hairs, the remaining part of the lower surface light green and subglabrous. Upper leaves ovate to elliptic, 1–3 × 0.5–1.5 cm, upper surface green-olivaceous, subglabrous palmate-pinnate veined, lower surface densely covered in thick white hairs. Capitula sessile and distantly spaced upwards to the inflorescence axis; disposed in spikes, involucre 6-seriate, cylindrical, ca. 15 × 5 mm; phyllaries papyraceous, glabrous, or sparsely pilose, outer phyllaries ovate, acute, ca. 2 × 1 mm; inner phyllaries linear-oblong to lanceolate, acute, mid-vein dark green, margin pale to pale green. ca. 15 × 0.3 mm. Florets ca. 3–4, flowers not present. Achenes ca. 2–3 mm, densely pilose, pappus reddish-brown, ca. 7 mm long.

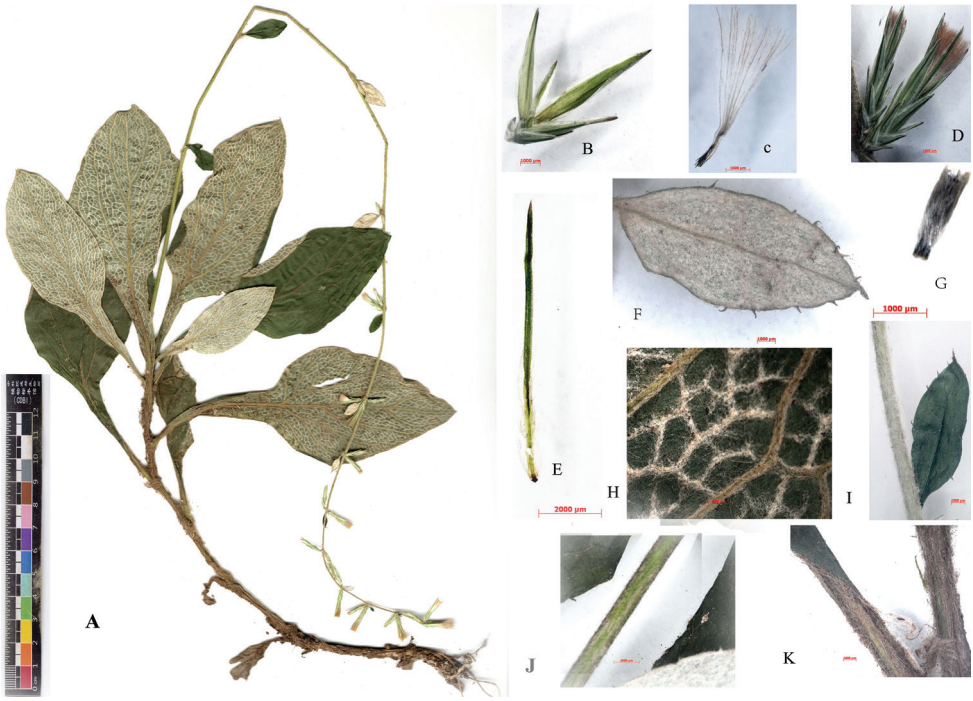

Figure 1. *Ainsliaea daheishanensis* Y.L. Peng, C.X. Yang & Y. Luo, sp. nov. **A** habit **B** involucres **C** pappus **D** inflorescences **E** inner phyllary **F** upper leaf **G** magnified achene **H** magnified abaxial surface of median part leaves of the stem **I–J** upper part of stem and leaves, respectively **K** lower part of the stem. Photo taken by Y.L. Peng based on the holotype.

Etymology. The new specific epithet "daheishanensis" refers to the name of the Dahei Mountain, located at the border between China and Myanmar, where the novel species was discovered.

Phenology. Flowering was not observed, fruiting in November-March.

Distribution and habitat. *Ainsliaea daheishanensis* is only known from the type collection cited above, at 2100–2300 metres altitude, under evergreen forests (Figure 4). The other examined specimens e.g. Y.Y.Qian 2818, have no detailed collection information; they are only found in Yunnan Province.

Additional material examined. China. Yunnan: Menglian County, Lafu village, under evergreen forest, elevation 2300 m, 8 November 2010, S.S. Zhou 7755 (HITBC). Yunnan Province: Menglian County, 8 March 1993, Y.Y.Qian 2818(HITBC).

Discussion. This new species is mostly similar to *Ainsliaea foliosa* in the broadly winged leaves that are loosely aggregated near the median part of the stem and having an ovate blade. *Ainsliaea daheishanensis* can be distinguished from *A. foliosa* by its protruding white reticulate veins on the abaxial surface of the lower part of cauline leaves, which is covered with thick white hairs and by the innermost phyllaries that are narrow and slightly shorter than the crown hairs (Table 1) (Fig. 1A, B, E, H). *Ainsliaea daheishanensis* resembles *A. latifolia* by its leaves and inflorescences. Both species have ovate to elliptic leaf

Figure 2. The whole plant *Ainsliaea daheishanensis* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov. in its habitat (under evergreen forest).

Figure 3. The lower part of the plant *Ainsliaea daheishanensis* Y.L.Peng, C.X.Yang & Y.Luo, sp. nov. in the field.

Table 1. List of the morphological differences amongst *Ainsliaea daheishanensis*, *A. foliosa* and *A. latifolia*.

Characters	*Ainsliaea daheishanensis*	*Ainsliaea foliosa*	*Ainsliaea latifolia*
Leaf arrangement patterns	Alternated in lower and median part of stem.	Loosely aggregated or occasionally alternated in median part of stem.	Basally clustered, rosulate.
Leaf morphology	Lower surface with obvious reticular veins, which are covered with thick white hairs.	Lower surface with sparse trichomes and obscure reticular veins	Lower surface densely covered with white fluff, mixed with long, slightly stiff hair of the same colour.
Petioles	4–6 cm, obviously shorter than leaf blade.	2.5–5 cm, almost equal or shorter than leaf blade.	(2) 4–9(11) cm, almost equal in length to leaf blade.
Capitula	Sessile, 1–3 clustered, arranged in spikes, 3–4 flowered.	Subsessile or shortly pedunculate, arranged in racemes or spikes, 4– or 5–flowered.	Subsessile or shortly pedunculate, (1 or) 2–4 clustered, arranged in spikes or panicles, 3-flowered.
Involucre	6 to 7-seriate, cylindrical, 8–10× ca. 4 mm; phyllaries papyraceous; outer phyllaries ovate, acute, 2–3 × ca. 1 mm, inner phyllaries linear-oblong, acute, mid-vein usually green, 15× 0.3 mm, slightly longer than the pappus.	Involucre 4-seriate, subleathery, outer phyllaries broadly ovate, 2.5–3 mm, inner phyllaries ovate to elliptic, apex purple, mid-vein usually dark green, 10 × 0.8 mm, evidently shorter than the pappus.	5 to 7-seriate, cylindrical, 8–10 × ca. 4 mm; phyllaries papyraceous; outer phyllaries ovate, acute, 2–3× ca. 1 mm, apically strigose; inner phyllaries linear-oblong, acute, mid-vein usually dark, 7–12 × ca. 1 mm, shorter than the pappus.

Figure 4. Distribution of *Ainsliaea daheishanensis* Y. L. Peng, C. Y. Yang & Y. Luo. • *A. daheishanensis*.

blades, with long and winged petioles and the capitula are arranged in spikes. These similarities between the two species led some researchers to wrongly identify the specimens of *Ainsliaea daheishanensis* as *A. latifolia*. Morphologically, *Ainsliaea daheishanensis* differs from *A. latifolia* in the position of the leaves appearing above the base of the stem (vs. a basal rosette in *A. latifolia*), and in the evident reticulate veins of the abaxial surface of leaves with thick white hairs, mainly occurring in the reticulate veins. The abaxial surface of *A. latifolia* leaves is densely covered with white fluff, mixed with long stiff hairs of the same colour. A key to the three closely related *Ainsliaea* species in China is provided below.

Key to *Ainsliaea daheishanensis*, *A. foliosa* and *A. latifolia*

1 Leaves loosely aggregated or occasionally alternated in the median part of the stem, abaxial surface subglabrous, sparsely or partially hairy **2**

– Leaves basally clustered, rosulate, the abaxial surface densely covered with white fluff ..... ***Ainsliaea latifolia***

2 Abaxial surface of leaves with recognisable reticular veins, thick white hairs only on the reticular veins, involucre 6 to 7-seriate; inner phyllaries

linear-oblong, acute, apex green, mid-vein usually green, slightly longer than the pappus .....***Ainsliaea daheishanensis***

– Reticular veins of the abaxial surface of the leaves obscure, scattered with trichomes, involucre phyllaries 4-seriate, subleathery, inner phyllaries ovate to narrowly elliptic, apex purple, 0.8–1.1 cm, mid-vein usually dark green, noticeably shorter than the pappus ..... ***Ainsliaea foliosa***

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