Two new species of Paraboea (Gesneriaceae) in Caryota obtusa forests in Southwest China, with compound and simple dichasia, respectively

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Abstract
Two new species of Gesneriaceae, *Paraboea myriantha* sp. nov. and *P. brevipedunculata* sp. nov. are described and illustrated with photos. They grow in the Caryota obtusa forests from Yunnan Province of China. *P. myriantha* is closely related to *P. glutinosa* (Hand.-Mazz.) K.Y.Pan, but differs mainly in corolla outside glandular-puberulent, adaxial corolla lobes semicordate, corolla tube obliquely campanulate, and filaments glandular-puberulent. *P. brevipedunculata* is closely related to *P. crassifolia* (Hemsley) B. L. Burtt, but different mainly in simple dichasia with 1 and 2 flowers, peduncles 0.5–2 cm long and capsules slightly twisted. The geographical relationship between the two new species and their similar species has been discussed.

Keywords
Dichasia, Karst regions, new species, *Paraboea brevipedunculata*, *Paraboea myriantha*
Introduction

The genus *Paraboea* (Clarke) Ridl. (Gesneriaceae), including about 90 species, mainly occurs in Bhutan, China, Indonesia, Malaysia, Myanmar, Philippines, Thailand and Vietnam (Xu et al. 2008). Recently, several new species have been published (Chen et al. 2008, 2012; Kiew 2010; Xu et al. 2012; Wen et al. 2013; He et al. 2018). Most of them are distributed in the karst regions in South China and Indo-China (Li 1987; Wang 1990; Xu 1993; Fang et al. 1995; Zhu et al. 2003; Li and Wang 2004; Shui and Chen 2006; Zhu 2007; Shui et al. 2017). The genus is easily recognised by the thick hairs on the adaxial surface and lax hairs on the abaxial surface of the leaves in the karst regions, especially in *Caryota obtusa* forest in southwest China (Chen et al. 2017). The forest is a special vegetation subtype in the karst regions and harboured numerous endemic species, such as *Paraboea hekouensis* Y.M. Shui & W.H. Chen and *P. manhaoensis* Y.M. Shui & W.H. Chen in Gesneriaceae (Chen et al. 2012; Chen et al. 2019).

Long-term surveys of *Caryota* forests revealed some new findings in the karst regions in Southwest China. From 2001 to 2005, during our botanical exploration to *Caryota* forests in karst areas in the southeast of Yunnan Province, China, we collected some species of the genus *Paraboea* in Gesneriaceae in Hekou County of SE Yunnan, China (Figure 1). Amongst them, one species with up to 0.9 m tall habit, produces a compound dichasium with hundreds of flowers (Shui and Chen 2006; Chen et al. 2008). With

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**Figure 1.** The geographical distribution of *Paraboea brevipedunculata* W.H. Chen & Y.M. Shui, sp. nov. (square) and *P. myriantha* Y.M. Shui & W.H. Chen, sp. nov. (star).
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further observation, it is similar to *P. glanduliflora* Barnett in glandular hairs outside the corollas and different in the basal leaves (Wang et al. 2012). After careful comparison with the other species of *Paraboea* in China (Li 1987; Wang 1990; Fang et al. 1995; Li and Wang 2004; Chen et al. 2008, 2012, 2017; He et al. 2018) and bordering countries (Thúợngtiền 2000; Xu et al. 2008), we confirmed that the species represents an undescribed species of *Paraboea* in Gesneriaceae. After a complete examination to the main worldwide herbaria, we confirmed several additional specimens collected in the adjacent karst regions in China during the 2001–2018 period.

In June 2013, on the other hand, we collected one small doubtful species of *Paraboea* with fruits in Malipo county in the southeast of Yunnan Province (Figure 1). In the field, it grows on cliffs, as well as in the *Caryota* forest at the border with Vietnam in Malipo county, Yunnan, China. However, we missed the flowering period in 2014 and 2015. In May 2016, we collected the plants with flowers and confirmed that it belonged to the genus *Paraboea*. After an examination of literatures and related specimens, we determined that it is unique in ca. 5 cm high habit and simple dichasia and should be an undescribed species in the genus. It is possible that it may be collected in Vietnam in the future (Figure 1).

**Materials and methods**

We confirmed two new species after examination of the specimens preserved in worldwide herbaria (E, IBSC, K, KUN, P, PE). We took photographs of the habit and macro-morphological characters in the field. Subsequently, we carried out morphological observations and measurements of the two new species, based on living plants in the field and Kunming Botanical Garden, together with additional specimens in KUN. All micro-morphological characters were observed and photographed with a Leica S8 APO stereomicroscope and a Nikon D700 microscope camera.

**Taxonomy**

*Paraboea myriantha* Y.M. Shui & W.H. Chen, sp. nov.
urn:lsid:ipni.org:names:77211197-1

Figure 2

**Type.** China. Yunnan Province: Hekou County, Nanxi Community, 22°38′18.44″N, 104°00′28.93″E, in the limestone forests, alt. 900 m, 26 August 2005, in flowers, *Y.M. Shui et al. 44536* (holotype KUN).

**Diagnosis.** The new species is similar to *P. glutinosa* (Hand.-Mazz.) K.Y.Pan in winged petioles, leaf-like bracts and compound dichasia, but distinguished by adaxial corolla lobes semicordate (vs. nearly rounded), tube obliquely campanulate (vs. urceolate) outside glandular-puberulent (vs. glabrous or rarely pubescent) and laterally
uneven (vs. even), and glandular-puberulent filament (vs. covered by a beard of multicellular hairs); and similar to *P. thorelii* (Pellegr.) B.L.Burtt in winged petioles and compound dichasia, but distinguished by corolla tubes 9–10 mm long (vs. 3–4 mm long) outside glandular-puberulent (vs. glabrous) and staminodes 2 (vs. inconspicuous).

**Description.** Herbs, up to 90 cm tall, stems 10–20 cm. Leaves opposite, clustered at stem apex; petiole 5–8 (–15) cm long and winged, wings (1–) 5–20 mm wide each side; leaf blade obovate, 12–30 (–48) × 5–13 (–16) cm, chartaceous, adaxially sparsely pubescent to glabrous, abaxially densely matted arachnoid, base cuneate to wing-like on petiole, margin repand-crenate and involute, apex mucronate to rounded; midrib depressed adaxially, protuberant abaxially; lateral veins 8–13 (–16) pairs, obscure adaxially and distinct abaxially. Dichasium terminal paniculate, with hundreds of flowers; peduncles up to 70 cm, densely arachnoid when young, sparsely puberulent to glabrous when mature; bracts (the lowermost fertile leaves) 2, leaf-like, ca. 7 × 3 cm, densely arachnoid abaxially; bracteoles 2, linear, ca. 2 × 0.5 mm; pedicels 5–8 mm long. Calyx 5-sect from base; segments linear, ca. 1 mm long, glabrous. Corolla purple adaxially and white abaxially (corollas purple when young), outside glandular-puberulent; tube obliquely campanulate, ca. 10 mm long, outside glandular-puberulent; adaxial lip 2-lobed, lobes semicordate ca. 3 × 6 mm; abaxial lip 3-lobed, lobes ca. 5 × 6 mm. Stamens 2, included; filaments lateral-fixed, ca. 8 mm long, glandular-puberulent from middle to top; anthers ca. 5 mm long; staminodes 2, 3–5 mm long. Pistil glabrous; ovary oblong, ca. 6 mm long; style linear, 4–5 mm long; stigma capitate. Capsule obviously twisted, 4.5–6.7 cm long, glabrous, with persistent calyx. Seeds ellipsoid, 0.6–0.7 × 0.15–0.2 mm.

**Etymology.** The new species is named after its numerous flowers per an individual.

**Distribution and habitat.** The new species only grows in *Caryota obtusa* forests of limestone areas in Hekou and Maguan counties of Yunnan, China (Figure 1).

**Phenology.** Flowering from June to August; fruiting from July to November.

**Additional specimens examined (paratype).** China. Yunnan Province: Hekou County, in dense forests on the limestone hillsides, alt. 700–950 m, 21 October 2001, *Y.M. Shui et al. 15105* (KUN); at the same county, in the limestone seasonal forests, alt. 1000–1200 m, with fruits of last year, 28 March 2002, *Y.M. Shui et al. 20595* (KUN); at the same county, in dense forests on limestone hillsides, alt. 1000 m, with young dichasia, 28 March 2002, *Y.M. Shui et al. 20946* (KUN); at the same county, Nanxi Zhen, 22°40′8″N, 104°01′16″E, in forests, alt. 900 m. 6 September 2013, *Y.M. Shui, B. Xiao, J. Wang et al. B2013-528* (KUN). Maguan County, Gulinqing Community, 22°43′N, 103°59′E, in the evergreen broad-leaved forests on limestone hillsides, alt. 1000 m altitude, 3 October 2002, *Y.M. Shui et al. 30261* (KUN); at the same county, 3 October 2002, *Y.M. Shui et al. s.n.* (KUN); at the same county, in the limestone evergreen broad-leaved forests, alt. 794 m, 11 November 2006, *Y.M. Shui et al. 16118* (KUN); at the same county, Jihanqing Community, Moshizhai Village, 9 August 2018, *Y.M. Shui et al. B2018-183* (KUN).

**Note.** The new species appeared as *Paraboea auriculata* Y.M. Shui & W.H. Chen (nom. nud.) because of its winged petioles in Shui and Chen (2006). However, we de-
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cided to name it as _Paraboea myriantha_, after careful comparison of references and type specimens with similar species, _P. glutinosa_ (Hand.-Mazz.) K.Y.Pan and _P. thorelii_ (Pel-legr.) B.L.Burtt. The new species is similar to the above two species on winged leaves and compound dichasia, but distinguished by corolla lobes (shape) and tubes (shape and indumenti) and glandular filament, which are described in diagnostics (Figure 2; Xu et al. 2008; Vu et al. 2011). Furthermore, _P. glutinosa_ is distributed in South China, _P. thorelii_ in South Laos (type locality) and North Vietnam, but the new species we proposed seems geographically distributed between the above two similar species. So, the future molecular work in the context of the whole genus may reveal if the above three species become a species complex with obvious geographical replacement.

**Paraboea brevipedunculata** W.H. Chen & Y.M. Shui, sp. nov.

urn:lsid:ipni.org:names:77211198-1

Figure 3

**Type.** **China.** Yunnan province: Malipo County, Tianbao community, 22°58’33.31”N, 104°50’32.92”E, in limestone forests, alt. 900 m, 30 April 2017, Y.M. Shui & W.H. Chen B2017-1342 (holotype, KUN).

**Diagnosis.** _Paraboea brevipedunculata_ is similar to _P. crassifolia_ (Hemsley) B. L. Burtt in morphology and indumenti of the leaves, but different in simple dichasia with 1–2 flowers (vs. compound dichasia with many flowers), peduncle 0.5–2 cm (vs. 8–12 cm), 4–5 mm calyx segments (vs. 2–3 mm), capsules slightly twisted (vs. multi-twisted) and 0.6–0.7 mm long when mature (2–2.5 cm long). The new species is also similar to _P. velutina_ (W.T.Wang & C.Z.Gao) B.L.Burtt. in the small plant, short peduncle and simple dichasia, but distinguished by purple corolla (vs. white), calyx 4–5 mm long (vs. ca. 1 mm), lobes of adaxial lip ca. 3 × 5 mm (vs. ca. 1.5 × 1 mm), lobes of abaxial lip ca. 5 × 7 mm (vs. ca. 1.5 × 2.3 mm) and capsule slightly twisted (vs. not twisted).

**Description.** Herbs 4–5 cm high and without stems. Leaves clustered; petiole very short, 0.2–1 cm, densely arachnoid; leaf blade obovate, 2.6–6 × 1–3 cm, thick papyry, adaxially pubescent when young and subglabrous when mature, abaxially densely matted arachnoid, base cuneate, margin subentire to shallowly repand-crenate, apex rounded; midrib depressed adaxially, protuberant abaxially; lateral veins 4–7 pairs, obscure adaxially and distinct abaxially. Dichasium terminal axillary, with 1–4 flowers; peduncle 0.5–2 cm, densely arachnoid; bracts 2, 0.5–0.6 × ca. 0.1 cm, sparsely pubescent abaxially; bracteoles 2 (sometimes absent), linear, ca. 2 × 0.5 mm; pedicel 0.3–1.2 cm long, densely arachnoid. Calyx 5-sect from base; segments linear, 4–5 × 1–2 mm, glabrous. Corolla purple, glabrous; tube 5–7 mm; adaxial lip 2-lobed, lobes ca. 3 × 5 mm; abaxial lip 3-lobed, lobes ca. 5 × 7 mm. Stamens 2, included; filaments curved, ca. 4 mm long, glabrous; anthers ca. 2 mm long; staminodes 3, the lateral two ca. 1 mm long and the middle one ca. 0.5 mm long. Pistil glabrous; ovary oblong, ca. 2 mm long; style linear, 6–7 mm long; stigma capitate. Capsule 0.6–0.7 mm long when mature, slightly twisted, glabrous, with persistent calyx. Seeds ellipsoid, 5–7 × 0.2–0.3 mm.

**Etymology.** The new species is named after its short peduncle per dichasium.
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Figure 3. Paraboea brevipedunculata W.H. Chen & Y.M. Shui, sp. nov. A habit B adaxial surface of leaf C abaxial side of leaf D adaxial surface of leaf, showing indumentum E, F abaxial surface of leaves, showing indumenti G dichasia H front view of flower I vertical view of flower, showing bracteoles (br) and calyx lobe (ca) J opened corolla, showing staminodes (sta) and pistil K pistil with calyx lobes (All photographed by Yu-Min Shui).
Distribution and habitat. The new species only grows in Caryota obtusa forests of limestone areas in Malipo County of Yunnan, China (Figure 1).

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

Additional specimens examined (paratype). CHINA. Yunnan Province: Malipo County, 22°58′33.31″N, 104°50′32.92″E, in limestone forests, alt. 900 m, 24 June 2013, Y.M. Shui & W.H. Chen B2013-094 (KUN); Malipo County, Tianbao, 22°58′33.31″N, 104°50′32.92″E, in limestone forests, alt. 900 m, 30 April 2017, Y.M. Shui & W.H. Chen B2017-1342 (KUN); the same place, 14 September 2018, in fruits, Y.M. Shui & W.H. Chen B2018-021 (KUN).

Note. The new species is more similar to P. crassifolia than P. neurophylla (Collett & Hems1.) B.L. Burtt in its linear bracts (Wang et al. 1998; Li and Wang 2004). P. crassifolia is distributed in W Huibei, SE Chongqing, Guizhou, Guangxi and SE Yunnan in China, while P. neurophylla is distributed in China (Central and West Yunnan) and Myanmar. The new species is distributed in SE Yunnan and shares the similar distribution with P. crassifolia, which is considered as the similar species to the new species. Besides, as to the small habit and fruits, it is somewhat similar to P. velutina in West Guangxi, which is next to SE Yunnan, but distinguished by corolla colour, size of calyx and corolla lobes, and twisted capsules (see the above diagnosis).

Vu et al. (2011) reported Paraboea neurophylla as a new record in Vietnam. The voucher specimens are collected from Ba Be National Park, Bac Kan province, Vietnam. However, the figure (based on HLF 608 in HN) reveals that it seems to be conspecific with the new species we proposed here. Additionally, the description and geographical distribution of the new record in Vietnam roughly match that of the new species (Vu et al. 2011). Although we are still waiting for further confirmation from the detailed surveys, it is possible that the new species will also occur in North Vietnam. In fact, P. neurophylla grows at ca. 2000 m elevation in China (Yunnan, e.g. B.Y. Qiu 55121 in PE, P. I Mao 1322 in PE, S. E. Liu 831, 13970, 14087, 19713 and 20886 in PE, K.M. Feng 10115 in PE, K.Y. Pan 1 in PE, J. Wu WJ2015010 in PE, Z.J. Qiu QZJ-0936 in PE, C.J. Chen 38 in PE, J.S. Xin 51404 in IBSC) and Myanmar (Shan hills, Collett 804, holotype K and isotype in E), but its habitat is very different from the habitat of the new species at less than 1000 m elevation (Wang 1990; Wang et al. 1998; Xu et al. 2008).

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References

Chen WH, Möller M, Shui YM, Zhang MD (2008) A new species of Paraboea (Gesneriaceae) from a karst cave in Guangxi, China, and observations on variations in flower and dichasia architecture. Botanical Journal of the Linnean Society 158(4): 681–688. https://doi.org/10.1111/j.1095-8339.2008.00873.x

Chen WH, Möller M, Zhang MD, Shui YM (2012) Paraboea hekouensis and P. manhaoensis, two new species of Gesneriaceae from China. Annales Botanici Fennici 49(3): 179–187. https://doi.org/10.5735/085.049.0304

Chen WH, Shi JP, Wen J, Guo SW, Chang TF, Shui YM (2017) Composition and geographical affinity of the tree species Caryota obtusa forests in the Honghe region, SW China. Biodiversity Science 25(8): 823–829. https://doi.org/10.17520/biody.2016289

Chen WH, Shui YM, Xu TY, Yang HS, Mao FF, Li JD (2019) Chapter 9 Other vegetations in Maguan County. In: Shui YM, Chen WH, Wu JY, Jia Y, Zhang XC, Wei R (Eds) Biodiversity Vegetation of Higher Plants and Vegetation of Maguan County, China. Yunnan Science & Technology Press, Kunming, 229–247.

Fang RZ, Bai PY, Huang GB, Wei YG (1995) A floristic study on the seed plants from tropics and subtropics of Dian-Qian-Gui. Acta Botanica Yunnanica (Supp VII): 111–150.

He DM, Feng YF, Pan FZ, Hong X, Wen F (2018) Paraboea wenshanensis, a new species of Gesneriaceae from Yunnan, China. PhytoKeys 95: 83–91. https://doi.org/10.3897/phytokeys.95.21586

Kiew R (2010) Two new species of Paraboea (Gesneriaceae) from peninsular Malaysia and Thailand. Edinburgh Journal of Botany 67(2): 209–217. https://doi.org/10.1017/S0960428610000107

Li B (1987) The forest flora of Gulinqing Conservation in Maguan County of South-east Yunnan. MSc Thesis. Sun Yat-Sen University, Guangzhou, China.

Li ZY, Wang YZ (2004) Plants of Gesneriaceae in China. Henan Science and Technology Publishing House, Zhengzhou, 305–332.

Shui YM, Chen WH (2006) Seed Plants of the Karst Region in China. Vol. 1, Southeast Yunnan. Science Press, Beijing, 173–174.

Shui YM, Chen WH, Qin XS (2017) Checklist of Seed Plants in the Karst Regions in China. Science Press, Beijing, 273 pp.

Thương tiến H (2000) Didissandra (Gesneriaceae). In: Phạm Hoàng H (Ed.) An Illustrated Flora of Vietnam vol. 3. Youth Publishing, Ho Chi Minh City, 25–27. [In Vietnamese]

Vu XP, Do TX, Wen F, Wei YG (2011) Two occurrence taxa in Paraboea (C.B. Clarke) Ridl. (Gesneriaceae) for flora of Vietnam. Guihaia 31(3): 288–290.

Wang WT (1990) Gesneriaceae. In: Wang WT (Ed.) Flora Reipublicae Popularis Sinicae 69. Science Press, Beijing, 460–472.

Wang WT, Pan KY, Li ZY, Weitzman AL, Skog LE (1998) Gesneriaceae. In: Wu ZY, Raven PH (Eds) Flora of China, vol.18. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 244–401.

Wang HC, Sun H, Zhou XM, He ZR (2012) Paraboea glanduliflora, a newly recorded species of Paraboea (Gesneriaceae) from China. Guihaia 32(6): 756–758.
Wen F, Hong X, Chen LY, Zhou SB, Wei YG (2013) A new species of *Paraboea* (Gesneriaceae) from a karst limestone hill in south-western Guangdong, China. Phytotaxa 131(1): 1–8. https://doi.org/10.11646/phytotaxa.131.1.1

Xu WB, Huang YS, Wei GF, Tan WN, Liu Y (2012) *Paraboea angustifolia* (Gesneriaceae): A new species from limestone areas in northern Guangxi, China. Phytotaxa 62(1): 39–43. https://doi.org/10.11646/phytotaxa.62.1.8

Xu ZR (1993) A study of the limestone forest flora of southern and south-western China. Guihaia S4: 6–54.

Xu ZR, Burtt BL, Skog LE, Middleton DJ (2008) A revision of *Paraboea* (Gesneriaceae). Edinburgh Journal of Botany 65(2): 161–347. https://doi.org/10.1017/S0960428608005106

Zhu H (2007) The karst ecosystem of southern China and its biodiversity. Tropical Forestry S1: 44–47.

Zhu H, Wang H, Li B, Sirirugsa P (2003) Biogeography and floristic affinities of the limestone flora in southern Yunnan, China. Annals of the Missouri Botanical Garden 90(3): 444–465. https://doi.org/10.2307/3298536