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Two new species of Gesneriaceae from Eastern China

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ABSTRACT: *Palmatiboea curvituba* and *P. recurva* are described and illustrated here. Both species resemble *P. heucherifolia* in having the calyx divided to the base, palmately veined leave blades with eglandular hairs on both surfaces, and a pink, externally puberulent corolla. However, *P. curvituba* differs from *P. heucherifolia* in that its corolla tube curved-funnelform-tubular (*vs.* funnelform-tubular), ratio of the corolla tube length to the orifice diameter ca. 2.62–2.92 (*vs.* ca. 1.4–1.74); leaf blade abaxially glabrous between veins (*vs.* pubescent); calyx lobes margins entire (*vs.* denticulate). *P. recurva* differs from *P. heucherifolia* by: corolla tube with a distinct pit on the middle of adaxial lip (*vs.* without a pit), ratio of the corolla tube length to the orifice diameter ca. 2.82–3.17 (*vs.* ca. 1.41—1.74), upper half part of corolla tube slightly upward-curving (*vs.* not upward-curving); peduncle, abaxial surface of bracts and abaxial surface of calyxes villous and mixed glandular-pubescent (*vs.* villous mixed eglandular-pubescent). Based on the IUCN Red List Categories and Criteria, the conservation status of both new species is assessed as Data Deficient (DD).

KEY WORDS: Jiangxi Province, *Palmatiboea curvituba*, *Palmatiboea heucherifolia*, *Palmatiboea recurva*, Zhejiang Province.

INTRODUCTION

The genus *Didymocarpus* Wall., established by Wallich (1819), is one of the genera that have experienced the most frequent revisions in the Gesneriaceae (Wen *et al.,* 2024). A revision 27 years ago defined the narrow sense of *Didymocarpus*, which includes two sections: *Didymocarpus* sect. *Didymocarpus* and *Didymocarpus* sect. *Elati* Ridl., distributed across Southwest China, the greater Himalayan region, and the Indochinese Peninsula (Weber *et al.*, 1997). For species of this genus in China, Wang *et al*. (1990) classified them into two sections: sect. *Didymocarpus* (herbs with stems) and sect. *Heteroboea* W.T.Wang auct. non Benth (herbs without stems). The latter was initially defined by morphological characters, but on the basis of recent systematic results and morphological comparison, five species have been assigned to the genus *Petrocodon*, these species include *P. bonii* (Pellegr.) A.Weber & Mich. Möller, *P. mollifolius* (W.T.Wang) A.Weber & Mich.Möller, *P. niveolanosus* (D. Fang & W.T.Wang) A.Weber & Mich.Möller, *P. hancei* (Hemsl.) Mich.Möller & A.Webe and *P. subpalmatinervis* (W.T.Wang) F.Wen & Z.L.Li after a thorough study (Weber *et al.*, 2011; Li *et al.*, 2023). After the publication of Flora Reipublicae Popularis Sinicae (Vol. 69) (Wang *et al.,* 1990), five new taxa within this section were discovered and published: *Didymocarpus dissectus* F.Wen, Y.L.Qiu, Jie Huang & Y.G.Wei (Wen *et al.,* 2013) from Fujian Province, *D. heucherifolius* Hand.-Mazz var. *yinzhengii* J.M.Li & S.J.Li (Li and Li, 2014) from Hunan Province, *D. heucherifolius* Hand.-Mazz var. *gamosepalus* Xin Hong & F.Wen (Xu *et al.,* 2019) from Guangdong, China, *D. lobulatus* F.Wen, Xin Hong & W.Y.Xie (Xie *et al.,* 2020) from Zhejiang, China, and *D. pingyuanensis* Ling H.Yang, Q.Fan & F.Wen (Yang *et al.,* 2024) from Guangdong, China, among them, *D. heucherifolius* Hand.-Mazz var. *yinzhengii* J.M.Li & S.J.Li and *D. heucherifolius* Hand.-Mazz var. *gamosepalus* Xin Hong & F.Wen have been elevated to the species level base on molecular evidence. Recently, the circumscription of *Didymocarpus s. str.* have been redefined based on a combination of molecular phylogenetic and morphological evidence in their research (Liu *et al.,* 2025). A new genus, *Palmatiboea* F.P.Liu & Yin Z.Wang, is established to accommodate those species previously assigned to *Didymocarpus* sect. *Heteroboea* (Liu *et al.,* 2025). *Palmatiboea* is only distributed in Southeastern, Eastern and Southern China, they can be remarkably distinguished from other related group in morphological characteristics, for example, their leaves are palmately veined and lobed to parted or nearly divided, the corolla tubes are obliquely campanulate or funnelform-tubular. So far, *Palmatiboea* includes 11 species, viz. *P. cortusifolia* (Hance) F.P.Liu & Yin Z.Wang, *P. dissecta* (F.Wen, Y.L.Qiu, Jie Huang & Y.G.Wei) F.P.Liu & Yin

Z.Wang, *P. heucherifolia* (Hand.-Mazz.) F.P.Liu & Yin Z.Wang, *P. lobulata* (F.Wen, Xin Hong & W.Y.Xie) F.P.Liu & Yin Z.Wang, *P. sinoprimulia* (W.T.Wang) F.P.Liu & Yin Z.Wang, *P. reniformis* (W.T.Wang) F.P.Liu & Yin Z.Wang, *P. salviiflora* (Chun) F.P.Liu & Yin Z.Wang, *P. yuenlingensis* (W.T.Wang) F.P.Liu & Yin Z.Wang, *P. pingyuanensis* (Ling H.Yang, Q.Fan & F.Wen) F.Wen & Q.Fan, *P. yinzhengii* (J.M.Li & S.J.Li.) F.Wen & Q.Fan, *P. gamosepalus* (Xin Hong & F.Wen) F.Wen & Q.Fan (Wen *et al.,* 2024). Unlike genera of the Gesneriaceae such as *Primulina* and *Petrocodon*, which are typically distributed across Southern and Southwestern China and habitually grow on Karst limestone landscapes, this genus has a specific requirement for light conditions and is never found in mountainous cave environments (Monro *et al.,* 2018; Fu *et al.,* 2022; Wei *et al.,* 2025).

During a field investigation of biodiversity of Gesneriaceae in Ganzhou City, Jiangxi Province and Hangzhou City, Zhejiang Province in April 2024, we encountered two species in bloom, based on the morphological traits of their leaves and flowers, we confirmed that they belong to *Palmatiboea*, these two species resemble *P. heucherifolia* in their calyx all divided to the base, leaves palmately veined and both side with eglandular hairs, corolla pink and puberulent externally, a month later, we investigated the wild population of *P. heucherifolia* in Shicheng County, Jiangxi Province, which is its type locality, after carefully examining their specimens, we found that both of them differ from *P. heucherifolia* in some morphological traits, such as corolla tube shape and size, indumentum of inflorescences and leaf blade, and so on. After thorough morphological comparisons using herbarium specimens, digital images, and relevant literature on other similar species, we concluded that these plants represent two undescribed species (Wang *et al.,* 1990, 1998; Wen *et al.,* 2013; Li and Li, 2014; Xu *et al.,* 2019; Xie *et al.,* 2020). Here, the putative new species located in Hangzhou City which named *P. recurva*, and another located in Ganzhou City which named *P. curvituba,* are described and illustrated based on morphological observations and compared with closely related species. Additionally, in order to evaluate their phylogenetic position, we extracted their DNA for sequenceing nuclear DNA internal transcribed spacer (ITS) to reconstruct the phylogeny.

MATERIALS AND METHODS

***Morphological study*:** The authors collected and made specimens, carefully observed and measured both living mature individuals and dried specimens of the unknown species, recorded the size, shape, colour, and other characteristics of each part of the plant. Since the corolla tube orifice are not regular circular, the length of major and minor axes were measured on multiple living mature individuals. The major axis was measured from the junction of the two adaxial lip lobes to the midpoint of the abaxial central lip lobe base. The minor axis was measured between the lateral connection points of the adaxial and abaxial lip lobes. The indumentum on different parts of the plants was examined under an Olympus-ML31 dissecting microscope (Tokyo, Japan) and an Olympus-CX33 optical microscope (Tokyo, Japan). Morphological comparisons between the putative new species and its related species were based on dry specimens and living individuals the authors collected, relevant literature (Wang *et al.,* 1990*,* 1998; Wen *et al.,* 2013; Li and Li 2014; Xu *et al.,* 2019; Xie *et al.,* 2020), as well as digital images on the Chinese Virtual Herbarium (https://www.cvh.ac.cn/) and the Plant Photo Bank of China (https://ppbc.iplant.cn/). We described these presumed new species using the terminology of Beentje (2016) and Harris *et al*. (2006).

***Sampling and DNA sequencing*:** For the putative new species located in Ganzhou City, because there was only one population, we randomly selected three plants to collect leaves for DNA extraction. For another putative new species, because there were multiple populations in Hangzhou City, we selected three plants from different populations to collect leaves for DNA extraction. *P. heucherifolia* is a widely distributed species, however, their type locality is a narrow region, which is the mountainous area between Shicheng County in southeastern Jiangxi and Ninghua County in western Fujian (Wang *et al.,* 1990*,* 1998). Although we were able to download an ITS sequence of *P. heucherifolia* which sampled from Shicheng County from NCBI (https://www.ncbi.nlm.nih.gov/) (Yang *et al.,* 2024), for comparision, we additionally collected three samples of *P. heucherifolia* from different populations for DNA extraction in this study, the first sample (XGLSC02) was collected from Tongtianzai scenic spot, Shicheng County, Jiangxi province; the second sample (XGLYA01) was collected from Taoyuandong scenic spot, Yongan City, Fujian province, no more than 100 kilometers from Ninghua County; the last sample (XGLQLY05) was collected from Qinglongyan scenic spot, Xunwu County, Jiangxi province, which is about 200 kilometers from Shicheng County. Fresh leaf material was preserved in silica gel for rapid drying. Total genomic DNA was extracted from dried leaves using modified cetyl trimethylammonium bromide (CTAB) protocol (Doyle and Doyle, 1987). Phylogenetic relationships among the presumed new species and other members of Gesneriaceae were inferred based on sequences of the ITS region. Polymerase chain reaction was carried out based on the program setting as proposed by Lee *et al*. (2022) using the universal primers, ITS1 and ITS4 (White *et al.,* 1990). All other DNA sequences of species from Gesneriaceae were downloaded from NCBI, among them, *Palmatiboea cortusifolia, P. salviiflora, P. pingyuanensis,*

Table 1. Species names, specimen information and GenBank accession numbers of ITS sequences used in this study.

Taxon Name	Collection No.	Locality	ITS	Taxon Name	Collection No.	Locality	ITS
Allocheilos guangxiensis	*Y.G.Wei 06-02*	China	HQ632994	*Pa. dissecta*	-	China	KR336991
Chirita asperifolia	*1995-1205*	China	DQ912668	*Pa. gamosepalus*	*DNPC3386*	China	PP085420
Didymocarpus citrinus	*1983-0510*	Malaysia	DQ912669	*Pa. heucherifolia*	*20243*	China	PP085419
D. cordatus	*Weber 860816-2/1*	Malaysia	DQ912673	*Pa. heucherifolia*	*XGLSC02*	China	PX752296
D. glandulosus	*LJM057241*	China	KR336992	*Pa. heucherifolia*	*XGLYA01*	China	PX752297
D. glandulosus var. *minor*	*LJM10281*	China	KR336993	*Pa. heucherifolia*	*XGLQLY05*	China	PX752295
D. grandidentatus	*LJM1108245*	China	KR336994	*Pa. heucherifolia*	*FTS02*	China	KJ475413
D. leiboensis	*LJM1207241*	China	KR336998	*Pa. heucherifolia*	*LMT2012008*	China	MN636982
D. mengtze	*Zhang G11*	China	DQ912678	*Pa. heucherifolia*	*LJM1105024*	China	KR336996
D. niveolanosus	-	China	KR337001	*Pa. lobulata*	*20301*	China	PP085417
D. praeteritus	*LJM118161*	China	KR337002	*Pa. pingyuanensis*	*20221*	China	PP085415
D. pseudomengtze	*LJM058131*	China	KR337003	*Pa. recurva*	*ZHWXGL20250513*	China	PX752294
D. purpureobracteatus	*Moller 01-70*	China	DQ912676	*Pa. salviiflora*	*20304*	China	PP085416
D. silvarum	*LJM1108172*	China	KR337005	*Pa. sinoprimulia*	*LMT2012006*	China	MN627969
D. stenanthos	*Moller 01-156*	China	DQ912687	*Pa. yinzhengii*	*20265*	China	PP085421
D. stenanthos var. *pilosellus*	-	China	KR337009	*Pa. yuenlingensis*	*LJM1204271*	China	KR337011
D. stenocarpus	*LJM1108198*	China	KR337007	*Petrocodon hancei*	*GDLC05*	China	KY394846
D. tonghaiensis	*LJM1108301*	China	KR337010	*Pe. mollifolius*	*LJM1108211*	China	KR337000
D. villosus	*B.Adhikari SB 9*	Nepal	HQ633001	*Primulina juliae*	*YD08*	China	MK747149
D. yunnanensis	*QZJ0944*	China	OL753134	*Pr. linearifolia*	*GXNN01*	China	KY394921
Gyrocheilos chorisepalus	*LJM057157*	China	KR337014	*Pr. minutimaculata*	*GXLZ10*	China	KY394941
G. lasiocalyx	*M.Moeller MMO 06-881*	China	HQ632998	*Pr. obtusidentata*	*GZJK01*	China	KY394950
G. retrotrichus	*LJM2003069*	China	OL753120	*Pr. pinnata*	*LPW2016101*	China	MZ388124
Palmatiboea cortusifolia	*20302*	China	PP085418	*Raphiocarpus begoniifolius*	*72091*	China	OK322561
Pa. cortusifolia	*LMT2012010*	China	MN627924	*Sinningia incarnata*	*Skong 7784*	-	AY047083
Pa. curvituba	*JLSXGL20250516*	China	PX752293	*S. tubiflora*	*A. Chautems & M. Perret 97-011*	-	KY858489

"-" represent imformation cannot be obtained, the GenBank accession numbers of 20250427 and 20250428 are the same of JLSXGL20250516, the GenBank accession numbers of 2025416 and 2025502 are the same of ZHWXGL20250513.

P. yinzhengii were sampled from their type locality (Yang *et al.,* 2024), for comparision, we also downloaded other three ITS sequences of *P. heucherifolia* sampled from different locality from NCBI. Collection number, Locality, and GenBank accession numbers were provided in Table 1.

We assembled and aligned the newly obtained sequences along with those from GenBank using MAFFT v.7.017 (Katoh et al., 2002), the sequences were manually adjusted and Gblocks (Zhang *et al.,* 2020) was subsequently used to trim the aligned sequences. Phylogenetic trees were reconstructed using both the maximum likelihood (ML) and Bayesian inference (BI) approaches. The ML analysis was performed with IQ-TREE 1.6.12 (Nguyen *et al.,* 2015), applying the GTR+R6 model and 5000 ultrafast bootstrap replicates. Bayesian Inference analyses were conducted with MrBayes 3.2.6 (Ronquist *et al*., 2012) using two runs of four Markov Chain Monte Carlo (MCMC) chains, one million generations, with one tree sampled every 1000 generations and the first 25% of trees were discarded as burn-in.

RESULTS AND DISCUSSION

Molecular analysis

The aligned length of the ITS sequences was 762 bp. Consensus trees from the BI analyses exhibited identical topologies to those from the ML tree. The phylogeny reconstructed by both methods is shown in Fig. 1. The phylogenetic trees indicate that the species of *Palmatiboea* form a well-supported monophyletic group (UFBoot = 100%, BIPP = 1.00), two samples of *Pa. heucherifolia,* (20243 and XGLSC02), which collected from their type locality, along with XGLYA01 and XGLQLY05, which collected near their type locality form a closely related subclade I with a high support value (BIPP = 1.00, UFBoot = 100%), The two putative new species nested within clade *Palmatiboea*, three samples of *P. recurva* forms a sister group with *P. cortusifolia* and *P. lobulata* (BIPP = 0.999, UFBoot = 96%), and is not closely related to subclade I, however, they close related sample LMT2012008, which was identified to *Pa. heucherifolia* too, with a high support (BIPP = 1, UFBoot = 99%). The three samples of *P. curvituba* forms a sister group of subclade I with a high support value (BIPP = 1.00, UFBoot = 100%). Another

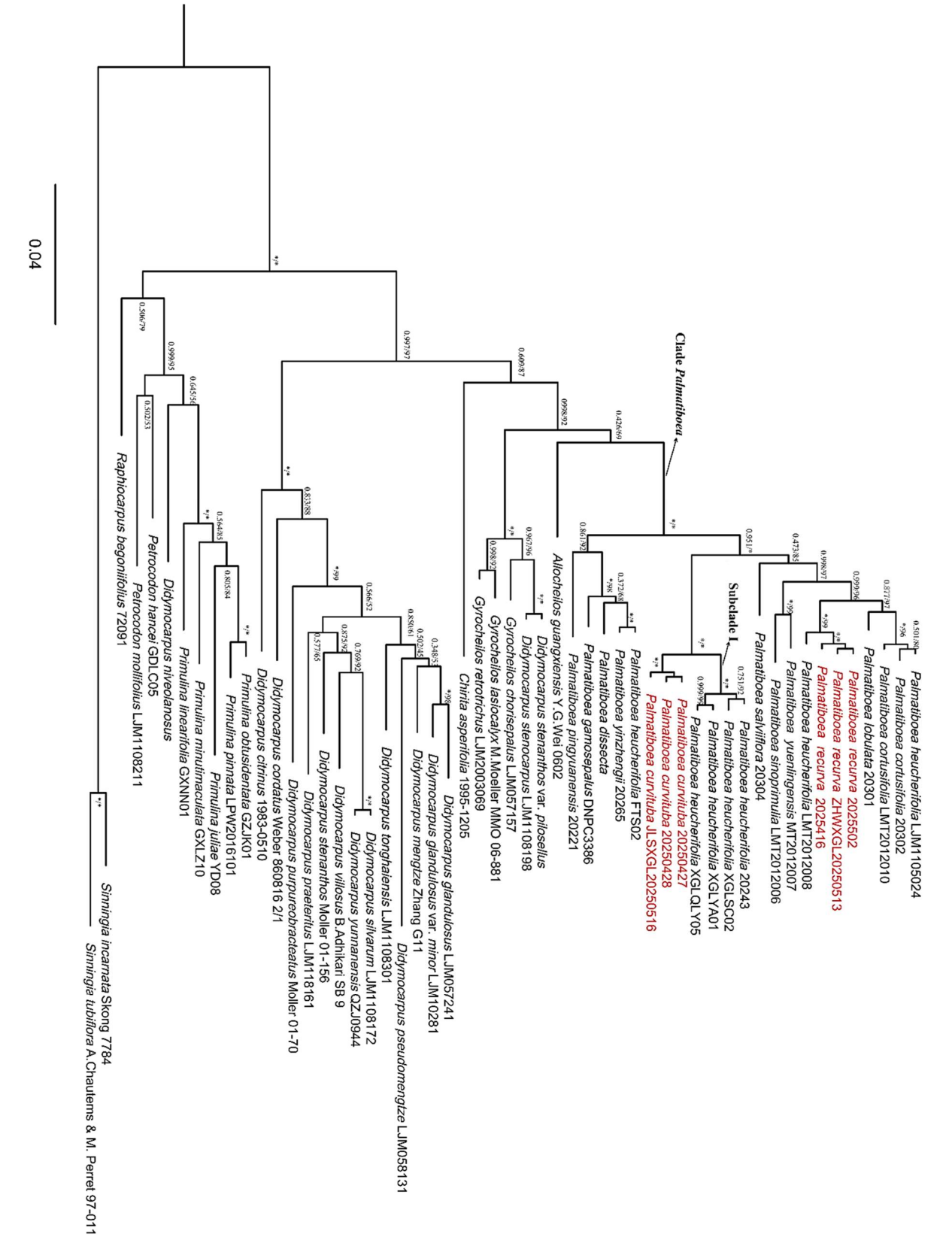

Fig. 1. The phylogenetic position of ***Palmatiboea curvituba*** and ***P. recurva*** based on ITS sequences. The numbers associated with branches are ultrafast bootstrap (UFBoot) values followed by Bayesian inference posterior probabilities (BIPP) values. The new species described in this study is shown in red. "*"indicates BIPP=1 or UFBoot=100.

Table 2. Comparison of morphological characteristics between ***Palmatiboea curvituba***, ***P. recurva***, ***P. heucherifolia***, ***P. yinzhengii*** and ***P. gamosepalus***.

Characters	*P. curvituba*	*P. recurva*	*P. heucherifolia*	*P. yinzhengii*	*P. gamosepalus*
Calyx	Margin entire, 5-lobed to the base	Margin denticulate, 5-lobed to the base	Margin denticulate, 5-lobed to the base	Margin denticulate, 5-lobed to the base	Margin denticulate, calyx shallowly 5-lobed to about two-thirds of the calyx length
Corolla Shape	Curved-funnelform-tubular; without a pit on adaxial lip; upper half part of corolla tube not upward-curving. The ratio of the corolla tube length to the orifice diameter ca. 2.62–2.92	Funnelform-tubular; with a pit on adaxial lip; upper half part of corolla tube slightly upward-curving..The ratio of the corolla tube length to the orifice diameter is ca. 2.82–3.17	Funnelform-tubular; without a pit on adaxial lip; upper half part of corolla tube not upward-curving. The ratio of the corolla tube length to the orifice diameter is ca. 1.41–1.74	Funnelform-tubular; without a pit on adaxial lip; upper half part of corolla tube not upward-curving. The ratio of the corolla tube length to the orifice diameter is ca. 2.36–2.77	Funnelform-tubular; without a pit on adaxial lip; upper half part of corolla tube not upward-curving. The ratio of the corolla tube length to the orifice diameter is ca. 1.44–1.76
filaments	8–10 mm long, straight	10–12 mm long, geniculate near the base	8–10 mm long, geniculate near the base	8–10 mm long, straight	10–12 mm long, geniculate near the base
Indumentum					
Leaf blade	Abaxially glabrous between veins	Abaxially puberulent between veins	Abaxially puberulent between veins	Abaxially puberulent between veins	Abaxially puberulent between veins
Inflorescence	Peduncle, calyxes and bracts villous and mixed glandular-pubescent; corolla glandular-pubescent internally and externally	Peduncle,calyx and bracts villous and mixed glandular-pubescent; corolla glandular-pubescent internally and externally	Peduncle, calyx and bracts villous and mixed eglandular-pubescent; corolla glandular-pubescent internally and externally	Peduncle, calyx and bracts villous and mixed eglandular-pubescent; corolla glabrous externally, glandular-pubescent internally	Peduncle, calyx and bracts villous and mixed eglandular-pubescent; corolla glabrous internally and externally

two samples, LJM1105024 and FTS02, which were identified to *P. heucherifolia* too, closely related to *P. cortusifolia* and *P. yinzhengii* respectively, both of them are not closely related subclade I. Additionally, the two putative new species not closely related to *P. yinzhengii* and *P. gamosepalus,* which were former variety of *P. heucherifolia.*

Morphological analysis

We carefully examined digital images of type specimen and other specimens of *P. heucherifolia* on the Chinese Virtual Herbarium and found that the specimens FCY2014005 (Figs.S1B–S1C, S1F–S1G), collected from Taoyuandong scenic spot, Yong'an City, Fujian province, clearly exhibit the same corolla tube shape and other morphological characteristics as the type specimens of *P. heucherifolia* (Figs. S1A, S1E). The populations of *P. heucherifolia* we encountered in Shicheng County (Figs. S2A, S3B), Xunwu County (Fig. S3A) and Yong'an City (Fig. S3C) also share these consistent morphological traits. Therefore, taking into account their phylogenetic relationships, distribution area, and morphological characteristics, we conclude that they belong to the same species as the type specimens of *P. heucherifolia*. The corolla tube shape of the two putative new species (Figs. S1H, S1L, S1N) is obviously different from that of the type specimens of *P. heucherifolia* (Figs. S1A, S1E). The corolla tube shape of the specimen LMT2012008 (Figs. S1I, S1K), which was collected from Leping City, Jiangxi province, is the same as that of the type specimens of *P. recurva*, but different from that of the type specimens of *P. heucherifolia*. Taking into account their close phylogenetic relationship and morphological characteristics, *P. recurva* and specimen LMT2012008 should be the same species. For the samples LJM1105024 and FTS02, we could not find their specimens, base on their phylogenetic relationships, they likely represent other species that were misidentified as *P. heucherifolia.*

P. recurva can be distinguished from *P. yinzhengii* by the upper half part of corolla tube slightly upward-curving and not obviously inflated, corolla tube with an obvious pit on the middle of adaxial lip and glandular-pubescent externally, contrasting with the latter upper half part of corolla tube obviously inflated and not upward-curving, corolla tube without pit on the middle of adaxial lip and glabrous externally (Li and Li 2014). *P. curvituba* can be distinguished from *P. yinzhengii* by corolla glandular-pubescent externally and calyx lobes entire, abaxial surface of leaf blade glabrous between veins, contrasting with the latter corolla glabrous externally, calyx lobes denticulate, leaf blade pubescent between veins abaxially (Li and Li, 2014). Furthermore, *P. recurva* and *P. curvituba* can be distinguished from *P. gamosepalus* by calyx 5-lobed to the base, corolla glandular-pubescent externally and internally, contrasting with the latter calyx shallowly 5-lobed to about two-thirds of the calyx length, corolla tube grablous externally and internally (Xu *et al.,* 2019).

The detailed morphological comparison between the putative species and its morphologically related species, *P. heucherifolia*, *P. yinzhengii*, and *P. gamosepalus* are shown in Table 2 and Figs. S1–S3.

Fig. 2. ***Palmatiboea curvituba*** sp. nov. **A.** habitat; **B.** plants; **C.** adaxial surface of leaf blades and petiole; **D.** abaxial surface of leaf blade and petiole; **E.** cyme; **F.** indumentum of peduncle; **G.** abaxial surfaces of bracts; **H.** adaxial surfaces of bracts; **I.** abaxial surfaces of calyx lobes; **J.** adaxial surfaces of calyx lobes; **K.** front view of corolla; **L.** lateral view of corolla; **M.** opened corolla; **N.** stamen; **O.** staminode; **P.** pistils; **Q.** mature capsule.

TAXONOMIC TREATMENT

Palmatiboea curvituba G.L.Xu, S.C.Zeng & Z.L.Li, ***sp. nov***. **Figs. 2, S2B, S1D, S1H, S1Q**

***Type*:** CHINA. Jiangxi Province, Ganzhou City, Ganxian District, Nantang Town, Zaijiu'ao Scenic Spot, 23°10'51.43"N, 113°21'8.11"E, altitude 216.6 m, 16 May, 2025, Guo-Liang Xu, Sang-Chun Zeng, *ZengSC3050* (Holotype: LBG [LBG20230073], isotype: SYS).

***Diagnosis*:** This new species differs from *Palmatiboea heucherifolia* in the following characters: corolla tube curved-funnelform-tubular (*vs.* funnelform-tubular), ratio of the corolla tube length to the orifice diameter (the average length of the major and minor axes of the corolla tube orifice) ca. 2.62–2.92 (*vs.* ca. 1.41–1.74); leaf blade abaxially glabrous between veins (*vs.* pubescent); peduncle, abaxial surface of bracts, and abaxial surface of calyxes villous and mixed glandular-pubescent (*vs.* villous and mixed eglandular-pubescent); calyx lobes margins entire (*vs.* denticulate).

***Description*:** Perennial herb, acaulescent. Rhizome horizontal, 1–3 cm long, ca. 1.0 cm in diam. Leaves 4–9 basal, clustered at the apex of the rhizome, opposite; petiole 2–7 cm long, spreading rust-brown villous and white puberulent; leaf blade orbicular-ovate to triangular, 3–9 × 3.5–11 cm, chartaceous, margin irregularly

triangular denticulate, adaxially densely villous, abaxially villous on veins and glabrous between veins; apex rounded, basal veins 4–5, with the central three typically having one alternating secondary vein on each side, emerging from the basal vein at a point 1/3 to 1/2 of the way up from the base. Cymes 1–4, axillary, 3 to numerous-flowered; peduncle 8–18 cm long, spreading villous and mixed glandular-pubescent. Bracts 2, opposite, elliptic, 5–10 mm long, adaxially sparsely pubescent, abaxially villous and mixed glandular-pubescent, margin entire or sparsely denticulate, densely ciliary; bracteoles 2, opposite, elliptic, 2–4 mm long, indumentum same as bracts. Pedicel 2–4 cm long, spreading villous and mixed glandular-pubescent. Calyx 5-lobed to the base, lobes unequal, the bigger lobe ca. 6 × 2 mm, other four lobes subequal, ca. 4 × 2 mm, oblong-linear, entire, abaxially villous and mixed sparsely glandular-pubescent, adaxially sparsely pubescent. Corolla pink, 4.2–4.8 cm long, glandular-pubescent externally and internally; tube curved-funnelform-tubular, 3.1–3.8 cm long; base circular, ca. 5 mm in diam, throat suboval, long axis 1.6–1.8 cm long, short axis 0.7–0.8 cm long; limb distinctly 2-lipped, adaxial lip 2-lobed to near middle, lobes obliquely triangular, 0.8–1 × 1.0–1.2 cm, abaxial lip 3-lobed to base, lobes oblong, 0.5–0.7 × 1.0–1.3 cm. Stamens 2, adnate to corolla ca. 2 cm above the base of the corolla tube; filaments white, 8–10 mm long, straight, subglabrous, sparsely glandular; anthers pale yellow, ca. 3 mm long, cohering face to face, white woolly. Staminodes 3, adnate to 4–11 mm above the base of the corolla tube, 1–2 mm long, white, glandular-pubescent. Disc annular, ca. 2 mm long, margin irregular, glabrous. Pistil ca. 4.6 cm long, glandular-puberulent, ovary ca. 4.0 cm long, stigma 1, cephaloid, centrally sunken, undivided. Capsule purplish-red when young, linear-cylindrical, glandular-puberulent, up to ca. 12 cm long.

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

Distribution and habitat: *Palmatiboea curvituba* is only known from its type locality, Zaijiu'ao Scenic Spot, Nantang Town, Ganxian District, Ganzhou City, Jiangxi Province. It grows on moist rock surfaces of the Danxia Landform. This new species is mainly accompanied by *Selaginella tamariscina* (P. Beauv.) Spring, *Cheilanthes chusana* Hook., *Selaginella nipponica* Franch. & Sav., and other common species on the Danxia Landform.

Etymology: The specific epithet refers to the corolla tube of this species is curved-funnelform-tubular. The Chinese name of the new species is here given as 弯花掌脉苣苔 (Wān Huā Zhǎng Mài Jù Tái).

Provisional conservation status: *Palmatiboea curvituba* is currently known from one populations, comprising approximately 1000 mature individuals, at the type locality, Zaijiu'ao Scenic Spot, Nantang Town, Ganxian District, Ganzhou City, Jiangxi Province, China. The current situation of this population is stable at present, because the habitat is protected by the administrator of this scenic location. The EOO and AOO of this new species are about 3 km² and 500 m² however, the field investigations of newly found species are often insufficient at the time of description. This situation might exist in our study, given that Danxia landforms are widely developed in South and Southeast China. Further field work is needed to confirm the exact geographical distribution of this new species. Therefore, following the IUCN Red List Categories and Criteria (IUCN, 2024), the conservation status of this new species should be assessed as Data Deficient (DD) based on current information.

Palmatiboea recurva G.L.Xu, H.W.Zhang & Z.L.Li, ***sp. nov.*** **Figs. 3, S1J, S1L, S1N, S1O, S1R, S2C**

***Type*:** CHINA. Zhejiang Province, Hangzhou City, Ling'an District, Longgang Town, 30°09'58.32"N, 119°11'36.86"E, altitude 129.9 m, 13 May, 2025, Guo-Liang Xu, Hong-Wei Zhang, *ZHWXGL20250513* (Holotype: LBG [LBG20230061], isotype: IBK).

***Diagnosis*:** This new species differs from *Palmatiboea heucherifolia* in that its corolla tube with an obvious pit on the middle of adaxial lip (*vs.* no pit), ratio of the corolla tube length to the orifice diameter ca. 2.82–3.17 (*vs.* ca. 1.41—1.74), upper half part of corolla tube slightly upward-curving (*vs.* not upward-curving); peduncle, abaxial surface of bracts, and abaxial surface of calyxes villous and mixed glandular-pubescent (*vs.* villous and mixed eglandular-pubescent).

Description: Perennial acaulescent herb. Rhizome 1–3 cm long, ca. 1.0 cm in diam. Leaves 4–9 basal, clustered at the apex of the rhizome, opposite; petioles 2–9 cm long, densely spreading rust-brown villous and white puberulent; leaf blades orbicular-ovate to orbicular-triangular, 3.0–10.5 × 2.5–13.0 cm, apex rounded, base cordate, margin irregularly triangular denticulate, chartaceous, adaxially densely villous, green, adaxially villous on veins and puberulent between veins, pale green, basal veins 4–6, with the central three typically having one alternating secondary vein on each side, emerging from the basal vein at a point 1/3 to 1/2 of the way up from the base. Inflorescences axillary, cymes 1–2-branched, 3–8-flowered; peduncle 4–16 cm long, green or purple, sparsely villous and mixed densely glandular-pubescent, pedicel 0.5–2 cm long, with indumentum as on the peduncle. Bracts 2, green or with purple color, opposite, elliptic, ca. 7 mm long, sparsely pubescent adaxially, villous and mixed sparsely glandular-pubescent abaxially, margin sparsely crenate from the middle upward to apex; bracteoles 2, opposite, subulate, ca. 3 mm long, indumentum same as bracts. Calyx actinomorphic, deeply 5-lobed to the base, lobes subequal, oblong-oblanceolate-linear, ca. 8 × 2 mm, apex denticulate, sparsely pubescent adaxially; densely puberulent and mixed glandular-pubescent abaxially,

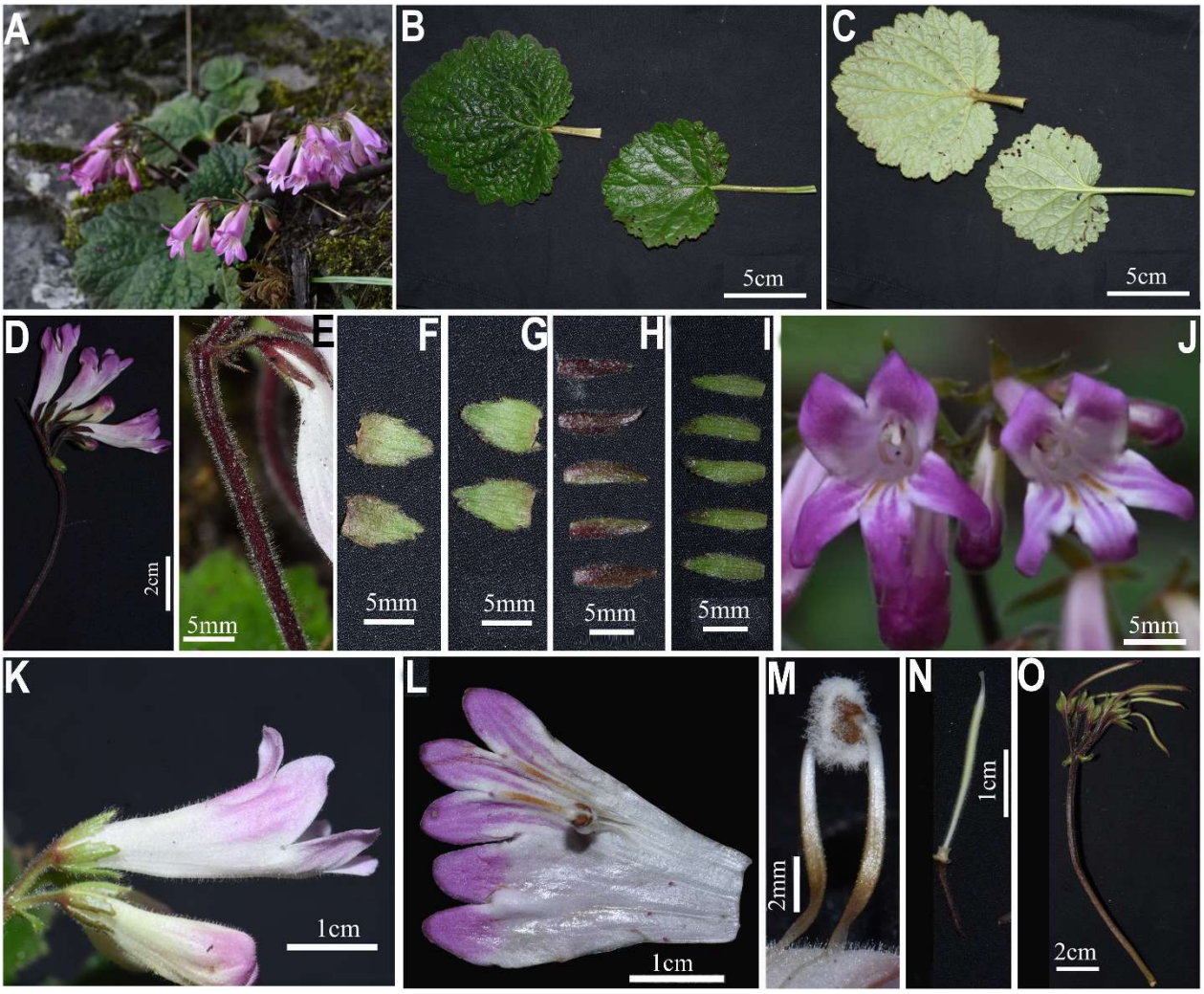

Fig. 3. ***Palmatiboea recurva*** sp. nov. **A.** plants; **B.** adaxial surface of leaf blades and petiole; **C.** abaxial surface of leaf blade and petiole; **D.** cyme; **E.** indumentum of peduncle, bracts, pedicel and calyxes; **F.** abaxial surfaces of bracts; **G.** adaxial surfaces of bracts; **H.** abaxial surfaces of calyx lobes; **I.** adaxial surfaces of calyx lobes; **J.** front view of corolla; **K.** lateral view of corolla; **L.** opened corolla; **M.** stamen; **N.** pistils; **O.** unmature capsule.

brownish-green. Corolla pink, 3.2–3.9 cm long, glandular-pubescent externally and internally; tube funnelform-tubular, upper half part slightly upward-curving, 2.4–2.7 cm long, orifice nearly circle, 8–9 mm in diam., outside with an obvious pit on the middle of adaxial lip; limb distinctly 2-lipped, adaxial lip 2-parted to near the middle, lobes ovate, ca. 7 × 6 mm, abaxial lip 3-lobed from the base, lobes oblong, ca. 8 × 5 mm, nearly equal. Stamens 2, adnate to corolla ca. 1.3 cm from base; filaments slender, 10–12 mm long, geniculate near the base, brownish glandular, anthers cohering face to face, white woolly, ca. 3 mm long, pale yellow; staminodes 3, capitate, ca. 1 mm long, adnate to corolla 6–10 mm from base, pink, glabrous. Disc annular, ca. 2 mm long, margin irregular, glabrous. Pistils 2.5–3.0 cm long, densely glandular-and eglandular-puberulent; ovary 2.2–2.5 cm long, yellowish-green. Stigma 1, terminal, depressed-globose, undivided, translucent. Capsule purplish-red when young, linear-cylindrical, glandular-puberulent, 5–7 cm long.

***Phenology*:** The flowering of *Palmatiboea recurva* is from April to May; and the fruiting is in June to July.

***Distribution and habitat*:** *Palmatiboea recurva* is known from its type locality, Longgang Town, Ling'an District, Hangzhou City, Zhejiang Province. It grows on moist surfaces of limestone and granite rock. This new species is mainly accompanied by *Pteris vittata* L., *Selaginella heterostachys* Baker, *Pilea swinglei* Merr.., and other plants that prefer moist habitats.

***Etymology*:** The specific epithet refers to the upper half part of corolla tube of this new species slightly upward-curving. The Chinese name of the new species is proposed as 翘筒掌脉苣苔 (Qiào Tóng Zhǎng Mài Jù Tái).

***Provisional conservation status*:** *Palmatiboea recurva* is currently known from three populations, comprising approximately 2000 mature individuals, at

Longgang Town, Ling'an District, Hangzhou City, Zhejiang Province, covering an area of approximately 50 km² in total, however, the field investigations are insufficient. Further field work is needed to confirm the exact geographical distribution of this new species. Therefore, following the IUCN Red List Categories and Criteria (IUCN, 2024), the conservation status of this new species should be assessed as Data Deficient (DD) based on current information.

Additional specimens examined: ***Palmatiboea curvituba*** (paratypes):China, Jiangxi, Ganzhou: Zaijiu'ao Scenic Spot, 23°10'10.01"N, 113°22'06.01"E, 208 m a.s.l., 30 April 2025, Guo-Liang Xu, *XGZS20250430* LBG [LBG20230069].

Palmatiboea recurva (paratypes): CHINA. Zhejiang Province, Hangzhou City, Ling'an District, Longgang Town, 30°10'43.45"N, 119°11'03.21"E, altitude 139 m, 14 May, 2025, Guo-Liang Xu, Hong-Wei Zhang, *ZHWXGL20250514*, LBG [LBG20230082].

Palmatiboea heucherifolia: China, mountains between Shicheng in southeastern Jiangxi and Ninghua in western Fujian, 1200 m a.s.l., 7 May 1921, Te-Hui Wang (E00155145, isotype); Fujian, Yongan City, Taoyuandong Scenic Spot, 26°10'21.74"N, 117°25'04.75"E, 150–300 m a.s.l., 15 May 2014, Cui-Yuan Feng, *HLH453* (PE02053419, PE02053419); Fujian. same location 26°01'26.09"N, 117°25'00.84"E, 200 m a.s.l., 10 Aprill 2018, Li-Hua Yang, Hang-Hui Kong, *FCY2014005* (IBSC0881913); Jiangxi, Leping County, Lijushan Town, 18 May 2012, Ming-Tao Liu, *LMT2012008* (PE01909927).

Palmatiboea yingzhengii: China, Hunan, Liuyang City, Yuanxi Town, 4 May 2014, Xun-Ling Yu, Ming Li, *14050403* (CSFI028539).

***Note*:** We compared the corolla of *Palmatiboea recurva* at different growth stages and found that its corolla tube shape is stable. For instance, the pit on the middle of the adaxial lip begins to develop at the bud stage (Fig. S1O), the upward curvature of the upper half part of the tube is present across all stages, being especially pronounced in buds (Fig. S1N). In contrast, these traits are absent at all growth stages in *P. heucherifolia* (Fig. S1M). Although indumentum traits can be variable in some species in different habitats or different growth stages, our examination of multiple individuals of *P. recurva*, *P. curvituba*, *P. heucherifolia* and *P. yinzhengii* from various habitats and stages indicates that pubescence is stable in these species. For example, the abaxial surface of leaf blade of *P. curvituba* always glabrous between veins (Fig. S1Q), whereas it is pubescent in the other three species (Fig. S1P, S1R–S1S). Similarly, the peduncles and the abaxial surface of sepals and the abaxial surface of bracts in the two new species are always intermixed with glandular pubescence (Figs. 2F, 3E), while *P. heucherifolia* and *P. yinzhengii* completely lack glandular hairs on these parts. Although corolla length varies with habitat in *P. recurva* and *P. curvituba* and is therefore unreliable for species distinction, their corolla tubes are markedly more slender than those of *P. heucherifolia* (Fig. S2). Accordingly, we use the ratio of corolla tube length to orifice diameter as a key diagnostic characteristic to distinguish these taxa.

Most species of *Palmatiboea* are restricted to specific habitats, for example, *P. curvituba* is one of six *Palmatiboea* species reported exclusively in Danxia landform; the others are *P. pingyuanensis*, *P. yinzhengii, P. reniformis*, *P. salviiflora*, *P. gamosepalus*. Additionally, three species only reported in Karst landform, including *P. yuenlingensis*, *P. sinoprimulia* and *P. dissecta* (Xu *et al.,* 2019). In comparison, *P. recurva* is distributed across both Karst and granite landscape, suggesting it may have broader habitat adaptability than most species of *Palmatiboea*.

Based on a detailed morphological comparison between all the species of *Palmatiboea*, an identification key to these 13 species is provided (Wang *et al.,* 1990*,* 1998; Wen *et al.,* 2013; Li and Li, 2014; Xu *et al.,* 2019; Xie *et al.,* 2020; Yang *et al.,* 2024).

1. Calyx divided from or near middle, tube more than 4 mm in length ... 2
- Calyx divided from or near base, tube less than 2mm in length ….. 8
2. Calyx zygomorphic, lobes unequal ..... ***P. yuenlingensis***
- Calyx actinomorphic, lobes equal 3
3. Calyx lobes overlapping 4
- Calyx lobes not overlapping 5
4. Bracts semiorbicular, calyx lobes depressed oblong, staminodes 2–3 mm long ..... ***P. salviiflora***
- Bracts elliptic, calyx lobes obovate, staminodes 0.4–0.8 mm long ..... ***P. pingyuanensis***
5. Calyx lobes margin denticulate 6
- Calyx lobes margin entire 7
6. Bracts margin entire; corolla white, puberulent externally …….. ..... ***P. cortusifolia***
- Bracts margin denticulate; corolla pink to magenta, glabrous externally ..... ***P. gamosepalus***
7. Leaf blade orbicular-ovate to orbicular-triangular, corolla puberulent externally ..... ***P. lobulata***
- Leaf blade reniform or orbicular-reniform, corolla glabrous externally ..... ***P. reniformis***
8. Corolla glabrous externally 9
- Corolla puberulent externally 11
9. Leaf blade 3-or 4-lobed, apex acute ..... ***P. dissecta***
- Leaf blade irregularly denticulate to serrate, apex rounded 10
10. Adaxial calyx lobe obviously bigger than the other four, corolla less than 2 cm long, corolla tube not curve ..... ***P. sinoprimulia***
- Calyx lobes nearly equal, corolla up to 4 cm, corolla tube obviously curve ..... ***P. yinzhengii***
11. Filaments straight, calyx lobes margin entire, abaxial surface of leaf blade glabrous between veins ..... ***P. curvituba***
- Filaments geniculate near the base, calyx lobes margin denticulate, abaxial surface of leaf blade pubescent between veins 12
12. Externally corolla tube with a pit on the adaxial lip; upper half part of corolla tube upward-curving; peduncle, abaxial surface of bracts and calyx lobes covered with glandular hairs ..... ***P. recurva***
- Externally corolla tube without a pit on the adaxial lip; upper half part of corolla tube not upward-curving; peduncle, abaxial surface of bracts and calyx lobes without glandular hairs ..... ***P. heucherifolia***

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LITERATURE CITED

Beentje, H. 2016 The Kew Plant Glossary, an illustrated dictionary of plant terms (2nd edition). Royal Botanic Gardens, Kew, 184.

Doyle, J.J., Doyle, J.L. 1987 A rapid DNA isolation procedure for small quantities of fresh leaf tissue. Phytochem. Bull. **19**: 11–15.

Fu, L.-F., Monro, A.K., Wei, Y.-G. 2022 Cataloguing vascular plant diversity of karst caves in China. Biodivers. Sci. **30(7):** 21537.

Harris, J.G., Harris, M.W. 2006 Plant Identification Terminology: an Illustrated Glossary. Spring Lake Publishing, Spring Lake, 216.

IUCN Standards and petitions committee 2024 Guidelines for Using the IUCN Red List Categories and Criteria. Version **15**. Prepared by the Standards and petitions committee. Available from:http://www.iucnredlist.org/documents/RedListGuidelines.pdf (accessed 21 December 2024).

Katoh, K., Misawa, K., Kuma, K., Miyata, T. 2002 MAFFT: A novel method for rapid multiple sequence alignment based on fast Fourier transform. Nucleic Acids Res. **30(14)**: 3059–3066.

Lee, S.Y., Xu, K.-W., Huang, C.-Y., Lee, J.H, Liao, W.-B., Zhang, Y.-H., Fan, Q. 2022 Molecular phylogenetic analyses based on the complete plastid genomes and nuclear sequences reveal *Daphne* (Thymelaeaceae) to be non-monophyletic as current circumscription. Plant Divers. **44(3)**: 279–289.

Li, J.-M., Li, S.-J. 2014 *Didymocarpus heucherifolius* var. *yinzhengii* (Gesneriaceae), a new taxon from Hunan, China. Phytotaxa **156(3)**: 187–190.

Li, Z.-L., Huang, Z.-J., Chen, D.-W., Hong, X., Wen, F. 2023 A new combination and a new synonym of Gesneriaceae in China. PhytoKeys **232**: 99–107.

Liu, F.-P., Han, M.-Q., Li, P.-W., Wang, Y.-Z 2025 Phylogenetic Reconstruction of *Didymocarpus* and Related Genera in Gesneriaceae with Establishment of Two New Genera. J. Syst. Evol. **63(2)**: 401–415.

Monro, A.K., Bystriakova, N., Fu, L.-F., Wen, F., Wei, Y.-G. 2018 Discovery of a diverse cave flora in China. Plos One **13(2):** e0190801.

Nguyen, L. T., Schmidt, H. A., Haeseler, A., Minh, B. Q. 2015 IQ-TREE: A fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. Mol. Biol. Evol. **32(1)**: 268–274.

Ronquist, F., Teslenko, M., Van der Mark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B., Liu, L., Suchard, M.A., Huelsenbeck, J.P. 2012 Mrbayes 3.2: Efficient Bayesian phylogenetic inference and model choice across a large model space. Syst. Biol. **61(3)**: 539–542.

Wang, W.-T., Pan, K.-Y., Li, Z.-Y. 1990 Gesneriaceae. In: Wang WT (Ed.) Flora Reipublicae Popularis Sinicae **69**: 420–451, Science Press, Beijing.

Wang, W.-T., Pan, K.-Y., Li, Z.-Y., Anna, L.W., Laurence, E.S. 1998 Gesneriaceae in: Wu, Z. Y., Raven, P. H. (eds.) Flora of China **18**: 244–401, Science Press, Beijing & Missouri Botanical Garden Press, St. Louis.

Weber, A., Burtt, B. 1997 Remodelling of *Didymocarpus* and associated genera (Gesneriaceae). Beitr. Biol. Pflanzen **70**: 293–364.

Weber, A., Wei, Y.-G., Puglisi, C., Wen, F., Mayer, V.E., Möller, M. 2011 A new definition of the genus *Petrocodon* (Gesneriaceae). Phytotaxa **23(1)**: 49–67.

Wei, Y.-G., Fu, L.-F., Monro, A. K., Wen, F. 2025 Karst Cave plants in China. Beijing: China Forestry Publishing House. 1–396.

Wen, F., Fan, Q. 2024 Several new combinations from previous *Didymocarpus* to *Palmatiboea* (Gesneriaceae). Phytokeys **250**: 1–6.

Wen, F., Qiu, Y.-L., Huang, J., Zhao, B., Wei, Y.-G. 2013 *Didymocarpus dissectus* sp. nov. (Gesneriaceae) from Fujian, Eastern China. Nord. J. Bot. **31(3)**: 316–320.

White, T.J., Bruns, T., Lee, S., Taylor, J., Innis, M., Gelfand, D., Sninsky, J. 1990 Amplification and Direct Sequencing of Fungal Ribosomal RNA Genes for Phylogenetics. In: Innis, M.A., Gelfand, D.H., Sninsky, J.J. White, T.J. (eds.) Pcr Protocols: a Guide to Methods and Applications, **18**: 315–322, Academic Press, New York.

Xie, W.-Y., Zhou, J.-J., Hong, X., Wen, F. 2020 *Didymocarpus lobulatus* (Gesneriaceae), a new species from Zhejiang Province, East China. PhytoKeys **157**: 145–153.

Xu, W.-J., Qin, W.-H., Wang, Z.-Q., Li, Z.-L., Fu, L.-F., Hong, X. 2019 A new variety of *Didymocarpus* (Gesneriaceae) from Guangdong, China. PhytoKeys **128**: 33–38.

Yang, L.-H., Dai, J.-M., Wen, F., Liu, J.-M., Lan, X.-Z,. Fan, Q. 2024 *Didymocarpus pingyuanensis* (Gesneriaceae), a new species endemic to Danxia landscape from Guangdong Province, China, and two new combinations in *Didymocarpus*. PhytoKeys **244**: 213–224.

Zhang, D., Gao, F., Jakovlić, I., Zou, H., Zhang, J., Li, W.-X., Wang, G.-T. 2020 PhyloSuite: An integrated and scalable desktop platform for streamlined molecular sequence data management and evolutionary phylogenetics studies. Mol. Ecol. Resour. **20(1)**: 348–355.

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