

Research paper

Four new species and a new record of Orchidinae (Orchidaceae: Orchideae) from China



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ARTICLE INFO

Article history:

Received 4 November 2020

Received in revised form

21 May 2021

Accepted 23 May 2021

Available online 5 June 2021

Keywords:

Orchidaceae

Herminium

Ponerorchis

Peristylus

Platanthera

China

ABSTRACT

Four new species of Orchidaceae from China, *Hemimium lijiangense*, *Peristylus fasciculatus*, *Platanthera milinensis*, and *Ponerorchis gongshanensis*, together with a new country record, *Peristylus tenuicallus*, are described and illustrated based on morphological and/or phylogenetic analyses. *Hemimium lijiangense* is closely related to *H. elisabethae* but differs from it by having the dorsal sepal ovate-orbicular and lip mid-lobe distinctly shorter than lateral lobes. *P. fasciculatus* is close to *Peristylus tradescantifolius* but is distinguished from it by having several fascicled and straight, root-like tubers (vs. one or two oblongoid tubers), old stems usually persistent, middle lobe of lip narrowly ligulate-lanceolate and half as long as the lateral lobes (vs. middle lobe deltoid, about a third as long as the lateral lobes or less), a raised callus at the base of each lateral lobe (vs. callus absent), spur gradually attenuate toward the apex (vs. spur clavate). *Platanthera milinensis* is similar to *P. stenochila* by sharing small green flowers and lip without a spur, but differs in having a creeping rhizome, a corymbose inflorescence, and a broadly ovate and slightly 3-lobed lip. *Ponerorchis gongshanensis* is similar to *P. faberi* in its small flowers, but differs in having a linear leaf c. 3 mm wide (vs. leaf 5–13 mm wide), in the lip having collar-like raised margins on the sides of the spur entrance, and a mid-lobe which is notched at the apex but not divided into two divergent lobules that are nearly as large as the lateral lobes, as in *P. faberi*. All the proposed species obtained high support in phylogenetic analysis as new species. The recently described genus *Apetalanthe* is reduced to synonymy of *Ponerorchis* and a new combination is made.

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1. Introduction

The subtribe Orchidinae (Orchidaceae: Orchideae) consists of about 50 genera and 1800 species, widely distributed in tropical, subtropical and temperate areas (Pridgeon et al., 2001; Chase et al., 2015; Ngugi et al., 2020). Five genera, *Habenaria* Willd., *Herminium*

L., *Peristylus* Blume, *Platanthera* Richard and *Ponerorchis* Rchb. f., are among the largest in Orchidinae (Pridgeon et al., 2001; Raskoti et al., 2016, 2017; Chase et al., 2015).

Phylogenetic studies have shown that *Herminium* s.s., *Platanthera* s.s. and *Ponerorchis* s.s. are paraphyletic (Bateman et al., 2009; Jin et al., 2014, 2017; Tang et al., 2015; Raskoti et al., 2016). *Herminium* was expanded to include *Androcorys* Schltr., *Bhutanthera* Renz, *Frigidorchis* Z.J. Liu & S.C. Chen and *Porolabium* Tang & F.T. Wang; even some species described in *Peristylus* and *Platanthera* have been found to be nested in *Herminium* (Jin et al., 2014, 2015, 2017; Raskoti et al., 2016, 2017). *Herminium* s.l. is characterized by

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Peer review under responsibility of Editorial Office of Plant Diversity.

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having a (sub) globose tuber, a lip with a concave or spurred base, and pollinia with reduced caudicles (Raskoti et al., 2016, 2017).

Platanthera s.s. was expanded to include certain satellite genera, such as *Diphylax* Hook. f., *Piperia* Rydb., and *Smithorchis* Tang & F.T. Wang (Bateman et al., 2009; Efimov 2016; Jin et al., 2014, 2017; Nowak et al., 2020). The resultant *Platanthera* s.l. is relatively well characterized by morphology, such as fleshy, more or less tapering roots, often forming fusiform tubers (except for the species

formerly included in the North American *Piperia*, which has sub-globose tubers), a usually spurred lip (rarely without a spur), a short and truncate column, and a broad connective (Bateman et al., 2009; Efimov 2016).

Traditionally, *Ponerorchis* s.s. was distinguished from its relatives *Amitostigma* Schltr. and *Neottianthe* (Rchb.) Schltr. in having each viscidium contained in a bursicle, as against bursicles lacking (Pridgeon et al., 2001; Chen et al., 2009). Results of molecular

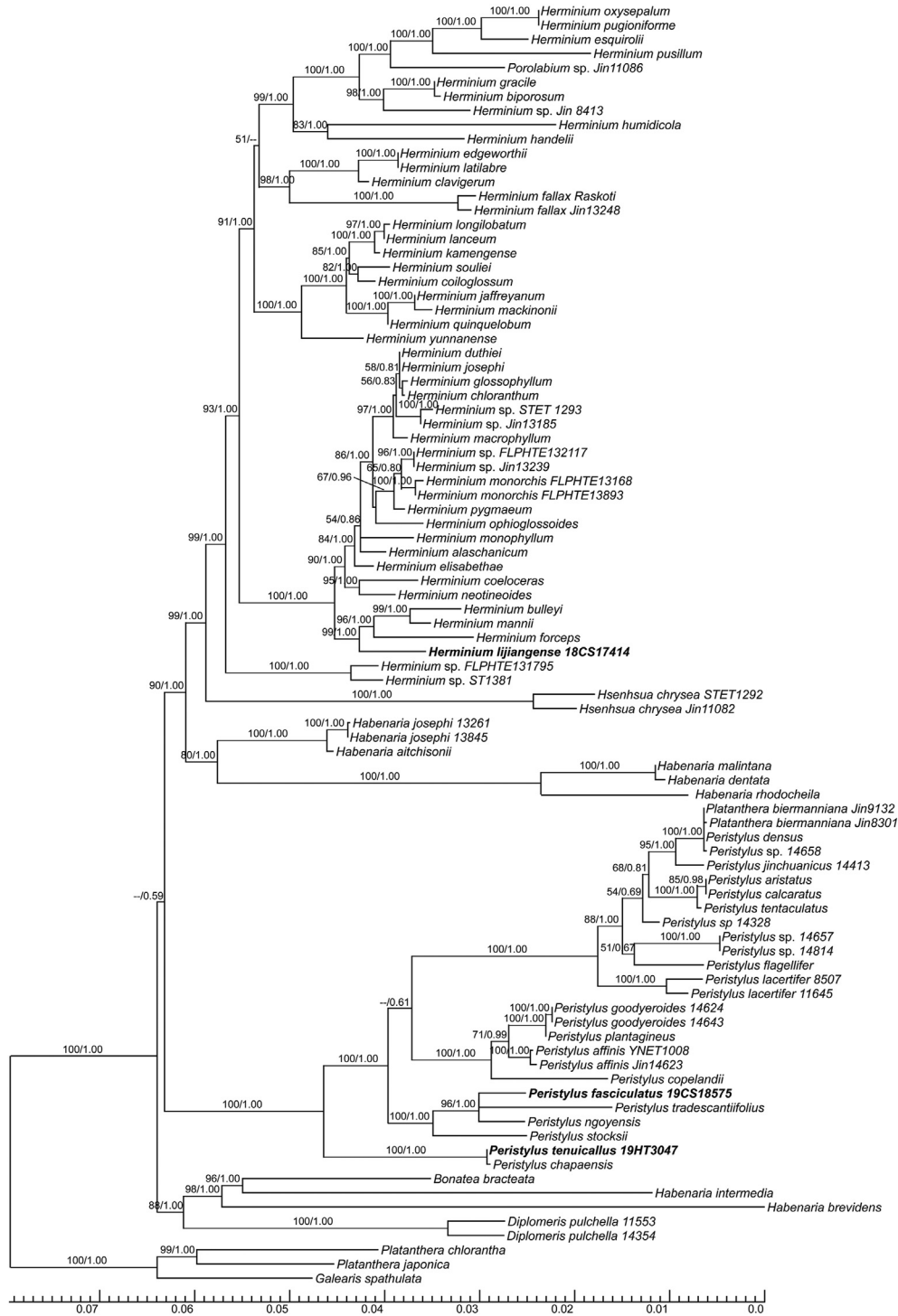


Fig. 1. Phylogram from maximum likelihood (ML) based on two nuclear markers (nrITS and *Xdh*) and five plastid markers (*matK*, *psaB*, *psbA-trnH*, *rbcL*, and *trnL-F*), showing the position of *Herminium lijiangense*, *Peristylus fasciculatus* and *P. tenuicallus*. Single numbers at nodes are bootstrap support. Numbers above branches indicate bootstrap percentages (BS) for ML and posterior probabilities (PP) for BI analysis, respectively. A dash (–) indicates support at a node < 50%, Asterisk (*) indicates BS = 100 or PP = 1.0.

phylogenetics indicated that *Amitostigma* and *Neottianthe* are nested within *Ponerorchis*, forming a moderately supported clade, and therefore *Amitostigma* and *Neottianthe* have been merged with *Ponerorchis* (Tang et al., 2015; Jin et al., 2015, 2017). *Ponerorchis* s.l. (Orchidaceae) consists of about 60 species, mainly distributed in Asia, with one species extending into Europe (Pedersen et al., 2002; Chen et al., 2009; Jin et al., 2014). Morphologically, *Ponerorchis* s.l. is characterized by an ovoid tuber, dorsal sepal and petals forming a hood, the base of the lip attached to a short column with parallel anther cells (Jin et al., 2014, 2017).

During our field surveys in South China, four new species of *Herminium*, *Peristylus*, *Platanthera*, and *Ponerorchis* were discovered. They are described and illustrated below.

2. Materials and methods

2.1. Morphological observations

Living plants were collected during field expeditions from 2018 to 2020. The morphology and colors of flowers and details of the



Fig. 2. Phylogram from maximum likelihood analyses (ML) based on one nuclear marker (nrITS) and two plastid markers (*matK* and *rbcl*), showing the position of *Platanthera milinensis*. Numbers at nodes are bootstrap support.

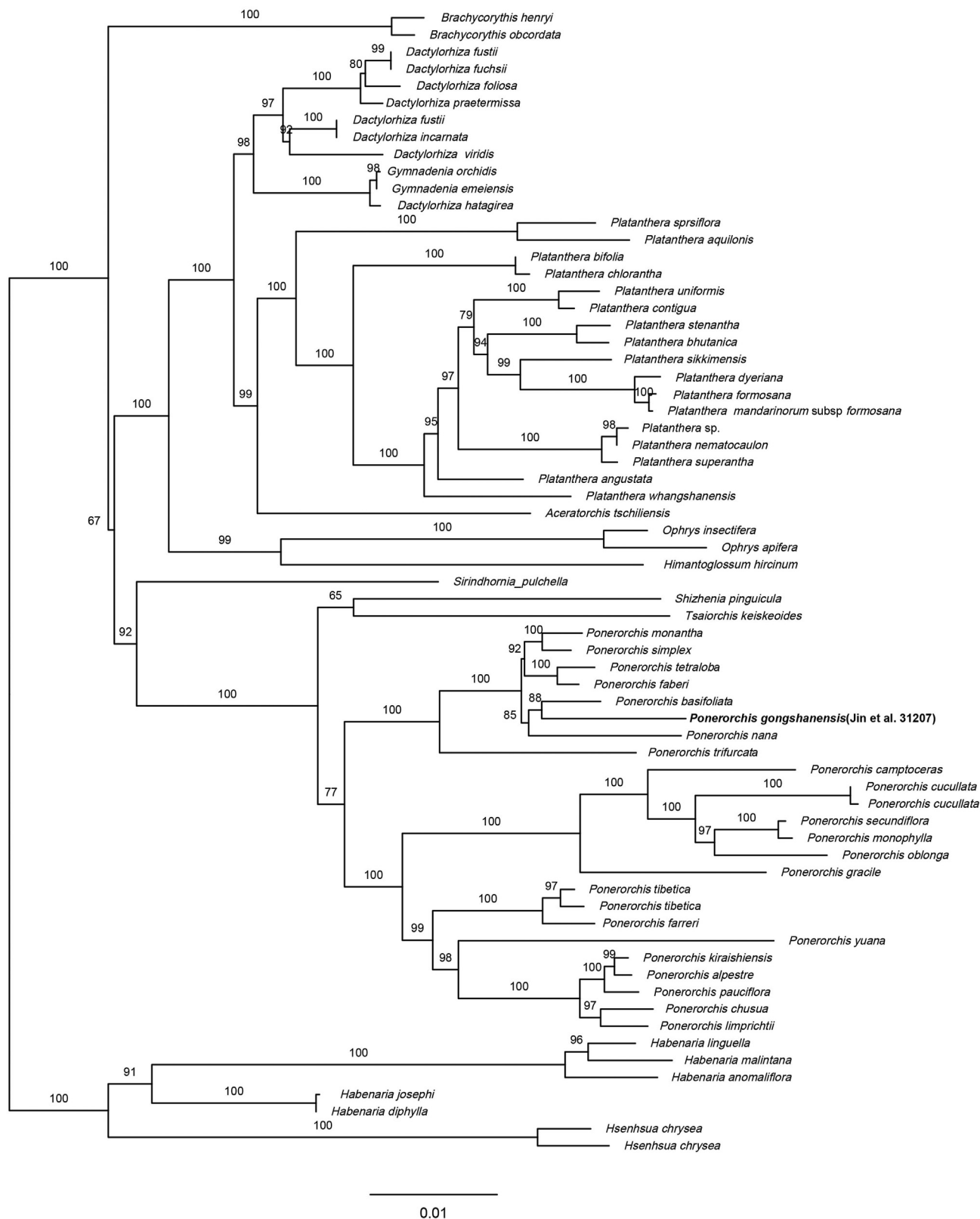


Fig. 3. Phylogram from maximum likelihood (ML) based on one nuclear marker (nrITS) and two plastid markers (*matK* and *rbcl*), showing the position of *Ponerorchis gongshanensis*. Numbers at nodes are bootstrap support values.

plants were observed, measured and photographed based on living material of five individuals of each species.

2.2. Phylogenetic analyses

The character matrix for phylogenetic analyses of *Herminium* and *Peristylus* consisted of two nuclear markers (*nrITS* and *Xdh*) and five plastid markers (*matK*, *psaB*, *psbA-trnH*, *rbcl*, and *trnL-F*). To produce this data set, we retrieved and newly sequenced marker sequences from a total of 83 species representing seven genera in Orchidinae (Table S1). Two genera, *Galearis* Raf. and *Platanthera*, were chosen as outgroups. The character matrix for phylogenetic analyses of the new species of *Platanthera* and *Ponerorchis* consisted of one nuclear marker (*nrITS*) and two plastid markers (*matK*, *rbcl*). The data set for the *Platanthera* phylogeny included marker sequences from 51 species, with five species of *Herminium* used as outgroup (Table S2). To produce the data set for phylogenetic analysis of *Ponerorchis*, we used sequences from 60 species, with *Habenaria* and *Hsenhsua* X.H. Jin, Schuit. & W.T. Jin used as outgroup (Table S3).

Both Bayesian inference (BI) and Maximum Likelihood (ML) methods were performed on all data sets to reconstruct the phylogenies. For all phylogenetic analyses, we partitioned the total data set and estimated the DNA substitution model for two DNA regions with a Bayesian information criterion using jModeltest 2 (Darriba et al., 2012). Markov chain Monte Carlo (MCMC) analysis was performed using MrBayes (Ronquist et al., 2012) for 10,000,000 generations for the total data set, with two simultaneous runs, each run comprising four incrementally heated chains. BI analysis was started with a random tree and sampled every 1000 generations. ML analysis was

conducted with RAxML 8.2.10 (Stamatakis 2014) using the GTR substitution model with gamma-distributed rate heterogeneity among sites and the proportion of invariable sites estimated from the data. Support values for nodes/clades were estimated from 1000 bootstrap replicates.

3. Results and discussion

Herminium forms a clade sister to *Hsenhsua* (Fig. 1) with strong support (PP = 1, BS_{ML} = 99). Phylogenetic analyses indicated that *Herminium lijiangense* is sister to a clade formed by *H. bulleyi*, *H. mannii* and *H. forceps* with high support (PP = 1, BS_{ML} = 99) (Fig. 1). *Peristylus fasciculatus* is nested within the clade formed by *P. tradescantiifolius* and *P. ngoyensis* with high support (PP = 1, BS_{ML} = 96) (Fig. 1). *Platanthera milinensis* is nested within the clade formed by *P. stenochila*, *P. roseotincta* and *P. silaensis* (Fig. 2) with moderate support (BS_{ML} = 77). *Ponerorchis gongshanensis* is sister to *P. basifoliata* and nested in a clade formed by *P. monantha*, *P. simplex*, *P. basifoliata*, *P. nana* and *P. tetraloba* with high support (BS_{ML} = 100) (Fig. 3).

3.1. Taxonomic treatment

3.1.1. *Herminium lijiangense* J.D. Ya & C. Liu, sp. nov. (丽江角盘兰)
Fig. 4, 5E–5H

Diagnosis: *Herminium lijiangense* is closely related to *H. elisabethae* (Duthie) Tang & F.T. Wang and *H. mannii* (Rchb.f.) Tang & F.T. Wang, but differs in having up to 50 flowers laxly along the rachis, floral bracts longer than pedicel and ovary, dorsal sepal

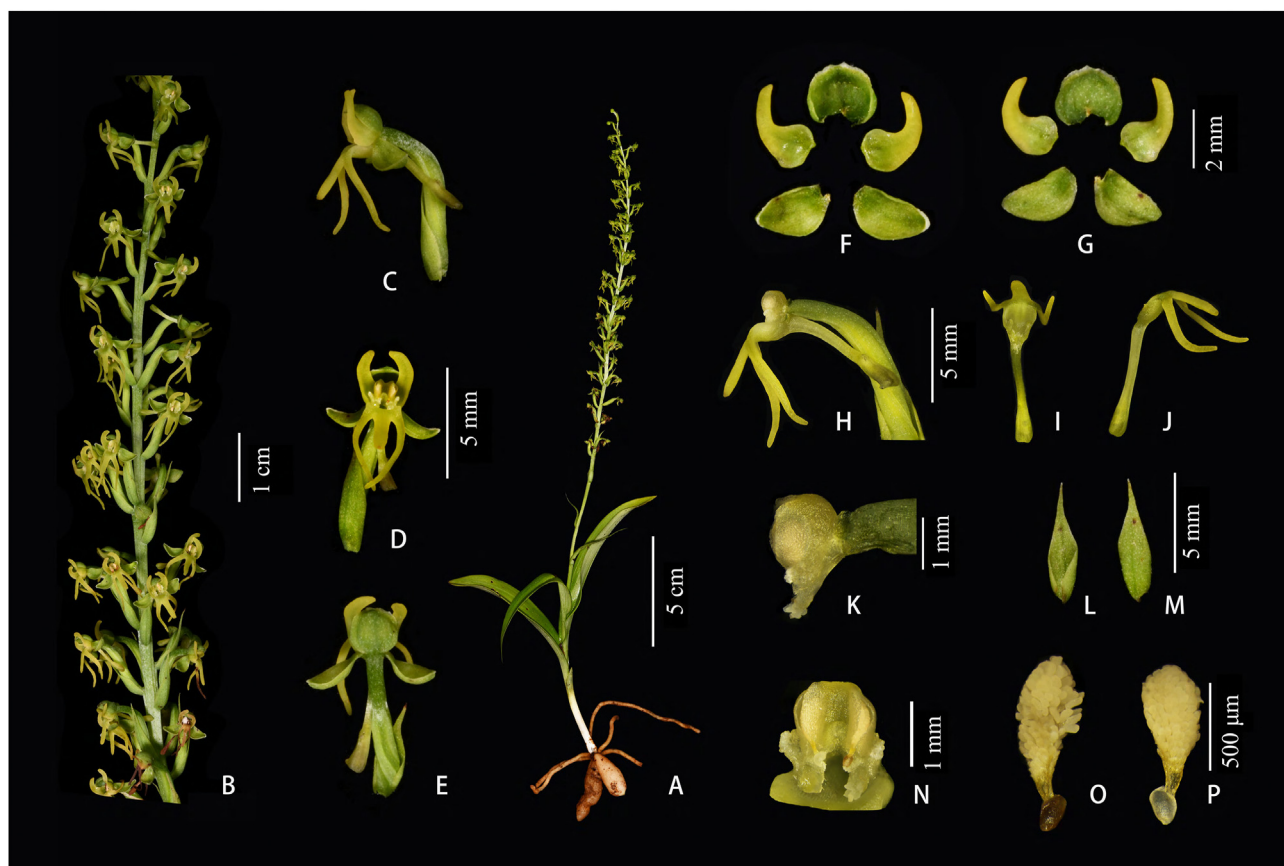


Fig. 4. *Herminium lijiangense* J.D. Ya & C. Liu, sp. nov. A. Plant. B. Inflorescence. C. Flower, side view. D. Flower, front view. E. Flower, dorsal view. F. Tepals, adaxial view. G. Tepals, abaxial view. H. Column with ovary and lip, side view. I. Lip, front view. J. Lip, side view. K. Column, side view. L. Bract, adaxial view. M. Bract, abaxial view. N. Column, front view. O. Pollinarium, dorsal view. P. Pollinarium, ventral view.

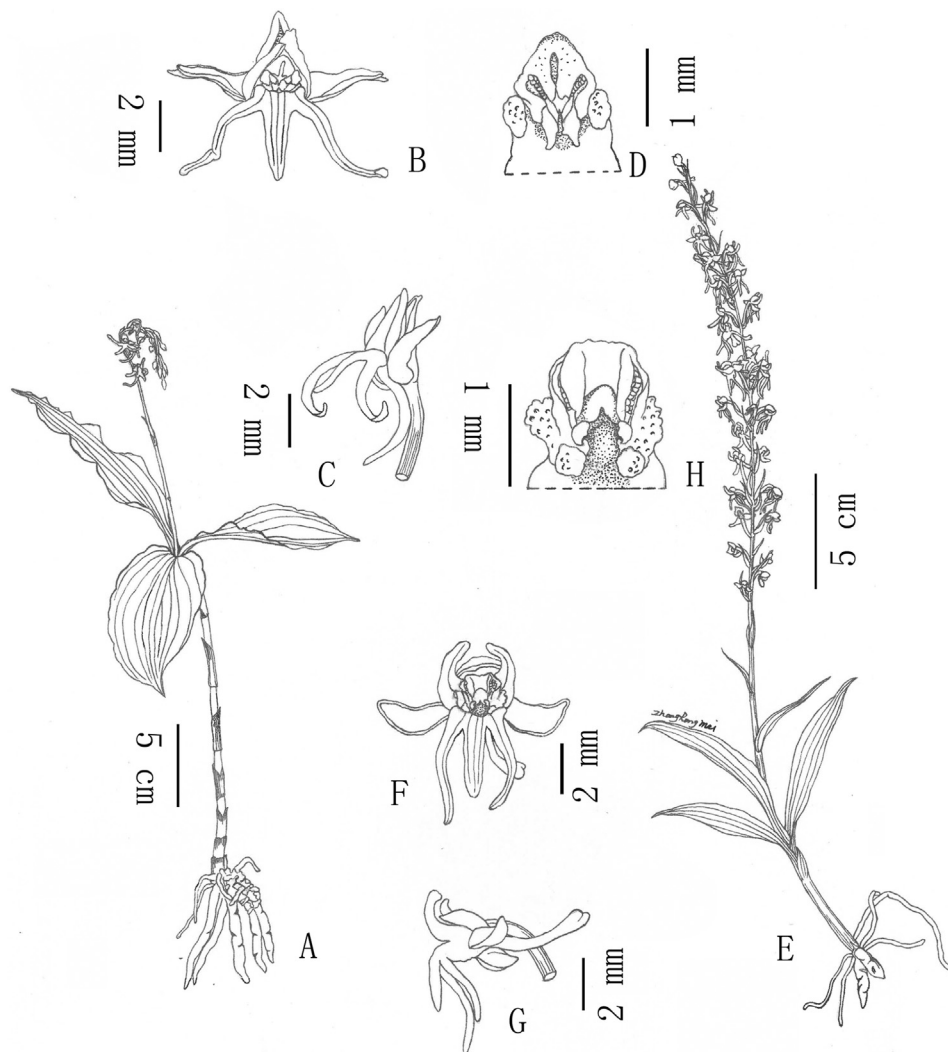


Fig. 5. Line drawings of *Peristylus fasciculatus* J.D. Ya, Schuit. & X.H. Jin, sp. nov. and *Herminium lijiangense* J.D. Ya & C. Liu. A–D. *Peristylus fasciculatus*. A. Flowering plant. B. Flower, front view. C. Flower, side view. D. Column, front view. E–H. *Herminium lijiangense*. E. Plant. F. Flower, front view. G. Flower, dorsal view. H. Column, front view.

ovate-orbicular, petals falcate-lanceolate, lip mid-lobe distinctly shorter than lateral lobes, spur clavate and 4.5–6.5 mm long.

Type: CHINA. Yunnan province, Lijiang prefecture, Gucheng District, on limestone slope, 1663m, 18 Aug. 2018, C. Liu, J.-D. Ya, S.-J. Min 18CS17414 (holotype: KUN!; isotype: KUN!).

Terrestrial herb, 25–35 cm tall. Tubers oblong-ellipsoid, fleshy, ca. 2.5–3.8 × 0.8–1.1 cm. Stem erect, smooth, with 1 tubular sheath at base and three basal leaves. Leaf lanceolate, ca. 5.5–10.0 × 1.0–1.5 cm, 7-veined, apex acuminate, base contracted into an amplexicaul sheath. Inflorescence 20.0–25.0 cm long, laxly ca. 50-flowered; peduncle-scales 2–3, lanceolate, 2.0–3.0 cm long, acuminate; floral bracts elliptic, 5.0–13.0 × 2.0–3.0 mm, longer than pedicel and ovary, glabrous, apex acuminate. Flowers yellowish green; pedicel and ovary twisted, ca. 6.0–9.0 mm long; ovary rostrate, with the apex hook-like bent downwards. Dorsal sepal ovate-orbicular, concave, ca. 2.0 × 2.6 mm, apex obtuse; lateral sepals obliquely ovate, concave, ca. 2.8 × 1.6 mm, apex subacute. Petals erect, falcate-lanceolate, horn-like, ca. 3.0 × 1.8 mm, apex acute. Lip deeply 3-lobed to near the base and with a concave basal part; mid-lobe linear, ca. 2.5 × 1.0 mm; lateral-lobes similar but longer than mid-lobe, ca. 4.2 × 0.5 mm; spur clavate, pendent, 4.5–6.5 mm long. Column ca. 1.0 mm long, groove, lateral erect; auricles 2; pollinia 2, granular-farinaceous, obovate, ca.

0.85 × 0.35 mm, each attached to a viscidium via a short caudicle; viscidia ovate, hornlike; rostellum triangular, with arm-like lobes; stigma lobes 2, free, raised; two prominent auricles laterally at the base of the anther.

Etymology: The name “*lijiangense*” refers to the type locality of the new species, Lijiang Prefecture, Yunnan, China.

Distribution and habitat: *Herminium lijiangense* is currently known only from the type locality in Lijiang Prefecture, Yunnan, China. It is a terrestrial species that grows on limestone at elevations of 1600–1700 m.

Phenology: Flowering in August–September.

3.1.2. *Peristylus fasciculatus* J.D. Ya, Schuit. & X.H. Jin, sp. nov. (宿茎阔蕊兰) Figs. 5A–5D, 6.

Diagnosis: *Peristylus fasciculatus* is similar to *P. tradescantifolius* (Rchb.f.) Kores and *Ponerorchis gracilis* Blume, but differs in having several fascicled and straight, root-like tubers (vs. one or two oblongoid tubers), old stems usually persistent, mid-lobe of lip narrowly ligulate-lanceolate and half as long as the lateral lobes (vs. midlobe deltoid, about a third as long as the lateral lobes or less), a raised callus at the base of each lateral lobe

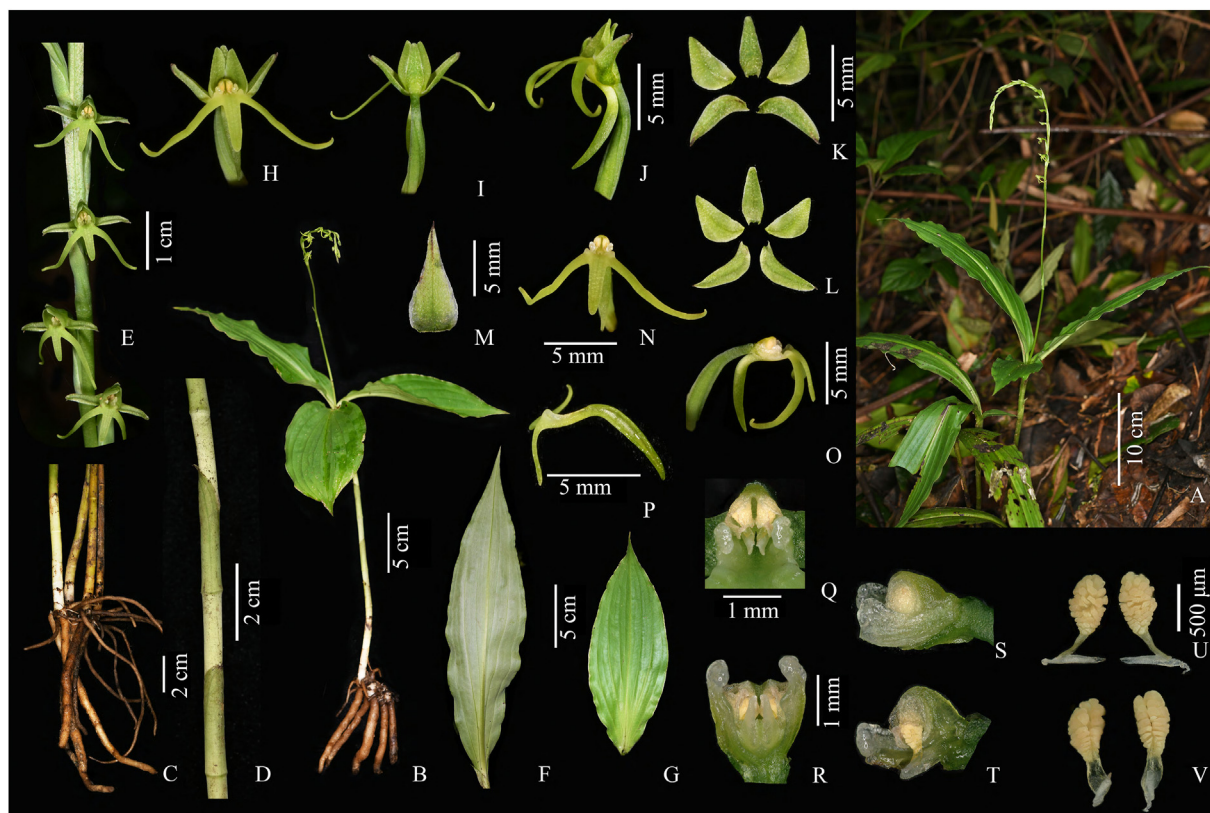


Fig. 6. *Peristylus fasciculatus* J.D. Ya, Schuit. & X.H. Jin, sp. nov. A. Flowering plant and habitat. B. Whole flowering plant. C. Roots. D. Stem. E. Inflorescence. F–G. Leaf (abaxial and adaxial view). H. Flower, front view. I. Flower, dorsal view. J. Flower, side view. K–L. Tepals (abaxial and adaxial view). M. Bract. N. Lip and column, front view. O–P. Column with ovary and lip, side view. Q. Column, front view. R. Column, dorsal view. S–T. Column, side view. U. Pollinaria, side view. V. Pollinaria, front view.

(vs. calli absent), spur gradually attenuate toward the apex (vs. spur clavate).

Type: CHINA. Yunnan province, Malipo County, in forest on limestone, 1200 m, 13 Aug. 2019, J.-D. Ya, W. Zhang, M.-F. Long 19CS18575 (holotype: KUN!).

Terrestrial herb, 40–65 cm tall. Tubers several, fascicled, cylindrical, 5.5–11.5 × 0.4–1.0 cm, fleshy, straight, pubescent, persistent; roots fleshy, slender, pubescent. Stem erect, terete, glabrous, with 6–8 tubular sheaths at base and 3 clustered leaves apically, old stems usually persistent. Leaves oblong to narrowly oblong, 14.0–22.0 × 4.5–7.5 cm, base attenuate and sheathed, leaf sheaths ca. 3.0 cm, apex acute to acuminate. Inflorescence slender, 14.0–30.0 cm long, nodding when young, becoming erect at anthesis, glabrous; peduncle 12.0–16.0 cm long, with 1–2 peduncle-scales, lanceolate, 1.5 cm long, amplexicaul at base, apex acuminate; rachis 6.0–16.5 cm long, laxly 10–20-flowered; floral bracts ovoid, ca. 10.5 × 4.5 mm, glabrous, apex acuminate. Flowers yellowish-green, pedicel and ovary 13.0 mm long. Dorsal sepal oblong-ovate, ca. 4.1 × 1.8 mm, concave, apex obtuse; lateral sepals obliquely oblong-ovate, ca. 5.0 × 1.8 mm, concave, apex acute and with a small mucro abaxially. Petals obliquely ovate, ca. 4.2 × 2.1 mm, apex acute. Lip 3-lobed near base; lateral lobes linear, ca. 7.5 × 0.9 mm, at the base with a raised callus c. 0.5 mm high; mid-lobe lanceolate, ca. 3.2 × 1.1 mm; spur cylindrical, ca. 5.5 × 1.0 mm, pendulous, curved inward, gradually attenuate toward apex. Column erect, about 2.0 mm tall, stout; rostellum with triangular arms parallel to basal grooves of anther, clasping viscidium; stigmas 2, large, elongate and oblong, ca. 1.3 × 0.8 mm, adnate to base of lip; pollinia 2, ca. 1.0 × 0.4 mm, caudicle ca 0.3 mm long, viscidium narrow oblong, 0.65 × 0.15 mm. Fl. August–September.

Etymology: The specific epithet “*fasciculatus*”, meaning fascicled, refers to the cluster of slender and straight, root-like tubers of this species.

Distribution and habitat: *Peristylus fasciculatus* is only known from the type locality in Malipo County, Yunnan, China. It is a terrestrial species that grows under forest in limestone regions at an elevation of ca. 1200 m.

Phenology: Flowering in August–September.

3.1.3. *Peristylus tenuicallus* Ormerod (细茎阔蕊兰), Fig. 7.

P. tenuicallus Ormerod, Turczaninowia 14, 96 (2011).

Terrestrial herb, plant slender, 10–20 cm tall. Tubers oblong, pubescent, 8.0 mm long, 5.0 mm in diam. Roots fleshy, pubescent. Stem erect, terete, glabrous, with 2 tubular sheaths at base and 3 clustered leaves apically. Leaves ovate to narrowly ovate, 1.5–3.5 × 1.0–1.5 cm, acute. Inflorescence erect, glabrous, slender, 8–12 cm long; peduncle 4.5–5.5 cm long, with one peduncle-scale, lanceolate, 1.3 cm long, amplexicaul, acuminate; rachis 5.0–6.0 cm long, laxly 6–7-flowered; floral bracts ovoid to narrowly ovate, 5.2–8.0 × 2.5 mm, shorter than or almost as long as ovary, glabrous, apex acuminate. Flowers yellowish-green, pedicel and ovary 7.0 mm long. Dorsal sepal ovate, ca. 2.0 × 1.0 mm, concave, apex subacute; lateral sepals oblong, ca. 2.0 × 0.8 mm, concave, shortly clawed at base, apex subacute. Petals obliquely ovate, ca. 2.1 × 1.4 mm, apex obtuse. Lip oblong-elliptic in outline, ca. 2.4 × 1.2 mm, 3-lobed near middle; disk slightly concave, raised at the base of lobes forming three calli, central callus ca. 0.5 mm high, lateral much smaller; lateral lobes triangular, tiny, inconspicuous; mid-lobe triangular-ovate, ca. 0.9 × 0.8 mm, bent downwards; spur triangular obovoid, ca. 1.5 × 1.2 mm, shallowly 2-lobed. Column erect, about 1.1 mm tall, groove, apex acuminate; pollinia 2, ca.

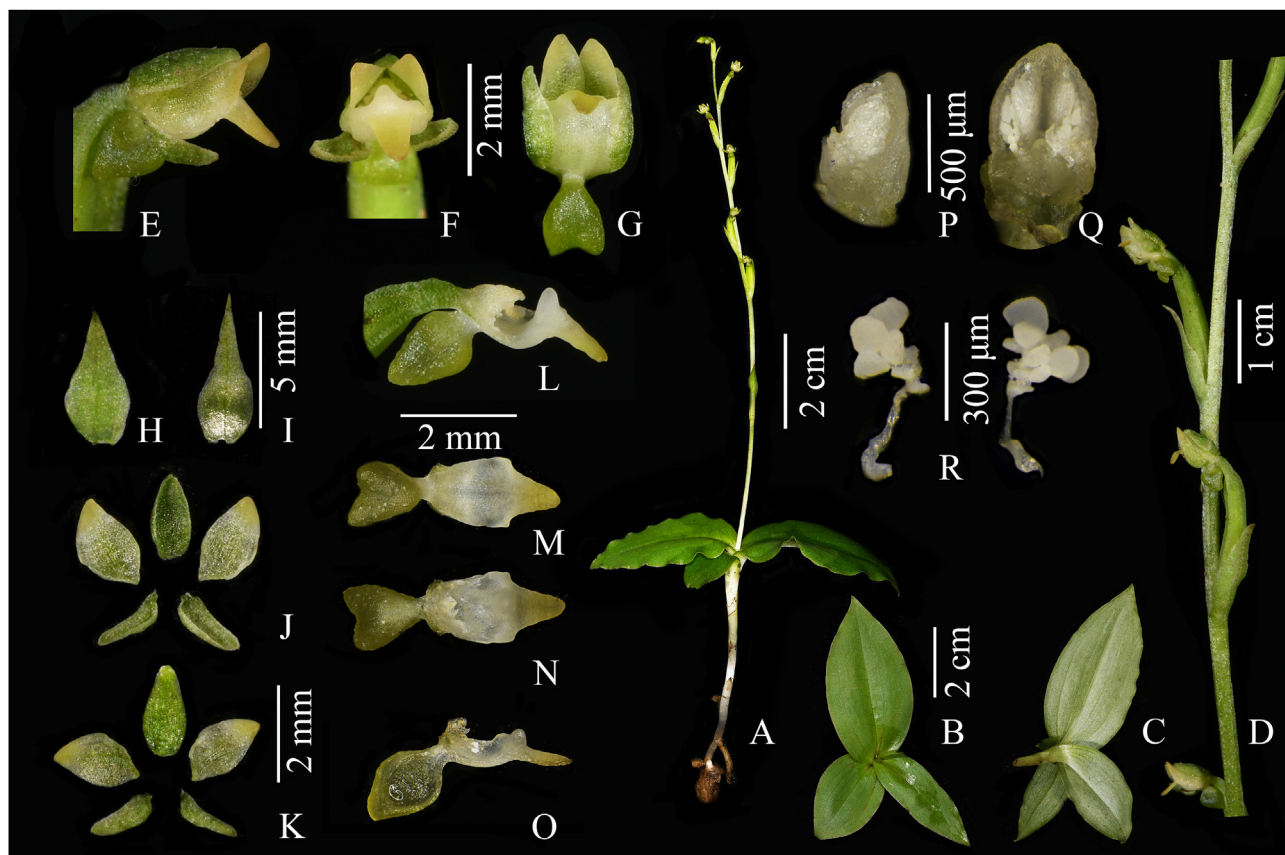


Fig. 7. *Peristylus tenuicallus* Ormerod. A. Flowering plant. B–C. Leaves (adaxial and abaxial view). D. Inflorescence. E–G. Flower (side, front and dorsal view). H–I. Bract (abaxial and adaxial view). J–K. Tepals, (adaxial and abaxial view). L. Lip and ovary (side view). M–O. Lip (abaxial, adaxial and side view). P–Q. Column (side and front view). R. Pollinarium.

0.3 × 0.2 mm, with few massulae, attached by elongate caudicle; viscidia oblong-ovate, small; stigma lobes 2, convex, adnate to base of lip.

Examined specimens: CHINA. Yunnan province, Malipo County, in forest on limestone, 1499 m, 14 Aug. 2019, J.-D. Ya, W. Zhang 19HT3047 (KUN).

Distribution and habitat: Vietnam (Lao Cai); new record for China (Malipo County, Yunnan province). Originally described from Vietnam (Lao Cai) and considered endemic. The type specimen was collected in montane broad-leaved forest on granite at an elevation of about 1500 m (Averyanov et al., 2020). In China, *P. tenuicallus* is an inconspicuous terrestrial species that grows in humid places in karst areas at elevations between 1450 and 1550 m.

Phenology: Flowering in August–September in China, June–July in Vietnam.

3.1.4. *Platanthera milinensis* X.H. Jin, Schuit. & C.B. Ma, sp. nov. (米林舌唇兰) Figs. 8, 9.

Diagnosis: *Platanthera milinensis* is similar to *P. stenochila* in its small green flowers and lip without a spur, but differs in having a creeping rhizome, a corymbose inflorescence, and a broadly ovate and slightly 3-lobed lip.

Type: CHINA. Xizang Autonomous Province, Linzhi City, Milin County, Duoxiongla, in limestone mountain scrub, elev. 3562 m, 15 Aug. 2020, Xiaohua Jin, Lin Dongliang & Ma Chongbo 31596 (holotype PE!, isotype PE!).

Terrestrial herb, ca. 6 cm tall. Rhizome creeping, internodes ca. 1 cm long, 2 mm in diam., densely hairy. Leaf one at the base of the stem, subsessile, ovate to long ovate, ca. 2.5–3 × 1.5–2 cm, with

somewhat raised veins. Inflorescence corymbose, densely 5–8-flowered; peduncle-scale 1, linear, 12 × 2 mm; floral bracts linear, 7–10 × 1–1.5 mm. Flowers green. Pedicel and ovary 3–4 mm long. Dorsal sepal ovate to broadly ovate, obtuse, ca. 3 × 1.5 mm, margins smooth; lateral sepals lanceolate, ca. 3.5 × 1.2 mm, 1-veined. Petals lanceolate, 2.5 × 1.1 mm, apex obtuse. Lip broadly ovate, slightly 3-lobed, 3 × 2.5 mm, apex acute and thickened; lateral lobes erect, clasping the column. Column ca. 1 mm long, stout; anther 2, adnate to column, 2-locular, locules parallel; rostellum small, triangular; stigma 1, convex surface surrounded by rostellum, semiorbicular. Pollinarium clavate, caudicles very short, viscidium orbicular.

Etymology: The species epithet refers to the type area, Milin County.



Fig. 8. *Platanthera milinensis* X.H. Jin, Schuit. & C.B. Ma, sp. nov.

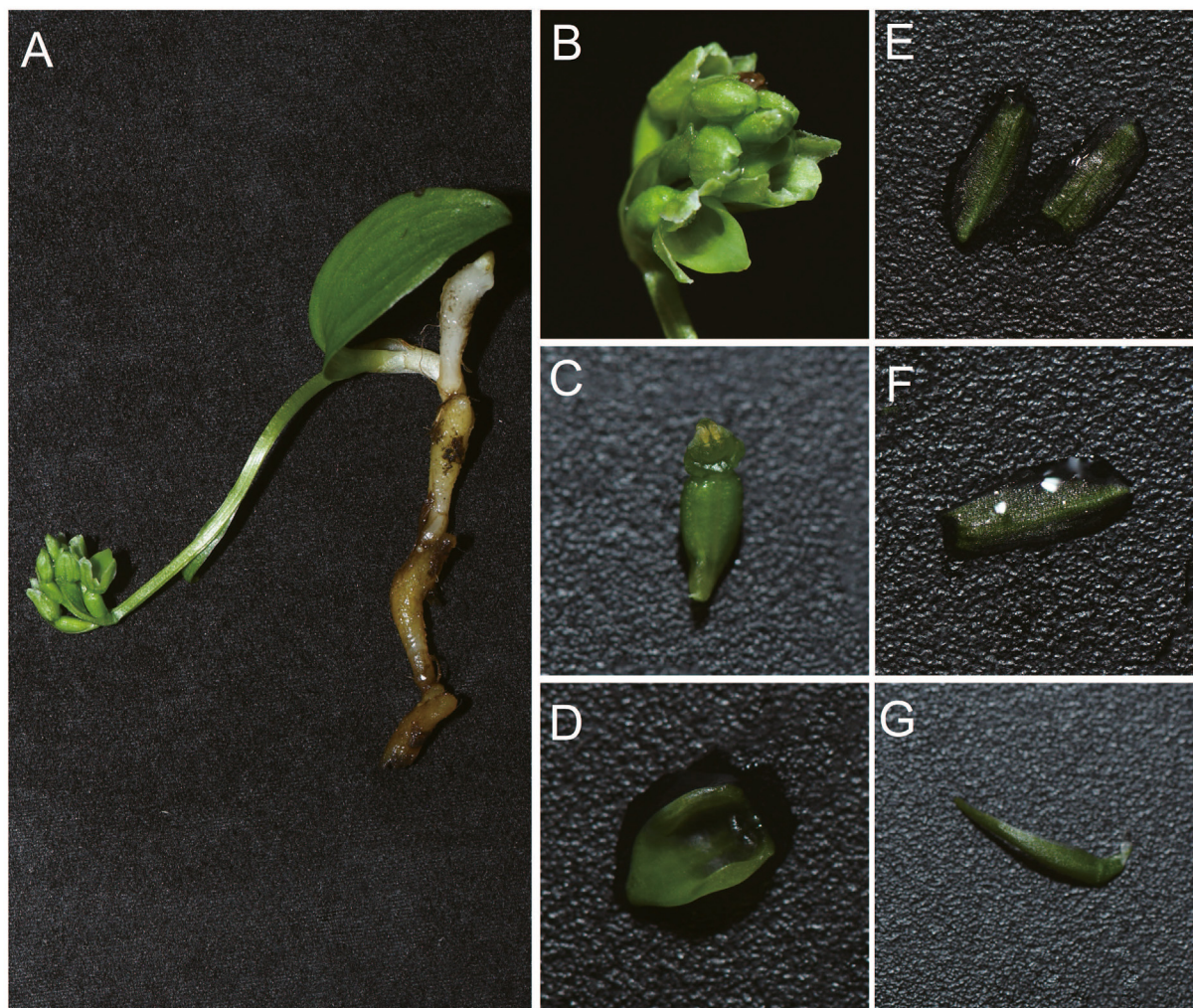


Fig. 9. *Platanthera milinensis* X.H. Jin, Schuit. & C.B. Ma, sp. nov. A. Plant. B. Inflorescence. C. Front view of column. D. Lip. E. Lateral sepals. F. Petal. G. Bract.

Distribution, habitat and Conservation status: *Platanthera milinensis* is only known from the type locality in the Douxiogla Mountains, Milin County, Linzhi City, Xizang, at an elevation of 3562 m. It grows on mossy limestone rock with shallow soil between alpine shrubs. Although our botanical survey indicates that this new species is remote from any direct threats, the area of occupancy is small and therefore the conservation status is undescribed here.

Phenology: Flowering in August–September.

3.1.5. *Ponerorchis gongshanensis* X.H. Jin, Schuit. & D.L. Lin, sp. nov. (贡山小红门兰), Fig. 10.

Diagnosis: *Ponerorchis gongshanensis* is similar to *P. faberi* (Rolfe) X.H. Jin, Schuit. & W.T. Jin in its small flowers, but differs in having a linear leaf c. 3 mm wide (vs. leaf 5–13 mm wide), in the lip having collar-like raised margins on the sides of the spur entrance, and a mid-lobe which is notched at the apex but not divided into two divergent lobules that are nearly as large as the lateral lobes, as in *P. faberi*.

Type: CHINA. Yunnan Province: Gongshan County, Gaoligong Mountains, elev. 2918 m, 24 June 2020, Xiaohua Jin & Dongliang Lin 31207 (holotype, PE!; isotypes, PE!).

Terrestrial herb, 9–15 cm tall. Tuber ovoid, 7 mm in diam., fleshy, densely covered with fine root hairs. Roots few, slender, 5–23 mm long, ca. 1 mm in diam. Stem slender, erect or suberect,

basally with 3 tubular sheaths, cylindrical, smooth. Leaf 1, narrowly lanceolate to linear, 3–3.6 cm × 3 mm, apex acuminate, base constricted into a cauline sheath. Inflorescence c. 5.5 cm long, without peduncle-scale, subaxly 4–5-flowered, flowers secund. Floral bracts lanceolate, acuminate, slightly shorter than ovary, ca. 5–9 mm long. Ovary fusiform, slightly twisted, glabrous, ovary and pedicel 6–8 mm long. Flowers small, pale lilac-pink, the lip at the base with some darker dots arranged in a semicircle. Dorsal sepal ovate, erect, concave, 2–3 × 1.5–2 mm, apex obtuse, 1-veined; lateral sepals ovate, ca. 3–4 × 2 mm wide below middle, apex obtuse, 1-veined. Petals forming a hood with the median sepal, ovate, 2 × ca. 1.5 mm wide below middle, apex rounded obtuse, 1-veined. Lip ovate to suborbicular, 3-lobed at base, basal margins collar-like raised on the sides of the spur entrance, 5–7 mm long; lateral lobes oblong, 4–5 mm long, near the apex 1.5–2 mm wide, apex obtuse; mid-lobe obovate, 3–4 mm long, 2.1–3.9 mm wide near apex, base cuneate, apex emarginate, bilobulate; lobules ca. 0.5–2 mm long, obtuse; spur clavate, 5.5–6.5 mm long, apex obtuse; pollinia ovoid, up to 1 mm long, viscidium narrowly ovate, 0.5 mm long; stigmas 3, forming a concavity below the rostellum.

Etymology. The new species is named after Gongshan County, where it was found.

Distribution, habitat and conservation status. *Ponerorchis gongshanensis* is only known from the type locality in Gongshan

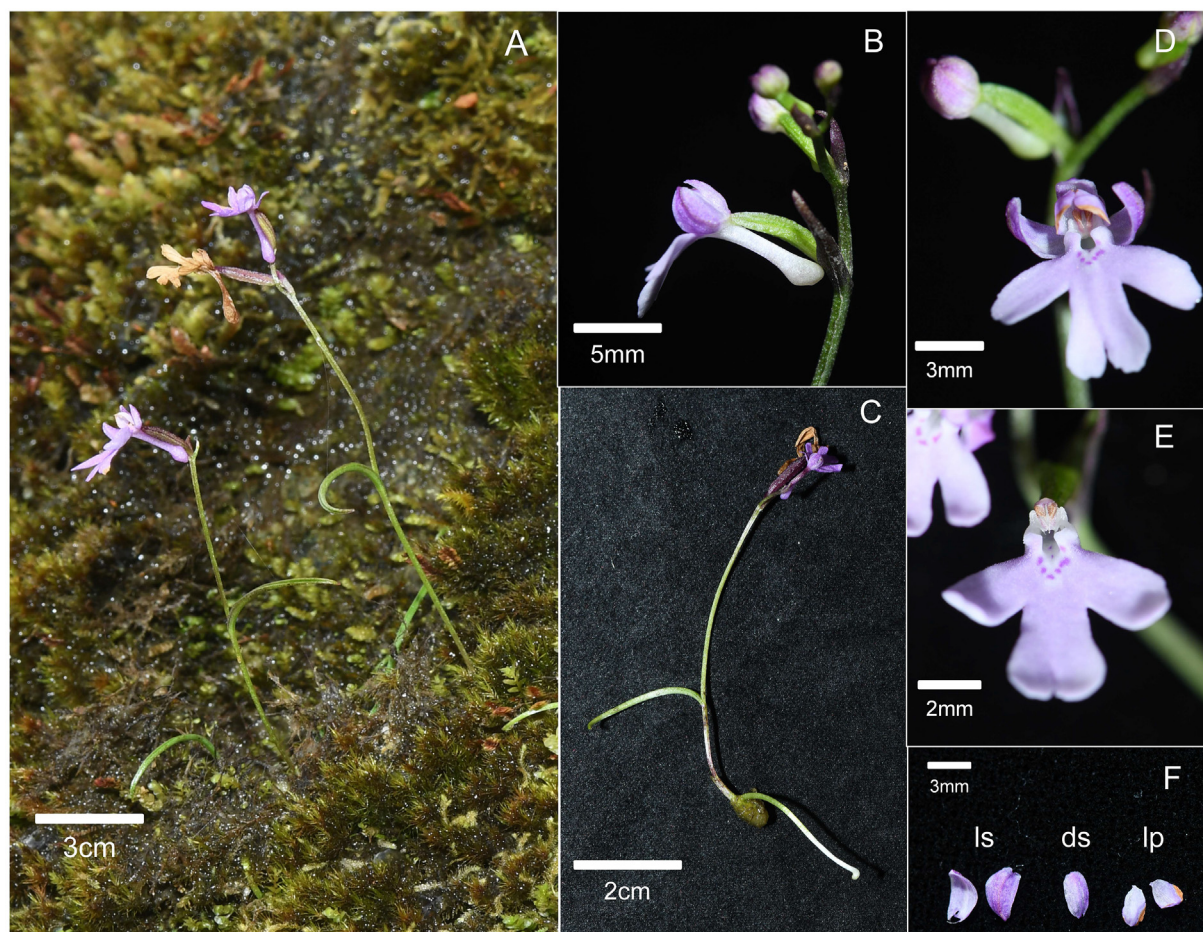


Fig. 10. *Ponerorchis gongshanensis* X.H. Jin, Schuit. & D.L. Lin, sp. nov. A. Flowering plant and habitat; B. Lateral view of flower; C. Whole plant; D. Front view of flower; E. Lip; F. Tepals; ls, lateral sepals; ds, dorsal sepal; lp, lateral petals.

County, Yunnan Province. It grows on damp mossy rock at an elevation of 2965 m in the Gaoligong Mountains. Our field observations indicate that this new species is under direct threat from activities of road construction; therefore, it is assessed as Endangered (EN) (IUCN 2020).

Phenology: Flowering in June–July.

3.1.6. Notes on *Apetalanthe*

In a recent paper, Averyanov et al. (2020) described a new genus from Vietnam, *Apetalanthe*, which they placed near *Ponerorchis*. The main distinguishing characters of the new genus were given as (1) an emarginate median sepal; (2) petals seemingly absent; (3) presence of calli at the base of the lip; (4) shape of the rostellum and (5) lack of a bursicle holding the viscidium. Judging from the illustrations provided, it seems to us that the petals are not absent but are incompletely fused, whereas it is the median sepal that appears to be lacking. The whole plant and the flowers are otherwise strikingly similar to *P. nana* (King & Pantl.) So. The calli at the base of the lip are hardly visible in the photographs (and look identical to the corresponding structure in *P. nana*) and appear exaggerated in the drawings. The morphology of the column and pollinia are variable in *Ponerorchis* s.l. (including presence or absence of a bursicle) and the stated differences in the rostellum may be due to misinterpretation. We conclude that the single species of *Apetalanthe* is best accommodated in *Ponerorchis*, necessitating the following transfer.

Ponerorchis nanoides Schuit. & X.H. Jin, nom. nov.

Replaced name: *Apetalanthe gracilis* Aver. & Vuong, *Taiwania* 65, 479 (2020).

Not *Ponerorchis gracilis* (Blume) X.H. Jin, Schuit. & W.T. Jin.

The epithet *nanoides* refers to the similarity of this species to *P. nana*. It is not impossible that it is a teratological form of that species.

Author contributions

XHJ, JDY, XLW, ZRZ, CB M, CL, and JDY discovered and identified the species. SS C, XLG and WBY performed the experiments and analyzed the data. DLL and JDY wrote the manuscript. AS, WBY, XHJ revised the manuscript. All authors read and approved last manuscript.

Declaration of competing interest

The authors declare no conflict of interest.

Acknowledgments

We are grateful to Lian-Yi Li for his help with image processing. Our special thanks go to Wei Zhang, and Changhong Li for their kind assistance during fieldwork. Funds were provided by Project of Orchid Biodiversity Survey of China, National Forestry and Grassland Administration, the National Natural Science Foundation of China (No. 31670194), the Large-scale Scientific Facilities of the

Chinese Academy of Sciences (Grant No. 2017-LSFGBOWS-02) and the National Wild Plant Germplasm Resource Center.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pld.2021.05.003>.

References

- Averyanov, L.V., Truong, B.V., Nguyen, V.C., et al., 2020. New Orchids in the flora of Vietnam III (Collabieae, Malaxideae, Nervilieae and Orchideae). *Taiwania* 65, 478–492.
- Bateman, R.M., James, K.E., Luo, Y.B., et al., 2009. Molecular phylogenetics and morphological reappraisal of the *Platanthera* clade (Orchidaceae: Orchidinae) prompts expansion of the generic limits of *Galearis* and *Platanthera*. *Ann. Bot.* 104, 431–445.
- Chase, M.W., Cameron, K.M., Freudenstein, J.V., et al., 2015. An updated classification of Orchidaceae. *Bot. J. Linn. Soc.* 177, 151–174.
- Chen, X.-Q., Cribb, P.J., Gale, S.W., et al., 2009. Neottianthe, Ponerorchis and Amitostigma. In: Wu, C.Y., et al. (Eds.), *Flora of China*, vol. 25. Beijing: Science Press and Missouri Botanical Garden Press, St. Louis, pp. 124–131.
- Darriba, D., Taboada, G.L., Doallo, R., et al., 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nat. Methods* 9, 772–772.
- Efimov, P.G., 2016. A revision of *Platanthera* (Orchidaceae: Orchidoideae; Orchideae) in Asia. *Phytotaxa* 254, 1–233.
- IUCN, 2020. The IUCN Red List of Threatened Species version 2020-1.
- Jin, W.T., Jin, X.H., Schuiteman, A., et al., 2014. Molecular systematics of subtribe Orchidinae and Asian taxa of Habenariinae (Orchideae, Orchidaceae) based on plastid matK, rbcL and nuclear ITS. *Mol. Phylogenet. Evol.* 77, 41–53.
- Jin, W.T., Schuiteman, A., Chase, M.W., et al., 2017. Phylogenetics of subtribe Orchidinae s.l. (Orchidaceae: Orchidoideae) based on seven markers (plastid *matK*, *psaB*, *rbcL*, *trnL-F*, *trnH-psbA*, and nuclear *nrITS*, *Xdh*): implications for generic delimitation. *BMC Plant Biol.* 17, 222.
- Jin, W.T., Xiang, X.G., Jin, X.H., et al., 2015. Generic delimitation of Orchidaceae from China: current situation and perspective. *Biodivers. Sci.* 23, 237–242.
- Ngugi, G., Le Pechon, T., Martos, F., et al., 2020. Phylogenetic relationships amongst the African genera of subtribe Orchidinae s.l. (Orchidaceae: Orchideae): implications for subtribal and generic delimitations. *Mol. Phylogenet. Evol.* 153, 106946.
- Nowak, S., Efimov, P., Szlachetko, D.L., et al., 2020. The genus *Platanthera* (Orchidaceae) in New Guinea with description of *Platanthera valkenburgii* sp. nov. *N. Z. J. Bot.* 58, 236–244.
- Pedersen, H.A.E., Suksathan, P., Indhamusika, S., et al., 2002. *Sirindhornia*, a new orchid genus from Southeast Asia. *Nord. J. Bot.* 22, 391–403.
- Pridgeon, A.M., Cribb, P.J., Chase, M.W., et al., 2001. *Genera Orchidacearum*, vol. 2. Oxford University Press, Oxford. Orchidoideae (Part 1).
- Raskoti, B.B., Jin, W.T., Xiang, X.G., et al., 2016. A phylogenetic analysis of molecular and morphological characters of *Herminium* (Orchidaceae, Orchideae): evolutionary relationships, taxonomy, and patterns of character evolution. *Cladistics* 32, 198–210.
- Raskoti, B.B., Schuiteman, A., Jin, W.T., et al., 2017. A taxonomic revision of *Herminium* L. (Orchidoideae, Orchidaceae). *PhytoKeys* 79, 1–74.
- Ronquist, F., Teslenko, M., Mark, P.V.D., et al., 2012. MrBayes 3.2: efficient bayesian phylogenetic inference and model choice across a large model space. *Syst. Biol.* 61, 539–542.
- Stamatakis, A., 2014. RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. *Bioinformatics* 30, 1312–1313.
- Tang, Y., Yukawa, T., Bateman, R.M., et al., 2015. Phylogeny and classification of the east Asian *Amitostigma* alliance (Orchidaceae: Orchideae) based on six DNA markers. *BMC Evol. Biol.* 15, 96. <https://doi.org/10.1186/s12862-12015-10376-12863>.