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Gastrochilus wamanus (Orchidaceae), a new species from Baoshan, China

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ABSTRACT: The newly discovered orchid, *Gastrochilus wamanus* (Aeridinae, Orchidaceae), found in Baoshan, Yunnan, China, is described and illustrated based on evidence from morphology, phenology, ecology and distribution. The species is morphologically similar to *G. gongshanensis*, *G. formosanus* and *G. calceolaris*, but can be differentiated by its relatively large plant stature, serrate epichile margin, papillate hairs on the epichile, and unique hypochile morphology. Molecular phylogenetic analyses based on the nuclear ribosomal internal transcribed spacer (nrITS) and four plastid regions (*atpI-atpH*, *matK*, *psbA*, and *trnL-F*) indicate that *G. wamanus* is sister to *G. gongshanensis* with strong support. These molecular results, combined with diagnostic morphological differences, support recognition of this taxon as a distinct new species.

KEY WORDS: Morphology, *Gastrochilus calceolaris*, *Gastrochilus formosanus*, *Gastrochilus gongshanensis*, Taxonomy.

INTRODUCTION

The genus *Gastrochilus* D. Don (1825: 32) (Orchidaceae: Epidendroideae, Vandeae, Aeridinae) was formally established in 1825 and is characterized by an epiphytic habit, monopodial growth, erect or pendulous stems, and generally distichously arranged leaves (Pridgeon *et al*., 2014). Additional key diagnostic features of the genus include a typically bilobed lip consisting of a saccate hypochile and broad epichile; two porate, globose pollinia attached to a slender stipe with a bilobed viscidium; and short axillary inflorescences (Tsi, 1996; Kumar *et al*., 2014).

Gastrochilus comprises approximately 70 species distributed across Southeast Asia, ranging from India to Japan and spanning tropical to temperate alpine regions (Pridgeon *et al.*, 2014; Hsu *et al*., 2018; Lee *et al*., 2019; Li *et al.*, 2021, 2022, 2023; Zhang *et al.*, 2022, 2024a; Liu *et al.*, 2023; Wu *et al.*, 2025). China is a major center of diversity for *Gastrochilus*, with over 45 species recorded there (Liu and Gao, 2018; Rao *et al.*, 2019; Zhou *et al.*, 2021a,b; Liu *et al.*, 2023; Zhang *et al.*, 2024b). It is difficult to distinguish species within this genus when flowers are absent. To tackle this problem, molecular biology techniques have been utilized (Liu *et al.*, 2019b; Liu *et al.*, 2023). Nevertheless, morphological comparisons remain critical for classifying the genus, as some species exhibit significant morphological differences despite their close evolutionary relationships.

During field surveys in Longyang District, Baoshan City, Yunnan Province, China, we collected an orchid morphologically assignable to *Gastrochilus*. Morphologically, this entity resembles *Gastrochilus gongshanensis* Z.H.Tsi, *G. formosanus* (Hayata) Hayata, and *G. calceolaris* (Buch.-Ham. ex Sm.) D.Don, yet it can be readily distinguished. Some living plants were transplanted to the Garden of Nanyang Institute of Technology for further study. Following standard taxonomic practice and extensive literature review, we confirm that this taxon represents a new species. We hereby formally describe *Gastrochilus wamanus* as a new species, and further explore its phylogenetic position within the genus.

MATERIALS AND METHODS

Morphological descriptions and measurements of the new *Gastrochilus* species were based on both living plants and dried herbarium specimens. The taxonomic description adheres to the terminology used by Beentje (2012). Voucher specimens are deposited in the Herbarium of the School of Biological and Chemical Engineering, Nanyang Institute of Technology (NYIST).

DNA extraction was performed following the protocols used in Zhang *et al*. (2024b). The nuclear ribosomal ITS region and four plastid markers (*atpI-atpH, matK, psbA-trnH, trnL-F*) were amplified and sequenced following standard protocols (Wu *et al*., 2025). Sequences were edited and assembled using SeqMan (Lasergene, DNASTAR) and checked manually. Alignments were performed using MAFFT v7.487 (Katoh and Standley, 2013) with default parameters. A total of 28 taxa were chosen as ingroup, while 5 taxa were selected as outgroup for taxonomic sampling. Voucher information and GenBank accession numbers are listed in

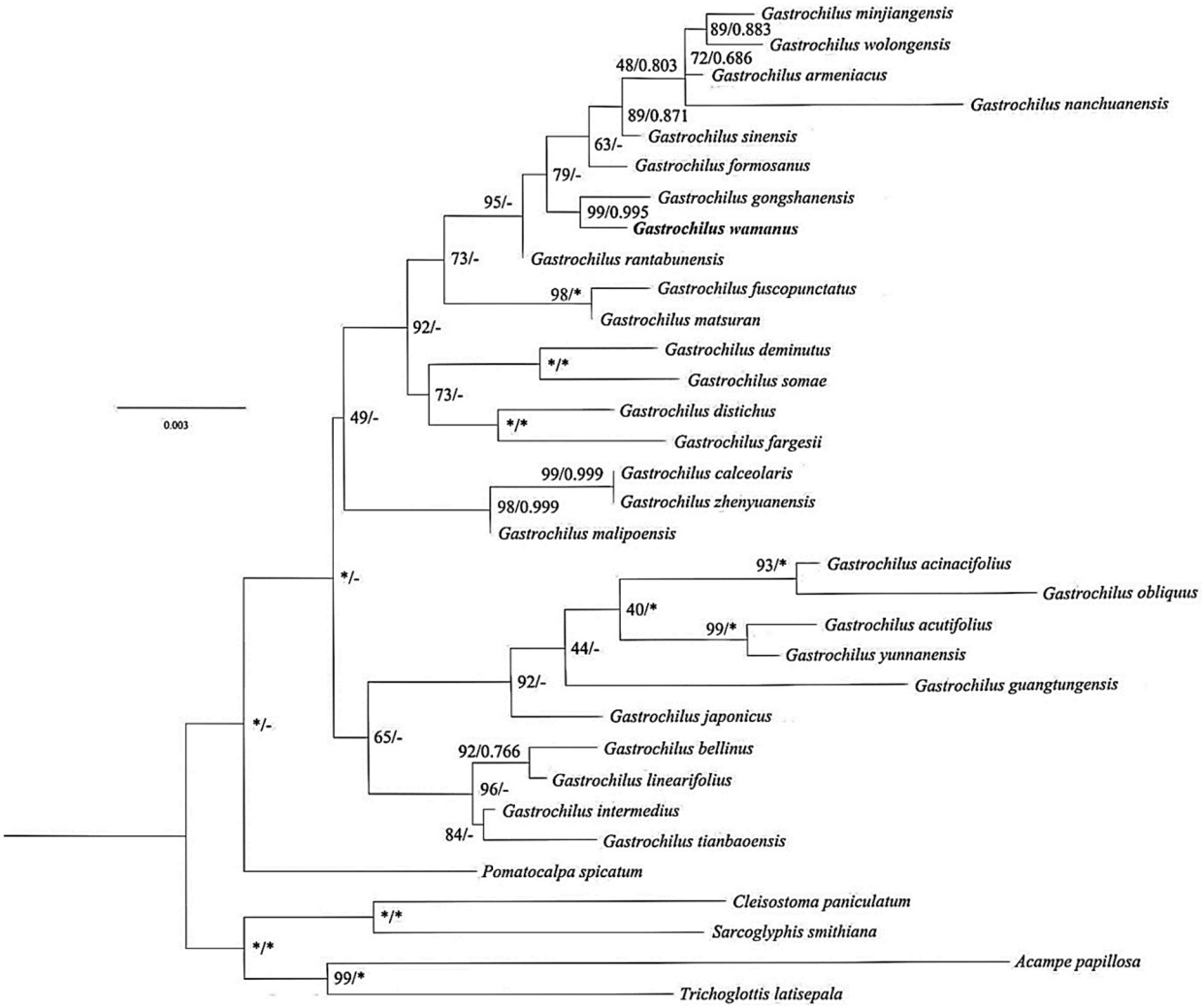

Fig. 1. Phylogenetic relationships of ***Gastrochilus*** based on the combined nrITS and plastid DNA. The numbers near the nodes are Bayesian posterior probabilities and maximum-likelihood bootstrap percentages (MLBS/PP). A dash (-) indicates that a node is inconsistent between the topology of the ML and the Bayesian trees; An asterisk (*) indicates 100% bootstrap support or a posterior probability of 1.00.

Table S1. A total of 17 sequences of *atpI-atpH*, 30 of *matK*, 19 of *psbA-trnH*, 28 of *trnL-F* and 30 of nrITS were obtained.

Phylogenetic analyses were conducted using Maximum Likelihood (ML) and Bayesian Inference (BI) according to Liu *et al*. (2019b). ML analyses were performed using IQ-TREE v2.2.0 (Nguyen *et al*., 2015) with 1000 ultrafast bootstrap replicates. BI analyses were performed using MrBayes v3.2.7a (Ronquist *et al*., 2012) with two independent runs of 10 million generations, sampling every 1000 generations.

RESULTS AND DISCUSSION

The lengths of the nrITS, plastid *atpI-atpH*, *matK*, *psbA-trnH* and *trnL-F* sequences of the new species were 655, 744, 1,545, 1,062 and 796 bp, respectively. Our combined nuclear and plastid phylogenetic analyses recovered a well-supported clade containing the new species, *Gastrochilus wamanus* and *G. gongshanensis* (Fig. 1). Within this clade, *G. wamanus* is resolved as sister to *G. gongshanensis,* with maximum Bayesian posterior probability (BPP = 0.995) and strong maximum-likelihood bootstrap support (MLBS = 99%).

A comprehensive comparison of morphological characteristics shows that the new species shares similarities with *Gastrochilus gongshanensis*, *G. calceolaris* and *G. formosanus*. However, the new species can be clearly differentiated from the three aforementioned species by differences in plant size, leaf morphology, petal and sepal characteristics, hypochile, and epichile shapes, as well as the variations in accessory structures. (Table 1, Figs. 2 and S1).

Supported by consistent diagnostic morphological traits and molecular phylogenetic evidence, we formally describe this taxon as a new species.

Table 1. Morphological comparisons among ***Gastrochilus wamanus***, ***G. gongshanensis***, ***G. calceolaris*** and ***G. formosanus***

Character	*G. wamanus*	*G. gongshanensis*[a]	*G. calceolaris*	*G. formosanus*[b]
Leaf size	4.8–5.3 × 1.0–1.5 cm	1.8–2.4 × 0.7–0.9 cm	20.0–23.0 × 1.5–2.5 cm	2.5 × 0.7 cm
Flower size	1.0–1.6 × 1.3–1.9 cm	1.3–1.6 × 1.6–1.8 cm	0.9–1.3 × 1.3–1.6 cm	0.8 × 0.9 cm
Sepals	sub-elliptic, concave, dorsal sepal 6.8–7.8 × 4.0–5.4 mm, lateral sepals 6.8–9.3 × 4.2–5.4 mm	sub-elliptic, concave, apex acute, dorsal sepal 4.5–5.6 × 5.1–5.9 mm, lateral sepals 5.9–6.8 × 5.1–6.0 mm	obovate-oblong, apex obtuse-rounded, dorsal sepal 4.9–6.2 × 2.5–3.4 mm, lateral sepals 4.8–6.2 × 2.8–3.4 mm	elliptic-oblong, concave, apex obtuse, dorsal sepal 4.2–5.6 × 2.5–3.5 mm,
Petals	oblong, 5.6–7.8 × 3.2–4.9 mm	sub-obovate, 5.8–6.4 × 4.4–5.6 mm, apex rounded	obovate-oblong, ca. 4.8–6.2 × 2.8–4.0 mm, apex obtuse-rounded	oblanceolate, 4.0–5.0 × 2.8–3.0 mm, apex rounded
Hypochile diameter × height	cup-shaped, 5.1–6.4 × 6.9–7.4 mm, sac with purple patches inside, outside of sac with sparse purplish-red spots	nearly subglobose, white with purple spots and purple margins, dark violet underneath the sac; densely hairy near entrance	saccate or helmetlike, 5.0–6.0 × 6.0–7.0 mm	subcupular, ca. 3.0 × 4.0 mm
Epichile	semicircular, with a serrated margin loosely covered by papillate hairs, 3.3–4.4 × 6.8–11.2 mm	reniform, densely short hair, apex rounded and broadly emarginate, white with sparse purple spots, flat, 5.7–6.0 × 9.8–12.7 mm	suborbicular-triangular or lunate triangular, adaxially with long white hairs, margin irregularly fimbriate or erose, 2.5–3.6 × 5.0–7.0mm	broadly triangular or nearly suborbicular, 2.2–3.2 × 7.0–9.0 mm, adaxially with a yellow densely papillate-hairy cushion, margin entire or slightly dentate-undulate, apex subtruncate or rounded

(**a**: data from Liu *et al*., 2019a; **b**: data from Zhang *et al*., 2022 and Chen *et al*., 2009).

TAXONOMIC TREATMENT

Gastrochilus wamanus P.Y.Wu & Yu T.Zhang, ***sp. nov.*** **瓦马盆距兰; Figs. 2**

Type: **CHINA. Yunnan**(云南): Wama Township, Longyang District, Baoshan (保山) City, epiphytic on tree trunks, 2100 m, 11 March 2025, cultivated and flowered in Nanyang, 2 April 2025, *P. Y. Wu BY03* (holotype, NYIST).

Diagnosis: The new species can be distinguished from *Gastrochilus gongshanensis* by its larger plant size (vs. smaller size), ovate hypochile with sparse purplish-red spots inside (vs. hemispherical hypochile with a distinct purplish-red patch inside), epichile with purple-red marks in the center portion, truncate apex, and serrate margins (vs. purple-red dots all over the surface, emarginate apex, and entire margins). It also resembles *G. calceolaris* but differs in having elliptic-oblong leaves (vs. linear-oblong leaves), and an epichile densely covered with papillate hairs and possessing serrate margins (vs. epichile with long white hairs and fimbriate margins). It can be further distinguished from *G. formosanus* by its larger, elliptic-oblong leaves (vs. smaller, purely elliptic leaves) and epichile densely covered with fine papillate hairs (vs. epichile mostly smooth except near the center) (Fig. S1).

Description: Epiphytic herbs, prostrate, leafy. Roots vermiform, up to 9.0 cm long. Stems shortly branched, green, glabrous, 0.4–0.6 mm thick, up to 15.0 cm long, covered with sheathing leaf bases; sheaths with purplish-red spots; internodes of stems 3.1–3.6 mm long. Leaves alternate, distichous, elliptic or oblong, with purplish-red spots on the abaxial leaf surface, 4.8–5.3 × 1.0–1.5 cm, margin smooth, apex acute and leathery. Inflorescence in racemes with 3 to 6 flowers, ca. 2.8 cm long. Peduncle 1.1–1.4 cm long. Flowers 1.0–1.6 × 1.3–1.9 cm, light yellowish green, with purple spots on petals and sepals; hypochile light yellow with purple spots and purple margins; epichile white; column with purple spots. Dorsal sepal sub-elliptic, concave, 6.8–7.8 × 4.0–5.4 mm. Lateral sepals similar to dorsal sepals, slightly pointed at the apex, 6.8–9.3 × 4.2–5.4 mm. Petals oblong, 5.6–7.8 × 3.2–4.9 mm. Lip distinctly divided into a saccate hypochile and a broadly rolled epichile. Hypochile attached to base of column, cup-shaped, 6.9–7.4 mm tall, 5.1–6.4 mm in diameter, sac with sparse purplish-red spots both inside and outside. Epichile semi-orbicular to reniform, with a serrate margin loosely covered with papillate hairs, 3.3–4.4 × 6.8–11.2 mm, with a yellow thickened cushion extending onto the hypochile; Column stout, ca. 3.0 mm; anther cap galeate with curved emarginate beak, 2.4–2.7 × 1.8–2.3 mm; pollinia 2, ca. 0.9 mm in diam, yellow, full and nearly spherical, with a depression in the center; stipe elongate, ca. 2.8-3.2 mm long; viscidium elliptic, ca. 1.0–1.3 × 0.5–0.7 mm; rostellum bilobed. Capsule not seen.

Etymology: The specific epithet *'wamanus'* refers to Wama town, Baoshan City, Yunnan, China, the type locality of the new species.

Note: *Gastrochilus gongshanensis* Z.H.Tsi was initially and validly published by Tsi in 1996, relying on a solitary and poorly preserved type specimen sourced from Gongshan County, located in the northwestern part of Yunnan. The original protologue merely documented fundamental organ dimensions and general morphological outlines. In contrast, crucial diagnostic characteristics, such as floral color patterns, detailed lip

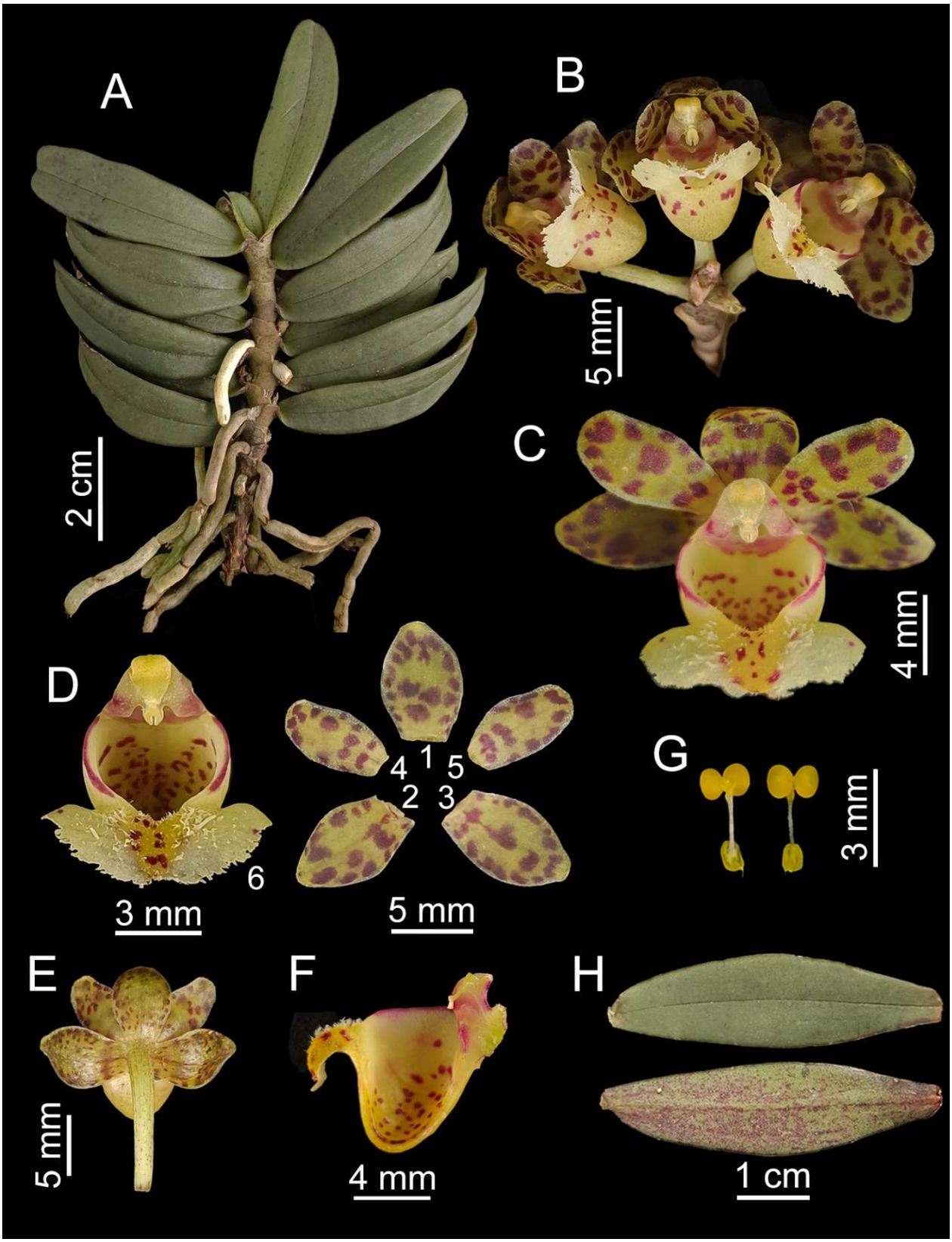

Fig. 2. ***Gastrochilus wamanus*** **A.** Plant. **B.** Inflorescence. **C.** Flower (front view). **D.** Anatomy of flowers (D1: dorsal sepal; D2 and D3: lateral sepals; D4 and D5: petals; D6: labellum). **E.** Flower (dorsal view). **F.** Labellum (longitudinal section). **G.** Pollinaria. **H.** Leaves (upper and lower views).

indumentum, and abaxial hypochile ridges, were not recorded. Owing to this limited information and the degraded type material, the exact species circumscription and diagnostic boundaries of *G. gongshanensis* have remained ambiguous for more than two decades.

Liu *et al*. (published the research online in May 2019a) subsequently collected fresh living specimens of this species from the Gaoligong Mountains in western Yunnan, and provided a comprehensive supplementary description accompanied by colour photographs. Their study precisely defined the key diagnostic characteristics of *G. gongshanensis*, including pendulous and infrequently branched stems, oblong leaves with purplish-red spots on the abaxial surface, yellowish flowers with purple speckles, a reniform epichile densely covered with short hairs and featuring a central yellow papillate cushion, and a subglobose hypochile with dense hairs near the entrance. Our morphological observations and specimen examinations agree fully with the species delimitation of Liu *et al*. (2019a), and we accept their revised taxonomic treatment.

In August 2019, Rao *et al*. described *Gastrochilus yunlongense* W.H.Rao, L.J.Chen & Z.J.Liu based on specimens collected from Yunlong County, Yunnan. Significantly, these two studies appeared within three months of one another, and offset submission timelines likely explain the absence of cross-citation between them. In their morphological comparison, Rao *et al*. depended exclusively on Tsi's (1996) incomplete original protologue of *G. gongshanensis* and did not consult the updated comprehensive treatment published earlier by Liu *et al*. (2019a). This probably prevented them from recognizing morphological congruence between the two taxa.

After a detailed comparison of the protologues, line-drawings, and photographic documentation of both names, it has been found that all the key morphological characteristics of *G. yunlongense*, such as growth habit, stem length, leaf shape and size, flower dimensions, shape, and indumentum of the epichile and hypochile, match perfectly with those of *G. gongshanensis*. Both taxa are also distributed in similar montane evergreen broad-leaved forest habitats at overlapping elevations within the contiguous Gaoligong Mountains region of western Yunnan. There are no consistent morphological differences to distinguish between the two entities. Consequently, we regard *G. yunlongense* W.H.Rao, L.J.Chen & Z.J.Liu, ***syn. nov.***, as a heterotypic synonym of *G. gongshanensis* Z.H.Tsi, with the latter name having nomenclatural priority. Correspondingly, in the current study, we compare our newly discovered species with *G. gongshanensis*, which is its closest morphological and phylogenetic relative.

Phenology: Flowering from March to April.

Distribution and habitat: *Gastrochilus wamanus*is currently known only from the vicinity of Baoshan city, Yunnan Province, China. It is epiphytic on tree trunks at an elevation of ca. 2100 m in evergreen broad-leaved forests.

Conservation status: *Gastrochilus wamanus* is currently only known from a single population in Wama Township, Longyang District, Baoshan City, Yunnan Province, China. Comprehensive surveys in adjacent areas have not identified any additional populations. In accordance with the IUCN Red List Categories and Criteria (IUCN, 2012), this species is here assessed as Data Deficient (DD) since the detailed information regarding its population size, distribution range, habitat status, and potential threats remains inadequate for a comprehensive threatened category assessment. Further field investigations are necessary to precisely evaluate its conservation status.

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