



Gastrochilus deltoglossus (Orchidaceae: Epidendroideae: Vandaeae: Aeridinae), a new species from Taiwan

Tian-Chuan HSU¹, Szu-I HSIEH^{2,*}, Jin-Hua WU³, Hsin-Chieh HUNG⁴

1. Botanical Garden Division, Taiwan Forestry Research Institute, No. 53, Nanhai Rd., Taipei 10066, Taiwan.

2. Department of Forestry, The Affiliated Taichung Agricultural Vocational Senior High School of National Chung Hsing University, No. 283, Taichung Rd., Taichung City, 401, Taiwan.

3. Nantou Forest District Office, Forestry Bureau, No. 456, Shiguan Rd., Caotun Town, Nantou 542, Taiwan.

4. Dr. Cecilia Koo Botanic Conservation and Environmental Protection Foundation, No. 31, Tongsing Rd., Gaoshu Township, Pingtung County 906, Taiwan.

*Corresponding author's email: silyvia0227@gmail.com

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ABSTRACT: A new species, *Gastrochilus deltoglossus*, is described and illustrated from Taiwan. This species is characterized by the presence of pendulous stems, leaves without awned apex, 3.5–4.0 mm tall subconical hypochile, and broadly deltoid, ciliate, adaxially sparsely short-hairy epichile that are approximately as wide as hypochile. Notes on its distribution, ecology, conservation status and taxonomic affinities are presented.

KEY WORDS: *Gastrochilus ciliaris*, *Gastrochilus raraensis*, Orchidaceae, Taiwan, Taxonomy.

INTRODUCTION

Gastrochilus D. Don (Orchidaceae: Aeridinae, Vandaeae, Epidendroideae) is a monopodial orchid genus comprising ca. 65 species widely distributed around E, SE and S Asia (Pridgeon *et al.*, 2014; Govaerts *et al.*, 2018; Liu and Gao, 2018). This genus is remarkable in the predominantly tropical subtribe Aeridinae (Pridgeon *et al.*, 2014) by its high species richness in East Asia and the Himalayas (Tsi, 1996). It has highest diversity (41 spp.) in China (Zhou *et al.*, 2016; Liu *et al.*, 2016; Liu and Gao, 2018) and is also the largest monopodial genus in Nepal, Taiwan, Japan and Korea, with eleven (Rokaya *et al.*, 2013; Raskoti, 2015), nine (Lin *et al.*, 2016), four (Yokota *et al.*, 2016) and two (Chang *et al.*, 2014) taxa respectively. Recent molecular phylogenetic studies (Zou *et al.*, 2015) have demonstrated that *Gastrochilus* is monophyletic and genetically closely related to *Pomatocalpa* and the monotypic genus *Haraella*. Though *Haraella* is indicated as sister to *Gastrochilus*, the monophyletic clade composed by *Gastrochilus* and *Haraella* was not highly supported (Zou *et al.*, 2015), and we still prefer to keep *Haraella* separate from *Gastrochilus*, following Su (2000), Chen *et al.* (2009), Lin *et al.* (2016) and Yokota *et al.* (2016), on the basis of their strikingly distinct floral morphology. In other words, we consider that the reduction of genus *Haraella* under the synonymy of *Gastrochilus* by Pridgeon *et al.* (2014), Chase *et al.* (2015), Zhou *et al.* (2016) and Govaerts *et al.* (2018) is currently unnecessary.

During 2016–2017, the third and fourth authors (Wu and Hung) successively discovered some individuals of

Gastrochilus without flowers in a mid-altitudinal mixed forest of central Taiwan. As *Gastrochilus* species are typically hardly identifiable without flower, these plants were regularly monitored by the third author in field until June 2018 when some blooms were observed. Preliminary study revealed that these flowering individuals belong to an unrecorded species as their flowers showed a unique combination of characters that could not perfectly match with any previously known taxa in Taiwan (Su, 2000; Lin *et al.*, 2016). A further comparative study of literature and herbaria materials from Taiwan and neighboring areas was then conducted, and eventually we describe it as *Gastrochilus deltoglossus*.

Gastrochilus deltoglossus T.C. Hsu, S.I. Hsieh, J.H. Wu & H.C. Hung, *sp. nov.* **Figs. 1, 2, 3A & 3D**

Type: TAIWAN. Nantou County: Ren'ai Township, 2000–2500 m elev., 8 Jun 2018, J. H. Wu 525 (holotype: TCF!; isotypes: TAIF!, TNM!).

Diagnosis: This new species is similar to *Gastrochilus raraensis*, from which it differs in having a wider (3.0–3.5 vs. ca. 2.0 mm) saccate lip hypochile and a smaller, deltoid (vs. semiorbicular to reniform), adaxially sparsely short-hairy (vs. densely long hairy) lip epichile. It is also similar to *G. ciliaris* but can be differentiated on the basis of its pendulous (vs. creeping) stems, larger (3.5–4.0 vs. 2.0–3.0 mm long) tepals, much larger (3.5–4.0 mm tall and 3.0–3.5 in diam. vs. 1.5–2.0 mm tall and ca. 2.0 mm in diam.) subconical (vs. semispherical) lip hypochile with acute (vs. rounded) bottom, and obtuse (vs. rounded or emarginate) epichile.

Morphology: Stems clustered, pendulous, rarely branched; 2–11 cm long; usually rooting. Leaves

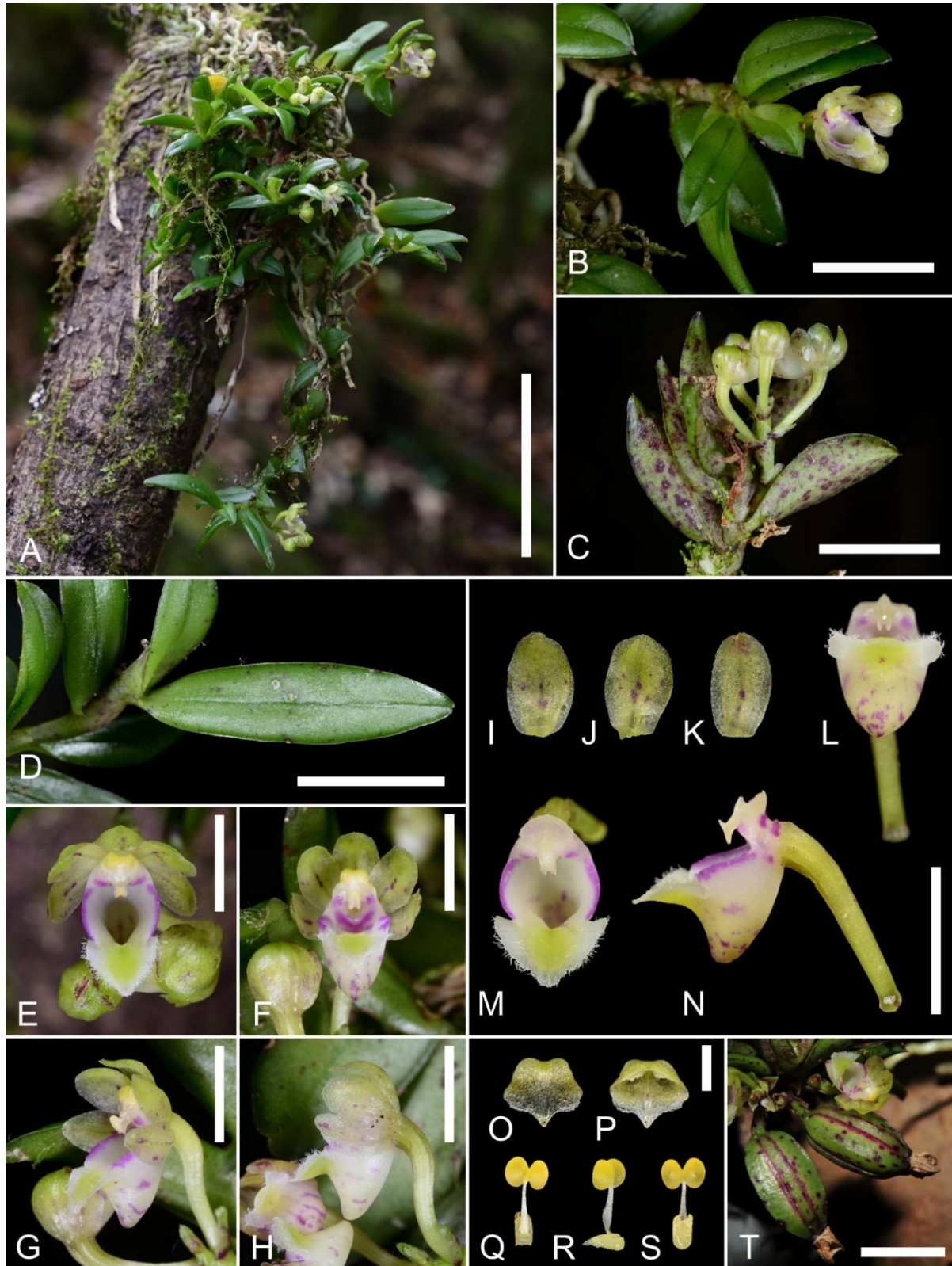


Fig. 1. Morphology of *Gastrochilus deltoglossus*, from J.H. Wu 525. **A–C.** Flowering habits. **D.** Leaf. **E–H.** Flower (**E**, top view; **F**, front view; **G–H**, side view). **I.** Dorsal sepal, adaxial view. **J.** Petal, adaxial view. **K.** Lateral sepal, adaxial view. **L–N.** Lip and column (**L**, front view; **M**, top view; **N**, side view). **O–P.** Anther cap (**O**, top view; **P**, bottom view). **Q–S.** Pollinarium (**Q**, top view; **R**, side view; **S**, bottom view). **T.** Capsules. Scale bars: A = 5 cm. B–D & T = 1 cm. E–N = 5 mm. O–S = 1 mm.

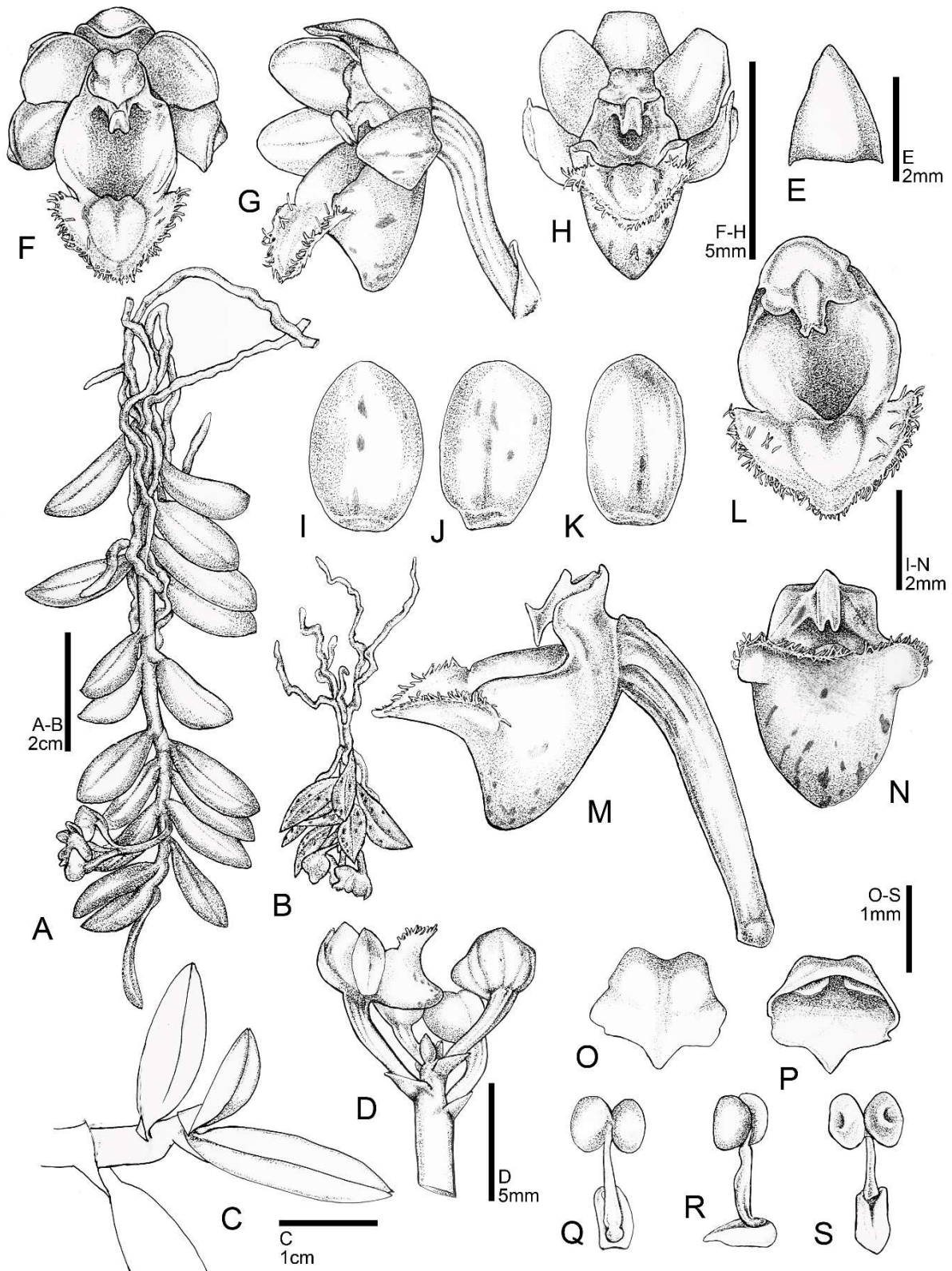


Fig. 2. Line drawing of *Gastrochilus deltoglossus*, from J.H. Wu 525. **A–B.** Flowering habits (**A**, bottom view; **B**, top view). **C.** Leaves. **D.** Inflorescence. **E.** Bract. **F–H.** Flower (**F**, top view; **G**, side view; **H**, front view). **I.** Dorsal sepal. **J.** Petal. **K.** Lateral sepal. **L–N.** Lip and column (**L**, top view; **M**, side view; **N**, front view). **O–P.** Anther cap (**O**, top view; **P**, bottom view). **Q–S.** Pollinarium (**Q**, top view; **R**, side view; **S**, bottom view). Illustrated by Hsin-Chieh Hung.

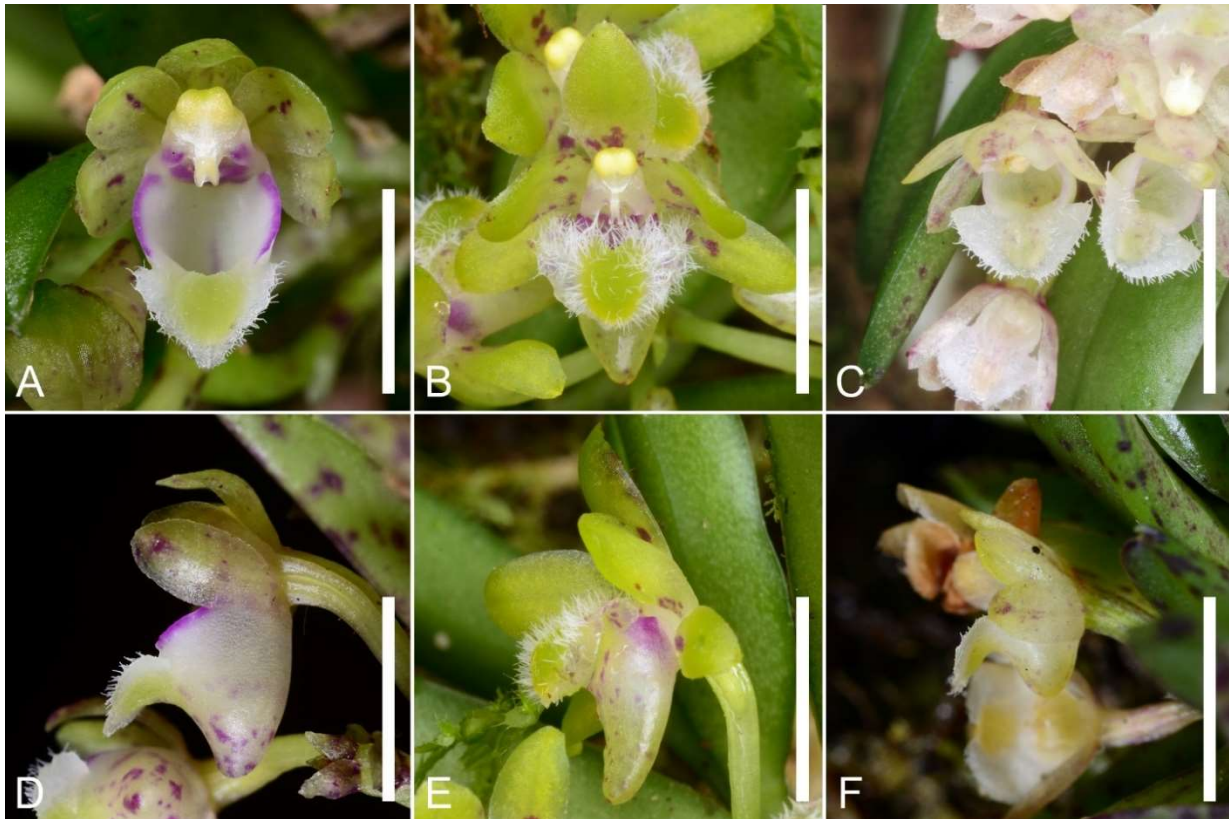


Fig. 3. Comparative floral morphology of *Gastrochilus deltoglossus* (A & D, from J.H. Wu 525), *G. raraensis* (B & E, from T.C. Hsu 6289, TAIF) and *G. ciliaris* (C & F, from T.C. Hsu 8580, TAIF). A–C. Front view. D–F. Side view. Scale bars = 5 mm.

distichous, twisted at bases and roughly lying in one plane, leathery, narrowly elliptic, 10–23 × 5–7 mm, base cuneate, apex acute, with obscurely bilobulate or trilobulate tips, surface glossy, usually spotted with dark purple dots. Inflorescence lateral, 4–20 mm long, usually beneath leaf planes, subumbellate, 2–4-flowered; peduncle 3–17 mm long, with a sterile bract; rachis slightly dilated, 1–3 mm long; bracts deltoid, 2.0–2.5 × 1.8–2.2 mm, apex acute. Pedicellate ovary 6–7 mm long. Flowers fleshy, partly open, 6–8 mm tall, 5–7 mm wide, pale yellowish green with beige-white lips, sparsely spotted with reddish purple dots or short stripes both adaxially and abaxially. Sepals and petals subequal, elliptic-oblong, slightly concave, 3.5–4.0 × ca. 2.0 mm, glabrous, abaxially slightly ridged, apex rounded, margin entire or minutely ciliate. Lip composed by a saccate hypochile and a flat epichile, 5.0–5.5 mm long; hypochile subconical, slightly bent forward, widest at mouth, 3.5–4.0 mm tall, 3.0–3.5 mm in diam., acute at bottom, glabrous and smooth on both surfaces; epichile broadly deltoid, approximately as wide as hypochile, 2.0–2.5 × 3.0–3.5 mm, obtuse at apex, ciliate in margin, with a pale green, glabrous or minutely papillate, longitudinally slightly furrowed central cushion and whitish, adaxially sparsely short-hairy surroundings. Column short and stout, ca. 1.5 mm long, 2.0 mm wide,

footless; rostellum retrose, forked at apex; anther cap subpentagonal, ca. 1.4 × 1.7 mm, mucronate-acute at apex; pollinarium ca. 2 mm long; pollinia 2, waxy, ellipsoid, porate; stipe slender, ca. 1.5 mm long; viscidium elliptic. Capsules trigonous-fusiform, green, spotted with reddish purple dots and stripes, 12–14 × 6–7 mm.

Chinese name: 三角唇松蘭.

Etymology: The specific epithet is a combination of “delta”, triangular, and “glossus”, tongue, derived from the characteristic deltoid lip epichile of the new species.

Habitat and ecology: *Gastrochilus deltoglossus* is currently only found in the mixed forest between 2000–2500 m in Ren'ai Township of Nantou County. The forest is dominant by *Quercus* spp., *Machilus japonica* Sieb. & Zucc. and *Schima superba* Gard. & Champ. var. *superb* with scattered *Chamaecyparis formosensis* Matsum. and *Taxus mairei* (Lemée & H. Lév.) S.Y. Hu. The new species is usually epiphytic on higher trunks and larger branches of both broadleaf and Coniferous trees. Its blooming has been observed in June and July. Enlarged capsules were also observed along with flowers (Fig. 1–T), implying that its fruiting period might last for more than one year, or it is also possible that this species has variable flowering seasons.

Distribution and conservation status: *Gastrochilus deltoglossus* is endemic to Taiwan. Currently only one

**Table 1.** Morphological comparison of *Gastrochilus deltoglossus*, *G. ciliaris* and *G. raraensis*.

	<i>G. deltoglossus</i>	<i>G. ciliaris</i>	<i>G. raraensis</i>
Stem posture	pendulous; usually rooting on proximal nodes only	creeping; usually rooting on both proximal and distal nodes	pendulous; usually rooting on proximal nodes only
Pedicellate ovary length	6–7 mm	3–4 mm	5–7 mm
Flower dimensions (height and width)	6–8 × 5–7 mm	4–5 × 4–5 mm	7–9 × 6–8 mm
Tepal dimensions	3.5–4.0 × 1.8–2.2 mm	2.0–3.0 × 1.0–1.4 mm	4.0–4.5 × 2.0–2.5 mm
Hypochile shape	subconical; acute at bottom	semispherical; rounded at bottom	cylindrical-conical; obtuse at bottom
Hypochile dimensions (height and diam.)	3.5–4.0 × 3.0–3.5 mm	1.5–2.0 × ca. 2.0 mm	3.5–4.5 × ca. 2.0 mm
Epichile shape	broadly deltoid; apex obtuse	semiorbicular to reniform; apex rounded	broadly deltoid to semiorbicular; apex rounded
Epichile dimensions	2.0–2.5 × 3.0–3.5 mm	2.5–3.0 × 3.5–4 mm	1.5–2.0 × 3.0–3.5 mm
Epichile hairiness	sparsely short-hairy adaxially; margin ciliate	densely long-hairy adaxially; margin ciliate	sparsely short-hairy adaxially; margin ciliate
Anther cap length	ca. 1.4 mm	ca. 1.0 mm	ca. 1.0 mm

subpopulation in Ren'ai Township of Nantou County has been observed, and no additional records could be detected after the thorough examination of the authors' private image collections, photos posted on the Internet and herbaria materials preserved in HAST, TAI and TAIF. The estimated EOO and AOO are 25 km² and 10 km² respectively. Though currently only ca. 30 mature individuals are known, considering that such a small epiphyte growing on higher tree trunk is usually difficult to discover, we estimate the total number of mature individuals to be below 100. Most wild orchids in Taiwan are still under the threat of collection by both commercial collectors and orchid hobbyists. Under these conditions, we assess *G. deltoglossus* as **Critically Endangered** [CR B1ab(v); C2a(i);D] based on IUCN Red List Categories and Criteria (IUCN, 2012; Editorial Committee of the Red List of Taiwan Plants, 2017). An artificial reproduction project for this new species will be launched by Dr. Cecilia Koo Botanic Conservation and Environmental Protection Foundation.

Taxonomic remarks: *Gastrochilus deltoglossus* belongs to sect. *Microphyllae*, a species group with small (mostly < 3 cm) leaves distichously arranged along an elongate (often > 5 cm) and slender (< 3 mm in diam.) stem (Tsi, 1996; Tsi *et al.*, 1999; Kumar *et al.*, 2014). This new species is distinguished from allied taxa in sect. *Microphyllae* by the combination of pendulous stem, leaves without awned apices, 3.5–4.0 mm tall subconical hypochile, and broadly deltoid epichile which are approximately as wide as the hypochile, ciliate in margin and sparsely short-hairy on adaxial surfaces. In gross outline, *G. deltoglossus* might be most similar to another Taiwan endemic species, *G. raraensis* Fukuy., in sharing pendulous stem, ca. 4 mm tall hypochile and 3–4 mm wide, hairy epichile. However, the later could be clearly distinguished by its 3–8-flowered inflorescence, distinctly narrower hypochile (ca. 2 mm in diam.), and slightly larger (ca. 3 × 4 mm), semiorbicular to reniform,

adaxially densely long-hairy epichile (Fukuyama, 1934; Lin, 1987; Su, 2000; Chen *et al.*, 2009). *G. deltoglossus* also shows similar floral morphology with *G. ciliaris* F. Maek, recorded from Taiwan and Japan, as both species bear broadly deltoid epichile with ciliate margin and sparsely hairy adaxial surface. Even so, *G. ciliaris* is easily distinguished by its creeping stem, smaller (2–3 mm long) tepals, much smaller (1–2 mm tall and ca. 2 mm in diam.) semispherical hypochile and slightly shorter epichile with rounded apex (Maekawa, 1936; Chung and Leou, 1993; Su, 2000; Chen *et al.*, 2009; Nakajima, 2012; Yokota *et al.*, 2016). In addition to above mentioned characters, the column and anther of *G. deltoglossus* are also larger than *G. raraensis* and *G. ciliaris*. Detailed morphological comparison between these three closely allied species is provided in Table 1, and a plate showing their floral morphology (Fig. 3) is also given.

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