



New and noteworthy orchids (Orchidaceae) discovered in Langbiang Plateau, southern Vietnam 1

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ABSTRACT: Recent field expeditions in Langbiang Plateau of southern Vietnam resulted in new data for the orchid flora of Vietnam. Two new species (*Nervilia pubilabia* and *Panisea sagittata*), two new national records (*Cheirostylis tortilacinia* and *Goodyera reticulata*) and the rediscovery of a supposedly extinct species (*Liparis nana*) are reported, and background data about their morphology, biogeography, ecology, conservation and taxonomy are also provided.

KEY WORDS: Bidoup-Nui Ba National Park, Indochina, new records, new species, rediscovered species, Orchidaceae, taxonomy.

INTRODUCTION

Langbiang Plateau, also known as Da Lat Plateau or Lam Vien Plateau, is located at the southern end of Truong Son (Annamite mountain range) in southern Vietnam (Fig. 1). This mountainous region is famous for its mild and consistent climate and has long been recognized as a biodiversity hotspot of the country. In 2002, Bidoup-Nui Ba National Park was established to conserve its vulnerable ecosystems. In 2015, this region was further recognized as “the Langbiang Biosphere Reserve” by UNESCO due to its rich and unique biodiversity. To date, new findings of various groups of organisms from this region are continuously being published (e.g., lichens, Joshi *et al.*, 2015; liverworts, Pócs *et al.*, 2019; ferns, Chen *et al.*, 2019; flowering plants, Luu *et al.*, 2018; insects, Takaoka *et al.*, 2015; lizards, Nazarov *et al.*, 2012; snakes, Nguyen *et al.*, 2019).

Toward a better understanding to its flora, the “Botanical survey in Langbiang Plateau, Vietnam” project was launched in 2018 as a collaboration between Vietnam and Taiwan. Based on the preliminary findings of the resulting field expeditions, here we present new taxonomic and biogeographic data in Orchidaceae, the largest vascular plant family of the country (Averyanov *et al.*, 2003). Two new species (*Nervilia pubilabia* T.C. Hsu, C.W. Chen & Luu and *Panisea sagittata* T.C. Hsu, H.C. Hung & Luu) are herein described and illustrated. Two new records (*Cheirostylis tortilacinia* C.S. Leou

and *Goodyera reticulata* (Blume) Blume) and the rediscovery of *Liparis nana* Rolfe, a poorly known and supposedly extinct species, are also reported with discussion of their diagnoses and taxonomic affinities. These new findings continue to reveal the astonishing biodiversity of Langbiang Plateau. Unfortunately, many primary habitats and native species, especially those located outside the protected area, are still under threat of logging, expansion of coffee plantations and commercial collection, and conservation strategies are thus urgently needed.

MATERIALS AND METHODS

Voucher specimens were collected during 2014–2019 from Langbiang Plateau of southern Vietnam, covering the northern part of Lam Dong Province and the western corner of Khanh Hoa Province (Fig. 1). Flowering specimens were dissected and photographed, and the descriptions were prepared based exclusively on measurements of fresh materials. Some additional flowers and inflorescences were also fixed and stored in 60–65% ethanol to keep their original structure, and partial fragments were separately stored within silica gel for genetic studies. The main set of voucher specimens was deposited in the herbarium of Southern Institute of Ecology, Vietnam Academy of Science and Technology (SGN), and duplicates, whenever available, were deposited in the herbarium of Taiwan Forestry Research Institute (TAIF). Specimen identification was mainly

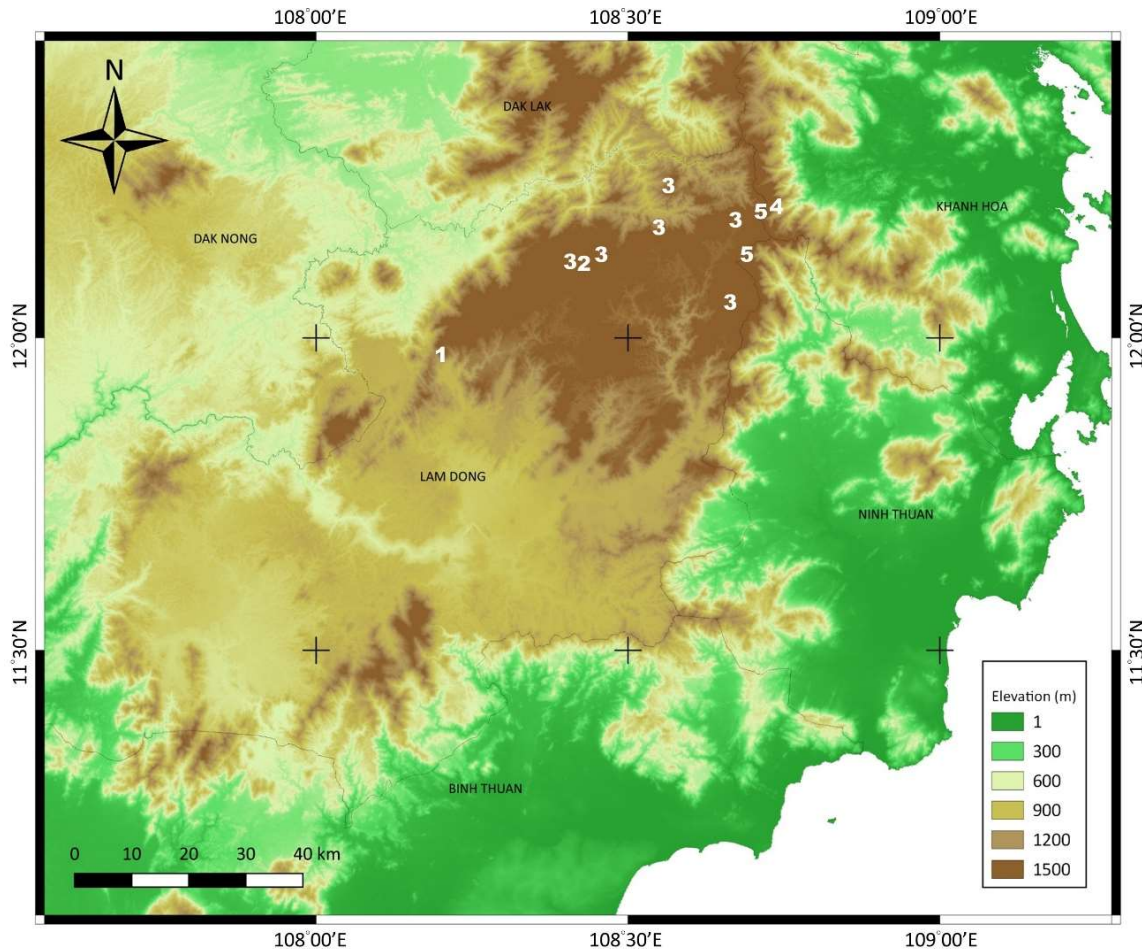


Fig. 1. Map of Lang Biang Plateau and known localities of the studied taxa: *Cheirostylis tortilacinia* (1), *Goodyera reticulata* (2), *Liparis nana* (3), *N. pubilabia* (4) and *Panisea sagittata* (5).

based on the modern floristic studies of Seidenfaden (1992) and Averyanov (2008; 2010; 2011b; 2013) plus new taxonomic data published in recent years. Conservation status of the studied taxa were evaluated based on the latest guidelines available on the IUCN website (IUCN Standards and Petitions Committee, 2019), and we used GeoCAT (Bachman *et al.*, 2011) to help assess the Extent of Occurrence (EEO) and the Area of Occupancy (AOO). The studied taxa are listed below in alphabetical order. Terminology used in morphological descriptions generally follows Beentje (2016) and Averyanov (2008).

TAXONOMIC TREATMENT

Cheirostylis tortilacinia C.S. Leou, Quart. J. Exp. Forest. 4: 72, f. 1–2 (1990); Leou, Fl. Taiwan 5: 802 (2000); Chen *et al.*, Fl. China 25: 59 (2009); Lin *et al.*, Taiwania 61: 87 (2016). **Type:** TAIWAN. Nantou County: Hoshe, ca. 1000 m, *C.S. Leou 4143* (holotype: NTUF, not found).

Fig. 2, A–F

Distribution: Previously known from China (Hainan, see Huang *et al.*, 2014) and Taiwan (Chiayi, 238

Nantou and Taichung); newly recorded from Vietnam (Lam Dong).

Habitat and phenology: In Vietnam, this species was found as a lithophyte growing on silicate rocks under primary broadleaved forest in a damp valley at an elevation of ca. 1200 m. Flowering was observed in late January.

Conservation status: In Vietnam, only one location with ca. 10 mature individuals was observed. More data are needed for the precise evaluation of its distribution and population size in Vietnam, and this species is thus considered as Data Deficient (DD) for now.

Studied specimens: VIETNAM. Lam Dong Province: Lam Ha District, Nam Ban Protection Forest, 1200 m, 27 January 2019, *Hsu 11247* (SGN). CHINA. Hainan Province: Baisha Li Autonomous County, Mt. Yingge, 800–1000 m, 9 February 2011, *Hsu 3625* (TAIF-474906). TAIWAN. Chiayi County: Shihcho to Shihzulu, 1300–1600 m, 30 March 2012, *Hsu 5542* (TAIF-391915). Nantou County: Hoshe, ca. 600 m, 7 January 1991, *Su 4143* (HAST-104744); Shenmu Village trail, 1200 m, 6 January 2007, *Lu 12971* (HAST-119117); Shenmu Logging Road, 1500 m, 23 January 2007, *Hsu 700* (TAIF-286753); Shenmutsun, 1200 m, 17 January 2013, *Shen s.n.* (TAI-282764). Taichung City: Basiashan National Forest Recreation Area, ca. 900 m, 17 February 2008, *Hsu 1227* (TAIF-303718).

Note: According to the protologue, the holotype of



Cheirostylis tortilacinia was deposited in the herbarium of Department of Forestry, National Taiwan University (herbarium code: NTUF) (Leou, 1990). However, neither the holotype nor any of the paratypes cited in the protologue could currently (November 2019) be located in NTUF or any other herbaria in Taiwan. Fortunately, the detailed description and illustrations presented in the protologue are sufficient for species identification. This species could be distinguished from the other 16 known *Cheirostylis* species in Vietnam (Averyanov, 2008; 2010; Averyanov *et al.*, 2015) by the combination of ascending to erect stems, ovate to ovate-deltoid, acute, uniformly dark green or dark reddish-green leaves, 1–5 cm long peduncles, densely glandular-pilose ovaries and sepals, ventrally distinctly saccate perianth tube, obliquely spatulate petals, and lip epichile lobes fringed with 3–5 sometimes twisted segments. The flowers of *C. tortilacinia* roughly resemble those of *C. chinensis* Rolfe, but the vegetative parts are quite distinct, as *C. chinensis* has basally creeping stems and grayish green leaves with dark green venation.

Goodyera reticulata (Blume) Blume, Coll. Orchid. 35, t. 9b (1858); Blume, Flora Javae et Insularum Adjacentium, Nova Series: t. 26, f. 1 (1858); Smith, Die Orchideen von Java, Figuren-Atlas: f. 92 (1908–1914); Comber, Orch. Java: 30, f. (1990). **Basionym:** *Neottia reticulata* Blume, Bijdr. Fl. Ned. Ind.: 409 (1825). **Type:** INDONESIA. Java, Mt. Gede, *C. L. Blume s.n.* (holotype: L-0061428 image!).

Fig. 2, G–J.

Distribution: Indonesia (Borneo, Java and Lesser Sunda Islands); newly recorded from Vietnam (Lam Dong).

Habitat and phenology: In Vietnam, this species was found growing under primary broadleaved forest along a stream at an elevation of ca. 1750 m. Flowering was observed in October.

Conservation status: In Vietnam, only one location with ca. 5 mature individuals was observed within a protected area. More data are needed for the precise evaluation of its distribution and population size in Vietnam, and this species is thus considered as Data Deficient (DD) for now.

Studied specimens: VIETNAM. Lam Dong Province: Lac Duong District, Dung K'No Commune, Bidoup-Nui Ba National Park, Cong Troi Station, 1750 m, 17 October 2019, *Hsu 12050* (SGN). INDONESIA. Java, Cianjur Regency, Cibodas, 1200–1400 m, 30 January 2010, *Hsu 2507* (TAIF-505040).

Note: The somewhat unexpected discovery of this Malesian species in southern Vietnam also represents its first record in Indochina. Among the *Goodyera* species recorded in Vietnam (Averyanov, 2008; Liu *et al.*, 2019), *G. reticulata* is closest to *G. hispida* Lindl. in sharing whitish reticulate venation on leaves and hardly opening small flowers arranged along an elongate rachis. Meanwhile, the former is readily distinguishable by its

glabrous ovaries and sepals and also by its lip hypochile obviously protruding between the lateral sepals. As noted by Lin *et al.* (2016), *G. reticulata* is also closely related to *G. hachijoensis* Yatabe and its variety *G. hachijoensis* var. *matsumuana* (Schltr.) Ohwi ex Hatusima & Amano distributed in Japan and Taiwan. Based on observation of fresh flowering materials, *G. hachijoensis* var. *matsumuana* from Taiwan is morphologically nearly identical to *G. reticulata* in Java and Vietnam but still slightly distinct in having a smaller lip with the hypochile barely protruding beyond the lateral sepals. We tentatively keep them separate and await more comprehensive study of this alliance.

Liparis nana Rolfe, 1913, Bull. Misc. Inform. Kew: 28 (1913); Gagnep., Fl. Gen. Indo-Chine 6, 2: 192 (1932); Seidenf., Dansk Bot. Ark., 31, 1: 20, fig. 9 (1976); id, Opera Bot., 114: 130, fig. 77 (1992); Aver., Ident. Guide Vietnam. Orch.: 140 (1994); P.H. Ho, Ill. Fl. Vietnam 3: 907, fig. 11374 (2000); Aver., Turczaninowia 16: 86, fig. 45, a–d (2013). **Type:** VIETNAM. “Annam”, *s. coll.*, *s.n.* (holotype: K-000943233!).

Fig. 3

Liparis meniscophora Gagnep., Bull. Soc. Bot. France 79: 166 (1932); id., l.c. 6, 2: 190 (1932). **Type:** VIETNAM. Lam Dong Province: Dalat, 11 July 1924, *Evrard 1029* (holotype: P-00327718 image!).

Liparis pygmaea auct. non King & Pantl.: Aver. & Averyanova, Updated Checklist Orch. Viet.: 43, 87 (2003).

Distribution: Vietnam (Lam Dong), endemic.

Habitat and phenology: *Liparis nana* was primarily found growing as a terrestrial herb among thick leaf litter under damp primary broadleaved forest at an elevation of 1400–1800 m. Sometimes it was also found growing on moss-covered rotten woods. Flowering was observed from June to July, and mature fruits were observed from September to December.

Conservation status: During 2014–2019, *Liparis nana* was recorded from six locations with estimated 1000 mature individuals and an EOO of 457 km² calculated in GeoCAT, and all known locations are within protected areas. Since it was confined to primary broadleaved forests which only occupy small patches among the predominant *Pinus kesiya* Royle ex Gordon forests in this region, we estimated a much smaller AOO of 20 km², but the subpopulations were not regarded as “severely fragmented” considering its potential for seed dispersal. This tiny unattractive species might face less threat of commercial collection, but the gradual expansion of coffee plantations and recreation areas would potentially pose a threat to the range and quality of its habitats. Considering these facts, this species is evaluated as Vulnerable [VU B1ab(iii)+2ab(iii); D1+2].

Studied specimens: VIETNAM. Lam Dong Province: Lac Duong District, Da Chais Commune, Giang Ly Station, 26 December 2014, *Hsu 7404* (SGN); Da Chais Commune, Mt. Bidoup, 1800 m, 23 June 2018, *Hsu 10714* (SGN, TAIF-519688); Da Nhim Commune, Dung Iar Rieng Station, 1680 m, 27 June 2018, *Hsu 10769* (SGN,



Fig. 2. Two newly recorded orchids in Vietnam. **A–F.** *Cheirostylis tortilacinia* C.S. Leou (A–D from Hsu 11247; E from Hsu 700; F from Hsu 3625). **A.** Flowering habit. **B.** Leaves. **C & D.** Flower. **E.** Flower of the specimen collected from Nantou, Taiwan (type locality). **F.** Habit of the specimen collected from Hainan, China. **G–J.** *Goodyera reticulata* Blume (from Hsu 12050). **G.** Flowering habit. **H.** Leaf. **I & J.** Inflorescence and flowers. Photographed and designed by T.C. Hsu.

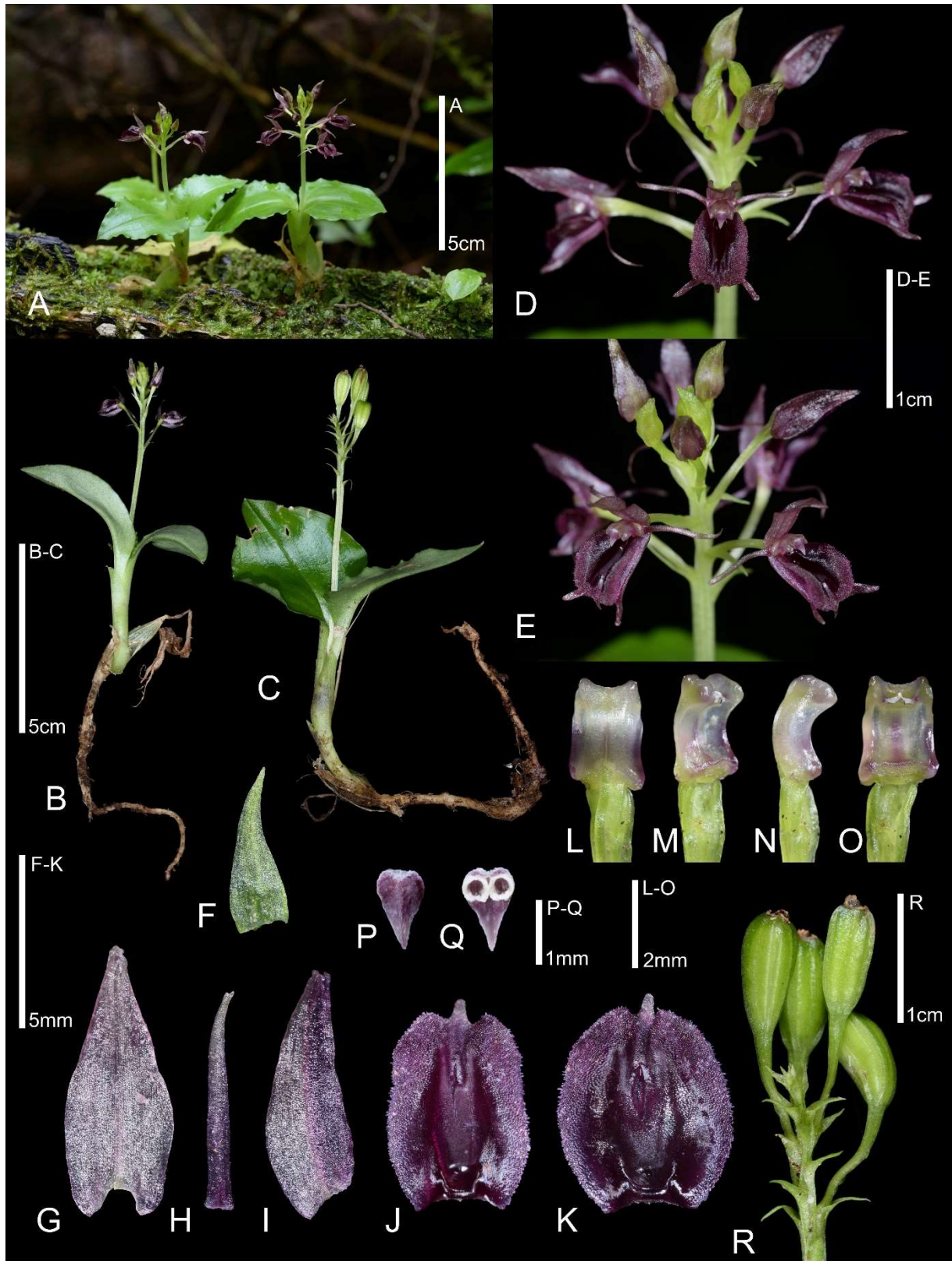


Fig. 3. Morphology of *Liparis nana* Rolfe rediscovered in Vietnam (A & D–E from *Hsu 11716*; B & F–Q from *Hsu 10714*; C & R from *Hsu 10962*). A & B. Flowering plants. C. Fruiting plant. D & E. Inflorescence and flowers. F. Bract. G. Dorsal sepal. H. Petal. I. Lateral sepal. J. Lip in natural position. K. Flattened lip. L–O. Column. P & Q. Anther cap. R. Infructescence and capsules. Photographed and designed by T.C. Hsu.



TAIF-519687); Da Nhim Commune, Dung Iar Rieng Village, 1400 m, 18 June 2019, *Hsu 11777* (SGN); Dung K'No Commune, Cong Troi Station, 1600–1800 m, 24 September 2018, *Hsu 10962* (SGN, TAIF-521483, TNM); same locality, 1600–1700 m, 9 June 2019, *Hsu 11716* (SGN, TAIF-524202, TNM); same locality, 1700–1800 m, 11 June 2019, *Hsu 11743* (SGN, TAIF-524203, TNM); Lat Commune, Cong Troi waterfall, 1600 m, 31 October 2019, *Hsu 12266* (SGN).

Note: *Liparis nana* has been considered possibly extinct because the last record dates back to 1924 (Averyanov, 2013). During an expedition in December 2014, a fruiting specimen was collected and speculated by the first author to be *L. nana*, but its identity was not confirmed until June 2018 when flowering individuals were finally observed. In the past two years, we further located several wild populations scattered around higher northern terrain of Langbiang Plateau within the range of Bidoup-Nui Ba National Park (Fig. 1). Its diminutive habit and dark-colored flowers possibly make it easily overlooked by investigators.

Our newly collected specimens generally agree with the type specimen of *Liparis nana*, especially in the diagnostic lip structure, with papillate-erose margin, mucronate apex and a large U-shaped basal callus (Fig. 3, J & K). However, we also found that some morphological characters were not precisely described in previous studies (Rolfe, 1913; Gagnepain, 1932a; 1932b; Seidenfaden, 1976; 1992; Averyanov, 2013) based on the very limited herbaria materials. A remarkable but previously unmentioned vegetative character of *L. nana* is that it has more or less distant pseudobulbs connected by obvious rhizomes (Fig. 3, B & C). The rhizome under a new pseudobulb generally elongates after anthesis and could thus be overlooked on flowering specimens. Such a growing habit has also been reported for other members of the genus, e.g., *L. montana* Lindl. (described from Java) and *L. petiolata* (D. Don) P.F. Hunt & Summerh. (described from Nepal) within *Liparis* sect. *Liparis* and clearly differentiates *L. nana* from a sometimes confused species *L. pygmaea* King & Pantl. (described from Sikkim) which has congested pseudobulbs. The stout (ca. 2.5×2 mm), broadly winged column is also characteristic (Fig. 3, L–O). However, it should be especially noted that the weird “petaloid” stylidia illustrated by Seidenfaden (1976; 1992) were not seen in any of our fresh materials. We suspect that this petaloid structure is a misinterpretation caused by morphological shifting of the old herbarium materials during the repeated dehydration and rehydration of its very fleshy column.

On account of its overall morphological appearance, we consider that *Liparis nana* might not be an evolutionarily isolated species as proclaimed by Seidenfaden (1976; 1992) and Averyanov (2013) since it shows close affinity with some Indonesian species, e.g., *L. montana* and *L. geophila* Schltr. (described from Sumatra). In fact, *L. nana* is especially closely allied to the poorly documented species *L. brevistylis* (J.J. Sm.)

J.J. Sm. described from Java. According to Smith's (1910) line drawing, the lip and column morphology of *L. brevistylis* and *L. nana* are very similar, but the basal callus of the lip in *L. brevistylis* seems to be smaller and rather columnar. Data from fresh materials of *L. brevistylis* might ultimately be necessary to clarify the affinity of these two taxa.

Nervilia pubilabia T.C. Hsu, C.W. Chen & Luu, *sp. nov.*

Figs. 4 & 5

Type: VIETNAM. Khanh Hoa Province: Khanh Vinh District, Son Thai Commune, 800–1000 m, 21 May 2015, flowering under cultivation, T.C. Hsu 7721 (holotype: SGN!, isotype: TAIF-497279!).

Diagnosis: Morphologically allied to *Nervilia mackinnonii* (Duthie) Schltr. in terms of leaf and lip outlines but differing in its rhomboid-obovate, entirely densely papillose-pubescent epichile with a broad low central ridge.

Description: Terrestrial herb up to ca. 12 cm tall in flowering plants. Tuber whitish, subglobose, 8–15 mm long and across, 3–7 noded, with short, stubby roots scattered at nodes. Subterranean stem emerging from apical node of tuber, pale brownish, 3–5 cm long, 1.8–2.8 mm in diameter, several-noded, bearing a short, membranous, sheathing cataphyll at each of the upper nodes, producing 1–3 horizontally extended, slender, 2–10 cm long runners in the leafing phase that each give rise to a daughter tuber at the apex. Petiole-like stalk erect, 2–5 cm long, pale greenish, sulcate, with 1 brown, membranous cataphyll at base. Leaf blade held a short distance above ground level, cordate-polygonal, uniformly green and glossy adaxially, pale green abaxially, thick papery, with 7 palmately divergent main veins, obtusely angulate at the tips of the main veins, $3.5\text{--}6.0 \times 4.0\text{--}6.5$ cm, deeply cordate at base, apex acute, margin flat. Scape 8.0–11.5 cm tall, pale yellowish green, bearing 2 membranous sheathing cataphylls 2.5–3.5 cm long, 1-flowered. Floral bract erect, lanceolate-oblong, $4.0\text{--}4.8 \times 2.0\text{--}2.2$ mm, acute. Pedicel and ovary 5–6 mm long, uniformly green. Flower nodding, semi-opening. Sepals subsimilar, uniformly yellowish green, narrowly lanceolate-elliptic, slightly cymbiform, acuminate, 3-veined; dorsal sepal $16\text{--}18 \times 2.4\text{--}2.7$ mm; lateral sepals indistinctly oblique, $17.5\text{--}19.0 \times 3.0\text{--}3.5$ mm. Petals uniformly yellowish green, linear-elliptic, $14.5\text{--}16.0 \times 2.2\text{--}2.5$ mm, acute, 3-veined. Lip oblong-elliptic when flattened, 14.5–15.5 mm long, obscurely swollen at the base, divided by a narrow waist at the middle into a semi-tubular hypochile and a broad epichile, white with pale green tint at base and a light yellow-green central stripe near the middle, sometimes with very scarce and obscure magenta spots scattered on the disc; hypochile involute and embracing the column in natural position, pandurate-obovate, $7.5\text{--}8.0 \times 6.0\text{--}6.5$ mm when flattened, terminating in a pair of ovate-deltoid, obtuse

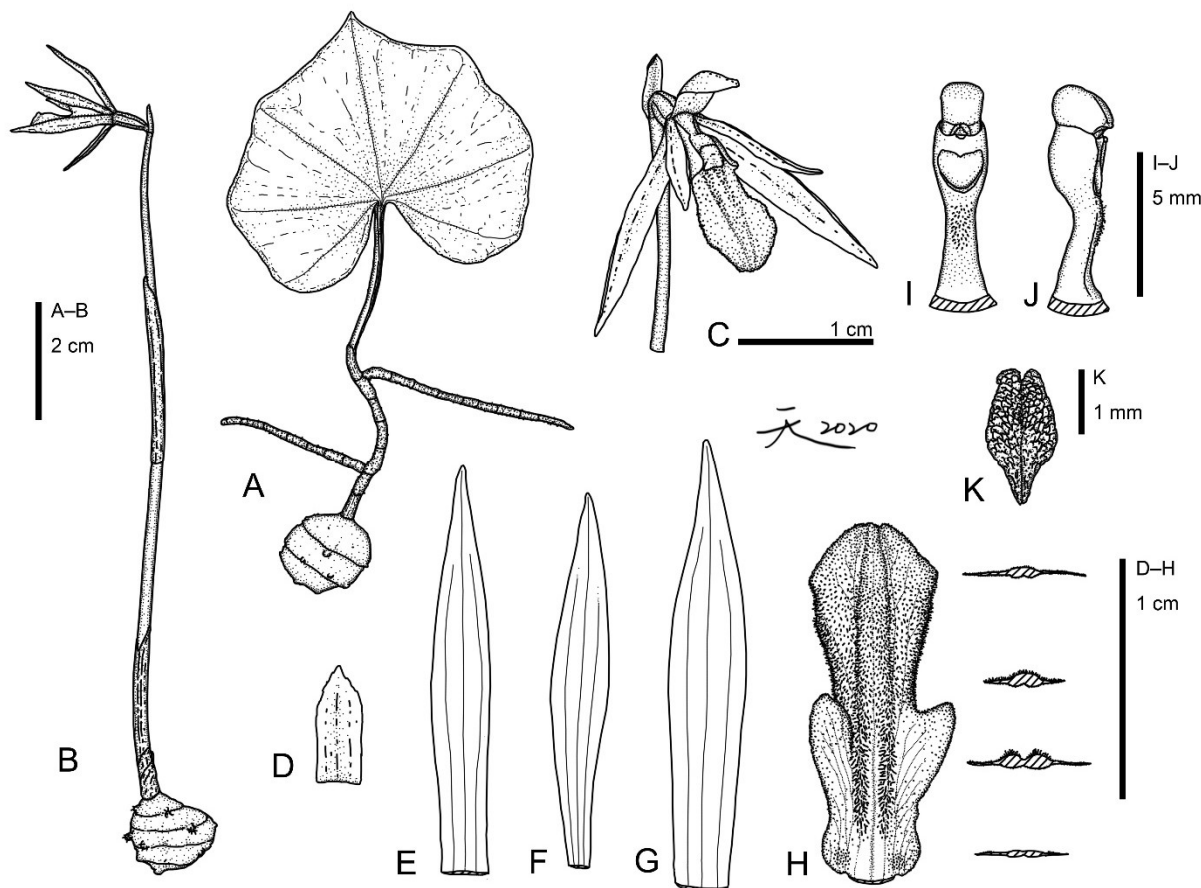


Fig. 4. *Nervilia pubilabia* T.C. Hsu, C.W. Chen & Luu (A from Hsu 7377; B–K from Hsu 7721). **A.** Vegetative plant. **B.** Flowering plant. **C.** Flower. **D.** Floral bract. **E.** Dorsal sepal. **F.** Petal. **G.** Lateral sepal. **H.** Lip. **I & J.** Column. **K.** Pollinia. Illustrated by T.C. Hsu.

auricles ca. 1.5 mm long, shortly papillose throughout, with two patches of slightly longer papillae near the base; epichile rhomboid-ovate, widest at around one-third below the apex, $8.0\text{--}8.5 \times 5.0\text{--}5.5$ mm, entire, rounded-subtruncate at the apex, densely papillose-pubescent throughout, with longer hair-like papillae from base to the widest part and shorter conical papillae toward the apex; disc with two adjacent pubescent ridges arising from near the base of the hypochile, forming a narrow channel that extends to the base of epichile, the ridges then merging into a single broad, rounded, densely papillose-pubescent ridge extending to the apex of the epichile. Column clavate, slightly sigmoid, 5.5–6.5 mm long (excluding anther), white flushed light green, with a patch of short hairs beneath the stigma; anther helmet-shaped, ca. 2.5 mm long; pollinium c. 2 mm long; rostellum thickened and protruding; stigma shield-shaped, slightly concave. Capsule not seen.

Distribution: Vietnam (Khanh Hoa), endemic.

Etymology: The specific epithet is composed by *pubi-*, downy, and *labia*, lip, referring to its characteristic papillate-pubescent epichile of lip.

Habitat and phenology: Terrestrial under shaded damp broadleaved forest at an elevation of 800–1000 m. Flowers observed in May under cultivation but unknown in the field; leaves appearing from June to December under cultivation.

Paratype: VIETNAM. Khanh Hoa Province: Khanh Vinh District, Son Thai Commune, 800–1000 m, 25 Dec 2014, leafing, Hsu 7377 (SGN!)

Conservation status: *Nervilia pubilabia* is currently only known from its type locality, with estimated 100 mature individuals growing in an unprotected forest. Due to the difficulty of recognizing and identifying taxa within the *N. adolphi/punctata* species alliance, we suspect that its occurrence is still under-recorded, and more investigations are needed to clarify its distribution range and population size. The species is thus tentatively regarded as Data Deficient (DD).

Note: *Nervilia pubilabia* belongs to the “*N. adolphi/punctata* species alliance”, a group of closely related 1-flowered taxa in sect. *Linervia* sharing an entire, slender, usually white and purple-marked lip and a glabrous angular leaf (Gale *et al.*, 2018). The new species

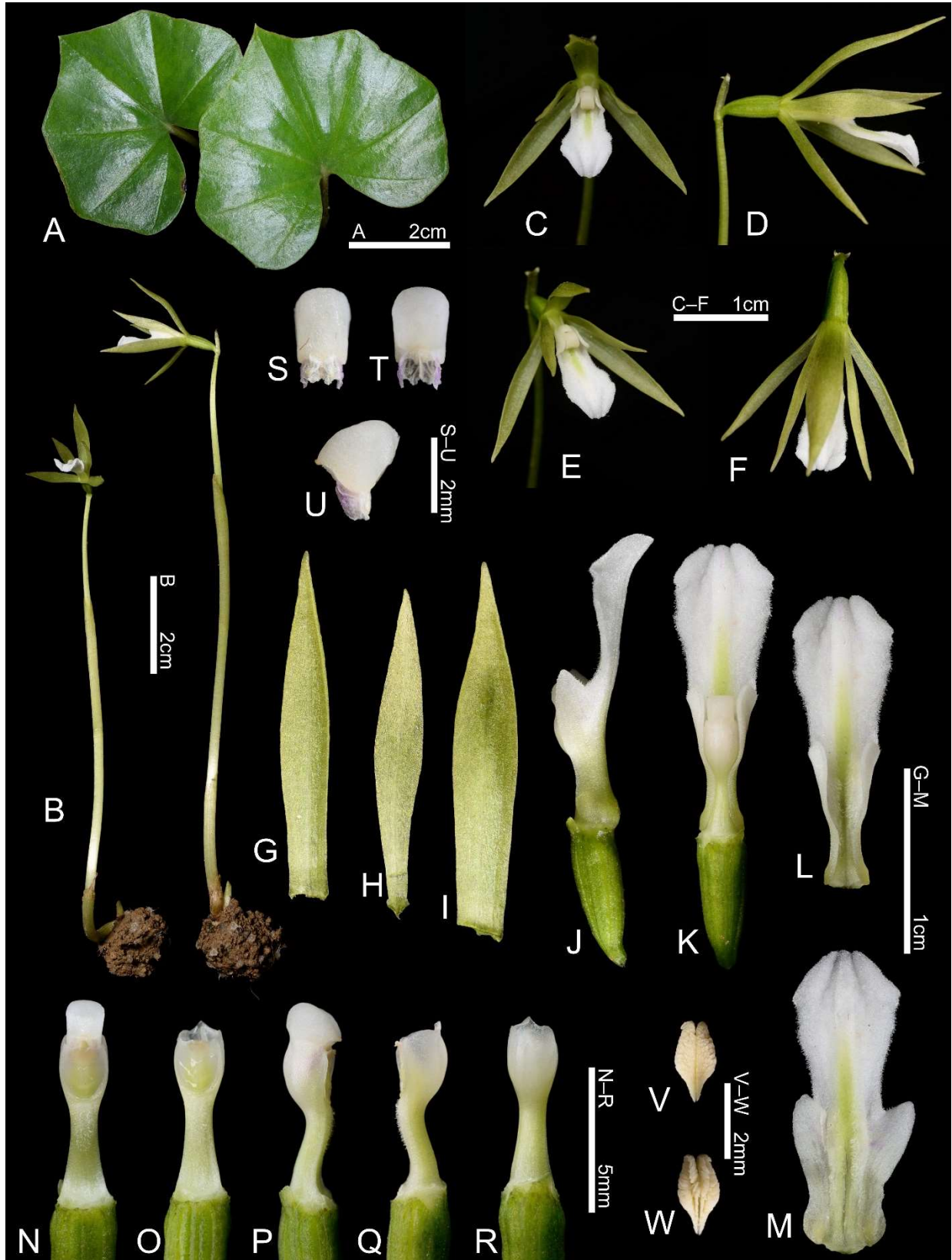


Fig. 5. *Nervilia pubilabia* T.C. Hsu, C.W. Chen & Luu (A from *Hsu* 7377; B–W from *Hsu* 7721). **A.** Leaves. **B.** Flowering plants. **C–F.** Flower. **G.** Dorsal sepal. **H.** Petal. **I.** Lateral sepal. **J & K.** Lip and column. **L.** Lip in natural position. **M.** Flattened lip. **N–R.** Column. **S–U.** Anther. **V & W.** Pollinia. Photographed and designed by T.C. Hsu.

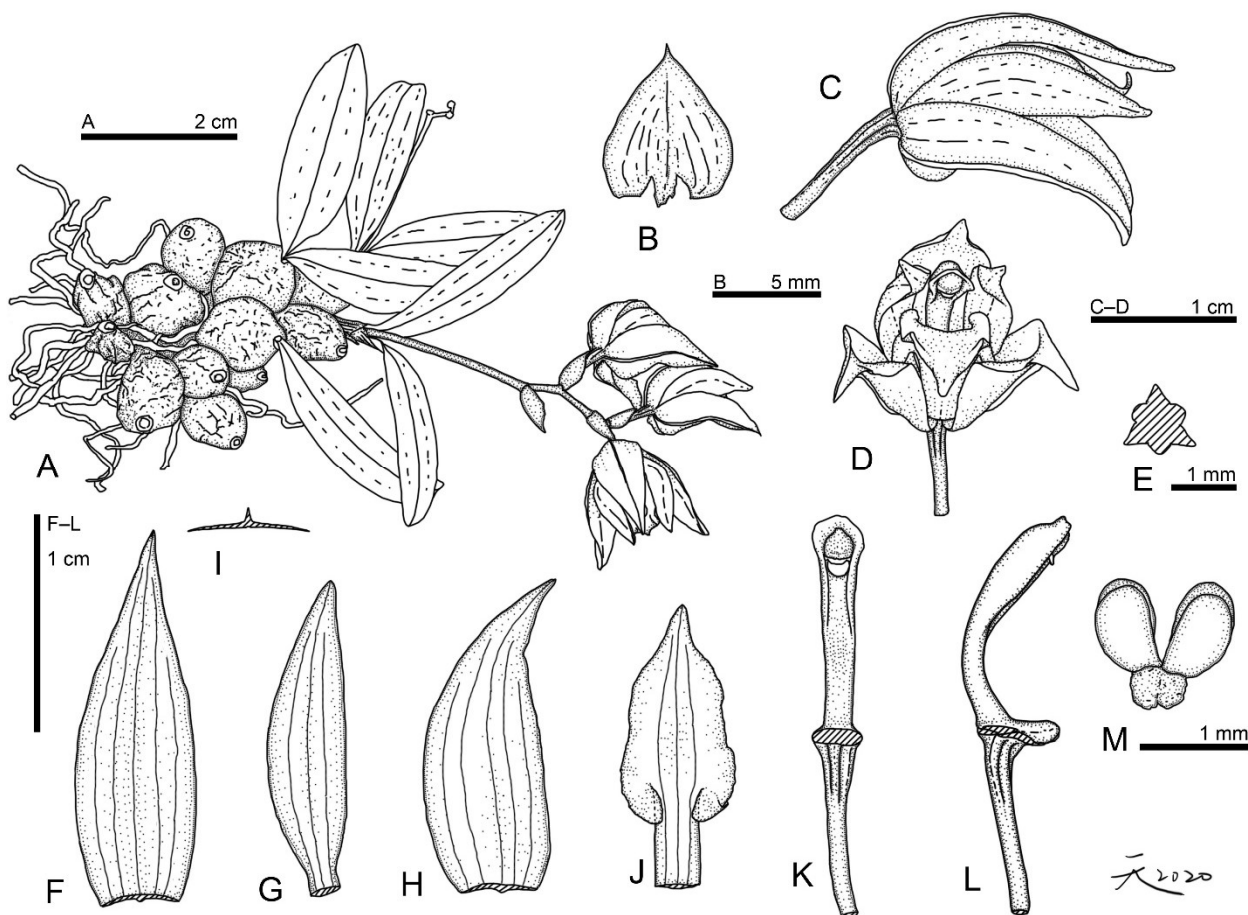


Fig. 6. *Panisea sagittata* T.C. Hsu, H.C. Hung & Luu (from *Hsu 10893*). **A.** Flowering plant. **B.** Floral bract. **C & D.** Flower. **E.** Dorsal sepal. **F.** Petal. **G.** Lateral sepal. **H.** Cross section of sepals. **I.** Lip. **J & K.** Column. **L.** Cross section of ovary. **M.** Pollinia. Illustrated by T.C. Hsu.

is remarkable in its rhomboid-obovate, entirely densely papillose-pubescent epichile with a broad low central ridge (Figs. 4H & 5M). Among the *N. adolphi/punctata* alliance currently confirmed in Vietnam, i.e. *N. gracilis* Aver., *N. mackinnonii* (Duthie) Schltr. and *N. muratana* S.W. Gale & S.K. Wu (Averyanov, 2011a; 2011b; Averyanov *et al.*, 2019), *N. pubilabia* most resembles *N. gracilis* and *N. mackinnonii* as they share a deciduous, angulate, uniformly green leaf and a lip with the hypochile roughly as long as the epichile. However, *N. mackinnonii* is distinct by its narrowly oblong epichile which is only ca. 2.5 mm wide and never described as densely papillose-pubescent (Seidenfaden, 1978; Chen and Gale, 2009; Raskoti and Ale, 2010; Averyanov *et al.*, 2019), and *N. gracilis* is also distinguishable in having a disc with two short glabrous keels instead of a long pubescent ridge. Additionally, *N. pubilabia* is also similar to the Thailand endemic *N. trangensis* S.W. Gale, Suddee & Duangjai in terms of lip outline and disc ornamentation, but the later differs in its acute (vs. obtuse) hypochile auricles and its broader (6.4–7.4 v.s. 5.0–5.5), less prominently papillose epichile based on the description, line drawing and photos given in the

protologue (Gale *et al.*, 2018). Although the type material of *N. pubilabia* is also remarkable in having entirely yellowish green sepals and petals and a nearly entirely white lip (Fig. 5, C–M), additional observation is necessary to confirm whether such floral coloration is diagnostic for the species.

Panisea sagittata T.C. Hsu, H.C. Hung & Luu, *sp. nov.*

Fig. 6 & 7

Type: VIETNAM. Lam Dong Province: Lac Duong District, Da Chais Commune, Bidoup-Nui Ba National Park, around Hon Giao Station, 1880 m, 19 September 2018, *T.C. Hsu 10893* (holotype: SGN!, isotypes: TAIF-524200!, TNM!).

Diagnosis: The new species differs from all other *Panisea* species in having a sagittate lip with a flat disc and a pair of backward-pointing basal lobules.

Description: Epiphytic herb ca. 5–10 cm tall. Rhizome obscure. Pseudobulbs densely clustered, ovate to ovate-spherical, 1.2–1.8 × 0.8–1.2 cm, smooth, dull, irregularly rugulose in dry condition, with 2 apical leaves; young pseudobulb covered with 4–6 brown caducous cataphylls at base. Leaves narrow-elliptic, (2)3–6 × (0.5)0.7

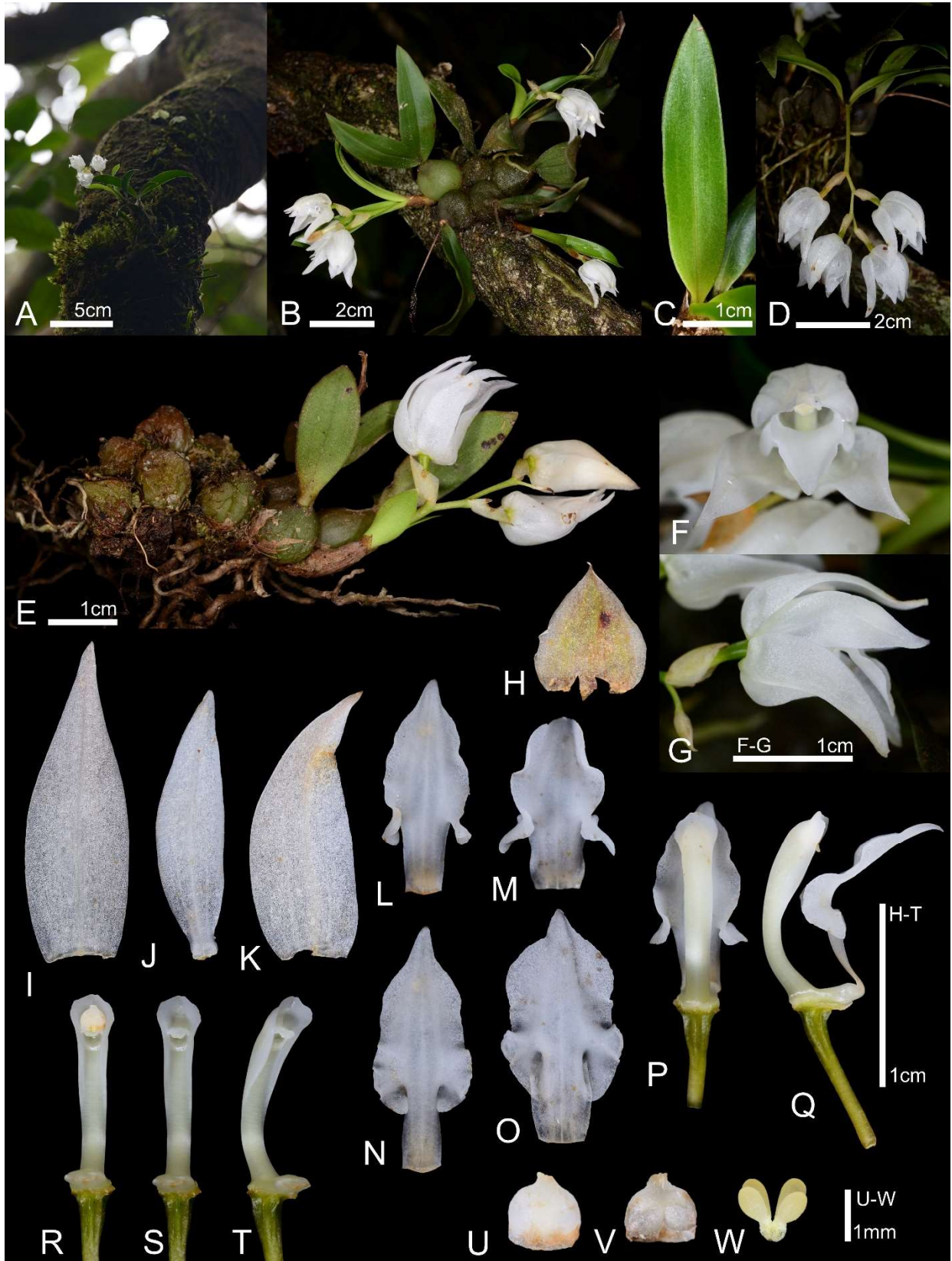


Fig. 7. *Panisea sagittata* T.C. Hsu, H.C. Hung & Luu (from *Hsu 10893*). **A, B & E.** Flowering plants. **C.** Leaf. **D.** Inflorescence. **F & G.** Flower. **H.** Floral bract. **I.** Dorsal sepal. **J.** Petal. **K.** Lateral sepal. **L & M.** Lips in natural position. **N & O.** Flattened lips. **P & Q.** Lip and column. **R–T.** Column. **U & V.** Anther. **W.** Pollinia. Photographed and designed by T.C. Hsu.



–1.0(1.2) cm, thin coriaceous, slightly glossy adaxially, attenuate and subsessile at base, acuminate at apex, with prominent mid-vein and 2 obscure lateral veins. Inflorescence subhysteranthous, pedunculate, distichously (1)2–4(5)-flowered; scape green, slender, (1.0)2.0–3.5(4.0) cm long, usually inclined, naked; rachis 0.5–2 cm. Floral bracts pale greenish white, papery, conduplicate, enclosing pedicels and ovaries, broadly ovate when flattened, 5–9 × 4–7 mm, acute at apex, withered but persistent after anthesis. Pedicels and ovaries 5–10 mm long, nearly straight. Flowers ± synchronously blooming, pure white, not widely opening, usually nodding, odorless, glabrous throughout. Sepals 5-veined, mid-vein keeled abaxially, slightly concave near base, acuminate at apex; dorsal sepal ovate-lanceolate, 16–18 × 4–6 mm; lateral sepals falcate-ovate, 15.0–16.5 × 4.0–5.5 mm. Petals obliquely narrowly rhombic-elliptic, 14.5–15.5 × 3.0–4.0 mm, 3-veined, flat, acute-acuminate at apex. Lip adnate to apex of column foot, sagittate and slightly sigmoid in natural position, elliptic when flattened, 3-veined, 12.5–14.0 mm long, divided into an unguiculate hypochile and a broad epichile; hypochile rectangular-oblong, 4.5–5.0 × 2.5–3.5 mm, slightly revolute; epichile ovate to ovate-elliptic, with two backward-pointing auriculate lobules at base, 10–11 × 5.5–7.0 mm including basal lobules, acuminate at apex, margin coarsely undulate; basal lobules 1.8–2.8 × 1.5–2.0 mm, ± inward curved when flattened, apex obtuse-rounded; disc flat. Column spatulate, curved, 10–11 × 2.0–2.5 mm, conspicuously winged on upper 2/3 of its length, broadening and ± galeate at apex; rostellum prominent, lamellate; stigma located just below rostellum, cup-shaped; column foot short but conspicuous, ca. 2 mm long, ± thickened. Anther white with beige-yellow tint, broadly ovoid, ca. 1.5 × 1.5 mm; pollinia 4, in 2 pairs, pale yellowish, obovoid, with caudicles. Capsule not seen.

Distribution: Vietnam (Lam Dong), endemic.

Etymology: The new species is named after its characteristic sagittate lip.

Habitat and phenology: Epiphytic on upper trunks and branches in constantly humid ridge-top broadleaved forests at an elevation of 1700–1900 m. Flowers observed from September to November.

Conservation status: This species is likely restricted to the constantly humid ridge-top forests around the borders of Lam Dong, Khanh Hoa and Ninh Thuan Provinces and is currently known from two locations. Its estimated range is small (AOO: 8 km²), though mostly within protected areas. Meanwhile, its horticultural value could be comparable to *Panisea albiflora* (Ridl.) Seidenf., which has been cultivated and traded on the internet as a kind of “miniature orchid”, and hence the potential threat of commercial collection should be taken into account. Based on the above consideration, *P. sagittata* is evaluated as Endangered [EN B2ab(v)].

Paratypes: VIETNAM. Lam Dong Province: Lac Duong District, Da Chais Commune, Mt. Gia Rich, 1700 m, 5 November 2019, Hsu 12271 (SGN, TAIF-524201).

Note: The new species is unique in the small genus *Panisea* on account of its sagittate lip with backward-pointing basal lobules and a flat disc. In other congeneric species with trilobed or basally auriculate lips, the side-lobes or basal auricles are either forward-pointing (e.g., *P. uniflora* (Lindl.) Lindl.) or erect (side-pointing when flattened; e.g., *P. apiculata* Lindl., *P. distelidia* I.D. Lund, *P. moi* M.Z. Huang, J.M. Yin & G.S. Yang and *P. vinhii* Aver. & Averyanova), and the lips of these species all bear calli or thickened veins on the discs (Lund, 1987; Averyanov and Averyanova, 2005; Huang *et al.*, 2012). Despite the remarkable lip morphology, *P. sagittata* could be neglected in the field due to its superficial resemblance of *P. albiflora*, a relatively well-known southern Vietnam endemic (Averyanov and Averyanova, 2003; Averyanov *et al.*, 2003), which also occurs in Bidoup-Nui Ba National Park. The two species share nearly identical habits and similar pure white flowers, yet *P. albiflora* is readily distinguishable by the entire lip with two ridges on disc and the much shorter column.

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