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Pseudochirita trifoliata (Gesneriaceae), a new species from karst limestone in northern Vietnam

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Abstract

Pseudochirita trifoliata, a new Gesneriaceae species from Pu Luong-Cuc Phuong limestone mountain range in northern Vietnam is described and illustrated here. This new taxon is the second species of the narrowly endemic genus *Pseudochirita* which is known from limestone areas in southern China and northern Vietnam. It is easily distinguished from *P. guangxiensis* by a set of differences on the leaves, bracts, calyx, external corolla indumentum, staminode number, pistil length, ovary indumentum, style indumentum, and capsule length. A detailed description, illustration, information on distribution, ecology, phenology, provisional conservation assessment using IUCN categories and criteria of the proposed new species, and comparison with its similar species, are also provided.

Keywords: limestone flora, new taxa, subfamily Didymocarpoideae

Introduction

The southeastern Asian karst limestones are a unique geological formation and also of great conservation importance, because of its species richness and high level of endemic plants (Clements 2006, Williams 2008). Many new taxa of Gesneriaceae were recently discovered and published from subtropical and tropical limestone areas of south-east Asia (Chen *et al.* 2008, Wei *et al.* 2010, Middleton & Möller 2012, Rafidah 2019, Li *et al.* 2019, Sirimongkol *et al.* 2019, Nguyen *et al.* 2019). In Vietnam, karst limestone landforms mainly occur in the north and centre, with a small area at Ha Tien-Kien Luong, Kien Giang province, in the south. Vietnamese karst areas exemplify aesthetic, cultural and biological values associated with Southeast Asian karst, including World Heritage Sites (Ha Long Bay and Phong Nha-Ke Bang National Park), Global Centres of Plant Diversity (Pu Luong-Cuc Phuong and Bac Me-Na Hang-Ba Be mountain ranges) and numerous sites of international biodiversity importance (World Bank 2005). Within continental Asia, the limestone area of southern and south-western China and adjacent regions of Vietnam are one of the diversity centres of species of subfamily Didymocarpoideae (Gesneriaceae).

The genus *Pseudochirita* Wang (1983: 21) (Didymocarpoideae, Gesneriaceae) comprises only one species (*P. guangxiensis* (Huang 1980: 102) Wang (1983: 21)) and one variety (*P. guangxiensis* var. *glauca* Wei & Yan Liu (2004: 555)), and is mostly found in karst limestone habitats of southern China and north-central Vietnam (Huang

1980, Wang *et al.* 1998, Wei & Liu 2004, Wei *et al.* 2010, Vu 2018, Wen *et al.* 2019). During floristic explorations on the Pu Luong-Cuc Phuong limestone mountain range in northern Vietnam in late October 2016 and late November 2019, we collected some fruiting specimens of a Gesneriaceae species in karst areas of the Kho Muong cave, Thanh Son commune, Ba Thuoc district, within Pu Luong Nature Reserve, Thanh Hoa province and the Doi cave, Ngoc Son commune, Tan Lac district, within Ngoc Son-Ngo Luong Nature Reserve, Hoa Binh province. After carefully checking the phyllotaxy of all individuals in the recorded populations and collecting specimens of this unknown Gesneriaceae, we confirmed that these have leaves arranged in whorls of three. More recently, in July 2020, the first author collected flowering specimens from the same population in the Kho Muong cave and adjacent areas within the Kho Muong village. With view to morphological characters, these specimens were regarded to belong to the genus *Pseudochirita* by having infundibuliform calyx tube, basifixed anthers, coherent at apex, parallel thecae not confluent at apex, dehiscing longitudinally and connective not projecting, and unequally 2-lobed stigma, which are mainly characteristics to be distinguished from *Henckelia* Sprengel (1817: 402). Furthermore, these specimens are characterized by persistent, semi-orbicular bracts, infundibuliform-tubular corolla tubes, two staminodes, glabrescent to glabrous styles, 2.9–3.3 cm long, and glabrous ovaries. Those morphological characteristics, together with its leaves in whorls of three, confirmed that the specimens represent a new species of *Pseudochirita*, which is here described and illustrated.

Materials & methods

The studied specimens were collected from Pu Luong & Ngoc Son-Ngo Luong Nature Reserves, North Vietnam. These specimens of this new species are deposited in herbaria of Vietnam National Museum of Nature (VNMN), Vietnam Academy of Science and Technology and Guangxi Institute of Botany (IBK), China.

The macromorphological features were observed on the specimen sheets and from living specimens in the field, while micromorphological observations and photographs were taken using an optical microscope (Stemi DV4; LEICA S8 AP0, Wetzlar, Germany) and digital camera (Canon EOS 3000D, Japan). The morphological characters were compared with descriptions in the protologue and with type specimens of the existing *Pseudochirita* species deposited at GXMI and IBK herbaria.

Furthermore, the relevant literature (Huang 1980, Wang 1983, Wang *et al.* 1998, Wei & Liu 2004, Wei *et al.* 2010, Vu 2018, Wen *et al.* 2019) and other specimens of *Pseudochirita guangxiensis* var. *guangxiensis* and var. *glauca* deposited in the following herbaria: HN, HNU, IBK, KUN, PE, and VNMN, were also reviewed.

The description of the new species follows the terminology used by Wang *et al.* (1990), Wang *et al.* (1998), Harris & Harris (2001), and Haston & Ronse De Craene (2007). Assessment of the conservation status of the new species is according to current IUCN (2019) categories and criteria.

Taxonomic treatment

Pseudochirita trifoliata T.V.Do & F.Wen, *sp. nov.* (Figs. 1–3)

The new species differs from *Pseudochirita guangxiensis* by having leaves in whorls of three (vs. opposite in pairs), infundibuliform calyx tube (vs. campanulate to cupuliform), staminodes number (two vs. three), glabrous ovary (vs. glandular puberulent), glabrescent to glabrous style (vs. glandular puberulent) and longer capsule (5.5–7 cm long vs. 3–4.5 cm long).

Type:—VIETNAM. Thanh Hoa province: Pu Luong Nature Reserve, Ba Thuoc district, Thanh Son commune, Kho Muong village, moist and humid limestone cliffs nearby rice field, 20°28.894'N, 105°07.902'E, elev. ca. 371 m, 26 July 2020, *Do Van Truong DVT 371* (Holotype VNMN!, isotypes IBK!, VNMN!).

Perennial herbs to subshrubs. Stems up to 120 cm tall, many branches appearing from base, densely velutinous. Leaves in whorls of three, strongly anisophyllous; petioles 1–8 cm long, densely appressed grey villous; leaf blade ovate to elliptic, (3–)6–22(–25) × (2.5–)4–9(–11) cm, adaxially pubescent, abaxially densely appressed grey villous; base strongly oblique, broadly cuneate to rounded; apex acute to abruptly acuminate, ca. 1 cm long; margin serrulate; lateral veins 9–11 pairs, slightly sunken on adaxial leaf surface and prominent on abaxial leaf surface. Inflorescences dichasial cymes, 1–3-branched, cyme 3–18-flowered, axillary near stem apex; peduncles/1st hypopodium 10–13 cm



Holotype

VNMN HERBARIUM
FLORA OF VIETNAM

Scientific name: *Pseudochirita trifoliata* T.V.Do & F.Wen, sp. nov.
Family: Gesneriaceae
Collector: Truong Van Do
Collecting number: ĐVT 371
Locality: 20°28.894'N, 105°07.902'E, Kho Muong village, Thanh Son commune, Pu Luong Nature Reserve, Thanh Hoa province, Vietnam
Collecting date: 26th July 2020
Description and habitat: Leaves in whorls of three, staminodes 2, ovary glabrous. Growing on moist and humid limestone cliffs

FIGURE 1. Holotype of *Pseudochirita trifoliata* T.V.Do & F.Wen sp. nov. (Do Van Truong ĐVT 371 (deposited at VNMN)). (Photo by Do Van Truong)

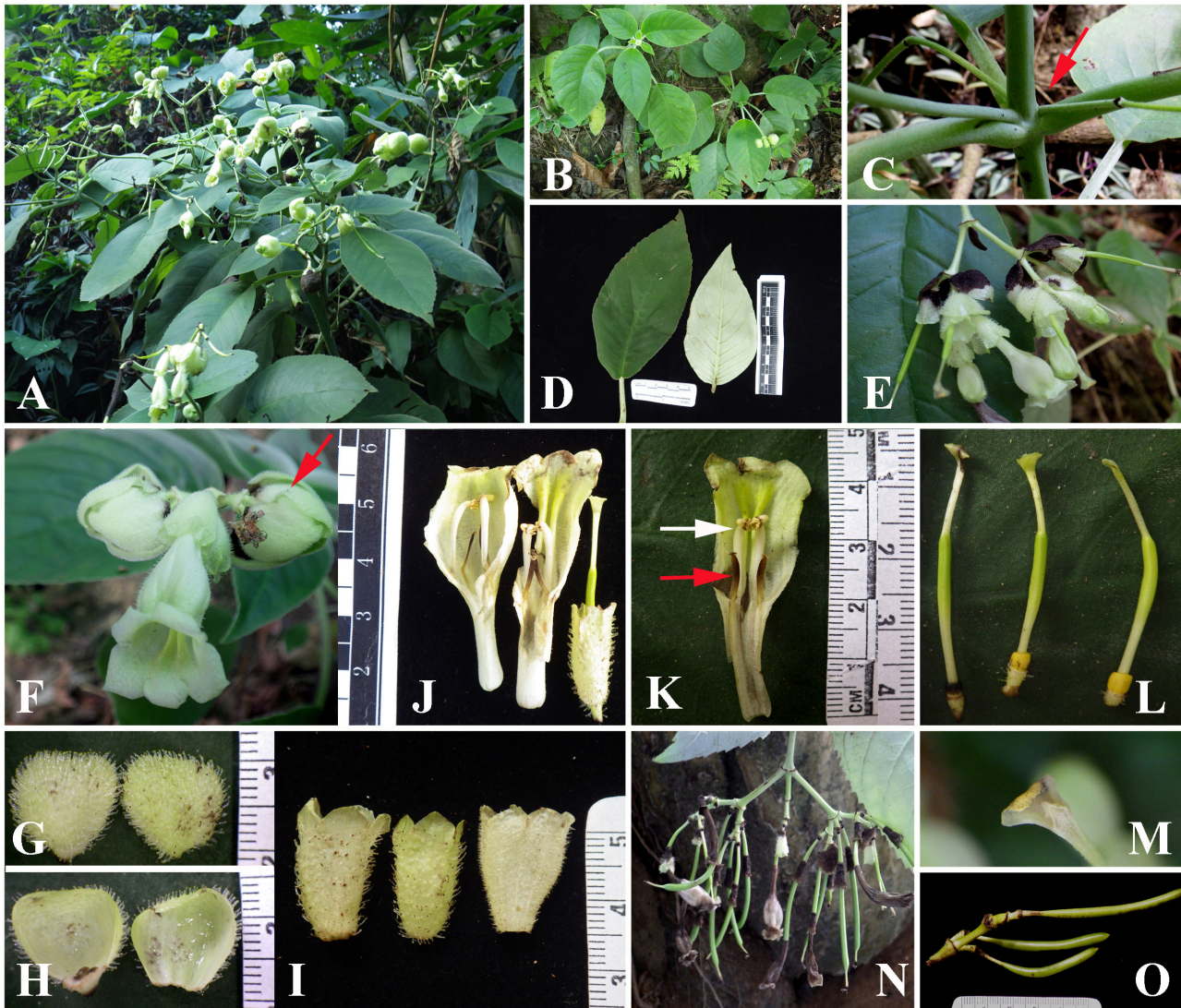


FIGURE 2. *Pseudochirita trifoliata* T.V.Do & F.Wen *sp. nov.* **A–B.** Habitat & habit; **C.** Leaves in whorls of 3 (red arrow); **D.** Adaxial and abaxial leaf surfaces; **E.** Dichasial cyme inflorescence; **F.** Oblique frontal view of open flower and involucrate, semi-orbicular bracts (red arrow); **G.** Densely glandular indumentum outside of bracts; **H.** Glabrous inside of bracts; **I.** Infundibuliform calyx; **J.** Two longitudinally sectioned flowers showing internal floral parts and calyx plus pistil; **K.** Abaxial part of a longitudinally sectioned corolla tube showing two stamens (white arrow) and two staminodes (red arrow); **L.** Shape and colour of a range of pistil; **M.** Close up of an unequally 2-lobed stigma; **N.** Inflorescence; **O.** Close up of maturing oblong capsules. (All photos by Do Van Truong from the population at the type locality)

long, 2nd axis hypopodium 2–5 cm long, 3rd axis 1–1.5 cm long, all pubescent; bracts 2, persistent, semi-orbicular, involucrate, 1–1.2 cm in diam., yellowish-green, outside with dense glandular indumentum, inside glabrous, margin entire; pedicel 3–5 mm long, sparsely spreading villous. Calyx with connate sepals, forming an infundibuliform calyx tube, 10–16 × 5–7 mm, shallowly 5-lobed, actinomorphic, lobes broadly triangular, 4–5 × 2–3 mm, pale yellow, outside densely glandular, inside glabrous, margin entire, apex acute. Corolla zygomorphic, greenish to pale yellow to yellowish-white, 3–4.5 cm long, outside sparsely glandular, inside glabrous; tube infundibuliform-tubular, 3–3.8 cm long, suddenly constricted at ca. a third of corolla tube from the base, 1.4–1.8 cm long from the bottom to a third of tube, 2–3 mm in diam. at the bottom, somewhat constricted at the mouth, 1.6–2 cm long from a third of tube to the mouth, 1.2–1.3 cm in diam. near the mouth; limb distinctly 2-lipped, adaxial lip 2-lobed, usually retroflexed, shorter than abaxial lips, lobes broadly ovate, 3–4 × 2.5–3 mm, apex rounded, abaxial lip unequally 3-lobed, central one symmetrical and narrower than the two lateral lobes, lobes broadly ovate or sub-orbicular, 5–6 × 3–4 mm, apex acute; throat with two yellow ridges on tube floor. Stamens 2, equal, included, adnate to 1.1–1.3 cm above the base of corolla tube; filaments straight, filiform, 1.3–1.5 cm long, white, with some glands at the tip close to the anthers; anthers basifixed, coherent at apex, 1.8–2 mm long, glabrous, thecae parallel, not confluent at the apex, dehiscing

longitudinally, not projecting. Stamines 2, equal, adnate to 1.3–1.5 cm above the base of corolla tube, filaments filiform, 1.2–1.4 cm long, straight, brownish, glabrous, apex capitate. Disc cupular, 2–2.2 mm high, yellow, margin entire, glabrous. Pistil linear, 2.9–3.3 cm long; stipitate, 8–10 mm long, 1–1.2 mm in diam., narrower than ovary, but somewhat wider than style, white, glabrescent to glabrous; ovary 10–11 mm long, 1.5–2 mm in diam., green, glabrous; style 9–10 mm long, 0.8–1 mm in diam., white, glabrescent to glabrous; stigma green, adaxial lobe smaller, broadly triangular, 1–1.2 mm long, apex acute; abaxial lobe larger, narrowly obtrapeziform, 1.5–2 mm long, apex emarginate. Capsule oblong, straight in relation to pedicel, 5.5–7 cm long, 2.5–3 mm in diam., glabrous.

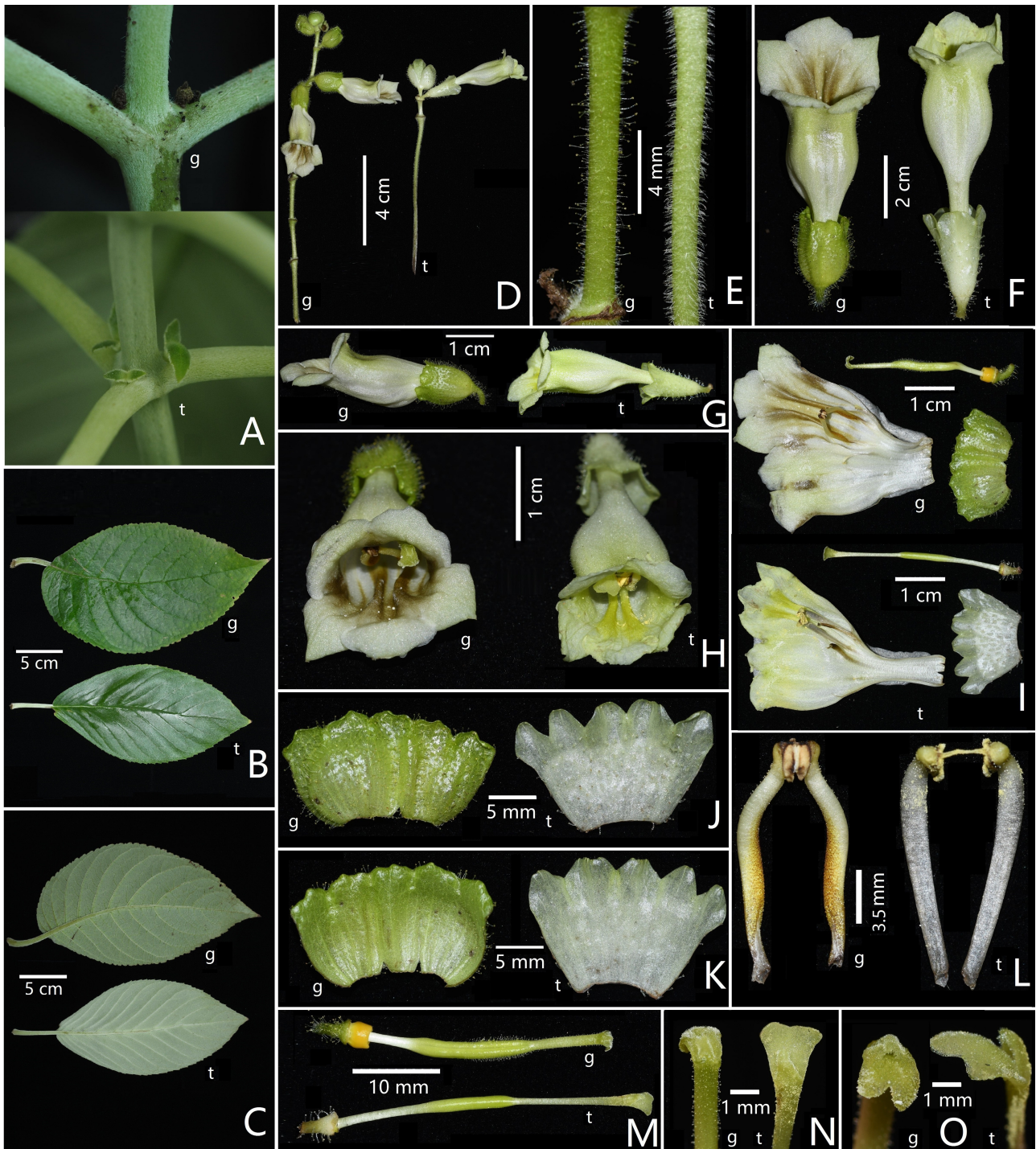


FIGURE 3. Morphological comparison between *Pseudochirita trifoliata* T.V.Do & F.Wen *sp. nov.* (t) and *P. guangxiensis* (S.Z.Huang) W.T.Wang (g). **A.** Leaf insertion on the nodes (3-whorled in *P. trifoliata*, and opposite in *P. guangxiensis*); **B.** Adaxial leaf surfaces; **C.** Abaxial leaf surfaces; **D.** Cymes; **E.** Peduncle indumentum; **F.** Top view of corolla and calyx; **G.** Lateral view of corolla and calyx; **H.** Front view of corolla; **I.** Cut opened corolla and calyx, and pistil; **J.** Outside surfaces of cut opened calyx; **K.** Inner surfaces of cut opened calyx; **L.** Stamens with anthers and filaments; **M.** Pistil and discs; **N.** Top view of stigmas; **O.** Lateral view of stigmas. (All photos by De-Chang Meng and Fang Wen from living plants of the two species)

Phenology:—Flowering occurs from May to August, and fruiting from June to September.

Etymology:—The specific epithet “*trifoliata*” is derived from the number of leaves at each node, which is the most notable morphological feature of the new species.

Vernacular name:—Cây giã Ri ta 3 lá (name translation into Vietnamese).

Distribution and habitat:—*Pseudochirita trifoliata* is currently known from two localities: i.e. Kho Muong cave at Pu Luong Nature Reserve, and Doi cave at Ngoc Son-Ngo Luong Nature Reserve, both in northern Vietnam, lying on the Cuc Phuong-Pu Luong limestone mountain range (Fig. 4). This species grows on humid limestone rock surfaces on the ground at limestone cave entrances or on moist and humid limestone cliffs. It is usually accompanied by *Adiantum sp.*, *Begonia sp.*, *Elatostema sp.*, *Gynostemma sp.*, *Henckelia sp.*, *Microchirita sp.*, *Pellionia sp.*, *Petrocodon sp.*, *Pilea sp.*, *Tectaria sp.*, and *Tradescantia sp.*

Conservation status:—We currently know of five collection points of *Pseudochirita trifoliata*, all from the Cuc Phuong-Pu Luong limestone mountain range, northern Vietnam and together appearing to represent at least three distinct populations. One population is at the Kho Muong cave, and another is at the margins of a limestone hill nearby a rice field of the Kho Muong village, both located in Pu Luong Nature Reserve of Thanh Hoa province. A third population is located at the Doi cave in Ngoc Son commune, within the Ngoc Son-Ngo Luong Nature Reserve of Hoa Binh province. Estimated from the locations of the three populations, the Extent of Occurrence (EOO) is ca. 100 km² and the Area of Occupancy (AOO) is ca. 12 km². All three populations occur in buffer zones of the Nature Reserves. On this basis, and in accordance with the IUCN Red List criteria (IUCN 2019), we propose to categorize this species as Near Threatened (NT). The Endangered (EN) category could be used (B2a, AOO < 500 km² and the number of locations ≤ 5). The fact that three populations occur in protected forest areas, however, suggests that if declines and fluctuations are occurring, they are not extensive.

Morphological affinities:—*Pseudochirita trifoliata* is morphologically similar to *P. guangxiensis* (Fig. 3) by sharing an obliquely elliptic to ovate leaf blade, appressed grey villous indumentum on the abaxial leaf surface, dichasial cymes, connate sepals, zygomorphic corolla, 2 fertile stamens, and other characteristics. However, it is clearly different from the latter by a combination of morphological differences on the leaves, bracts, calyx, external corolla indumentum, staminode number, pistil length, ovary indumentum, style indumentum, and capsule length. A detailed comparison of the new species with *P. guangxiensis* is provided in Table 1.

TABLE 1. Main morphological differences between *Pseudochirita trifoliata* and *P. guangxiensis*.

Characters	<i>P. trifoliata</i>	<i>P. guangxiensis</i> *
Phyllotaxis	whorls of three	opposite in pairs
Bracts	persistent, semi-orbicular, 1–1.2 cm long	deciduous, ovate, ca. 1.5 cm long
Calyx shape	infundibuliform	campanulate to cupuliform calyx tube
Calyx lobes	actinomorphic, lobes broadly triangular, 4–5 × 2–3 mm	bilabiate, adaxial central lobe broadly ovate, 2 × 3 mm, other lobes depressed deltoid, 1 × 2.5 mm
Corolla tube shape	infundibuliform-tubular, suddenly constricted at ca. a third of corolla tube from the base	broadly tubular, constricted at near the base of corolla tube
Stamen	1.3–1.5 cm long, straight	1–1.3 cm long, curved
Staminodes	two, both 12–14 mm long	three, central staminode 0.2 mm long, laterals 4.5–5 mm long
Pistil length	2.9–3.3 cm	2.4–2.9 cm
Ovary indumentum	glabrous	glandular puberulent
Style indumentum	glabrescent to glabrous	glandular puberulent
Capsule length	5.5–7 cm	3–4.5 cm

*Morphological characteristics followed the protologue, type specimens and our own observation from living collection.



FIGURE 4. Distribution map of *Pseudochirita trifoliata* in northern Vietnam (localities indicated by black dots)

Additional specimens examined (paratype):—VIETNAM. Thanh Hoa province: Pu Luong Nature Reserve, Ba Thuoc district, Thanh Son commune, Kho Muong cave, 20°28.025'N, 105°08.258'E, elev. ca. 371 m, 26 July 2020, *Do Van Truong DVT 370* (VNMN!); 21 October 2016, *Wen Fang et al. 546* (IBK!, VNMN!). Hoa Binh province: Ngoc Son-Ngo Luong Nature Reserve, Tan Lac district, Ngoc Son commune, Doi cave, 30 October 2019, *Wen Fang et al. 1212* (IBK!, VNMN!).

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