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Cynanchum quangbinhense (Apocynaceae: Asclepiadoideae), a new species from Vietnam, and additional information on *C. officinale*

Van The PHAM[1,2,*], Thanh Trang PHAM[3], Ngoc Bon TRINH[4], Sinh Khang NGUYEN[5], Minh Truong DAO[6], Maxim S. NURALIEV[7,8]

1. Laboratory of Ecology and Environmental Management, Science and Technology Advanced Institute, Van Lang University, Ho Chi Minh City, Vietnam. ORCID:0000-0002-1223-0175.
2. Faculty of Technology, Van Lang University, Ho Chi Minh City, Vietnam.
3. Department of Forest Plant, Faculty of Forest Resource and Environmental Management, Vietnam National University of Forestry, Xuan Mai Township, Chuong My, Hanoi City, Vietnam.
4. Department of Silviculture foundation and Forest Phytodiversity, Silviculture Research Institute, Vietnamese Academy of Forest Sciences, Hanoi City, Vietnam.
5. Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Cau Giay, Hanoi City, Vietnam.
6. Central Institute for Natural Resources and Environmental Studies, Vietnam National University, Hanoi City, Vietnam.
7. Department of Higher Plants, Biological Faculty, M.V. Lomonosov Moscow State University, 1, 12, Leninskie Gory, 119234 Moscow, Russia.
8. Joint Russian-Vietnamese Tropical Scientific and Technological Center, Cau Giay, Hanoi City, Vietnam.
[*]Corresponding author's email: phamvanthe@vlu.edu.vn; Tel. +84988154444

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ABSTRACT: This research provides a description and illustrations for a new species from the Phong Nha-Ke Bang National Park, *Cynanchum quangbinhense*. The distribution, habitat, phenology and conservation assessment for the species are also presented. The new species differs from closely related species, *C. ovalifolium* in many characters such as leaf shape, inflorescence type, fewer and smaller flowers, colour of petals, margins of the corona, and anthers appendages shape, and differs from *C. kwangsiense* in having small leaves, umbellate inflorescences, triangular sepals, retuse apex of petals, and plicate margin of corona. Our discovery raises the known species of this genus in Vietnam to seven. In addition, a key to species of *Cynanchum* in Vietnam, and notes on morphological variation of *C. officinale* are presented in this paper.

KEY WORDS: *Cynanchum kwangsiense*, *C. ovalifolium*, conservation, Indochina, IUCN, National Park, taxonomic key.

INTRODUCTION

The genus *Cynanchum* L. (1753) (Apocynaceae, Asclepiadoideae), also known as "dog-strangling vines", consists of nearly 300 species worldwide distributed in the North and South America, Africa, Europe, Asia to Australia (Forbes *et al.,* 1890; Li *et al.*, 1995; Liede, 1999; Khanum *et al.*, 2016; Shen *et al.*, 2019; GBIF <https://www.gbif.org/>; World Flora Online <http://www.worldfloraonline.org/>). The typical characteristics of the genus are erect and twining plant with white or yellow latex, simple and opposite leaf, extra-axillary cymose to sciadioidal inflorescences, rotate to tubular white corolla, membranous or fleshy corona inserted at base of sessile gynostegium, membranous apical appendages of anthers, pollinia 2 per pollinarium and pendulous (Li *et al.*, 1995; Liede, 1999; Khanum *et al.*, 2016).

In Vietnam, *Cynanchum* is mainly distributed in open place of secondary or primary forests in the North Vietnam (Costantin, 1912; Pham, 2003). It grows in wet places near rivers or streams from lowlands to high mountains (Costantin, 1912; Pham, 2003). To date, six species of *Cynanchum* have been recorded for the country (Costantin, 1912; Pham, 2003; Tran, 2017).

During a botanical survey in the limestone areas of Phong Nha - Ke Bang National Park in 2011 (Fig. 1), we found some unknown plants of Apocynaceae. After careful analysis and identification, we found that the morphological characters of the newly collected species well fit with the genus *Cynanchum.* In addition, the specimens with the typical characteristics of small leaves with lanceolate to broadly lanceolate blade, umbellate inflorescences, small flowers, yellow-green petals, and tubular corona, do not fit with any of the previously reported species of *Cynanchum* in the nearby regions (Forbes *et al.,* 1890; Costantin, 1912; Li *et al.*, 1995; Liede, 1999; Pham, 2003; Khanum *et al.*, 2016; Middleton and Rodda, 2019; Shen *et al.*, 2019). Futhermore, it is clearly distinct from closely related species, *C. ovalifolium* Wight (1834) and *C. kwangsiense* Tsiang & H.T.Zhang (1974) reported from India to Australia (Tsang and Li, 1974; Li *et al.*, 1995; Middleton and Rodda, 2019). Hence, we treat these plants as a new species.

This research provides a morphology description, distribution and habitat, phenology, conservation assessment, and taxonomic remarks for the new species. Furthermore, we provide additional information on morphological characters for *C. officinale* which was found from

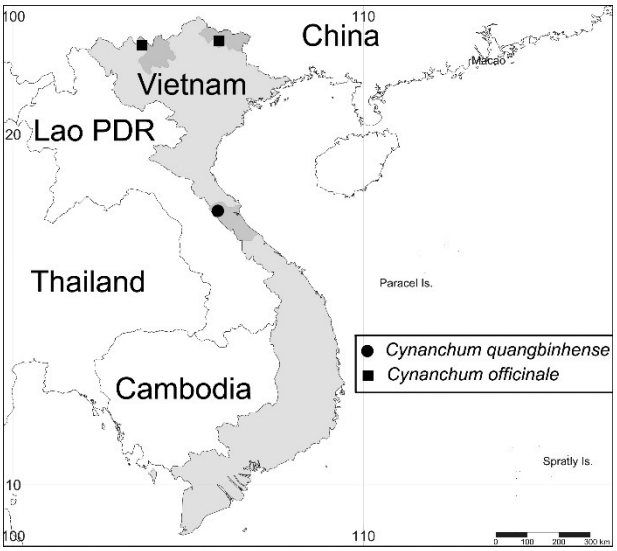

Fig. 1. Distribution of ***C. quangbinhense*** in Quang Binh Province, and ***C. officinale*** in Cao Bang and Lao Cai Provinces, Vietnam. Prepared with SimpleMappr < https://www.simplemappr.net/>

Phia Oac-Phia Den National Park, and Bat Xat Nature Reserve (Fig. 1). Moreover, a key to species of *Cynanchum* in Vietnam is presented based on a literature review.

MATERIALS AND METHODS

The fresh specimens of *Cynanchum* species and photographs were collected and taken from the wild in 2011–2021 from Phong Nha - Ke Bang, Phia Oac - Phia Den National Parks, and Bat Xat Nature Reserve. The collection and fixing specimens were followed the usual procedures for botanical specimens (Liesner, 1995; Maden, 2004). Identification and morphological description were based on Li *et al.* (1995), Liede (1999), Ollerton and Liede (2003), and Chang *et al.* (2012). The plant terminology in general followed Harris and Harris (1994). The specimens were examined in Ton Duc Thang University and deposited at HNU, LE (acronyms according to Thiers, 2015). Types and other specimens of *Cynanchum* spp. were accessed from E, K virtual herbaria. The scientific names are consulted from World Flora Online <http://www.worldfloraonline.org/> and International Plant Names Index <https://www.ipni.org/>. Conservation analysis was performed using criteria from the International Union for the Conservation of Nature (IUCN, 2019)

TAXONOMIC TREATMENT

Cynanchum quangbinhense Nuraliev & V.T. Pham, ***sp. nov.*** **Figs. 2, 3**

Type**:** VIETNAM, Quang Binh Province: Minh Hoa district, Hoa Son municipality, primary closed evergreen forest on limestone mountains, rocky slope to stream valley, around point 17°41′25.6″N 105°53′40.4″E, at elevation 460 m a.s.l., 06 August 2011, *N.T. Hiep, L. Averyanov, N.S. Khang, N.Q. Vinh, N.V. Tap, P.V. The & L.T. Kien*, *CPC 4103* (holotype: HNU; isotype: LE).

Diagnosis**:** *Cynanchum quangbinhense* is morphologically most similar to *C. ovalifolium*, but differs in having lanceolate to broadly lanceolate leaves with cuneate base and narrowly acute apex, short and umbellate inflorescences, narrowly ovate petals with apex retuse, plicate margins of corona, and broadly lanceolate anther appendages with retuse apex. *Cynanchum quangbinhense* differs from *C. kwangsiense* in having small leaves, umbellate inflorescences, yellow-green corolla, and glabrous sepals.

Description: Plants twining, twisted, slender, up to 4 m long, with white latex. **Stem** dark green, densely covered with flexuous trichomes when young, sparsely covered with trichomes or glabrous when old. Internodes 3–7 cm long, 1.1–1.2 mm in diam.; nodes swollen, ca. 2 mm in diam. **Leaves** opposite, simple, 4.0–5.7 cm long; petioles 1.0–1.2 cm long, 0.8–0.9 mm in diam., curved, adaxially grooved, sparsely covered with flexuous trichomes; leaves blade lanceolate to broadly lanceolate, leathery, 3.0–4.5 × 1.5–2 cm, base equilateral, cuneate, apex narrowly acute, adaxial surface dark green, shiny, abaxial surface pale green, brown at the margin; margins entire, slightly revolute, sparsely covered with short trichomes; venation pinnate, secondary veins 4–7 pairs, distinct on both sides, adaxial side sparsely covered with short trichomes. **Inflorescences** axillary, umbellate, with up to 6 flowers, ca. 1.5 cm long; peduncle terete, stout, pale green, ca. 7.5 mm long, 1 mm in diam., sparsely covered with flexuous trichomes. **Flowers** ca. 6.5 mm long, bracts dirty brown, triangular, 0.5–0.8 mm long and wide, sparsely covered with flexuous trichomes; pedicels 3–4 mm long, 0.8–0.9 mm in diam., sparsely covered with flexuous trichomes. **Calyx** of 5 sepals, glabrous, ca. 2.5 mm in diam.; sepals free, triangular, light green, appressed to corolla, 0.9 × 0.6–0.9 mm, thick, margin membranous, apex acute. **Corolla** of 5 petals, rotate, yellow-green, glabrous, ca. 7 mm in diam.; petals united to 1/8 of their length from base, narrowly ovate, curved, yellow-green with slightly reddish at outside of base and venation inside, 3.0–3.2 × 1.6–1.8 mm, apex retuse. **Corona** ca. 2 mm high, white greenish, glabrous, tubular, membranous, exceeding the gynostegium, rugose, margin plicate. **Gynostegium** sessile, 1.5 mm high and in diam.; anther appendages broadly lanceolate, base yellow-green, apex white, retuse; stigma head flat, ca. 1 mm in diam. Pollinaria of two pollinia, each pollinium connected with a corpusculum by a retinaculum; corpusculum chestnut-coloured, shortly ovoid, longitudinally grooved, ca. 0.15 × 0.1 mm; retinacula transparent and elastic, 0.1 × 0.09 mm; pollinia dull yellow, ovoid, 0.15–0.2 × 0.09 mm. **Fruits** not seen.

Distribution, habitat and phenology**:** *Cynanchum quangbinhense* was found in the protected area of Phong

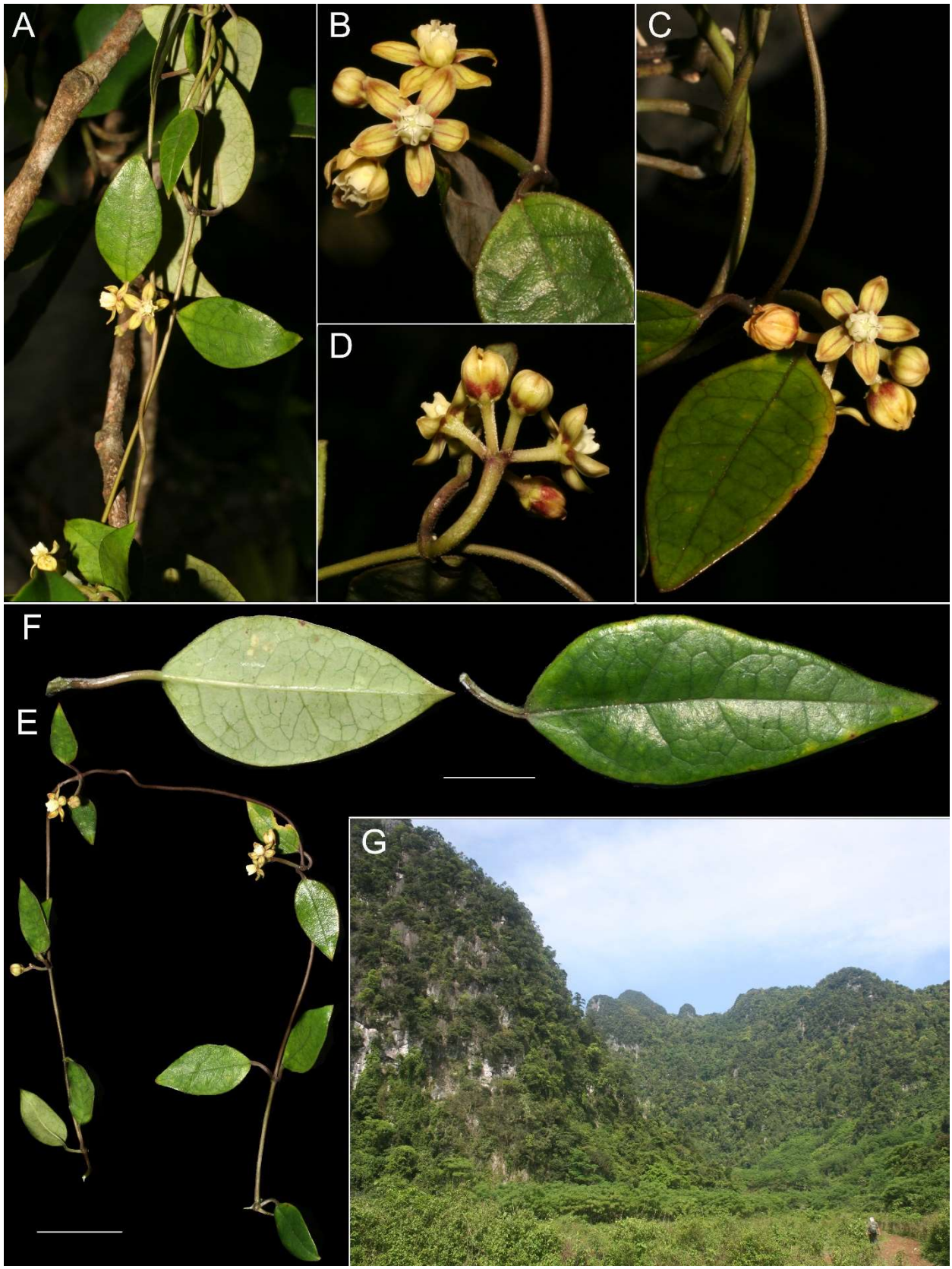

Fig. 2. ***Cynanchum quangbinhense*** and its natural habitat. **A-D**. Living plant with inflorescences. **E.** Habit. **F.** Leaf, abaxial (left) and adaxial (right) views. **G.** Natural forest on limestone mountain habitat. Scale bars: **E** = 2 cm; **F** = 1 cm. Photos and design by V.T. Pham.

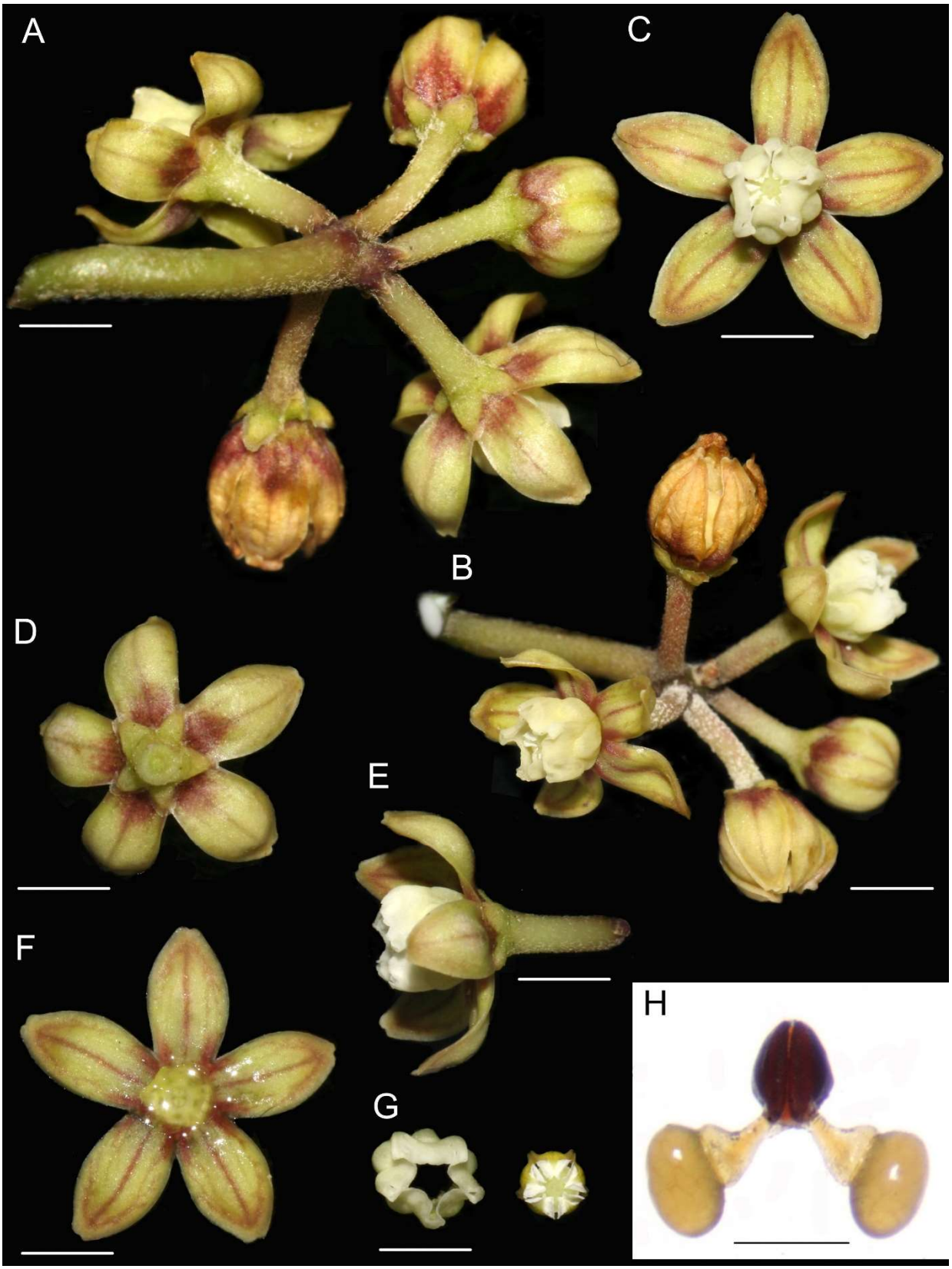

Fig. 3. ***Cynanchum quangbinhense***. **A-B**. Inflorescences, straight and behind views. **C-E**. Flower, straight, behind, and lateral views. **F.** Corolla, straight view (corona removed). **G.** Corona (left), and stigma head (right). **H.** Pollinaria. Scale bars: **A-G** = 2mm; **H** = 0.2 mm. Photos and design by V.T. Pham.

Table 1. Comparison of ***Cynanchum quangbinhense***, ***C. ovalifolium*** and ***C. kwangsiense.***

Characters	***C. quangbinhense***	***C. ovalifolium***	***C. kwangsiense***
Petiole length	1.0–1.2 cm	(0.5–)1–4 cm	ca. 1.5 cm
Leave blade shape	lanceolate to broadly lanceolate, base cuneate, apex narrowly acute	oblong to elliptic, base rounded or cordate, apex acute or rounded-cuspidate, sometimes subacuminate	elliptic, base cuneate or rounded, apex acuminate or caudate
Leave blade size	3.0–4.5 × 1.5–2 cm	2.5–10 × (1–)1.5–6 cm	6–10 × 2.5–4 cm
Inflorescences	umbellate, to 6 flowers	raceme-like, to 35 flowers	raceme-like, 5–10 flowers
Inflorescence length	ca. 1.5 cm	2.0–4.7 cm	2–3 cm
Cymules	different type	2-flowered	–
Peduncle length	ca. 7.5 mm	5–35 mm	10–20 mm
Pedicel length	3–4 mm	5–12 mm	ca. 5 mm
Sepal shape	triangular	ovate-oblong	ovate
Sepal size	0.9 × 0.6–0.9 mm	1.2–5 × 1–2 mm	ca. 1.5 × 0.8 mm
Corolla diam.	ca. 7 mm	6–10 mm	–
Petal shape	narrowly ovate	oblong	oblong-ovate
Petal size	3.0–3.2 × 1.6–1.8 mm	3–5 × ca. 1.5 mm	ca. 3.2 × 1.7 mm
Petal apex	retuse	acute, obtuse	acute or obtuse
Corona margins	plicate	lacerate or with 5 long teeth	with 10 teeth
Anther appendages	broadly lanceolate, retuse	rounded to reniform, apex mucronate or obtuse	ovate, apiculate
Pollinia	ovoid	broadly ovoid, oblong	elliptic
Stigma head	flat	slightly elevated	raised

Nha-Ke Bang National Park, Quang Binh Province, Central Vietnam (Fig. 1). It grows on a rocky slope to stream valley in a primary closed evergreen broad-leaved forest on limestone mountains at an elevation of 460 m a.s.l. Some plant species could be found in this area including *Asplenium cheilosorum* (Aspleniaceae), *Anoectochilus calcareus*, *Bulbophyllum auratum*, *B. retusiusculum*, *Cleisostoma birmanicum*, *C. striatum*, *Dendrobium aduncum*, *D. angustifolium*, *D. nobile*, *D. plicatile*, *D. salaccense*, *Goodyera hispida*, *Mycaranthes floribunda*, *Panisea tricallosa* (Orchidaceae), *Clematis uncinata* (Ranunculaceae), *Campylotropis henryi* (Fabaceae), *Ficus chartacea* (Moraceae), *Tirpitzia sinensis* (Linaceae), *Glycosmis puberula* (Rutaceae), *Wikstroemia meyeniana* (Thymelaeaceae), *Vatica cinerea* (Dipterocarpaceae), *Myrsine seguinii* (Primulaceae), *Psychotria serpens* (Rubiaceae), *Alyxia hainanensis* (Apocynaceae), *Brandisia glabrescens* (Paulowniaceae), *Abelia chinensis* (Caprifoliaceae), *Pittosporum pauciflorum* (Pittosporaceae). Flowering in August.

***Etymology*:** The species epithet "*quangbinhense*" refers to Quang Binh province, the province of the type locality of the new species. The Vietnamese name is proposed here as "Sát khuyển Quảng Bình".

***Conservation assessment*:** Currently, the species is protected in Phong Nha-Ke Bang National Park. No record affected the species such as overharvest or degenerate habitat. Suggestion for the species, more botany investigations are needed to give a certain evaluation on the individual number, population size, and current potential geographical distribution range. According to IUCN 2019 categories, the conservation status of the species may be assessed as Data Deficient (DD).

***Remarks*:** *Cynanchum quangbinhense* is most similar to *C. ovalifolium* (including *C. formosanum* (Maxim.) Hemsl. accepted by Li *et al.*, 1995) but it can be distinguished in many ways. The new species clearly differ from *Cynanchum ovalifolium* in lanceolate to broadly lanceolate leaf blade with a cuneate base and narrowly acute apex (*vs.* oblong to elliptic leaf blade with rounded or cordate base, and acute or rounded-cuspidate, sometimes sub-acuminate apex), shorter and umbellate inflorescences (*vs.* racemelike), fewer and smaller flowers, triangular sepals (*vs.* ovate-oblong), narrowly ovate petals with apex retuse (*vs.* oblong with apex acute or obtuse), plicate margins of corona (*vs.* lacerate or 5 long teeth), broadly lanceolate anther appendages with retuse apex (*vs.* rounded to reniform with mucronate or obtuse apex), and many others. The new species may resemble *C. kwangsiense* but is mainly different in smaller leaves (3.0–4.5 × 1.5–2 cm *vs.* 6–10 × 2.5–4 cm), inflorescence type (umbellate *vs.* raceme-like), triangular sepals (*vs.* ovate), retuse apex of petals (*vs.* acute or obtuse), plicate margin of corona (*vs.* 10 teeth), and many others. The detailed comparison of the new species with related species is presented in Table 1.

Additional information on *Cynanchum officinale*

Cynanchum officinale (Hemsl.) Tsiang & Zhang, Acta Phytotax. Sin. 12(1): 90 (1974); Tran in Fl. Vietnam 15: 263 (2017) **Fig. 4**

Pentatropis officinalis Hemsl., J. Linn. Soc., Bot. 26: 110 (1890). ***Type***: CHINA, Hubei, Patung, Ichang, 05/1888, *A. Henry, 4814* (K000872718!)

***Distribution, habitat and phenology*:** Recently, the species was found in humid shady places along streams, or on stone outcrops of the mountain slopes in evergreen

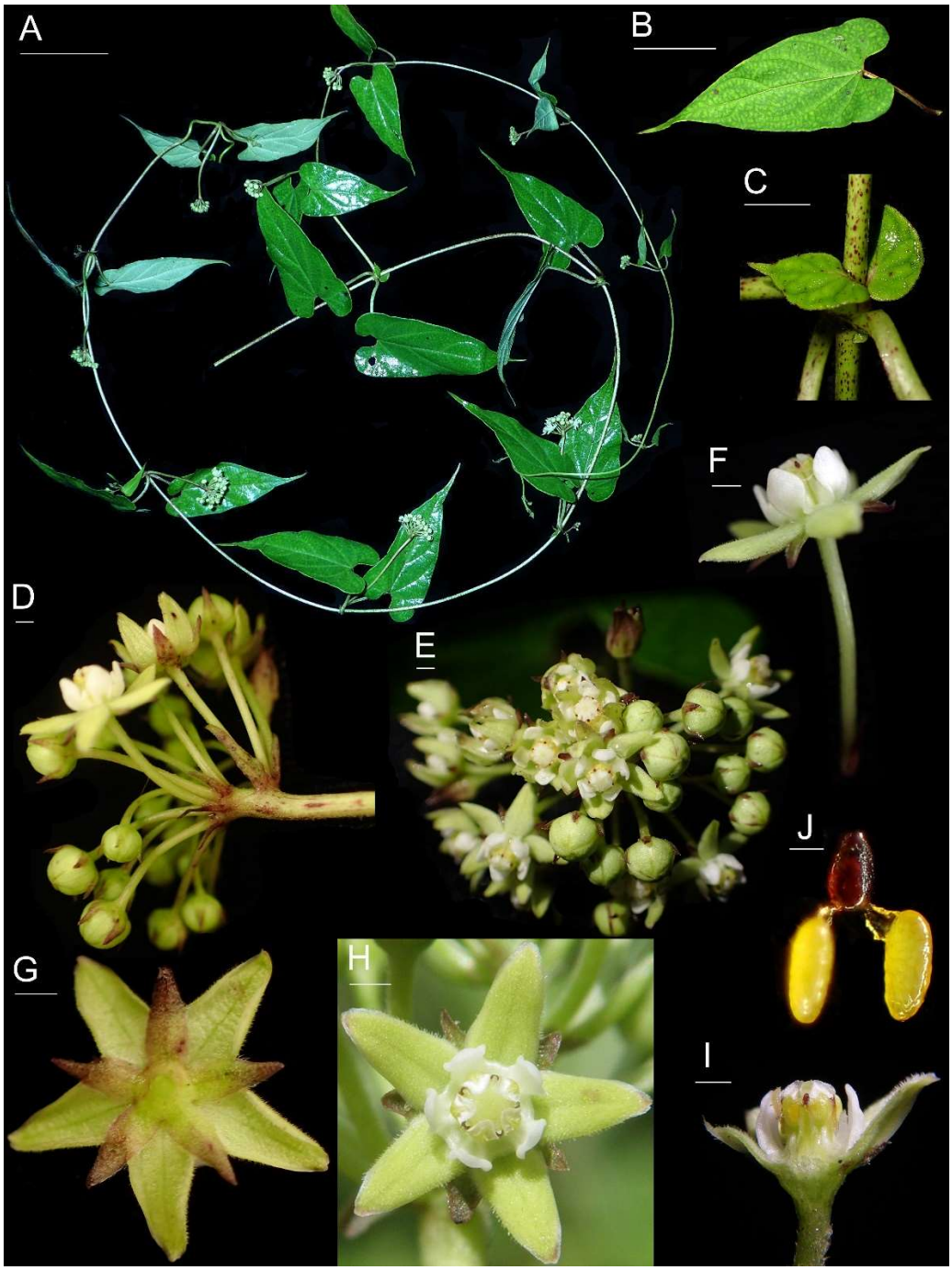

Fig. 4. ***Cynanchum officinale***. **A**. Fresh flowering specimen. **B**. Leave, adaxial view. **C.** Stipules. **D-E.** Inflorescences. **F.** Flower with pedicel, side view. **G-H**. Flower, behind and straight views. **I.** Flower, side view (petal removed). **J.** Pollinaria. Scale bars: **A** = 5 cm; **B** = 2.5 cm; **C** = 1 cm; **D-I** = 1 mm; **J** = 50 µm. Photos by N.B. Trinh and M.S. Nuraliev, design by V.T. Pham.

broad-leaved forests at elevation of 1650–2240 m a.s.l. of Phia Oac-Phia Den National Park and Bat Xat Nature Reserve, respectively in Cao Bang and Lao Cai Provinces (Fig. 1). Some shrubs, herbs and trees could be found in the areas such as *Pteris* sp. (Pteridaceae), *Tectaria* sp. (Tectariaceae), *Magnolia lanuginosa*, *M. fordiana* var. *hainanensis* (Magnoliaceae), *Cryptocarya hainanensis* (Lauraceae), *Paris caobangensis* (Melanthiaceae), *Smilax* sp. (Smilacaceae), *Ophiopogon cordylinoides* (Asparagaceae), *Siliquamomum tonkinense* (Zingiberaceae), *Carex* sp. (Cyperaceae), *Sinarundinaria* sp. (Poaceae), *Clematis buchananiana* (Ranunculaceae), *Polygala* sp. (Polygalaceae), *Rubus* sp. (Rosaceae), *Elatostema atropurpureum* (Urticaceae), *Euonymus laxiflorus* (Celastraceae), *Adinandra annamensis* (Pentaphylacaceae), *Aucuba* sp. (Garryaceae), *Adina*

pilulifera, Geophila repens (Rubiaceae), *Crawfurdia pasquieri* (Gentianaceae), *Olea dioica* (Oleaceae), *Lysionotus serratus* (Gesneriaceae), *Strobilanthes* sp. (Acanthaceae), and *Schefflera ciliata* (Araliaceae). Flowering in June.

***Specimens examined*:** VIETNAM, Cao Bang Province, Nguyen Binh district, Phan Thanh municipality, Phia Oac-Phia Den National Park, in humid primary forest slightly impacted, around points 22°36'26.02"N 22°36'26.02"E, alt. 1679 m, 4 June 2020, *Trinh Ngoc Bon, Pham Van The, Phan Ke Loc, Vu Thuy Duong, TB 236* (VAFS); Lao Cai Province, Bat Xat district, Bat Xat Nature Reserve, 7 km SE of Y Ty village, near trail to Lao Than summit, disturbed mountain slope, on stone outcrop, 22°37'22"N 103°40'01"E, alt. 2240 m, 12 June 2019, *Nuraliev M.S. № 2705* (HN; MW0757749; SING).

***Remarks*:** The observed plants in the two populations of Vietnam are clearly distinct from the previous description in longer peduncles (3.5–6 cm *vs.* 1–3.5 cm), the shape of sepals (lanceolate *vs.* ovate-oblong), shorter corona lobes (3.5–4 mm *vs.* 4.5–5 mm) and sometimes shorter than gynostegium. In addition, this study provides some additional information on morphology as follows: corolla lobes pale green; corona lobes white; corpusculum chestnut-coloured, narrowly ellipsoid, ca. 125 × 75 µm; retinacula transparent and elastic, deltoid, ca. 50 × 50 µm; pollinia bright yellow, narrowly ellipsoid, ca. 170 × 75 µm.

Key to the species of *Cynanchum* in Vietnam

1a. Plant erect ……..… 2
1b. Plant twining ……..… 3
2a. Leaves opposite or in whorls of 3-6; sepals lanceolate; corolla pale yellow, white, or dark red; corolla lobes acute ..…… ***C. verticillatum***
2b. Leaves opposite; sepals ovate-oblong; corolla purple, less often greenish-yellow; corolla lobes obtuse ……..…… ***C. stauntonii***
3a. Corona deeply 5-lobed……..… 4
3b. Corona tubular ……..……..… 5
4a. Corolla lobes oblong, 3.5–5 mm long ……..…….…… ***C. officinale***
4b. Corolla lobes triangular, 7–8 mm long ……...…...… ***C. utriculosum***
5a. Leaf base cuneate; blade lanceolate to broadly lanceolate ……..…..
……..…..…….... ***C. quangbinhense***
5b. Leaf base cordate or rounded to subcordate-hastate; blade ovate, ovate-oblong, ovate-triangular, oblong-hastate or linear-lanceolate …….. 6
6a. Leaf blade 1–4 × 0.1–1.5 cm; sepals oblong; corolla lobes ca. 2 × 1 mm; corona tube ca. 2 mm high, without teeth …..…… ***C. insulanum***
6b. Leaf blade 4.5–12(–20) × 3.5–8(–10) cm; sepals ovate; corolla lobes ca. 5 × 1.5 mm; corona tube 3–4 mm high, with 10 marginal teeth ..…
……..…… ***C. corymbosum***

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