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Two endangered ornamental orchid species, *Bulbophyllum coveniorum* and *Esmeralda bella* (Orchidaceae), new in the flora of Vietnam

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Key words: *Bulbophyllum coveniorum*, *Esmeralda bella*, flora of Vietnam, orchids, Orchidaceae, medicinal plants, plant conservation, plant diversity.

Summary. Two rare endangered ornamental species of orchids (Orchidaceae) – *Bulbophyllum coveniorum* J. J. Verm. et P. O’Byrne and *Esmeralda bella* Rchb. f., new for the flora of Vietnam were discovered during botanical field surveys of medicinal plants conducted by Department of Pharmacognosy of Hanoi University of Pharmacy in years 2015–2016. According to people from local minorities, both species are used in traditional medicine, but no scientific data on medicinal activity of any substances obtained from these plants are yet available. Meanwhile, the wide deforestation in areas of discovered species is the main fatal factor of their fast extinction in known localities. Hence, they should be regarded as nationally critically endangered (CR) in terms of IUCN Red List categories and criteria. The extensive commercial collecting of both species as highly demanded medicinal and ornamental plants is additional factor of their extinction even in intact habitats. At the same time, any present field data on both species are very scarce for understanding of their current distribution, natural resources, ecology, biology and morphological variation. The paper provides relevant information for these species including valid name, main synonyms, data about type materials, common names, short morphological description, data on ecology and phenology, distribution, threat and estimated IUCN Red List status, use in traditional medicine, notes on taxonomy and related species and data on studied specimens with indication of herbaria where they are housed. Data on medicinal use of studied species in folk medicine were obtained by talks and interview with old local people from national minorities living in areas of species distribution. Identification of collected specimens was performed in Department of Pharmacognosy (Hanoi University of Pharmacy) on the base of comparative morphologic analysis with use of relevant taxonomic literature.

Два исчезающих декоративных вида орхидей – *Bulbophyllum coveniorum* и *Esmeralda bella* (Orchidaceae), новых для флоры Вьетнама

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Ключевые слова: *Bulbophyllum coveniorum*, *Esmeralda bella*, Orchidaceae, лекарственные растения, орхидные, охрана растений, разнообразие растений, флора Вьетнама.

Аннотация. Два редких, исчезающих декоративных вида орхидей (Orchidaceae) – *Bulbophyllum coveniorum* J. J. Verm. et P. O’Byrne и *Esmeralda bella* Rchb. f. – новых для флоры Вьетнама, были обнаружены во время

полевых исследований лекарственных растений, проводимых Отделом фармакогнозии Ханойского Университета аптечного дела в 2015–2016 годах. По собранным устным сообщениям представителей народных меньшинств оба вида используются в народной медицине местных племен, однако какие-либо научные данные о биологической активности веществ, содержащихся в этих растениях, на настоящий момент отсутствуют. Наряду с этим, повсеместное обширное сведение лесов в области обитания открытых видов создает угрозу их быстрого исчезновения во всех известных местонахождениях, из-за чего их природоохранный статус на национальном уровне определен, в соответствии с критериями Международного Союза охраны природы (IUCN Red List), как близкий к вымиранию (nationally CR). Массовый сбор взрослых цветущих экземпляров коммерческими сборщиками для торговли на местных рынках и продажи за рубеж (главным образом, в Китай) в качестве востребованных рынком декоративных растений также является важным фактором исчезновения этих видов даже в первичных, ненарушенных местах обитания. В то же время современные данные по этим видам недостаточны для определения их действительного распространения, природных запасов, экологии, биологии и морфологической изменчивости. В публикации анализируются все имеющиеся данные и приводятся обобщенные сведения по этим видам, включающие: научное и народные названия, основные синонимы, данные о типе, краткое морфологическое описание, экологическую и фенологическую характеристику, данные о распространении, важнейших факторах, определяющих вымирание и использовании в народной медицине, предлагаемый охранный статус, заметки о таксономии и родственных связях, а также список изученных образцов с указанием места их хранения. Данные об использовании изученных видов в народной медицине получены на основе устных сообщений старейшин племен, населяющих области обитания указанных растений. Определение собранных образцов проводилось в Отделе фармакогнозии Ханойского Университета аптечного дела на основе детального сравнительно-морфологического анализа с использованием всех доступных литературных источников.

Introduction

The orchid flora of Vietnam includes presently at least 1210 documented species belonging to 172 genera according to the last available accounts (Averyanov, 2015, 2016). Meanwhile, it still remains far from complete inventory, and each new botanical investigation, particularly in remote mountainous areas, reveals new discoveries. Thus, two rare species of orchids, *Bulbophyllum coveniorum* J. J. Verm. et P. O'Byrne and *Esmeralda bella* Rchb. f., new for the flora of Vietnam, were discovered during botanical field surveys of medicinal plants conducted by Department of Pharmacognosy of Hanoi University of Pharmacy in years 2015–2016. According to people from local minorities both species are used in traditional medicine, but any scientific data on medicinal activity of any substances obtained from these plants are not yet available. The wide deforestation in areas of discovered species is the main fatal factor of their fast extinction in known localities. Hence, they should be regarded as nationally critically endangered (CR) in terms of IUCN Red List categories and criteria (The IUCN Red List, 2016). The extensive commercial collecting of both species as highly demanded medicinal and ornamental plants is additional factor of their extinction even in intact habitats. At the same time, any present field data on both species are very scarce for acceptable understanding of their current distribution, resources, ecology, biology and morphological variation. Below we provide relevant available information of these

species including valid name, main synonyms, data about type materials, common names, short morphological description, data on ecology and phenology, distribution, threat and estimated IUCN Red List status, use in traditional medicine, notes on taxonomy and related species and data on studied specimens with indication of Herbaria where they are housed.

Materials and methods

The surveys of medicinal plants were conducted in northwestern part of Vietnam (Lai Chau province, Sin Ho district, Ta Ngao commune) and on the south of the country (Kon Tum province, Ngoc Linh Mountains) with assistance of famous Vietnamese orchid enthusiasts Mr. Nguyen Phong and Mr. Chu Xuan Canh. Observed and reported species were confirmed by photographs and voucher herbarium specimens housed presently in Herbarium of Department of Pharmacognosy, Hanoi University of Pharmacy. Some previously collected herbarium specimens were also used in the current studies. Data on medicinal use of studied species in folk medicine were obtained from talks and interview with old local people from national minorities living in areas of species distribution. Identification of collected specimens was performed in Department of Pharmacognosy (Hanoi University of Pharmacy) by Nguyen Hoang Tuan on the base of comparative morphologic analysis with use of relevant taxonomic literature (Vermeulen, O'Byrne, 2003; Chen Xinqi, Wood, 2009; Muennig, 2010).

List of studied species

Bulbophyllum cowniorum J. J. Verm. et P. O'Byrne,

2003, Gard. Bull. Singapore 55: 150, fig. 12; Newman et al., 2007, Checklist Vasc. Pl. Lao PDR: 255; Schuit. et al., 2008, Nord. Journ. Bot. 26: 267 (Fig. 1).

Described based on the single cultivated type specimen originated expectedly from Laos, without indication of certain locality ("Laos"). **Type** ("SNG-03622") – SING (holotype).

Description. Creeping epiphyte. Rhizome rigid, woody, 4.5–6 mm diam., with erect pseudobulbs distant on 0.9–1.6 cm, remnants of bracts persistent as fine fibres. Roots mainly below the pseudobulbs. Pseudobulbs ovoid to cylindrical, 3.5–5.5 × 1.2–1.6 cm. Leaves petiolate; petiole 3–5.5 cm long; leaf blade elliptic to obovate, 10–16.5 × 2.7–4.2 cm, obtuse. Inflorescence 1–1.2 cm long, erect to patent, with 2–3 bracts, the longest 1.4–1.8 cm long. Floral bracts tubular, 1.5–1.8 cm long, acute. Pedicel and ovary 7–8 cm long, slightly curved at the base and apex. Flowers resupinate, not widely opening. Sepals and petals dull yellowish-green with red spots, free, spreading, rather thick, glabrous, entire, 8–9-veined, tapering and acute at apex. Median sepal erect, narrowly triangular-ovate, 2 × 1.2 cm, at the base suddenly shortly narrowing; lateral triangular-ovate, oblique, 2.3 × 1.2 cm, acute, lower margin with a prominent fold at the middle, broadly attached to column foot. Petals narrowly triangular-ovate, 2 × 0.6 cm, with broad base. Lip movable, white flushed with purple to the base, oblique ovoid in outline, recurved, 10.5 × 7.5 mm; obtuse, thick, entire, almost glabrous, somewhat coarsely warty near apex, in basal half concave, finely ciliate at margin near the base. Column broad, 4 mm tall, stigma concave; column foot prominent, strongly bent forward; stielidia minute, triangular, acute, 3–3.5 mm long. Anther almost hemispheric, glabrous to finely papillose. Pollinia 4, ovoid, unequal, in two pairs.

Common names. English – Cowen's *Bulbophyllum* (named after Mr. and Mrs. Cowen, who cultivated this species and successively made it flowering in their garden in Thailand), proposed Vietnamese name – Long hoa lon.

Ecology and phenology. Creeping branch and trunk epiphyte. Evergreen broad-leaved submontane forests on silicate rocks. 800–1500 m a.s.l. Flowers in March – April. Flowering in cultivation was observed in January–March, October and December

(Vermeulen, O'Byrne, 2003; Schuiteman *et al.*, 2008).

Distribution. Vietnam: Dak Lak province (Chu Yang Sin Mountains) and Kon Tum province (Ngoc Linh Mountains); Laos: Champasak province (no exact locality, Schuiteman *et al.*, 2008).

Threat and conservation. The wide deforestation due to uncontrolled primitive burning and shifting agriculture, as well as forest logging throughout the Lao PDR territory, is the leading factor of the species extinction (Cockel, 2013). Additional threat factor is commercial plant collecting, mainly for export to China as ornamental and medicinal plant used in traditional oriental medicine (Lamxay, 2009). While this species appears rather common in the orchid trade and in cultivation, its distribution and occurrence in Lao PDR remains unclear (Vermeulen, O'Byrne, 2003; Schuiteman *et al.*, 2008; Cockel, 2013). Beside the type, two additional available reports in Laos are based on cultivated specimens originated from Champasak province without indication of exact locality and data on ecology (Schuiteman *et al.*, 2008). Present record of this species in Vietnam is based on the single observed, highly depleted population standing on the verge of full extinction due to overexploitation and habitat loss. The absence of any current field data makes IUCN Red List criteria not well applicable for identification of species' status. Data deficient (DD) status should be formally applied for this species in formal terms, whereas in fact it may be very near to full extinction in the nature (nationally CR).

Use. This and similar related species are used in traditional medicine for treating hemoptysis, pneumonia, sore throat and chronic gastritis according to verbal information obtained from people of local minorities. Scientific data on medicinal activity of any substances obtained from these plants are not yet available.

Notes. *Bulbophyllum cowniorum* belongs to the group of closely related species of *B. lobbii* Lindl. complex including *B. microglossum* Ridl. (found in Thailand, Malacca Peninsula, Kalimantan), *B. smitinandii* Seidenf. et Thorut (Thailand, Vietnam) and *B. orectopetalum* Garay, Hamer et Siegerist (Myanmar, Thailand, Cambodia, Laos), but well differs in purple spotted tepals and purple lip ciliate at the base and lacking central callus on the disk near the base. The present discovery represents first record of this species in Vietnam.

Studied specimen. Southern Vietnam, Dak Lak Province. Chu Yang Sin Mountains, November 2014, Nguyen Van Canh, s.n., herbarium specimen prepared from cultivated plant 27 February 2017

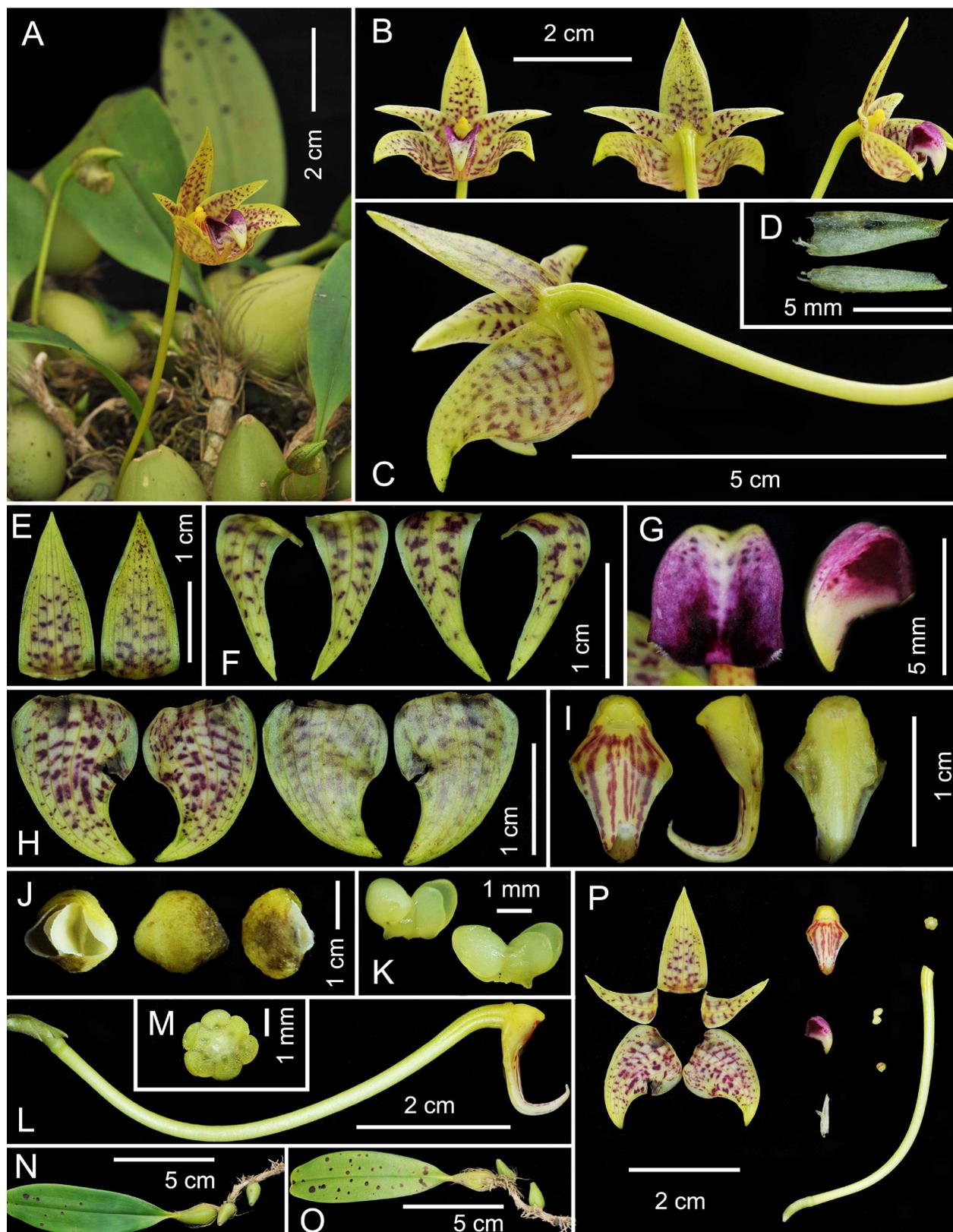


Fig. 1. *Bulbophyllum coveniorum* J. J. Verm. et P. O'Byrne. A – Flowering plant. B – Flower, frontal, back and side views. C – Flower, pedicel and ovary, side view. D – Floral bracts. E – Median sepal, abaxial and adaxial views. F – Petals, abaxial and adaxial views. G – Lip, view from above and side view. H – Lateral sepals, abaxial and adaxial views. I – Column and column foot, frontal view, side view and view from back. J – Operculum, view from below, view from above and frontal view. K – pollinia. L – Pedicel and ovary. M – Transversal ovary section. N, O – Portion of rhizome with leaf and pseudobulbs. P – Dissected floral parts. Photos of Nguyen Hoang Tuan, design and correction by Leonid V. Averyanov.

L.Averyanov CPC 7684 (LE). Southern Vietnam, Kon Tum province, Ngoc Linh nature reserve, 28 March 2016, Nguyen Phong HNPI/03/2016/LHL (Herbarium of Department of Pharmacognosy, Hanoi University of Pharmacy).

Esmeralda bella Rchb. f.,

1888, Gard. Chron. Ser. 3, 3: 136; Chen Xinqi, Wood, 2009, Fl. China 25: 465.

≡ *Arachnanthe bella* (Rchb. f.) C. H. Wright et Dewar, 1894, Johnson's Gard. Dict.: 1045.

≡ *Arachnis bella* (Rchb. f.) J. J. Sm., 1912, Natuurw. Tijdschr. Ned. – Ind. 72: 76.

– *Esmeralda clarkei* auct. non Rchb. f.: Aver., 2006, Turczaninowia 2006, 9, 3: 65, fig. 1, f. (Fig. 2).

Described without indication of origin (“... Mr W. Bull, whose No. 1022 it is among the Orchids sent me out of his large stores.”). **Type** (“W. Bull, 1022”) – not located, W?

Description. Monopodial epiphyte with pendulous and ascending stems. Stems to 1 m long, 1 cm in diam., stout, rigid, with many nodes. Leaves many, distant, distichous. Leaves sessile, leaf blade oblong, 13–16 × 2.5–3 cm, leathery, unequally bilobed at apex. Inflorescences ascending raceme, 12–18 cm long, often 2 or 3 on individual shoot, each with 2–3 sparse flowers; scape 5–12 cm long, with 3–6 short tubular sheaths; floral bracts broadly ovate, 1–1.7 cm long. Pedicel and ovary white to greenish, 4 cm long. Flowers odorless, widely opening, 5.5–7 cm across. Sepals and petals broadly oblanceolate, obtuse, yellowish, densely marked with transverse reddish-brown stripes; dorsal sepal 3 × 1 cm, rather straight or slightly curved forward; lateral sepals obliquely falcate, 2.7 × 0.8 cm; petals obliquely falcate, 2.7 × 0.7 cm. Lip somewhat pandurate, 2.1–2.3 mm long, 3-lobed; claw 2 mm long; lateral lobes erect, sub-quadrate, 4 mm long and wide, obliquely truncate; median lobe obscurely triangular, 8 × 9 mm, narrowing at the base, apex abaxially with fleshy callus, margin of median lobe irregularly denticulate; disk with a thick keel running from base to apex, at the base with bilobed callus and a movable lid-like appendage; sac at the base of median lobe small, 3 × 2 mm. Column stout, 12 mm tall. Anther cap slightly flattened, 5 × 4 mm. Pollinia 2, globular, each distinctly notched into two halves; stipe large, arcuate, saddle-shaped.

Common names. English – The Beautiful Arachnanthe, Chinese – Kou Gai Hua Zhi Zhu Lan, proposed Vietnamese name – Bo cap sin ho.

Ecology and phenology. Pendulous monopodial branch and trunk epiphyte. Evergreen broad-leaved

humid forests, preferably on karstic limestone. 1500–1600 m a.s.l. Flowers in November–December.

Distribution. Vietnam: provinces – Lai Chau (Sin Ho district) and Lao Cai (Sa Pa district). India, Myanmar, Nepal, SW China (SE Xizang, SW Yunnan), Thailand.

Threat and conservation. Almost total deforestation in areas of known populations is the main fatal factor of species extinction in Vietnam. Habitats harboring few discovered populations are currently degrading fast due to forest logging, road construction and agricultural landscape transformations. The gathering of mature samples for local and international trade (mainly to China) as a highly demanded ornamental plant is also significant factor of the species extinction even in intact natural conditions. Very strict area of distribution and rapid habitat loss lead to strong declining of populations during last decade. Therefore, species should be tentatively estimated as nationally critically endangered (CR) in terms of IUCN Red List categories and criteria (The IUCN Red List, 2016).

Use. According to people from local minorities, the leaves may be used in traditional medicine for treating stomach pain and pimple. However, scientific data on medicinal activity of any substances obtained this species are not yet available.

Notes. This species was previously recorded in Vietnam under the name *Esmeralda clarkei* Rchb. f. s. l. (Averyanov, 2006) regarding its probable synonymy with *E. bella* Rchb. f. However, later some taxonomists accept these species as separate taxa (Chen, Wood, 2009). Subquadrate lip side lobes, truncate at apex and disk with moveable lid-like appendage at the base were reported as the main morphological characteristics separating *E. bella* from *E. clarkei*. These characters well fits the studied Vietnamese specimens; hence, their re-identification as *E. bella* is proposed here as a new record for the flora of Vietnam. At the same time, *E. bella* remains purely studied, extremely rare species. Except northwestern Vietnam, it is expectedly occurs also in Nepal, northeastern India, Myanmar, northern Thailand and in southwestern China (Chen, Wood, 2009). However, its distribution and morphological variation needs further studies as presently available herbarium collections are very scarce.

Studied specimen. Northern Vietnam, Lao Cai province, Sa Pa district, vicinity of Sa Pa town, mountain forest at 1500 m, epiphyte with pendulous ascending shoots 25–40 cm long, flowers odorless, sepals and petals light yellowish with purple-brown

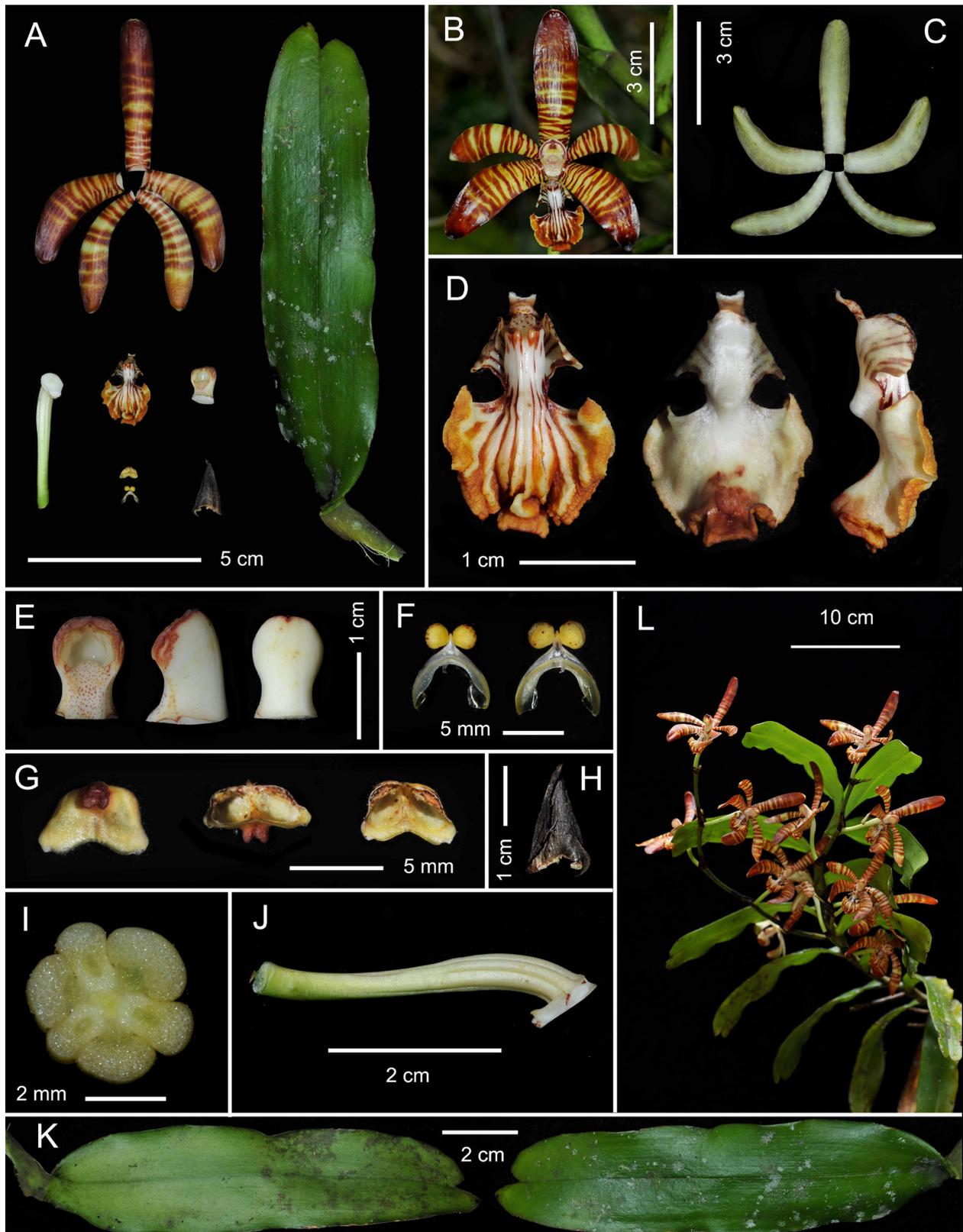


Fig. 2. *Esmeralda bella* Rchb. f. A – Dissected floral parts and leaf. B – Flower, frontal view. C – Sepals and petals from behind. D – Lip, frontal view, view from behind and side view. E – Column, frontal view, side view and view from behind. F – Pollinaria. G – Anther cap. H – Floral bract. I – Transversal ovary section. J – Pedicel and ovary. K – Leaf, view from adaxial and abaxial side. L – Flowering plant. Photos of Nguyen Hoang Tuan, design and correction by Leonid V. Averyanov.

transversal stripes, lip white with purple-brown longitudinal stripes and brown margin, column white, rare, 24 November 2005, L. Averyanov, P. K. Loc, HAL 8311 (LE). Northern Vietnam, Lai Chau province, Sin Ho district, Ta Ngao municipality, Hai Ho village, around point 22°16'09"N, 103°14'34"E, remnants of primary broad-leaved evergreen closed wet forest on very steep rocky slopes and cliffs of remnant mountains composed with stratified solid gray highly eroded limestone at 1500–1600 m, epiphyte and lithophyte with pendent shoot up to 1 m long on very steep rocky slopes and on shady vertical cliffs, flowers yellowish with brown-purple marks, not common, 20 November 2006, N. T. Hiep, L. Averyanov, P. V. The, HAL 10061 (HN, LE, MO). Northern Vietnam, Lai Chau province,

Sin Ho district, anno 2014, Chu Xuan Canh CXC 108 (LE). Northern Vietnam, Lai Chau province, Sin Ho district, Ta Ngao commune, around point 22°18'17.1"N, 103°18'45.5"E, 15 December 2015, Chu Xuan Canh, HNPI/12/2015/BCSH (Herbarium of Department of Pharmacognosy, Hanoi University of Pharmacy).

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