

**TAXONOMY OF *HOYA LYI*,
HOYA YUENNANENSIS
AND *HOYA MEKONGENSIS*
(APOCYNACEAE – ASCLEPIADOIDEAE)**

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Hoya lyi H.Lév. and *H. yuennanensis* Hand.-Mazz. (Apocynaceae – Asclepiadoideae), described at the beginning of the 20th century from specimens collected in South West China, have often been confused with each other and with *H. carnosa* R.Br. Currently *Hoya yuennanensis* is considered a synonym of *H. lyi* but after the selection of lectotypes and the comparison of extensive herbarium materials from the region two species are once again recognised. Emended descriptions and illustrations are provided. The recently described *Hoya mekongensis* M.G.Gilbert & P.T.Li is synonymised with *H. yuennanensis*.

Keywords. Lao PDR, lectotypification, South West China, taxonomy, Vietnam, Yunnan.

INTRODUCTION

Hoya R.Br. (Apocynaceae) is a monophyletic genus well rooted within Asclepiadoideae (Wanntorp *et al.*, 2006). It was last revised in De Candolle's *Prodromus* (Decaisne, 1844) and is in urgent need of revision (Meve, 2002).

The International Plant Names Index lists more than 600 *Hoya* species names but estimates of the true number of species are extremely variable, ranging between 200 and 300 (Forster *et al.*, 1998; Kleijn & Van Donkelaar, 2001). These are very conservative estimates and likely many more species are still undescribed.

Apart from the lack of a complete revision, the broad Indomalaysian-Australian-Western Pacific distribution also makes an accurate estimate of the number of species difficult. The regions with the highest known species diversity are the Philippines and New Guinea but many parts of the distribution of the genus are still undercollected (Forster *et al.*, 1998).

Chinese *Hoya* are rather better known because they have recently been revised for the *Flora of China* (Li *et al.*, 1995) where 32 species and one variety of *Hoya* are recorded. With the recently published *Hoya baishaensis* Shao Y.He & P.T.Li (He *et al.*, 2009a), *H. bawanglingensis* Shao Y.He & P.T.Li (He *et al.*, 2009b) and *H. persiciniconornaria* Shao Y.He & P.T.Li (He *et al.*, 2009c), the total number of Chinese *Hoya* species has been raised to 35. In these treatments *Hoya yuennanensis*

was considered a synonym of *H. lyi* although neither species has been lectotypified. While searching for suitable lectotypes at the herbaria of B, BM, C, E, FI, GH, HBG, HITBC, IBSC, K, L, P, S, SING, TO, W, WRS�, WU and Z it became apparent that two separate morphological entities are present and, therefore, the name *Hoya yuennanensis* should be resurrected. It also became apparent that *Hoya mekongensis* (Gilbert *et al.*, 1995) is morphologically indistinguishable from *H. yuennanensis*.

In the present paper I (i) discuss the taxonomic history of *Hoya lyi* and *H. yuennanensis*, (ii) emend their descriptions, (iii) lectotypify *H. lyi* and *H. yuennanensis*, (iv) resurrect the name *H. yuennanensis*, and (v) synonymise *H. mekongensis* with *H. yuennanensis*.

TAXONOMIC HISTORY AND CURRENT STUDY

In 1907, when *Hoya lyi* was published (Léveillé, 1907), only two Chinese *Hoya* species had previously been described, *H. carnosã* R.Br. and *H. pottsii* Traill (Dunn, 1911). In 1934, *Hoya lyi* was synonymised into *H. carnosã* (Rehder, 1934) but two years later Tsiang (1936) resurrected it, stating ‘It cannot be confused with *H. carnosã* which belongs to a different series of the section’, citing his two collections (*Tsiang* 4681 and 4738) as ‘exactly matching the type’. Nonetheless, attached to specimen 4738 there is a note by Tsiang: ‘*Tsiang* 4738 = *Ching* 6727 seems not identical with *Hoya lyi*, but more material will show transitions H. Handel-Mazzetti, in litt., June 11, 1935’. On the specimen *Tsiang* 4681, Tsiang annotated instead: ‘Identical with the type of *H. lyi* and I agree now that it is a good species, different from *H. carnosã* H. Handel-Mazzetti, in litt’. Here Tsiang was probably referring to specimen *Handel-Mazzetti* 7971, collected in China in 1915 and distributed as *Hoya carnosã*. After revising his Chinese collections Handel-Mazzetti (1936) published *Hoya yuennanensis* based on this specimen. Surprisingly, Tsiang & Li (1977) considered *Hoya yuennanensis* a synonym of *H. lyi*.

In the most recent edition of the *Flora of China* Li *et al.* (1995) made no changes from the earlier Chinese language version (Tsiang & Li, 1977) but did provide an extended description of the taxon.

The name *Hoya yuennanensis* was recently misapplied in Wanntorp & Forster (2007) to *Micholitzia obcordata* N.E.Br., a species now included in *Hoya* and whose currently recognised name is *H. manipurensis* Deb.

Correct application of names in *Hoya* is still problematic due to the complex and often confused nomenclature, partly caused by horticultural interest in *Hoya* species that has led to a proliferation of synonyms.

It is clear from the examination of the lectotypes and of the cited specimens of *Hoya lyi* and *H. yuennanensis* that there are two separate species, both ecologically and morphologically. *Hoya lyi* is a small lithophytic species with variable leaves that can be oval, elliptic or oblong. It is found only on limestone, in deep shade, growing tightly appressed to the rock surface. *Hoya yuennanensis*, in contrast, is a more rampant climber, generally with elliptic or oblanceolate leaves found on siliceous and

limestone outcrops in exposed locations. Both species have white to pale pink flowers of similar size but they can be easily discriminated by the shape of their coronas. *Hoya lyi* has a rather flat-topped corona with rounded and flattened slightly ascending outer corona lobes while *H. yuennanensis* has erect corona lobes with rounded outer processes and a depressed stigmatic head (Fig. 1). They can also be discriminated in their pollinia: *Hoya lyi* has smaller pollen masses with an elongated retinaculum while *H. yuennanensis* has a massive retinaculum compared to the size of the pollinium (Fig. 2). For these reasons *Hoya yuennanensis* should be reinstated. A complete comparison between *Hoya lyi* and *H. yuennanensis* based on all examined specimens is presented in Table 1.

Hoya yuennanensis was initially confused with *H. carnosa* (Handel-Mazzetti, 1927) but the two species can be easily separated by the flat-topped corona lobes of *H. carnosa* that have acute inner and outer lobes.

Often *Hoya* species are known from one or just a few specimens and an assessment of their variation is, therefore, impossible. The study of an extensive number of specimens of *Hoya lyi* has highlighted its morphological variation across the distribution range. Leaves can vary greatly in shape (oval, elliptic, oblong) and size, ranging from 1.5 to 10 cm long. The calyx can have very short narrow lobes or rather broad lobes. Flowers can be variable in colour, from fully white to white with a prominent pink or purple centre, and corona lobes that can be either completely flat and perpendicular to the pollen tube, or slightly ascending. The large variation may be due to the broad distribution range. *Hoya lyi* appears to be closely related to *H. thomsonii* Hook.f. They are both lithophytic species adapted to limestone rocks, they grow in very shady conditions and they bear white villous corollas and rounded corona lobes.

Hoya thomsonii was described from India but is also found in northern Thailand and southern China. Biogeographic links have been observed between the floras of Nepal and Thailand (Pendry *et al.*, 2009) suggesting that the distribution of *Hoya thomsonii*, and possibly of *H. lyi*, may be more extensive than so far observed. Since the extent of morphological variation of *Hoya thomsonii* is unknown, further studies are required to establish whether *H. lyi* falls within the range of variation of *H. thomsonii*.

While searching for specimens of Chinese *Hoya* species, the holotype of *Hoya mekongensis* was compared with specimens of *H. yuennanensis*. The two species appear to be indistinguishable on morphological grounds. Furthermore, *Hoya yuennanensis* and *H. mekongensis* are together known only from three collections in a very restricted area along the Mekong River (Fig. 3). Pollinaria from *Hoya mekongensis* have been included in Fig. 2 for comparison. It is therefore suggested that *Hoya mekongensis* is a new synonym of *H. yuennanensis*.

TAXONOMY

Hoya lyi H.Lév., Bull. Soc. Bot. France 54: 369 (1907); H.Lév., Fl. Kouy Tchéou 42 (1915). – Type: China, Guizhou, Tsien-Sen-Kiao, xi 1904, *Ly* 1879 (lecto E! (barcode E00279452), designated here). **Figs 1, 2.**

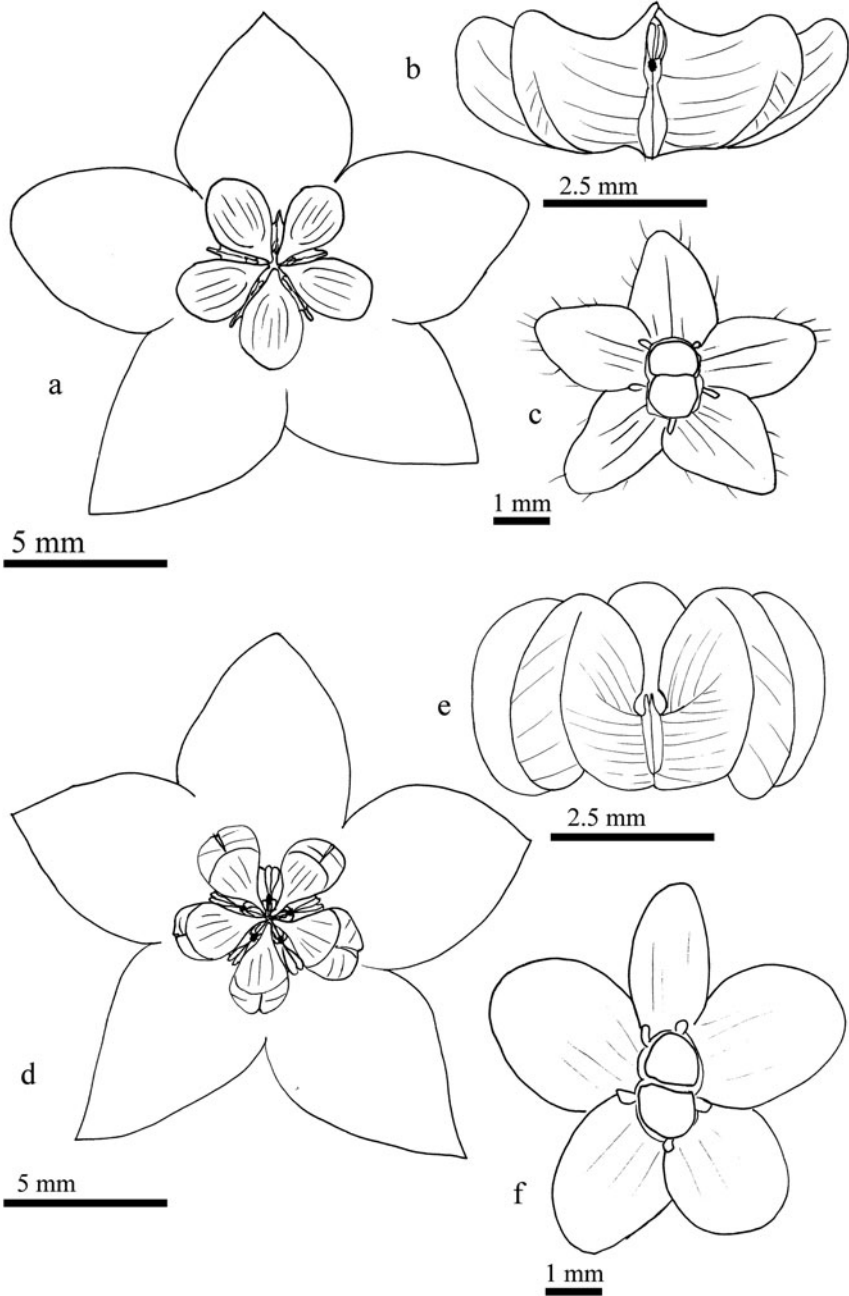


FIG. 1. *Hoya lyi* H.Lév. (above; a, b, c) and *H. yuennanensis* Hand.-Mazz. (below; d, e, f). a, d: corolla, only shape of corolla lobes drawn; b, e: corona, from side; c, f: calyx. Drawn by M. Rodda from *Ly* 1879 (*Hoya lyi*, E, lectotype) and *Handel-Mazzetti* 7971 (*Hoya yuennanensis*, E, isolectotype).

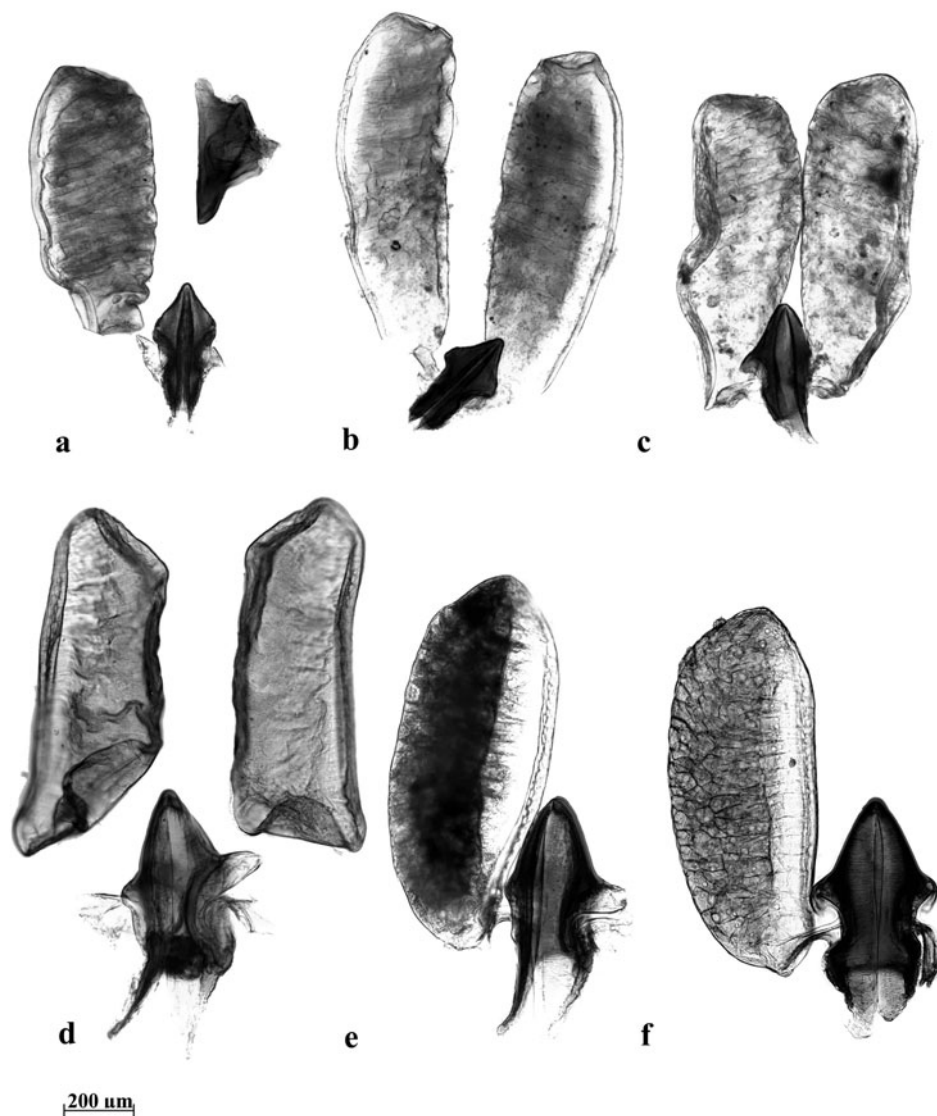


FIG. 2. Pollinaria from herbarium specimens of *Hoya lyi* (above; a, b, c) and *H. yuennanensis* (below; d, e, f). a: *Ly* 1879 (E, lectotype); b: *Martin & Bodinier* 1853 (E); c: *Poillane* 2138 (P); d: *Handel-Mazzetti* 7971 (E, isolectotype); e: *Soulié* 1598 (P, holotype of *Hoya mekongensis*); f: *Kingdon Ward* 1139 (E). The pollinia of *Handel-Mazzetti* 7971 appear to be immature or not well preserved.

All measurements from rehydrated material.

Semi-woody, lithophytic or rarely epiphytic vine, delicate, with white latex. *Leafy stems* up to 2–3 m, generally shorter, cylindrical up to 3 mm in diameter, young stems hirsute. *Internodes* 1–5(–10) cm, conspicuously rooting along stems. *Leaves*

TABLE 1. Morphological comparison between *Hoya lyi* and *H. yuennanensis*

Character	<i>Hoya lyi</i>	<i>Hoya yuennanensis</i>
Leaf shape	Very variable in shape, from oval to elliptic or oblong	Variable, elliptic or oblanceolate (suborbicular)
Leaf base	Base rounded, less often truncate or shortly attenuate	Base rounded to obtuse
Leaf apex	Apex acute or rounded	Apiculate to abruptly acute
Leaf length	(1.5–)3–5(–10) cm	6–13 cm
Leaf width	1–3 cm	4–5 cm
Leaf nerves (number)	3–5 pairs	c.7 pairs
Leaf secondary nerves (branching angle)	90° (60–120°)	60°
Flower peduncle length	2–5 cm	1–2.5(–5) cm
Flower peduncle surface	Hirsute when young	Pubescent
Calyx lobes shape	Elliptic to ovate	Broadly ovate to orbicular
Corolla surface (adaxial)	Villous throughout	Hirsute
Corona lobe shape	Boat shaped, flattened above	Ovoid, flattened internally
Corona lobe inner process	Acute, about as high as outer processes and stigmatic head	Acute, incumbent on gynostegium
Corona lobe outer process shape	Rounded, slightly ascending	Rounded, erect
Pollinarium length	900 µm	1100 µm
Pollinarium width	350 µm	450 µm
Retinaculum length	400 µm	700 µm
Retinaculum width	200 µm	350 µm

opposite, petiolate; petiole 3–5(–10) mm long, 1–1.5 mm wide, hirsute; lamina stiff, fleshy, very variable in shape, from oval to elliptic or oblong, (1.5–)3–5(–10) × 1–3 cm, apex acute or rounded, base rounded, less often truncate or shortly attenuate, margin entire, adaxially dark green, hirsute, lighter green on abaxial side, hirsute, penninerved, main vein ridged on adaxial surface, less evident on abaxial surface, secondary veins 3–5 pairs evident when dry, nearly at right angles from main nerve but variable, from 60 to 120°, anastomosing near leaf margins. *Inflorescences* pseudo-umbelliform, convex, 4–10(–20)-flowered; peduncle extra-axillary, perennial, 2–5 cm long, 1.5–3 mm wide, hirsute when young; pedicels 2.5–3 cm × c.1 mm, hirsute. *Calyx* 4–5 mm in diameter, lobes elliptic to ovate, 2–3 × 1–1.5 mm, apex rounded, glabrous inside, sparsely pubescent outside, rugose, margins ciliate, 1–3 basal glands at the junction between the lobes. *Corolla* flattened to slightly convex, white to light pink, 14–18 mm in diameter, abaxial side glabrous, adaxially villous throughout; lobes 7–8 × 4–5 mm, ovate to rhomboid with acute apex. *Corona*

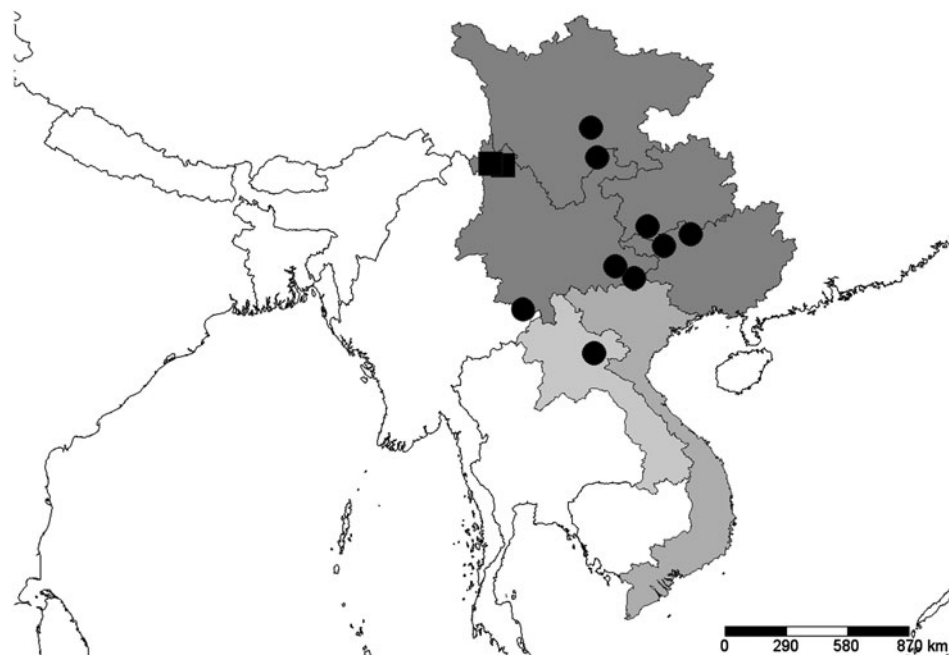


FIG. 3. Distribution of *Hoya lyi* and *H. yuennanensis* based on specimens indicated by (*) within main text. *Hoya lyi* is indicated by a full circle; *H. yuennanensis* by a full square. The Chinese provinces of Guangxi, Guizhou, Sichuan and Yunnan are indicated in dark grey. In lighter shades of grey are indicated Vietnam and Lao PDR. Map constructed using SimpleMappr (www.simplemappr.net).

staminal, ivory white with purple centre, 2–3 mm high, 5–7 mm diameter, lobes boat shaped, $2.5\text{--}3 \times 1.5$ mm, flattened above; outer processes rounded, slightly ascending, inner processes acute, about as high as outer processes and stigmatic head; basal anther process free from the filament tube. *Pollinarium* (all measurements approximate) 1100×750 μm , pollinia oblanceolate, 900×350 μm , base obliquely truncate, apex rounded, retinaculum 400×200 μm , caudicles thin, 100 μm long. *Ovary* bottle shaped, c.2 mm long, 1 mm wide. *Fruits* and seeds not seen.

Distribution. The localities of the syntypes indicated in L veill  (1907) could not be equated with modern Chinese localities. L veill  (1915) noted that the three specimens were collected in Guizhou. More recent collections have been made in Sichuan, Guangxi and Yunnan, as mentioned by He *et al.* (2009a). Zhu *et al.* (2003) identified *Hoya lyi* as one of the characteristic species in limestone habitats in southern Yunnan. In the present study I have also identified specimens of *Hoya lyi* from Vietnam and Lao PDR, a first record for these countries (Fig. 3).

Ecology. *Hoya lyi* is a delicate climber, often lithophytic on limestone where it grows tightly appressed to the rock surface. It prefers moderately moss-covered rocks in very shady places, usually on the north side of cliffs or in deep gorges or where the sunlight is filtered by an overhanging tree canopy. It can be found at the northern limit of the distribution area of *Hoya* (in particular *Wilson* 5071) and appears to be one of the most cold-tolerant species in the genus.

Specimens examined (* indicates specimens mapped in Fig. 3). CHINA. **Guangxi:** Nandan, *sin. coll.* 99659* (IBSC barcode 520490); Baise Qin, Wanglao Shan, Langping, *sin. coll.* 618173* (IBSC barcode 520491). **Guizhou:** Kouy Tcheou, *Cavalerie* s.n. (P); *sin. loc.*, vii 1909, *Esquirol* 1590 (E barcode E00281697); Ha Hai Tre, x 1910, *Esquirol* 2517 (P); Na-Kan, Cheng-Feng, *Tsiang* 4738* (IBSC barcodes 520503 & 520504); Na-Kan, Cheng-Feng, *Tsiang* 4681* (IBSC barcodes 520505 & 520506); Gan-Pin, 20 ix 1897, *Martin & Bodinier* 1853 (syn E barcode E00279451, P); Lo-Pié, 7 x 1897, *Martin & Bodinier* 1853 (syn P barcode P00634485). **Sichuan:** Leibo, Zhongshan Ping, *Z.T. Guan* 9658* (IBSC barcode 520622); Mt. Omi, *Wilson* 5071* (BM, IBSC, K); *sin. loc.*, *Wilson* 4098 (BM, K). **Yunnan:** *sin. loc.*, xi 1904, *Cavalerie* 1879 (K); *ibid.*, 10 ii 1905, *Ducloux* 3477 (P); *ibid.*, Xishuangbanna, 100°30'E, 21°30'N, 14 x 1978, *Tao Guo Da* 35474* (HITBC); Yan Shan, *Wang* 591772* (IBSC barcode 520495); Le Tchong, 15 x 1904, *Ducloux* 2909 (P).

LAOS. **Xieng Khouang:** Tam La, 19 x 1920, *Poilane* 2138* (P barcodes P00700446 & P00700534).

VIETNAM. **Ha Giang:** Yen Minh distr., Lao Va Chai municipality, vicinity of Lao Va Chai village, 9 x 1999, *Hiep, Binh, Averyanov, Cribb* NTH 3470* (K).

Notes. There are some inaccuracies in the citation of specimens by Lévillé in the first publication of *Hoya lyi* (Lévillé, 1907). The three specimens cited are: Gan Pin, *Martin & Bodinier* s.n., 20 ix 1897; Lo Pie, *Martin & Seguin* 1853, 7 x 1897 and *Ly* 1879, xi 1904.

Martin & Bodinier s.n., the material from Gan Pin, has been located in E and P but bearing the collection number 1853. On the E specimen there is a reference to specimen Lo Pie, *Martin & Seguin* s.n., 7 x 1897 as belonging to the same species. It is reasonable to assume that this is actually a reference to *Martin & Bodinier* 1853, 7 x 1897 from Lo Pie, a specimen extant in P.

Specimen *Ly* 1879, xi 1904 was found in E and is here selected as lectotype since it does not present any citation incongruence with the original publication and was collected by the person, Jean Ly, after which *Hoya lyi* is named. Also, the specimen is in good condition, possessing leafy stems and two pseudo-umbels.

Hoya yuennanensis Hand.-Mazz., *Symb. Sin. Pt. VII*: 1001 (1936). – Type: China, Yunnan, Lota Tanschan & Tsedjrong, ad fluvium Landsang-djiang (Mekong), 10 ix 1915 or 4 x 1915 (see notes below), *Handel-Mazzetti* 7971* (lecto WU (number WU0043535), designated here; isolecto E (barcode E00281696), GH (barcode A00076426), K, W (number 1924-0011093), WU (number WU0043536)). **Figs 1, 2.**

Hoya mekongensis M.G.Gilbert & P.T.Li, Novon 5(1): 10 (1995), **syn. nov.** – Type: China, Yunnan: Tsékou, 1895, *Soulié* 1598* (holo P (barcode P00639769); iso P (barcodes P00639770, P00639771, P00639772)). **Fig. 2.**

All measurements from rehydrated material.

Semi-woody, lithophytic or epiphytic climbing vine. *Leafy stems* cylindrical up to 5 mm in diameter, young ones hirsute, mature ones glabrescent. *Internodes* (5–)10–20 cm, conspicuously rooting along stems. *Leaves* opposite, petiolate; petiole flattened above, rugose, 0.7–1.6 cm long, 3–4 mm wide, densely puberulent; lamina stiff, fleshy, variable, elliptic or oblanceolate (rarely suborbicular), 6–13 × 4–5 cm, apex apiculate to abruptly acute, base rounded to obtuse, margin entire, minutely hairy, penninerved, main vein sulcate on adaxial side, secondary veins c.7 pairs, poorly defined, held at c.60° from main nerve, anastomosing and forming a secondary reticulate venation. *Inflorescences* pseudo-umbelliform, convex, at least 8-flowered; peduncle extra-axillary, perennial, 1–2.5(–5) cm long, c.2 mm wide, pubescent; pedicels 2–3 cm × c.1 mm, sparsely hairy. *Calyx* 4–5 mm in diameter, lobes broadly ovate to orbicular, 1.5–2 × 1.5 mm, apex rounded, inside glabrous, outside rugose with a few hairs, margin sparsely ciliate, 1–2 basal glands at the junction between the lobes. *Corolla* flattened to slightly convex, white to light pink, 17–19 mm in diameter, abaxial side glabrous, adaxially hirsute; lobes 6–8 × 5 mm, ovate with acute reflexed apex. *Corona* staminal, ivory white, c.3 mm high, 5–7 mm in diameter, lobes ovoid, flattened internally, 2.5–3 × 2 mm; outer processes rounded, erect, inner processes acute, incumbent on gynostegium, just meeting in the centre; stigmatic head depressed; anther free from the filament tube. *Pollinarium* (all measurements approximate) 1350 × 1100 µm, pollinia oblanceolate, 1100 × 450 µm, base and apex rounded, retinaculum 700 × 350 µm, caudicles thin, 200 µm long. *Ovary* triangular, c.2.5 mm long, 1 mm wide. *Fruits* and seeds not seen.

Distribution. *Hoya yuennanensis* has only been found in three localities along the Mekong River, near the villages of Lota, Tsékou and Loudre. These localities have been identified using the map in Handel-Mazzetti (1927) where Tsékou is spelled Tseku (Fig. 3).

Ecology. Handel-Mazzetti (1927) provides a description of the habitat where *Hoya yuennanensis* was collected: ‘Among other plants growing on the arid rocks, receiving a little shade from the sclerophyllous shrubs above them, were numerous orchids, now out of flower, and *Hoya carnososa*, a creeper with thick fleshy leaves; *Sedum diymarioides*, a little stonecrop with numerous glands, and the large *S. indicum*, *Polypodium nipponicum*, a fern with bluish creeping rootstocks, and a few mosses’. In the same book there is a picture of the collection locality above Lota, along the Mekong River (Handel-Mazzetti, 1927, cap. 18, fig. 31).

The species appears to be adapted to grow on rocks along the Mekong River and can be quite a rampant climber. From the limited material available it does not look

like it grows tightly attached to the rock surface as is the case for *Hoya lyi*. Since it grows above 2000 m a.s.l. at the northern limit of the distribution area of *Hoya* it is one of the most cold-tolerant species in the genus.

Additional specimen examined (* indicates specimen mapped in Fig. 3). CHINA. **Yunnan:** Loudre, 18 x 1913, *Kingdon Ward* 1139* (E barcode E00281698).

Notes. An attempt at lectotypification was made by D. H. Kent in 1989 who labelled the specimen *Handel-Mazzetti* 7971 (W) as the lectotype of *Hoya yuennanensis*, a name he considered to be a synonym of *H. lyi*. However, it was never published so has no standing. The same specimen was cited in Wanntorp & Forster (2007) as the holotype. It must be noted that *Handel-Mazzetti* 7971 is likely a mixed accession. On the labels of the various duplicates studied two collection dates co-occur: 10 ix 1915 and 4 x 1915. Probably plants were collected with the same collection number at the same locality on different days. This is also suggested by the reference on the specimens to two notes in Handel-Mazzetti's diary (1477 and 1569). Unfortunately the diary is missing and these notes cannot be verified (Handel-Mazzetti, 1996). Among the duplicates of *Handel-Mazzetti* 7971, the specimen here designated as the lectotype is the only one with a single leafy shoot with attached flowers. Although it is impossible to determine on which of the two possible dates it was collected it cannot be a mixed accession and is, therefore, available for lectotypification. Likewise it is impossible to state definitively which isolectotype was collected on which date and it is possible that not all of them are, strictly speaking, duplicates of the lectotype.

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REFERENCES

- DECAISNE, J. (1844). *Hoya*. In: DE CANDOLLE, A. P., *Prodromus* 8: 634–640.
- DUNN, S. T. (1911). A Supplementary List of Chinese Flowering Plants, 1904–1910. *J. Linn. Soc., Bot.* 39: 411–506.
- FORSTER, P. I., LIDDLE, D. J. & LIDDLE, I. M. (1998). Diversity in the genus *Hoya* (Asclepiadaceae–Marsdenieae). *Aloe* 35: 44–48.
- GILBERT, M. G., STEVENS, W. D. & LI, P. T. (1995). Notes on the Asclepiadaceae of China. *Novon* 5: 1–16.
- HANDEL-MAZZETTI, H. (1927). *Naturbilder aus Südwest China*. Vienna: Österreichischer Bundesverlag.

- HANDEL-MAZZETTI, H. (1936). *Symbolae Sinicae* 7: 1001.
- HANDEL-MAZZETTI, H. (1996). *A Botanical Pioneer in South West China: Experiences and Impressions of an Austrian Botanist during the First World War*. David Winstanley.
- HE, S. H., ZHUANG, X. Y., LI, P. T., LIN, J. Y. & LI, M. (2009a). *Hoya baishaensis* (Apocynaceae), a new species from Hainan, China. *Ann. Bot. Fenn.* 46: 155–158.
- HE, S. H., LI, P. T., LIN, J. Y. & ZENG, M. L. (2009b). A new species of *Hoya* (Apocynaceae, Asclepiadoideae) from Hainan, China. *Novon* 19: 357–359.
- HE, S. H., LI, P. T., LIN, J. Y. & YANG, X. H. (2009c). *Hoya persiciniconaria* (Apocynaceae, Asclepiadoideae), a new species from Hainan, China. *Novon* 19: 475–478.
- KLEIJN, D. & VAN DONKELAAR, R. (2001). Notes on the taxonomy and ecology of the genus *Hoya* (Asclepiadaceae) in Central Sulawesi. *Blumea* 46: 457–483.
- LÉVEILLÉ, H. (1907). Nouvelles espèces de la Chine. *Bull. Soc. Bot. France* 54: 369.
- LÉVEILLÉ, H. (1915). *Flore du Kouy-Tchéou*. Le Mans.
- LI, P. T., GILBERT, M. G. & STEVENS, W. D. (1995). Asclepiadaceae. *Flora of China* 16: 228–236. Beijing: Science Press and St Louis: Missouri Botanical Garden Press.
- MEVE, U. (2002). Species numbers and progress in Asclepiad taxonomy. *Kew Bull.* 57(2): 459–464.
- PENDRY, C. A., PARNELL, J. A. N. & VAN WELZEN, P. C. (2009). Biogeographic links between Thailand and Nepal and the potential for collaboration between their Flora projects. *Thai For. Bull. (Bot.), Special Issue*: 169–185.
- REHDER, A. (1934). Notes on the ligneous plants described by Léveillé from Eastern China. *J. Arnold Arbor.* 15: 267–326.
- TSIANG, Y. (1936). Asiatic Apocynales III. *Sunyatsenia* 3: 121–239.
- TSIANG, Y. & LI, P. T. (1977). Asclepiadaceae. *Flora Reipublicae Popularis Sinicae* 63: 475–492. Beijing: Science Press. [In Chinese.]
- WANNTORP, L. & FORSTER, P. I. (2007). Phylogenetic relationships between *Hoya* and the monotypic genera *Madangia*, *Absolmsia* and *Micholitzia* (Apocynaceae, Marsdenieae): Insights from flower morphology. *Ann. Missouri Bot. Gard.* 94: 36–55.
- WANNTORP, L., KOCYAN, A., VAN DONKELAAR, R. & RENNER, S. S. (2006). Towards a monophyletic *Hoya* (Marsdenieae, Apocynaceae): Inferences from the chloroplast trnL region and the rbcL-atpB spacer. *Syst. Bot.* 31(3): 586–596.
- ZHU, H., WANG, H., LI, B. P. & SIRIRUGSA, P. (2003). Biogeography and floristic affinities of the limestone flora in Southern Yunnan, China. *Ann. Missouri Bot. Gard.* 90: 444–465.

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