

Nine new species and one new subspecies of *Hoya* (Apocynaceae: Asclepiadoideae) from Borneo

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ABSTRACT. In the present paper we publish nine new species and one new subspecies from Borneo, *Hoya ariffinii* Rodda & S.Rahayu, *H. boycei* Rodda & S.Rahayu, *H. curtisii* King & Gamble subsp. *collariata* S.Rahayu & Rodda, *H. dulitensis* Rodda & S.Rahayu, *H. kaikoeana* S.Rahayu & Rodda, *H. kapuasensis* S.Rahayu & Rodda, *H. kerangasensis* Rodda & S.Rahayu, *H. peltata* Rodda & S.Rahayu, *H. polypus* S.Rahayu & Rodda and *H. sangguensis* S.Rahayu & Rodda. Five species are endemic to Kalimantan, two to Brunei and one to Sarawak. Only *Hoya kerangasensis* is found in Brunei, Sabah and Sarawak, and only *H. sangguensis* is also found outside Borneo in Peninsular Malaysia. With these new species the number of *Hoya* of Borneo reaches 85 species and four subspecies.

Keywords. Brunei, Indonesia, Kalimantan, Malaysia, Malesia, Sabah, Sarawak

Introduction

The genus *Hoya* R.Br., with an estimated 350–450 species, is the largest among Asian Apocynaceae (Rodda, 2015; Endress et al., 2019) and is to be found over a large area from the Himalayan foothills to Okinawa (Japan) and through Southeast Asia and Malesia to Australia and the Fiji Islands.

The morphological diversity of *Hoya*, with particular emphasis on Bornean species, was extensively discussed in Lamb et al. (2014) and Lamb & Rodda (2016).

Based on the available data (Pelser et al., 2011 onwards; Lamb & Rodda, 2016; Cámara-Leret et al., 2020) the centres of diversity of *Hoya* are Borneo, New Guinea and the Philippines. What is known of the diversity of the genus in the three areas, however, differs markedly, leading to either an underestimation or an overestimation of the number of species. At one extreme is New Guinea, which is the least explored but has seen a recent increase in taxonomic research (Cámara-Leret et al., 2020; Rodda & Simonsson, in press). In New Guinea there are 77 recognised *Hoya* taxa (including five subspecies), 19 of which have been published since 2017 due to recent field collections (Nathalie Simonsson spent six years in Papua New Guinea, 2010–2016, and conducted extensive field work) and extensive examination of specimens

(Simonsson Juhonewe & Rodda, 2017; Rodda & Simonsson, in press). Six species are considered doubtful either because of lack of type material or unavailability of complete specimens (updated from Cámara-Leret et al., 2020; Rodda & Simonsson, in press) but the other species are all fairly well known and unlikely to be synonymised. A guidebook to *Hoya* of New Guinea is in preparation and will include short descriptions and images of most species. More than 90% of the New Guinean taxa are considered endemic and it is almost certain that with more intensive field collections further novelties will be collected and described.

At the other extreme is the Philippines, where Pelsner et al. (2011 onwards) list as many as 202 *Hoya* taxa, but state that ‘The number of *Hoya* species in the Philippines is doubtlessly much lower than suggested by this account’. We agree that many names will become synonyms once the genus is revised.

The diversity of *Hoya* in Borneo has been recently studied quite extensively and publications include Lamb & Rodda (2016), an illustrated guidebook to *Hoya* of Borneo including 71 species and one subspecies, with about 50% endemic taxa. Rodda (2017) clarified the types of all of these names. Since then, the number of taxa has been steadily increasing, reaching 76 species and three subspecies (Rahayu & Rodda, 2021).

We here describe an additional nine species and one subspecies from Borneo. Five were recently collected in Kalimantan, Indonesia, which is the largest yet the most poorly explored part of Borneo; four are only known from one or few herbarium specimens from Brunei, Sabah or Sarawak; and one is endemic to the heath forests of Brunei. The number of *Hoya* taxa occurring in Borneo is therefore updated to 85 species and four subspecies. In preparation for this paper, specimens of *Hoya* were examined in person or via loans from A, BM, BO, FI, K, L, LAE, MO, P, SING and UC herbaria (Thiers, continuously updated). We are well aware that describing new taxa based on one or very few collections, as is the case for most of the taxa described here, only allows for a very incomplete understanding of the morphological variability of each taxon. When and if new collections become available, species descriptions, habitat and ecological information, and conservation assessments will be updated. We are also aware that more collections of these taxa might narrow the morphological discontinuities between similar taxa. Nonetheless, we do not consider any of the taxa described here to be part of known variable species complexes such as *Hoya verticillata* (Vahl) G.Don or *Hoya camphorifolia* Warb., and are therefore less likely to be synonymised in the future. In this paper, the global conservation categories and criteria follow IUCN Standards and Petitions Committee (2022).

Taxonomy

1. *Hoya ariffinii* Rodda & S.Rahayu, **sp. nov.**

Similar to *Hoya sammannaniana* A.Lamb et al. in habit (terrestrial or hemi-epiphytic), leaf texture (thinly coriaceous) and shape (lanceolate or elliptic), number and shape

of flowers (generally 1 open at a time, corolla campanulate-urceolate), but can be distinguished in leaf surface (flat in *H. ariffinii* vs undulate with recurved margins in *H. sammannaniana*), corolla tube-lobe ratio (tube > 2 times lobe length in *H. ariffinii* vs tube < 2 times lobe length in *H. sammannaniana*), corolla tube shape (broader at base in *H. ariffinii* vs broader at mouth in *H. sammannaniana*) and corona shape (broadly conical in *H. ariffinii* vs almost flat-topped in *H. sammannaniana*). – TYPE: Brunei, Belait, Bukit Sawat, Jln Labi km 13, Jln Sg Liang-Labi, entrance sub road behind nursery, 4°34'32"N 114°30'19"E, 71 m, 23 November 2010, *Ariffin & Azlan BRUN 23277* (holotype BRUN [acc. no. B030492]; isotypes K n.v., SING n.v.). (Fig. 1, 2)

Climber or creeper, terrestrial or hemi-epiphytic, latex white in all vegetative parts, glabrous. **Stems** cylindrical, slender, to 3 m long, 2–3 mm diam., internodes (1.5–)7–12 cm long, older stems with pale peeling bark. **Roots** basal, no adventitious roots observed. **Leaves** opposite or alternate, petiole channelled above, 3.5–10 mm long, 1–1.5 mm diam.; lamina flat, lanceolate or elliptic, thinly coriaceous, 7–15 × 2–5 cm, apex acuminate, base attenuate; venation pinnate, secondary veins 4–6 each side, tertiary venation reticulate; basal colleters not present. **Inflorescence** one per node, with one open flower at a time; **peduncle** extra-axillary, positively geotropic, terete, 2–7 cm long, 1–1.5 mm diam., older peduncles forming a rachis from previous flowerings, glabrous; **pedicels** filiform, 10–15 mm long, 0.3–0.5 mm diam., glabrous. **Flowers** in bud globose, 5-ridged, pale yellow, positively geotropic. **Calyx** 3–3.2 mm diam.; lobes broadly deltate, 1–1.2 × 0.8–1.2 mm, apex acute, outside sparsely pubescent, inside glabrous, ciliate; basal colleters one at each calyx lobe sinus, oblong, c. 0.15 mm long. **Corolla** campanulate-urceolate, 11–12 mm long, 12–14 mm diam.; **tube** c. 15 mm long, basally broadly campanulate, then straight, narrowing towards the mouth, glabrous; **lobes** broadly triangular, spreading at anthesis, 5–7 × 2–3 mm, apex obtuse, glabrous. **Gynostegium** sessile. **Corona** staminal, conical, 3.5–3.8 mm high, 6–6.5 mm diam.; **lobes** rhomboid, 3–3.5 × 1.8–2.2 mm, inner process acuminate, ascending-erect, outer processes spreading, apex rounded, with basal revolute margins. **Anthers** triangular, with apical round membranous appendage c. 1 × 1 mm. **Pollinia** oblong, 500–600 × 200–250 µm, with pellucid margin, **corpusculum** rhomboid, 250–300 × c. 150 µm, **caudicles** attached to the middle part of the corpusculum, triangular, c. 120 µm long. **Ovary** conical, 2.2–2.4 mm long, glabrous. **Fruit** and **seed** not observed.

Distribution. Endemic to Brunei, where it appears to be locally common in the white sands in Tutong and Belait Districts.

Habitat and ecology. Terrestrial or hemi-epiphytic in heath (kerangas) forest, white sandy soils, at 15–71 m altitude. It appears to be flowering throughout the year as fertile specimens were collected in April, June, September and November.

Etymology. The species is named after Muhammad Ariffin A. Kalat, formerly forest botanist at the Brunei National Herbarium, the first and type specimen collector.

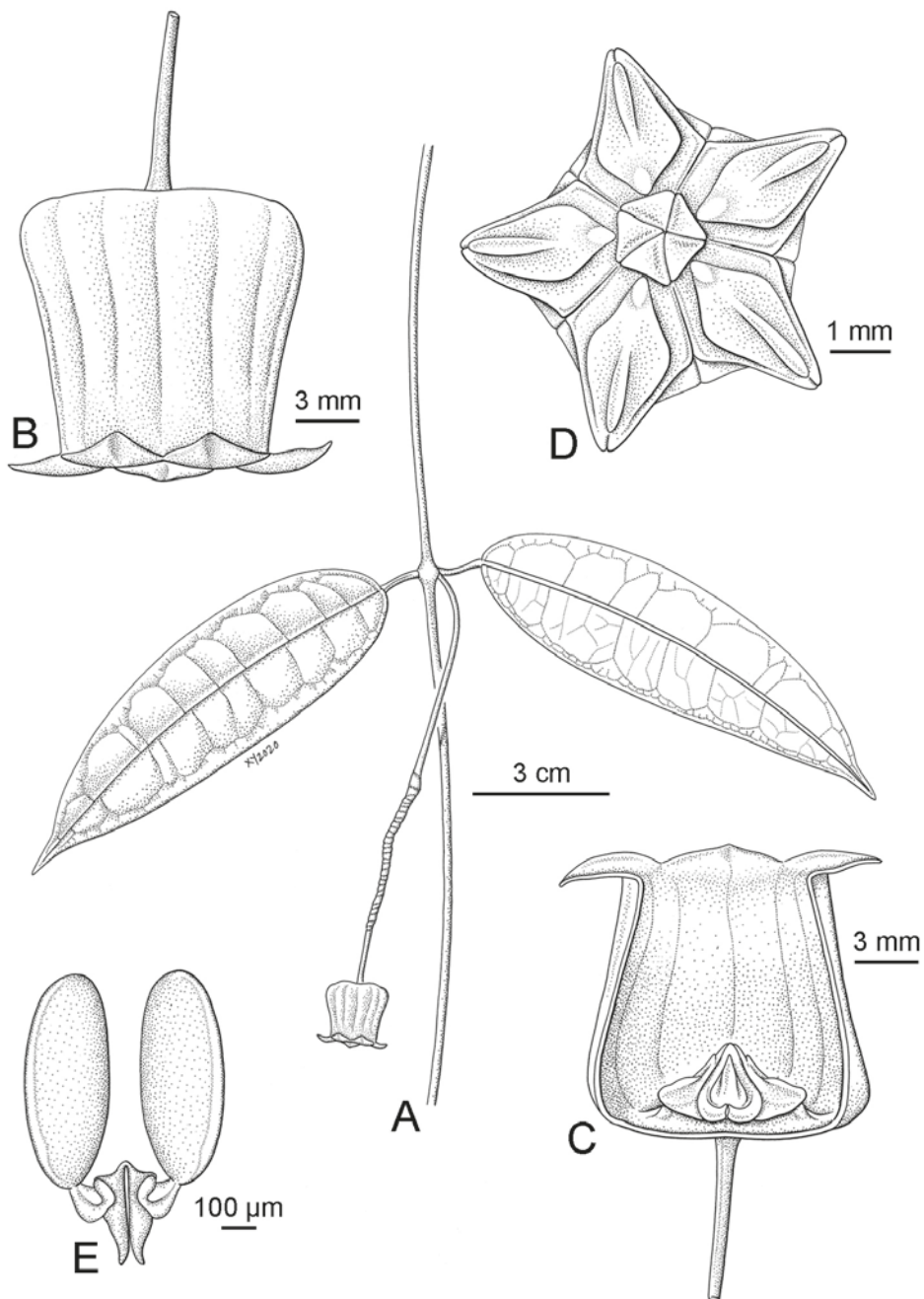


Fig. 1. *Hoya ariffinii* Rodda & S.Rahayu. **A.** Habit. **B.** Flower (side view). **C.** Flower (side view with part of corolla removed). **D.** Corona (from above). **E.** Pollinarium. All from *Ariffin et al. BRUN 16429*. Drawn by X.Y. Loh.



Fig. 2. *Hoya ariffinii* Rodda & S.Rahayu. **A.** Habit. **B.** Inflorescence (side view). **C.** Flower, showing staminal corona. **D.** Flower (from above). From *Ariffin & Azlan BRUN 23277*. (Photos: Muhammad Ariffin A. Kalat)

Provisional IUCN conservation assessment. Endangered (EN B1ab(iii), B2ab(iii)). The estimated EOO is 102 km², the AOO is 12 km². The species appears to be relatively common in Tutong and Belait Districts but may be locally endemic as it has not been recorded from elsewhere, and the lowland heath forest habitat is in decline in Borneo, including in Brunei, as it is threatened by fire and drought (Miyamoto et al., 2021).

Additional specimens examined. BRUNEI: **Belait:** Bukit Sawat, Sungai Mau, Labi Road km 13, along road to plantation, 4°34'N 114°29'E, 15 m, 20 Jun 1996, *Ariffin et al. BRUN 16429* (BRUN [sheet no. B 005 684], K); Bukit Sawat, Sungai Mau, km 13 Jalan Labi-Sungai Mau, 3 Apr 2001, *Ariffin & Jangarun BRUN 19421* (BRUN [sheet no. B 005 762]). **Tutong:** Bt Beruang / Udal, Jln Ternakan Kolam Udang, 4°42'55.3"N 114°37'33.5"E, 32 m, 18 Sep 2012, *Zwah Asano [partially illegible] BRUN 23970* (BRUN).

Notes. *Hoya ariffinii* is an unusual species that often develops only one leaf at each node and has long thin inflorescence rachises (Fig. 2). As mentioned in the diagnosis, it is most similar to *Hoya sammanniana*, also endemic to Borneo. Other species with thinly coriaceous leaves and generally one open flower at a time are *Hoya wongii* Rodda et al., endemic to Borneo, *Hoya wallichii* (Wight) C.M.Burton from Borneo, Peninsular Malaysia and Singapore, and *H. mappigera* Rodda & Simonsson from Borneo and Peninsular Malaysia. They are all distinguished from *Hoya ariffinii* because their flowers have a broadly campanulate corolla while *H. ariffinii* has a campanulate-urceolate corolla. The corolla of *Hoya ariffinii* is somewhat similar to that of *Hoya vacciniiflora* O.Schwartz, from Gunung Mulu (Sarawak) which is so far only found in montane forest and its leaves are thick and fleshy, while *H. ariffinii* has thinly coriaceous leaves.

2. *Hoya boycei* Rodda & S.Rahayu, **sp. nov.**

Similar to *Hoya peltata* Rodda & S.Rahayu in lamina shape (broadly elliptic to round) and size (8–17 mm long), but can be distinguished in lamina pubescence and base shape (pubescent and papillose, base rounded to attenuate in *H. boycei* vs smooth and sparsely pubescent to glabrescent, base rounded to peltate in *H. peltata*), and inflorescence and flower size (inflorescence many-flowered, pedicels 18–40 mm long, corolla 7–9 mm diam. in *H. boycei* vs 1–2-flowered, pedicels 1–3 mm long, corolla c. 6 mm diam. in *H. peltata*). – TYPE: Brunei, Belait, Ulu Ingei, Bukit Batu Patam, lower slopes near Sungei Ingei, 4°5'N, 114°42'E, 70 m, 11 June 1989, *Boyce, Wong, Dransfield & Dransfield 305* (holotype BRUN [sheet no. B005714]; isotype K [spirit bottle no. 56265.000]). (Fig. 3)

Climber, likely epiphytic, latex colour unknown. **Stems** cylindrical, slender, to 1 m long, 0.8–1.5 mm diam., pale green, papillose and pubescent, internodes 1–3 cm long. **Roots** adventitious, occurring below the nodes. **Leaves:** petiole terete, 1–3 mm long, 0.8–2 mm diam., papillose and pubescent; lamina broadly elliptic to round, very coriaceous when dry, likely very fleshy when fresh, 8–17 × 6–13 mm, mid green above, almost white below, papillose and pubescent on both surfaces, apex acute to obtuse, often mucronulate, base rounded to attenuate; venation pinnate, secondary veins inconspicuous; basal colleter one at lamina base, ovoid, c. 0.2 mm long. **Inflorescence** one per node, pseudo-umbelliform, consisting of 3–10 flowers; **peduncle** extra-axillary, tropism unknown but likely positive, terete, 4.5–6 cm long, 0.8–1 mm diam., papillose and pubescent; **pedicels** filiform, 18–40 mm long, 0.3–0.4 mm diam., white

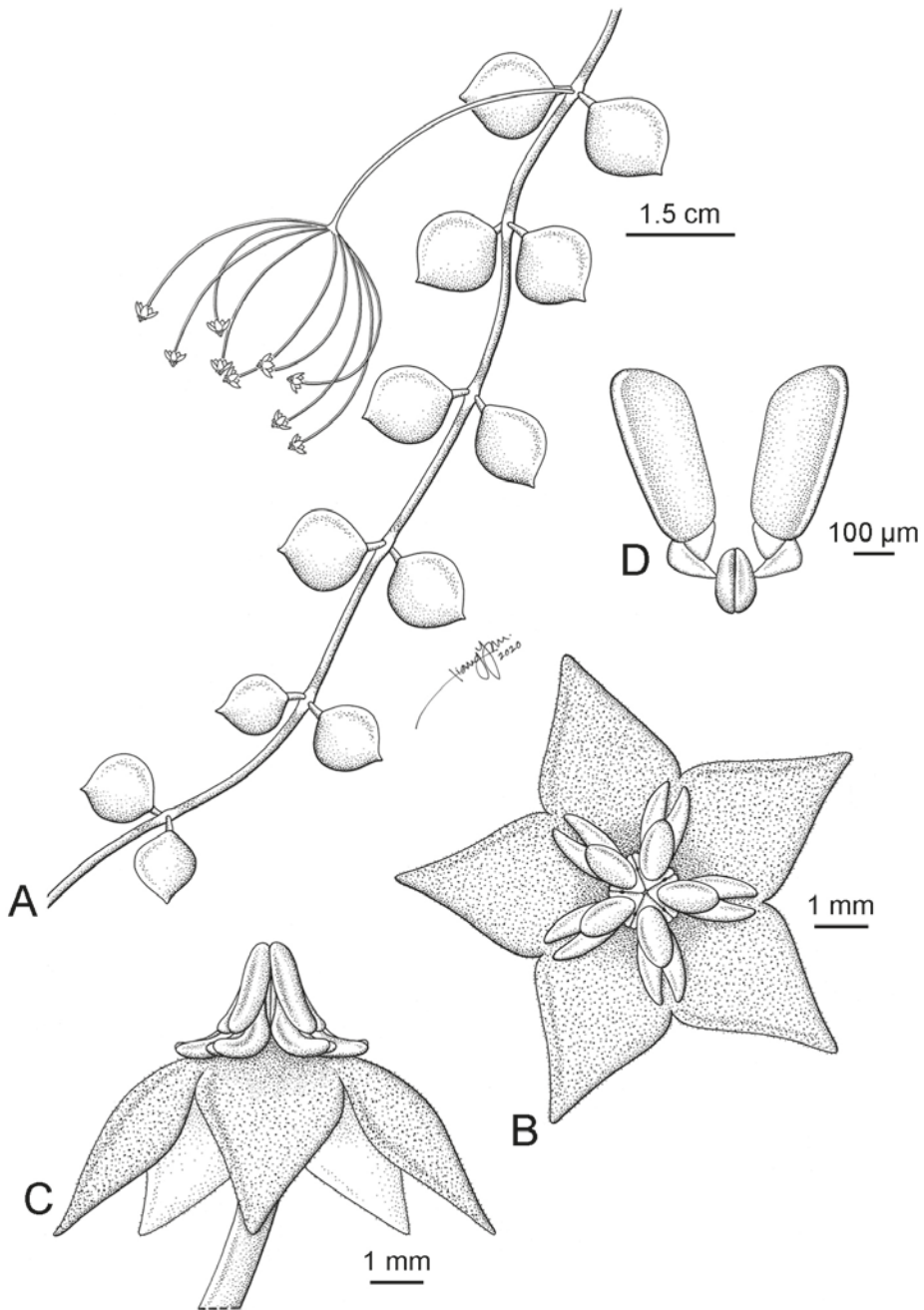


Fig. 3. *Hoya boycei* Rodda & S.Rahayu. **A.** Habit. **B.** Flower (from above, with flattened corolla lobes). **C.** Flower (side view). **D.** Pollinarium. All from *Boyce et al.* 305. Drawn by X.Y. Loh.

speckled pink, glabrous. **Calyx** c. 3 mm diam., calyx lobes deltate, c. 1.5×0.5 mm, apex acuminate to rounded, glabrous, sparsely ciliate; basal colleters not visible on the available material. **Flower** tropism unknown but likely positive. **Corolla** rotate with reflexed lobes or rotate with spreading lobes, 7–9 mm diam. when flattened, very pale pink; **tube** 1.5–2 mm long, outside glabrous, inside pubescent, glabrescent towards the centre; **lobes** deltate, $2.5\text{--}3 \times 2.5\text{--}2.8$ mm, apex acute, outside glabrous, inside pubescent. **Gynostegium** sessile. **Corona** staminal, c. 2 mm high, 3–3.5 mm diam., brown; **lobes** with a distinct inner and outer process, inner process incumbent on style head, broadly elliptic, $1\text{--}1.2 \times 0.5\text{--}0.6$ mm, apically acute, basally almost rounded, outer processes spreading, bilobed, each lobe $1.5\text{--}1.7 \times 0.3\text{--}0.4$ mm, with basal revolute margins. **Anthers** triangular, with apical round membranous appendage c. 0.7×0.6 mm. **Pollinia** oblong, c. 350×400 μm , with pellucid margin, **corpusculum** rhomboid, c. 150×100 μm , **caudicles** attached to the centre of the corpusculum, c. 100 μm long. **Ovary** narrowly conical, 0.3–0.5 mm long, c. 0.3 mm at the base, glabrous. **Fruit** and **seed** not observed.

Habitat and ecology. Mixed dipterocarp forest, on a gentle slope. Belait series sandstones.

Etymology. Named after British botanist Peter Boyce, the first and type specimen collector and a specialist on Araceae.

Provisional IUCN conservation assessment. Data Deficient (DD). *Hoya boycei* is known only from the type specimen and its distribution and population size are insufficiently known. The type locality, Bukit Batu Patam, is within the Labi Forest Reserve and very close to the border with Sarawak, Malaysia. Although Brunei still retains suitable habitat for *Hoya boycei*, the neighbouring forest in Malaysia is not protected and at risk of logging and conversion to oil palm plantation.

Notes. The available material of *Hoya boycei* is in bud close to anthesis, therefore the corolla shape cannot be verified, and the size of mature flowers may be slightly larger. Based on observation of similar species, the shape of the corolla is likely rotate with reflexed lobes (as shown in Fig. 3), or less likely with spreading lobes. *Hoya boycei* is one of the few species from Borneo belonging to one of the few monophyletic sections of the genus, *Hoya* section *Acanthostemma*, characterised by revolute corolla lobes, corona lobes with bilobed outer process apices, and pollinaria with broad, spatulate caudicles. The small, broadly elliptic to round leaves of *Hoya boycei* are also found in *H. peltata* (published here), which however has much smaller flowers borne in 1–2-flowered inflorescences. The inflorescences with long slender pedicels, the corolla rotate with reflexed lobes or spreading lobes, pubescent inside, and the corona with prominent bilobed outer processes make *Hoya boycei* similar to *H. beccarii* Rodda & Simonsson. The leaves of *Hoya beccarii*, however, are elliptic to narrowly lanceolate, $4\text{--}10 \times 2\text{--}3.5$ cm.

3. *Hoya curtisii* King & Gamble subsp. *collariata* S.Rahayu & Rodda, subsp. nov.

Similar to *Hoya curtisii* King & Gamble subsp. *curtisii* in habit (epiphytic creeper growing tightly attached to host tree trunk), leaf shape (round or broadly ovate), leaf thickness (very fleshy, to 3 mm thick), peduncle size (sessile, to 5 mm long), peduncle and flower tropism (negative), corolla type (rotate with reflexed lobes), and presence of annular corona below staminal corona, but can be distinguished by the corolla pubescence (glabrous throughout in subsp. *collariata* vs pubescent inside in subsp. *curtisii*), and corona lobe shape (oblong, erect, laterally flattened in subsp. *collariata* vs sub-spherical, apically flattened in subsp. *curtisii*). – TYPE: Indonesia, Central Kalimantan, Barito Selatan, Telang Anrau near Sanggu, lowland, wetland and heath forest, 27 April 2021, *Rahayu 1337* (holotype BO). (Fig. 4)

Epiphytic creeper growing tightly attached to host tree trunk, with white latex in all vegetative parts. **Stem** 1–2 mm diam., pubescent, internodes 0.5–4 cm long. **Roots** adventitious, produced all along the stem. **Leaves:** petiole terete, 1–5 mm long, 0.5–1 mm diam., sparsely pubescent; lamina round or broadly ovate, stiff and very fleshy, 0.7–1.5 × 0.7–1 cm, 1–3 mm thick, pale to mid green above, turning maroon or yellowish when exposed to bright light, sometimes with small grey markings, sparsely pubescent, pale green, sparsely pubescent to glabrescent underneath, base round, apex acute; basal colleters not observed on the available material. **Inflorescence** 4–7 cm diam., convex and bearing 5–20 flowers; **peduncle** sessile, generally negatively geotropic, forming a rachis c. 3 mm diam.; **pedicels** 2.8–3 cm long, c. 1 mm diam., pinkish white, glabrous. **Calyx** lobes broadly triangular, c. 1.5 × 1 mm, apex acute, pubescent outside, glabrous inside; basal colleters one at each calyx lobe sinus, oblong, c. 0.1 mm long. **Flowers** negatively geotropic. **Corolla** rotate with reflexed lobes, c. 1.5 cm diam. when flattened; **tube** 1–2 mm long, white inside, pinkish outside, glabrous; **lobes** oblong, c. 7 × 4 mm, white inside, pinkish outside, glabrous. **Corona** annular at the base of staminal corona, c. 1 mm wide, white, glabrous. **Gynostegium** sessile. **Corona** staminal, erect, c. 4 mm high, 4 mm diam., white; **lobes** oblong, erect, c. 4 mm tall, c. 1.5 mm wide, with a distinct inner and outer process, inner process oblong, erect with a rounded tip, outer process erect, widest at the base, progressively narrowing and becoming laterally flattened towards the apex, tip round. **Anthers** ovate, with apical round membranous appendage c. 0.7 × 0.7 mm. **Pollinia** oblong, 900–1100 × 200–300 μm, with pellucid margin, **corpusculum** ovate, 150–200 × 90–120 μm, **caudicles** attached to the middle part of the corpusculum, spatulate, 100–150 μm long. **Ovary** broadly conical, with a narrower apical part, c. 2 mm long, c. 1 mm diam. at base, glabrous. **Fruit** and **seed** not seen.

Distribution and ecology. This subspecies is only known from Central Kalimantan, Buntok, where it grows in lowland heath forest. Other species of *Hoya* found in the same area are *Hoya mitrata* Kerr., *Hoya elmeri* Merr. and *Hoya scortechinii* King & Gamble.



Fig. 4. *Hoya curtisii* King & Gamble subsp. *collariata* S.Rahayu & Rodda. **A.** Habit. **B.** Inflorescence (from above). **C.** Inflorescence (side view). From *Rahayu 1337*. (Photos: Abdul Lalang)

Etymology. The name *Hoya curtisii* subsp. *collariata* (from the Latin *collariatus* = with a collar) refers to the annular corona present at the base of the staminal corona.

Provisional IUCN conservation assessment. Data Deficient (DD). *Hoya curtisii* subsp. *collariata* is known only from the type specimen and its distribution and population size are insufficiently known. The site where it was collected is a community forest which is facing quite intensive logging activities. At the time of collection only a small population was observed (fewer than 50 individuals). However, exploration of suitable habitats in neighbouring areas is needed before the conservation assessment of *Hoya curtisii* subsp. *collariata* can be updated.

Notes. *Hoya curtisii* subsp. *curtisii*, is a widespread but rarely collected taxon from Thailand, Peninsular Malaysia, Borneo and the Philippines. The similarities with *Hoya curtisii* subsp. *collariata* extend to vegetative morphology, making them almost indistinguishable when dry, but they might be separated on lamina colour when fresh: the leaves of *H. curtisii* subsp. *collariata* are pale to mid green above, turning maroon or yellowish when exposed to bright light above, with few grey markings, while the leaves of *H. curtisii* subsp. *curtisii* are mid to dark green, turning maroon when exposed to strong light, with prominent grey markings. As mentioned in the diagnosis, the tropism of the inflorescence, type of corolla (but not pubescence), and presence of an annular corona are all shared features of the two subspecies. They may be distinguished in corolla pubescence and corona lobe shape. The erect, laterally flattened corona lobes of *Hoya curtisii* subsp. *collariata* bear strong similarities to those of three other species with negatively geotropic inflorescences: *Hoya greenii* Kloppenb. from the Philippines, *Hoya mitrata*, a widespread Sundaland species, and *H. oreostemma* Schltr. from New Guinea. They have upright, laterally flattened corona lobes but they are climbers with long internodes (generally > 5 cm long), linear-lanceolate to elliptic, coriaceous leaves > 5 cm long and are therefore easily separated from *Hoya curtisii* subsp. *collariata* which is a shorter creeper with short internodes (0.5–4 cm long) and small laminas (0.7–1.5 × 0.7–1 cm).

4. *Hoya dulitensis* Rodda & S.Rahayu, **sp. nov.**

Similar to *Hoya cumingiana* Decne in the non-twining habit with flowering stems with tightly placed leaves, relatively short peduncles (0.5–1.5 cm in *H. dulitensis*, to 3 cm in *H. cumingiana*) and flowers with reflexed corolla lobes. It can be distinguished by the leaf shape, base and thickness (narrowly elliptic, base attenuate to acute, very thick and coriaceous in *H. dulitensis* vs broadly elliptic to round, base round to cordate, stiffly chartaceous in *H. cumingiana*), and flower colour (dark crimson in *H. dulitensis* vs greenish white to yellow corolla, yellow to purplish brown corona in *H. cumingiana*). – TYPE: Malaysia, Sarawak, Mount Dulit ridge, c. 1230 m, 9 September 1932, *anonymous native collector in Richards 1637* (holotype K; isotype OXF n.v.). (Fig. 5)

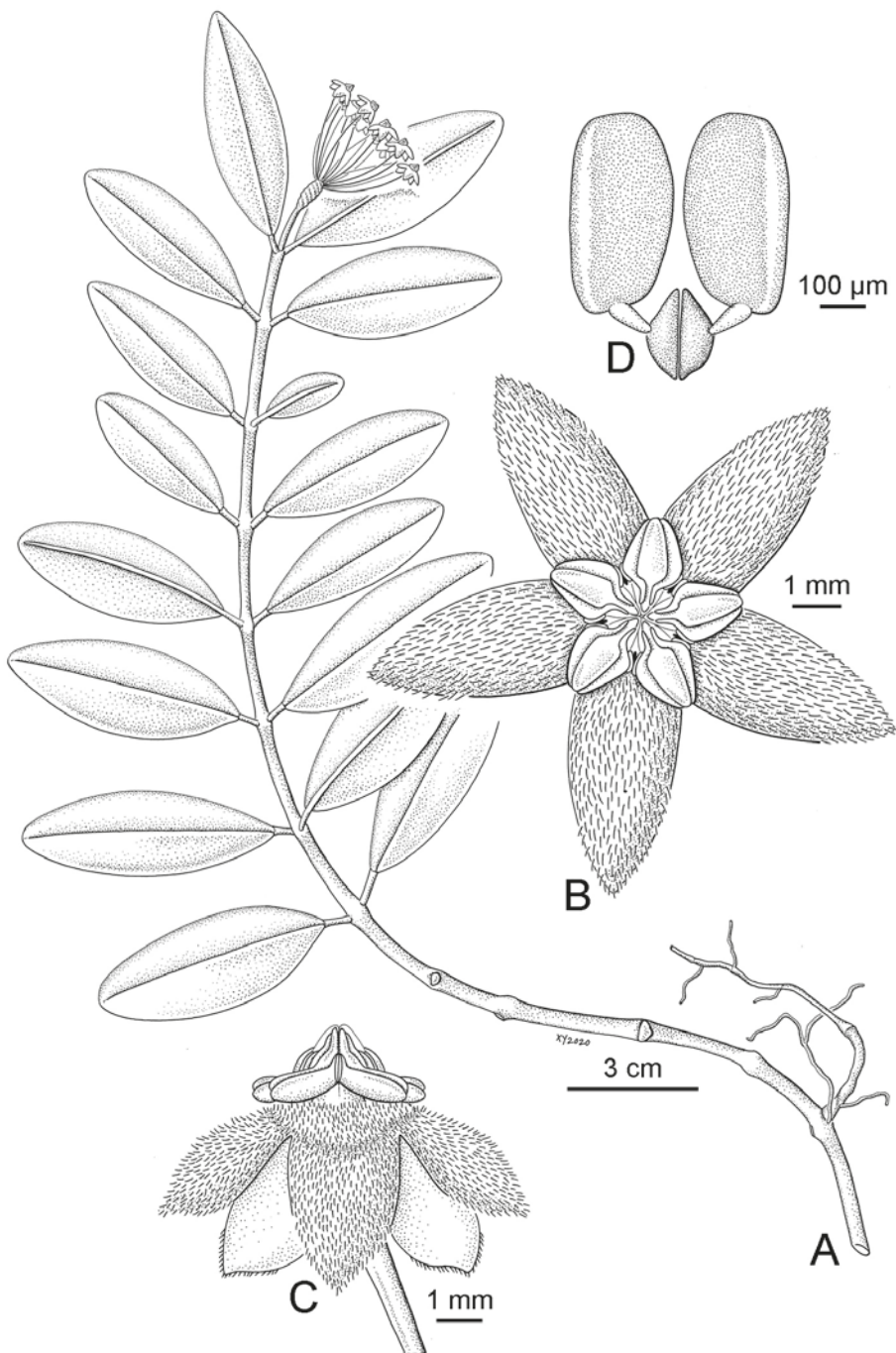


Fig. 5. *Hoya dulitensis* Rodda & S.Rahayu. **A.** Habit. **B.** Flower (top view). **C.** Flower (side view). **D.** Pollinarium. All from Richards 1637. Drawn by X.Y. Loh.

Climber, epiphytic, latex white. **Stems** of two types: climbing, with adventitious roots, internodes 5–12 cm long, sterile; non climbing, without adventitious roots, internodes 1.5–3 cm long, fertile, both types cylindrical, stout to slender, 1.5–5 mm diam., pubescent turning glabrescent when mature. **Leaves:** petiole terete, channelled above, 4–8 mm long, 1.2–2 mm diam., pubescent; lamina elliptic, very thick and coriaceous, 2.5–6.5 × 1–2.5 cm, dark green, glabrous above, very sparsely pubescent below, margin recurved, sparsely ciliate, apex rounded, base attenuate to acute; venation pinnate, secondary veins indistinct; basal colleters not observed on the available material. **Inflorescence** one per node, pseudo-umbelliform, convex, consisting of 9–20 flowers; **peduncle** extra-axillary, tropism unknown, likely positive, terete, 0.5–1.5 cm long, 1–1.5 mm diam., older peduncles forming a rachis from previous flowerings, pubescent; **pedicels** filiform, 23–28 mm long, c. 0.5 mm diam., glabrous. **Calyx** 2.5–3 mm diam., calyx lobes oblong, 0.8–1.1 × 0.4–0.5 mm, apex rounded or acute, dull red, outside sparsely pubescent, inside glabrous, ciliate; basal colleters one at each calyx lobe sinus, ovate, c. 0.1 mm long. **Corolla** rotate with reflexed lobes, 6–8 mm diam. when flattened, dark crimson; **tube** 1–1.2 mm long, outside glabrous, inside densely pubescent, glabrescent towards the centre; **lobes** ovate, 3–4 × 1.8–2.2 mm, apex acute, outside glabrous, inside densely pubescent. **Gynostegium** sub-sessile. **Corona** staminal, conical, 1.8–2 mm high, 3.5–4 mm diam., cream coloured; **lobes** broadly elliptic, 2–2.2 × 0.9–1.1 mm, with a distinct inner and outer process, inner process acuminate, erect, c. 0.5 mm long, outer processes spreading, apex rounded, with basal revolute margins. **Anthers** ovate, with apical round membranous appendage c. 0.7 × 1 mm. **Pollinia** oblong, 400–450 × 200–250 µm, with pellucid margin, **corpusculum** rhomboid, 180–200 × 130–150 µm, **caudicles** attached to the middle part of the corpusculum, clavate, c. 100 µm long. **Ovary** conical, 1–1.2 mm long, glabrous. **Fruit** and **seed** not observed.

Distribution. The species is only known from two collections on Mount Dulit in Sarawak.

Habitat and ecology. Montane mossy forest at c. 1230 m.

Etymology. The epithet ‘*dulitensis*’ refers to the type locality, Mount Dulit.

Provisional IUCN conservation assessment. Data Deficient as it is known only from two collections on Mt Dulit, both from 1932. More exploration of suitable habitats in neighbouring areas is needed to update the conservation assessment of *Hoya dulitensis*.

Additional specimen examined. MALAYSIA: **Sarawak:** Mount Dulit ridge, 6 Sep 1932, *Syngce 420* (K, OXF n.v.).

Notes. A species characterised by a non-twining habit, producing fertile stems with tightly placed leaves, making it similar to *Hoya cumingiana*. The type specimen only has non-climbing stems, whereas *Syngce 420* has some stems with more widely placed

leaves and producing adventitious roots all along.

Hoya dulitensis can be separated from *H. cumingiana* even when sterile because they have different leaves (elliptic, base attenuate to acute, very thick and coriaceous in *H. dulitensis* vs broadly elliptic to round, base round to cordate, stiffly chartaceous in *H. cumingiana*) and they occur in different habitats (montane forest for *H. dulitensis*, while *H. cumingiana* is from lowland forests). Both species occur in Borneo, but *Hoya cumingiana* is also found in Java and the Philippines.

5. *Hoya kaikoeana* S.Rahayu & Rodda, sp. nov.

Similar to *Hoya scortechinii* King & Gamble in lamina shape (lanceolate) and corolla lobes (reflexed), but can be distinguished on flower orientation (negatively geotropic in *H. kaikoeana* vs ageotropic in *H. scortechinii*) and size of pollinium and corpusculum (pollinium 900–1000 × 300–400 µm, corpusculum 250–300 × c. 200 µm in *H. kaikoeana* vs pollinium 530–560 × 190–210 µm, corpusculum 370–400 × 160–180 µm in *H. scortechinii*). – TYPE: Indonesia, West Kalimantan, Sanggau, lowland, heath forest, 23 May 2021, *Rahayu 1341* (holotype BO). (Fig. 6)

Climber, epiphytic, with white latex. **Stems** slender, c. 1 mm diam., glabrous, internodes 8–10(–21) cm. **Roots** adventitious, occurring all along the stem. **Leaves:** petiole terete, c. 1 cm long, c. 2 mm diam., glabrous; lamina lanceolate, succulent, (9–)15–20 × 1.5–2.5 cm, mid green to maroon or yellowish when exposed to bright light, immature leaves maroon-red, glabrous, base round, apex acute or acuminate; basal colleters present, c. 1.5 mm long. **Inflorescence** one per node, convex, consisting of 6–10 flowers; **peduncle** negatively geotropic or laterally held, 2–10 cm long, 1.2–1.6 mm diam., glabrous; **pedicels** c. 20 × 1 mm, pubescent. **Calyx** lobes deltate, c. 2 × 1 mm, apex acute, pubescent outside, glabrous inside; basal colleters one at each calyx lobe sinus, oblong, c. 0.1 mm long. **Flowers** negatively geotropic. **Corolla** reflexed, c. 1.5 cm diam. when flattened; **tube** 2–3 mm long, inside pale yellow to red, basally pubescent, outside very pale yellow to pale pink, glabrous; **lobes** triangular, c. 7 × 4 mm, apex acute, yellow with orange tips, yellowish red or red, margin slightly recurved. **Gynostegium** sessile. **Corona** staminal, 3.5–4 mm high, c. 5 mm diam., white with pink centre or fully red; **lobes** erect, broadly ovate, 3.5–4 × 2.5–3 mm, inner process a c. 0.5 mm long acute upcurved tip, outer process apex rounded, with basal revolute margins. **Anthers** ovate, with apical round membranous appendage c. 0.7 × 0.7 mm. **Pollinia** oblong, 900–1000 × 300–400 µm with a thin pellucid margin, **corpusculum** dark brown, guitar-shaped, 250–300 × c. 200 µm, **caudicles** attached to the base of the corpusculum, c. 100 µm long. **Ovary** oblongoid, c. 1.5 × 0.5 mm, glabrous. **Fruit** and **seed** not observed.

Distribution and ecology. This species is only known from the lowland, heath forest habitat in Sanggau and Kapuas Hulu, West Kalimantan. It was found growing near specimens of *Hoya scortechinii* and *Hoya corneri* Rodda & S.Rahayu.

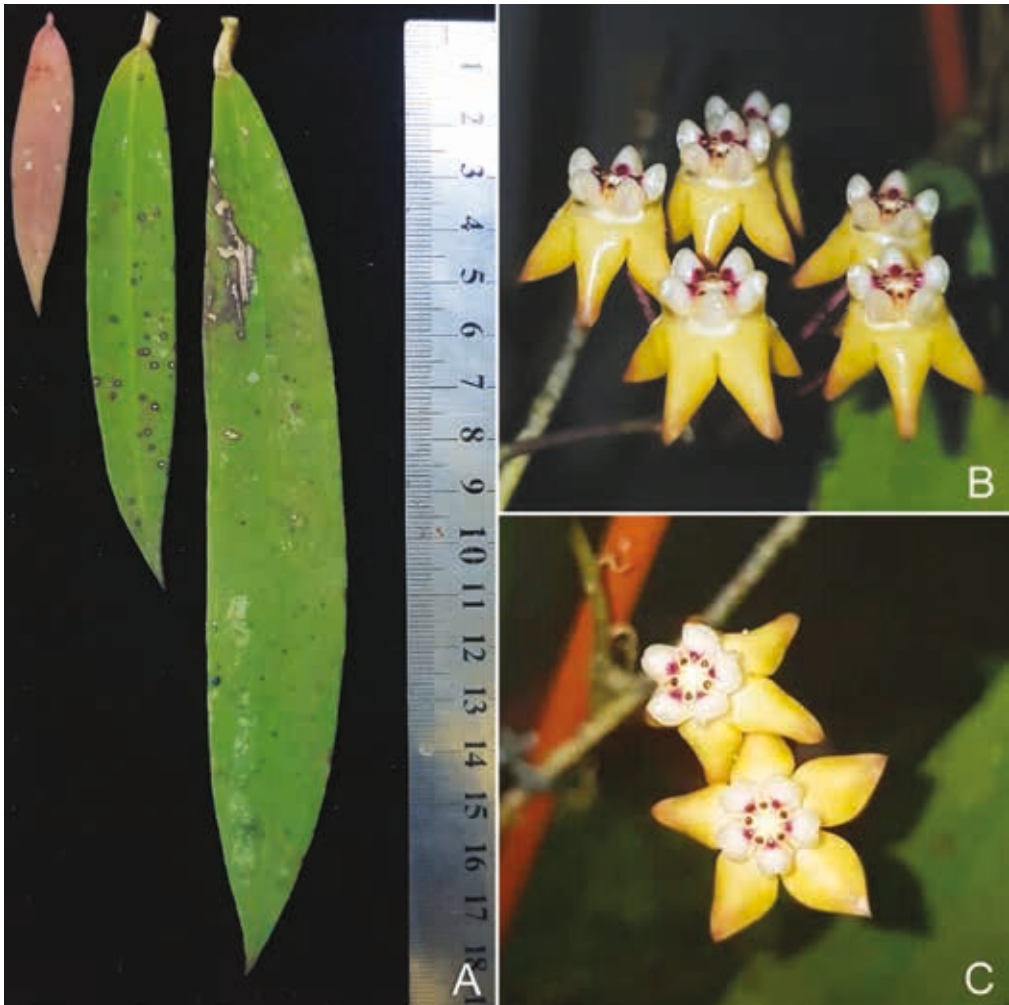


Fig. 6. *Hoya kaikoeana* S.Rahayu & Rodda. **A.** Leaves (left one immature). **B.** Inflorescence (side view). **C.** Inflorescence (from above). All from *Rahayu* 1341. (Photos: Ewaldus Heny)

Etymology. The species is named after Kaiko, daughter of Ewaldus, a plant collector from Sanggau, West Kalimantan who found this new species at about the same time as his wife was giving birth.

Provisional IUCN conservation assessment. Data Deficient as it is known only from two localities in Central Kalimantan and its distribution and population size are insufficiently known. The habitat at the type locality is mixed use forest which is disturbed by logging and land conversion to oil palm plantation. The population at the type locality appears to be very small. The population at Kapuas Hulu (West Kalimantan), the district next to Sanggau, is larger but not well documented and not yet vouchered. More exploration of suitable habitats in neighbouring areas is required before updating the conservation assessment for *Hoya kaikoeana*.

Notes. The flowers of *Hoya kaikoeana* are negatively geotropic, making it easily distinguishable from the otherwise morphologically similar *H. scortechinii*, which has ageotropic inflorescences. In Borneo, the only other species with negatively geotropic flowers are *Hoya curtisii*, *H. elliptica* Hook.f., *H. fauziana* Rodda et al. subsp. *angulata* Rodda et al., and *H. mitrata*. *Hoya kaikoeana* can be separated from *H. curtisii*, *H. elliptica* and *H. mitrata* even when sterile on leaf morphology (*H. mitrata* leaves form cabbage-shaped megadomatia, the leaves of *H. curtisii* subsp. *collariata* and *H. curtisii* subsp. *curtisii* are round or broadly ovate and < 2 cm long, *H. elliptica* has elliptic leaves to 6 cm long, while *H. kaikoeana* leaves are lanceolate (9–)15–20 cm long). *Hoya fauziana* subsp. *angulata* also has lanceolate leaves just like *H. kaikoeana*, but the two species can be separated on the orientation of the corolla lobes which are reflexed in *H. kaikoeana* and inrolled (making the corolla look turban shaped) in *H. fauziana* subsp. *angulata*. Further, *Hoya kaikoeana* is found in lowland heath forests while *H. fauziana* subsp. *angulata* is from hill forests.

6. *Hoya kapuasensis* S.Rahayu & Rodda, sp. nov.

Similar to *Hoya jiewhoeana* Rodda et al. in indumentum (stem, petiole and lamina are pubescent), leaf texture (coriaceous) and shape (elliptic to oblong), inflorescence shape (convex to spherical in *H. kapuasensis*) and corolla pubescence (tube inside very finely pubescent, more densely towards the centre, outside sparsely pubescent), and ovary indumentum (pubescent), but can be distinguished in inflorescence size (3–6 cm diam. in *H. kapuasensis* vs 8–10 cm in *Hoya jiewhoeana*), pedicel length (1.5–2.2 cm in *H. kapuasensis* vs 2.5–3 cm in *Hoya jiewhoeana*), and corona lobe outer apex (held almost horizontal (slightly raised) in *H. kapuasensis* vs erect in *Hoya jiewhoeana*). – TYPE: Indonesia, West Kalimantan, Kapus Hulu, lowland, 25 January 2021, *Rahayu 1333* (holotype BO). (Fig. 7)

Climber, epiphytic, latex white. **Stems** cylindrical, up to 5 mm diam., pubescent turning glabrescent when old, internodes 5–10(–20) cm long. **Roots** adventitious, rarely produced along the stem. **Leaves:** petiole terete, 1.5–2.5 cm long, c. 3 mm diam., pubescent; lamina elliptic to oblong, 5–14 × 3.5–6.5 cm, coriaceous, apex apiculate, base rounded or acute, upper surface rough, pubescent to glabrescent, lower surface densely velvety short pubescent; venation pinnate, secondary veins 3–5 each side; basal collectors present, c. 1 mm diam. **Inflorescence** convex to spherical, 3–6 cm diam., consisting of up to 12 flowers (to 25 in cultivation); **peduncle** extra-axillary, one per node, ageotropic, terete, 4–5 cm long, c. 3 mm diam., pubescent, older peduncles forming a rachis from previous flowerings; **pedicels** 1.5–2.2 cm long, c. 1 mm diam., cream or pinkish white, pubescent. **Calyx** lobes triangular, 1.8–2.2 × 1–1.2 mm, cream or pinkish white, apex acute or round, glabrous adaxially, pubescent abaxially; collectors one at each calyx lobe sinus, ovoid. **Flowers** ageotropic. **Corolla** rotate, 1.8–2 cm diam. when flattened; **tube** 6–7 mm long, inside glossy white-cream, very finely pubescent, more densely towards the centre, outside white to pale pink at the base, shiny and sparsely pubescent; **lobes** elliptic-ovate, 7–8 × 5–6 mm, inside white-

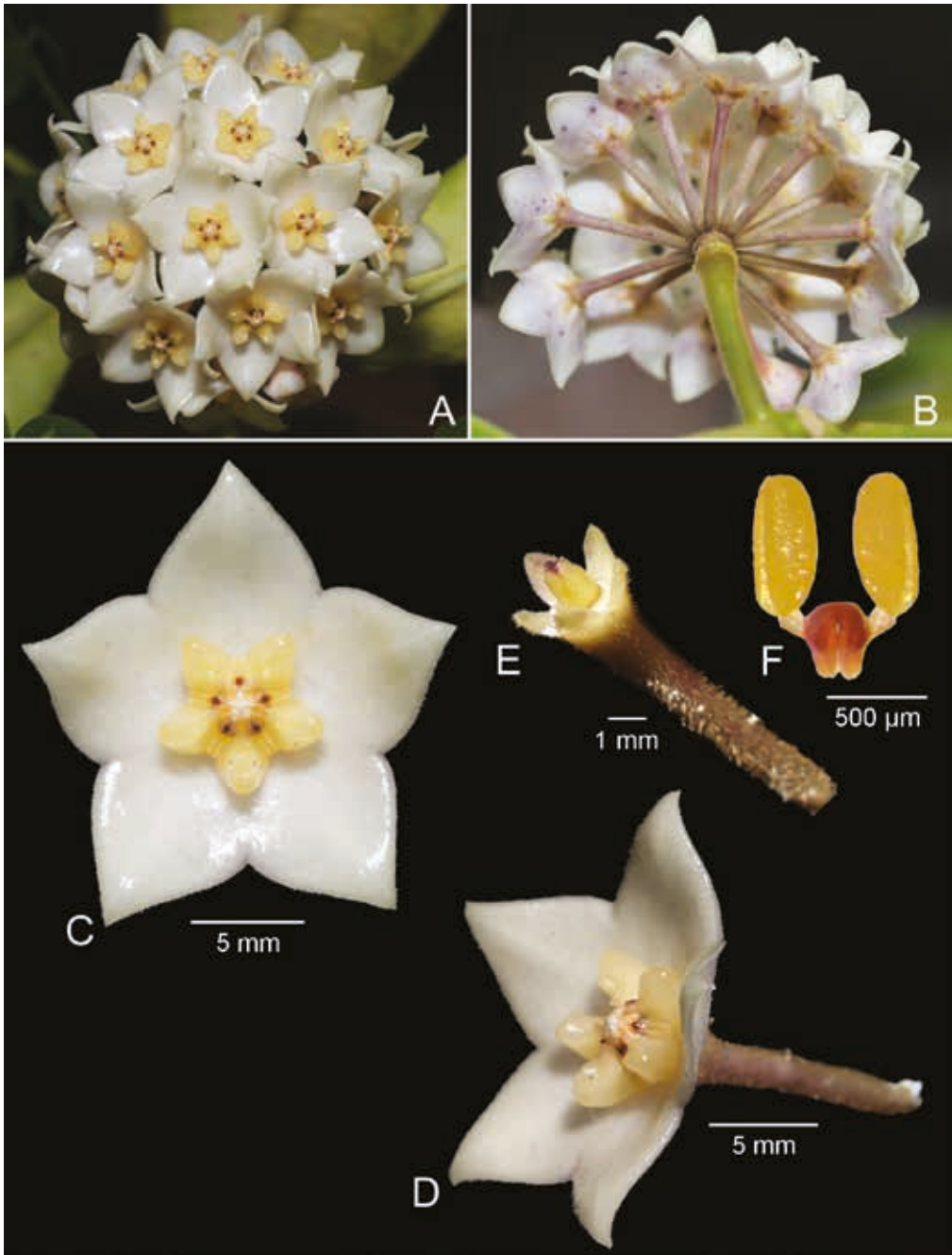


Fig. 7. *Hoya kapuasensis* S.Rahayu & Rodda. **A.** Inflorescence, front view. **B.** Inflorescence, from below. **C.** Flower (front view). **D.** Flower (side view). **E.** Pedicel, calyx and ovary. **F.** Pollinarium. All from Rodda MR 2188. (Photos: A–E, S. Somadee; F, M. Rodda)

cream, very finely pubescent to glabrescent, outside white to very pale pink, shiny and sparsely pubescent, margin recurved, apex acuminate. **Gynostegium** sessile. **Corona** staminal, c. 3 mm high, 6.5–8 mm diam., cream; **lobes** ovate, 2.5–3 mm × c. 1.5 mm, inner process oblong, shortly upcurved reaching just below the style head, apex acute, pinkish, outer process slightly raised, apex rounded. **Anthers** ovate, with apical round membranous appendage c. 1 × 1.2 mm. **Pollinia** oblong, 680–720 × 250–300 μm, with round apex and base and evident pellucid margin, **corpusculum** oblongoid, 400–500 × 280–320 μm, **caudicles** triangular, attached to the mid-section of the corpusculum, c. 120 μm long. **Ovary** conical, 1.5–2 mm long, c. 0.7 mm wide at the base, pubescent, apex round. **Fruit** and **seed** not observed.

Distribution and ecology. This species is only known from Kapuas Hulu in West Kalimantan, Indonesia, where it was found in lowland heath forest. Other species of *Hoya* growing nearby are *Hoya mitrata*, *Hoya elmeri* and *Hoya scortechinii*.

Etymology. The name *Hoya kapuasensis* refers to the type locality in Kapuas Hulu, West Kalimantan, Indonesia.

Provisional IUCN conservation assessment. Data Deficient. Only known from Kapuas Hulu, West Kalimantan where it occurs in a local community forest which is now also a protected forest. The population size was estimated at the time of collection as fewer than 50 individuals. It was also found in nearby logged forests. However, more exploration of suitable habitats in neighbouring areas is needed before updating the conservation assessment for *Hoya kapuasensis*.

Additional specimen examined. Cultivated in Thailand, Nov 2021, *Somadee in Rodda MR 2188* (SING).

Notes. *Hoya kapuasensis* is most similar to *H. jiewhoeana* but when sterile it is also similar to *H. hamiltoniorum* A.Lamb et al. as the three species have pubescent stems and leaves and coriaceous, elliptic (to oblong) leaves. *Hoya kapuasensis* can be distinguished from *H. hamiltoniorum* in corolla morphology (rotate in *H. kapuasensis* vs salverform in *H. hamiltoniorum*). *Hoya hamiltoniorum* and *H. jiewhoeana* occur in montane forests and are so far only known from Sabah, Malaysia, while *Hoya kapuasensis* occurs in lowland forests and is so far only known from West Kalimantan.

7. *Hoya kerangasensis* Rodda & S.Rahayu, **sp. nov.**

Similar to *Hoya fauziana* Rodda et al. in leaf shape (lanceolate), flower colour (pink or dull violet) but can be distinguished in lamina indumentum (sparsely pubescent in *H. kerangasensis* vs glabrous in *H. fauziana*), secondary venation (secondary veins prominent and arching in *H. kerangasensis* vs hardly visible, not arching in *H. fauziana*) and corolla lobe shape (reflexed in *H. kerangasensis* vs revolute in *H. fauziana*). – TYPE: Brunei, Temburong, Bukit Retak, montane forest, 3 May 1992, *Ibrahim Abdullah s.n.* (holotype BRUN [sheet no. B005727]). (Fig. 8)

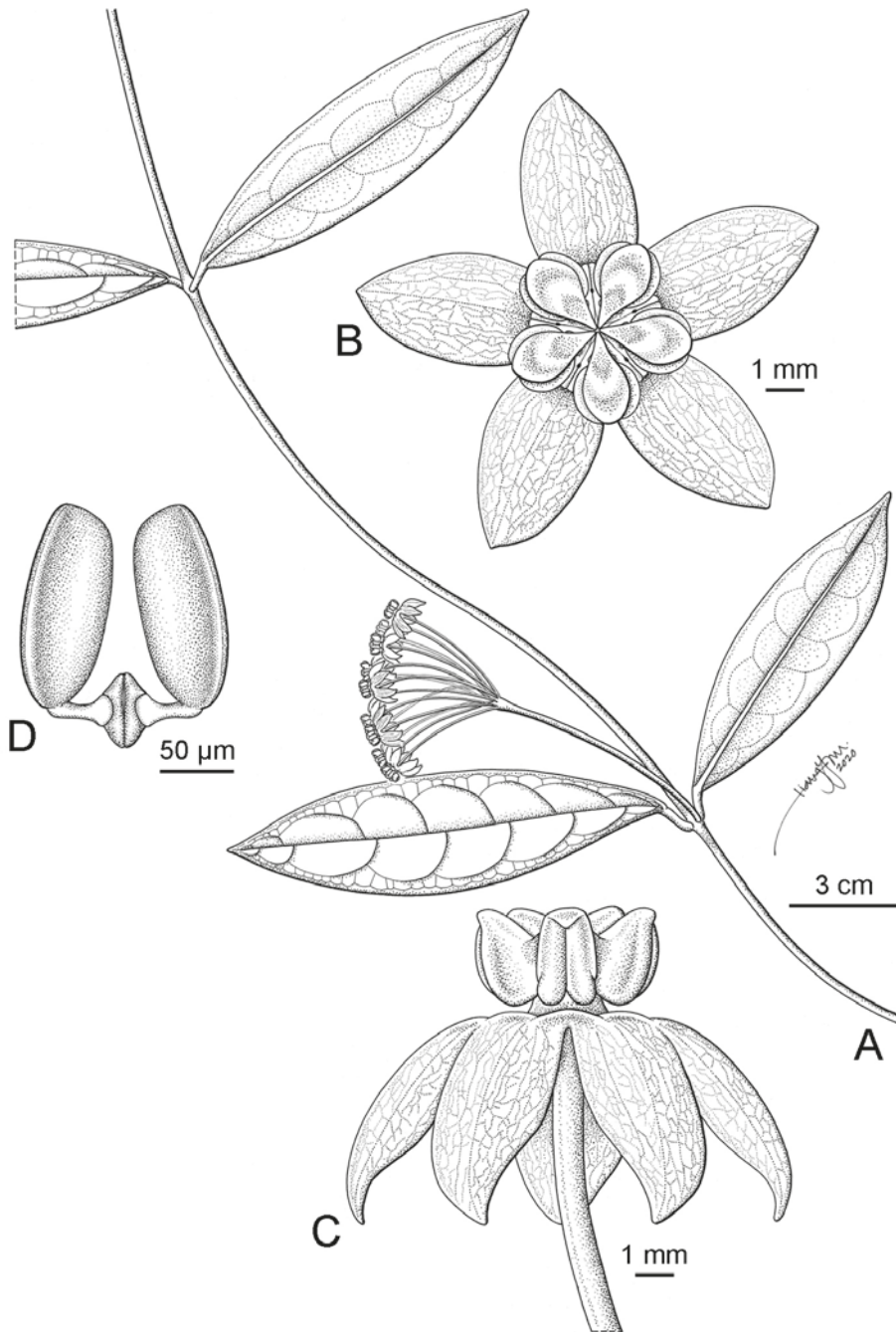


Fig. 8. *Hoya kerangasensis* Rodda & S.Rahayu. **A.** Habit. **B.** Flower (top view). **C.** Flower (side view). **D.** Pollinarium. All from Ibrahim Abdullah s.n. Drawn by X.Y. Loh.

Climber, likely epiphytic, latex white. **Stems** cylindrical, 1.5–2.5 mm diam., sparsely pubescent, internodes 15–20 cm long. **Roots** adventitious, sparsely produced along the stems. **Leaves:** petiole channelled above, 5–7 mm long, 1.5–2 mm diam., pubescent; lamina lanceolate, very coriaceous when dry, likely succulent when fresh, 4–11 × 0.8–3 cm, sparsely pubescent above, turning glabrescent, sparsely pubescent along midvein only below, apex acuminate, base cuneate; venation pinnate, secondary veins prominent and arching; basal colleters 3–4, ovoid, 0.2–0.3 mm long. **Inflorescence** one per node, pseudo-umbelliform, consisting of 8–20 flowers; **peduncle** extra-axillary, terete, tropism unknown, likely positive, 3.5–5 cm long, 1–1.5 mm diam., pubescent; **pedicels** filiform, 25–30 mm long, c. 0.3 mm diam., glabrous. **Calyx** c. 4 mm diam., calyx lobes deltate, 1–1.3 × 0.6–0.8 mm, apex rounded to acute, outside sparsely pubescent, inside glabrous; basal colleters one at each calyx lobe sinus, ovate, c. 0.2 mm long. **Flowers** tropism unknown, likely positive, pink or dull violet. **Corolla** rotate with reflexed lobes, 12–14 mm diam. when flattened; **tube** c. 1.2 mm long, outside glabrous, inside sparsely pubescent, glabrescent towards the centre; **lobes** elliptic, 5–5.5 × 3–3.5 mm, apex obtuse to acute, outside glabrous, inside sparsely pubescent. **Gynostegium** shortly stalked, stalk cylindrical, c. 0.5 × 1.5 mm, glabrous. **Corona** staminal, concave, 2.5–3 mm high, 4–4.5 mm diam.; **lobes** broadly ovate, 2.5–2.7 mm tall × 1.2–1.4 mm diam., inner process deltate, erect, c. 7 mm tall, c. 0.5 mm wide, outer processes raised, forming an acute angle with the inner process, apex rounded, with basal revolute margins. **Anthers** ovate, with apical round membranous appendage c. 1 × 1.2 mm. **Pollinia** oblong, 600–650 × 250–270 µm, with pellucid margin, **corpusculum** rhomboid, c. 150 × 200 µm, **caudicles** attached to the lower half of the corpusculum, perpendicular to corpusculum, c. 150 µm long. **Ovary** conical, c. 1.5 mm long, glabrous. **Fruit** and **seed** not observed.

Distribution. This species is known from the type locality in Brunei, Temburong, Bukit Retak, from one collection from Sarawak (*de Vogel 980186*) and one from Sabah (*Huisman et al. 8578*).

Habitat. From information on the specimens of *Huisman et al. 8578* the species is found in low open kerangas forest 5–10 m tall with much undergrowth of orchids and herbs. The habitat is indicated as montane forest on the type specimen.

Etymology. The epithet ‘*kerangasensis*’ refers to the habitat where the species was collected. Originally from the Iban language and meaning ‘land which cannot grow rice’, kerangas refers to heath forests.

Provisional IUCN conservation assessment. Endangered (EN B1ab(iii), B2ab(iii)). The estimated EOO is 1800 km², the AOO is 12 km². The species occurs in a protected habitat in Brunei but the two other localities in Sabah and Sarawak do not lie within protected areas and are at risk of habitat destruction.

Additional specimens examined. MALAYSIA: **Sarawak:** Kelabit Highlands, 1998, *De Vogel et al.* 980186 (L, spirit). **Sabah:** along trail Long Pa Sia to Long Samado, c. 2 km from the Sarawak border, 4°20'N 115°41'E, 1400 m, 25 Oct 1986, *Huisman et al.* 8578 (L [L0275605]).

Notes. Few species have so far been found in montane heath forest in Borneo. The only one similar to *Hoya kerangasensis* is *H. fauziana*. The two species can be separated on secondary venation (secondary veins prominent and arching in *H. kerangasensis* vs hardly visible, not arching in *H. fauziana*) and corolla lobe shape (reflexed in *H. kerangasensis* vs revolute in *H. fauziana*).

8. *Hoya peltata* Rodda & S.Rahayu, **sp. nov.**

Similar to *Hoya minutiflora* Rodda & Simonsson in leaf shape (broadly elliptic to round), peduncle length (3.5–10 cm) and flower size c. 6 mm diam., but can be distinguished in leaf base (peltate, rounded in *H. peltata* vs not peltate, rounded-truncate (subcordate) in *H. minutiflora*), number of flowers per inflorescence (1–2 in *H. peltata* vs 5–10 in *H. minutiflora*) and corolla diameter (spread out) (c. 6 mm in *H. peltata* vs c. 4 mm in *H. minutiflora*). – TYPE: Indonesia, North Kalimantan, Nunukan, N of Tarakan, low elevation, November 1953, *Meijer 1973* (holotype K; isotype BO n.v.). (Fig. 9)

Climber, epiphytic, latex colour unknown. **Stems** cylindrical, non-twining, 0.8–1 mm diam., sparsely pubescent to glabrescent, internodes (0.5–)1–2 cm long. **Roots** adventitious, occurring just below the nodes. **Leaves:** petiole terete, 1–1.5 mm long, c. 0.5 mm diam., sparsely pubescent to glabrescent; lamina broadly elliptic to round, peltate, thinly coriaceous when dry, likely very fleshy when fresh, 5–10 × 5–10 mm, very smooth and sparsely pubescent to glabrescent above, sparsely pubescent and papillose below, margin sparsely ciliate, apex acute to obtuse, often mucronulate, base rounded; venation pinnate, secondary veins inconspicuous; basal collectors not observed on the available material. **Inflorescence** one per node, consisting of 1–2 flowers; **peduncle** extra-axillary, tropism unknown but likely positive, terete, 7–10 cm long, 0.7–1 mm diam., sparsely pubescent to glabrescent, older peduncles forming a rachis from previous flowerings; **pedicels** filiform, 1–3 mm long, 0.2–0.3 mm diam., glabrous. **Calyx** not present on available material. **Flower** red-brown-violet, tropism unknown but likely positive. **Corolla** rotate with slightly reflexed spreading lobes, c. 6 mm diam. when flattened; **tube** c. 1.5 mm long, basally forming an irregularly lobed raised annulus surrounding the stalk, outside glabrous, inside pubescent; **lobes** narrowly triangular, 2.5–2.7 × 1.4–1.6 mm, apex rounded, outside glabrous, inside pubescent. **Gynostegium** stalked, stalk cylindrical, 0.7–0.9 × 0.5–0.7 mm, sparsely pubescent. **Corona** staminal, c. 1.5 mm high, 2.8–3 mm diam.; **lobes** broadly oblong, 1.8–2 × c. 0.5 mm, with a distinct inner and outer process, inner process acuminate, erect, outer processes downcurved, long-acuminate, acute. **Anthers** ovate, with apical round membranous appendage c. 0.5 × 0.6 mm. **Pollinia** oblong, c. 220 × 120 μm, with pellucid margin, **corpusculum** rhomboid, c. 150 × 80 μm, **caudicles** attached

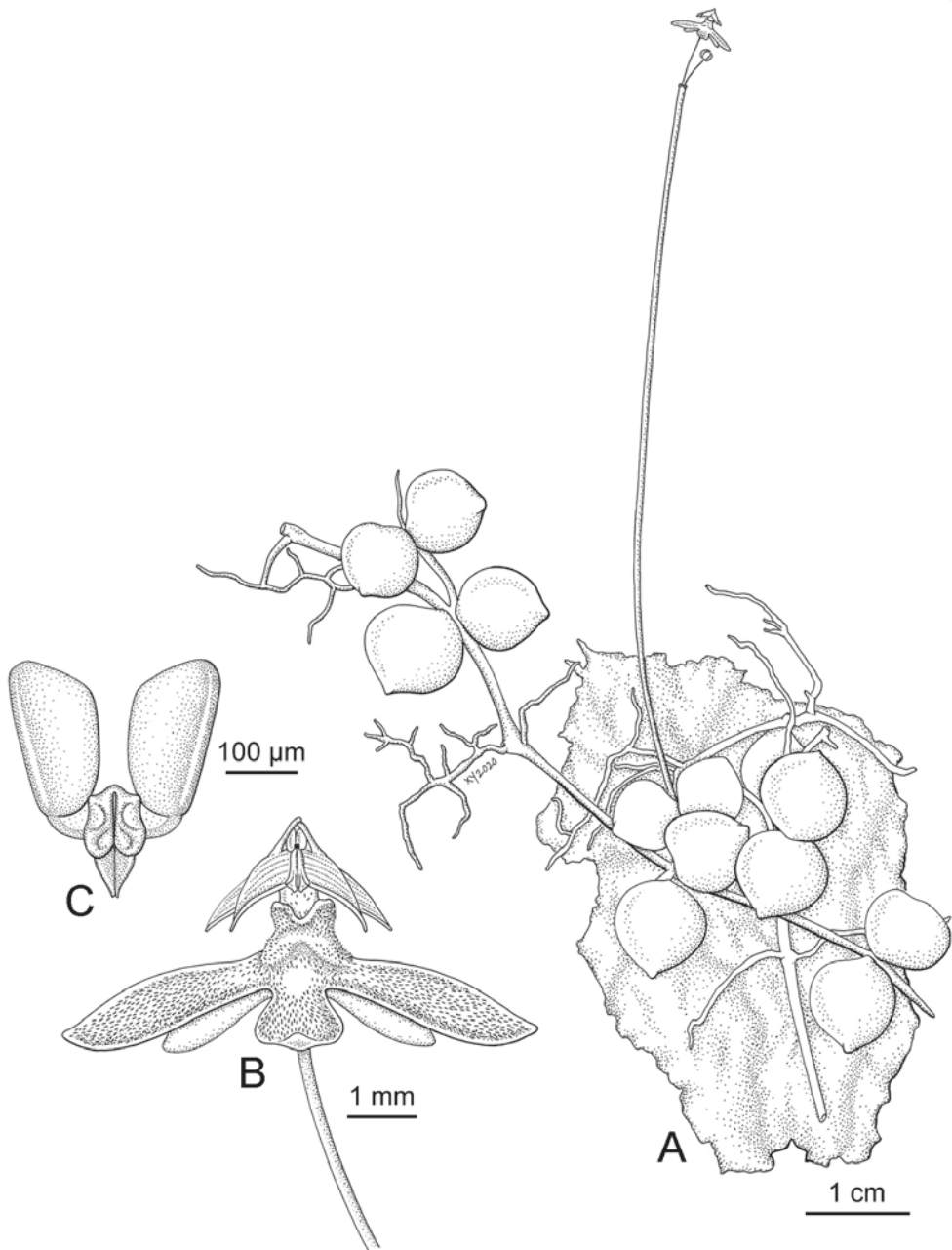


Fig. 9. *Hoya peltata* Rodda & S.Rahayu. **A.** Habit. **B.** Flower (side view). **C.** Pollinarium. All from Meijer 1973. Drawn by X.Y. Loh.

towards the middle of the corpusculum, spatulate, c. 50 μm long. **Ovary** not present on available material. **Fruit** and **seed** not observed.

Distribution and ecology. Only found in Indonesia, North Kalimantan, Nunukan, north of Tarakan, in dipterocarp forest at low elevation.

Etymology. The epithet '*peltata*' refers to the leaves which have a characteristic peltate base.

Provisional IUCN conservation assessment. Data Deficient as it is known only from the type specimen collected 48 years ago and its distribution and population size are not known.

Notes. A most unusual species with small broadly elliptic to round leaves growing tightly adpressed to the host tree bark but producing very long peduncles 7–10 cm bearing very small flowers (c. 6 mm diam. when flattened). It is somewhat similar to *Hoya minutiflora* but readily separated based on leaf base, corolla diameter and number of flowers in each inflorescence. Other species with very small flowers also occurring in Borneo are *Hoya ignorata* T.B. Tran et al. and *H. corymbosa* Rodda & Simonsson (< 2.8 mm diam. and < 7 mm diam. when flattened, respectively), but both species are small epiphytic shrubs and their flowers are borne in multi-flowered inflorescences with peduncles < 2 cm long, and are therefore easily separated from *H. peltata*. The leaves of *Hoya peltata* are similar to those of *H. boycei* in shape (broadly elliptic to round) and size (8–17 mm long), but can be distinguished on the lamina base shape and pubescence (base rounded to attenuate, pubescent and papillose in *H. boycei* vs base rounded, peltate, smooth and sparsely pubescent to glabrescent in *H. peltata*), inflorescence and flower size (inflorescence many-flowered on pedicels 18–40 mm long, corolla 7–9 mm diam. in *H. boycei* vs 1–2 flowered on pedicels 1–3 mm long, corolla c. 6 mm diam. in *H. peltata*).

9. *Hoya polypus* S. Rahayu & Rodda, **sp. nov.**

Similar to *Hoya ruthiae* Rodda as both have clear latex, lanceolate corolla lobes and a corpusculum that is about as large as the pollinium. They can be distinguished on corolla shape (with an urceolate tube in *H. polypus* vs with almost completely free lobes in *H. ruthiae*), and corona size and shape (conical, 4–5 mm high, c. 5 mm diam. in *H. polypus* vs almost flat topped (except apex of inner processes), 2.5–3 mm high, 6–7 mm diam. in *H. ruthiae*). – TYPE: Indonesia, East Kalimantan, Berau, lowland heath forest, 5 November 2021, *Rahayu 1355* (holotype BO). (Fig. 10)

Climber, epiphytic, with clear latex. **Stem** slender, 1–2 mm diam., glabrous, internodes 5–15 cm long. **Roots** adventitious, produced sporadically along the stems. **Leaves:** petiole terete, 5–15 mm long, 2–4.5 mm diam., sometimes thicker than stems; lamina elliptic, fleshy, 7–10 \times 3.5–4 cm, apex acute-acuminate, base round to acute, pale to mid



Fig. 10. *Hoya polypus* S.Rahayu & Rodda. Inflorescence. From a cultivated plant. (Photo: Umar)

green above, venation pinnate; basal colleters ovoid, 0.5–1 mm long. **Inflorescences** globular, 3–4 cm diam., 4–10-flowered; **peduncles** extra-axillary, terete, positively geotropic, 5–10 cm long, 1–1.5 mm diam., glabrous; **pedicels** c. 1.5 cm long, c. 1.5 mm diam., white, glabrous. **Calyx** lobes triangular, white-pink, c. 2 mm long, c. 1 mm wide, apex acute, glabrous; colleter 1 in each calyx lobe sinus, oblong, c. 0.15 mm long. **Flowers** ageotropic. **Corolla** salverform, c. 2 cm diam.; **tube** urceolate, 5.5–7 × 5.5–7 mm, cream-white; **lobes** narrowly lanceolate, laterally recurved, 9–11 × 3–4.5 mm, apex acuminate. **Gynostegium** stalked, stalk conical, c. 1 × 2 mm, glabrous. **Corona** staminal, conical, 4–5 mm high, c. 5 mm diam., white; **lobes** with a distinct outer and inner process, outer process elliptic in outline, 3–4 × c. 1.5 mm, concave and spoon-like, inner process erect, with a middle acute ridge pointing outwards and an acuminate apex pointing inwards. **Anthers** ovate, with apical round membranous appendage 1–1.5 × 0.9–1.2 mm. **Pollinia** oblong, with evident pellucid margin, c. 500 × 150–180 μm, **corpusculum** 500–600 × 200–250 μm, **caudicles** attached at the base of the corpusculum, oblongoid. **Ovary** linear, c. 3 mm long, each carpel c. 1 mm wide at the base, glabrous. **Fruits** and **seeds** not observed.

Distribution and ecology. This species is known from lowland mixed dipterocarp forest in East Kalimantan.

Etymology. The name *Hoya polypus* refers to the flower shape, with an urceolate corolla and long, narrow corolla lobes reminiscent of the shape of a polyp.

Provisional IUCN conservation assessment. Critically Endangered (CR D). The habitat at the type locality is mixed dipterocarp forest which was being logged at the time of collection. The population size at the time of collection was fewer than 40 individuals. Ex-situ conservation is particularly needed for this species, as well as more exploration of suitable habitats in neighbouring areas to better assess the distribution area and update the conservation assessment.

Notes. *Hoya polypus* belongs to the *H. uncinata* Teijsm. & Binn. complex which is defined as including species with clear latex, a deeply lobed rotate corolla and the corpusculum of the pollinarium almost as large as the pollinium itself (Rodda & Rahayu, 2018). The complex includes *Hoya uncinata* from Java and Sumatra, *H. ruthiae* from Borneo (Sabah), and *H. corneri* from Thailand, Peninsular Malaysia and Borneo (West Kalimantan). All species in the complex known so far have narrow corolla lobes and a very short tube (< 3 mm long). *Hoya polypus* instead has an urceolate tube that makes it easy to distinguish from all other species in the complex. The corona instead is most similar to that of *Hoya corneri* (lobes ovate, laterally compressed and slightly convex above) and the corolla lobes are most similar to those of *H. ruthiae* which are lanceolate.

10. *Hoya sangguensis* S.Rahayu & Rodda, sp. nov.

Similar to *Hoya caudata* Hook.f. in leaf shape, texture and margin (lamina (ovate to elliptic, (6–)9–20 × 4–7 cm, weakly succulent, apex acuminate (to cuspidate), base rounded or cordate, margin entire or undulate), and corolla and corona colour (corolla white or slightly yellowish (to pale pink in *H. caudata*), corona red, sometimes red and white in *H. caudata*). They can be distinguished in corolla shape (shallowly campanulate in *H. sangguensis* with tube about as long as lobes vs rotate in *H. caudata* with tube shorter than lobes), staminal corona lobes shape (inner process upcurved, acute tip, outer process upcurved, rounded in *H. sangguensis* vs inner process raised, acuminate, outer process spreading, rounded in *H. caudata*) and anther appendages (ovate, just covering style head in *H. sangguensis* vs linear and extending well beyond style head in *H. caudata*). – TYPE: Indonesia, Central Kalimantan, Buntok, Sanggu, lowland, wetland and heath forest, 27 October 2021, *Rahayu 1353* (holotype BO). (Fig. 11)

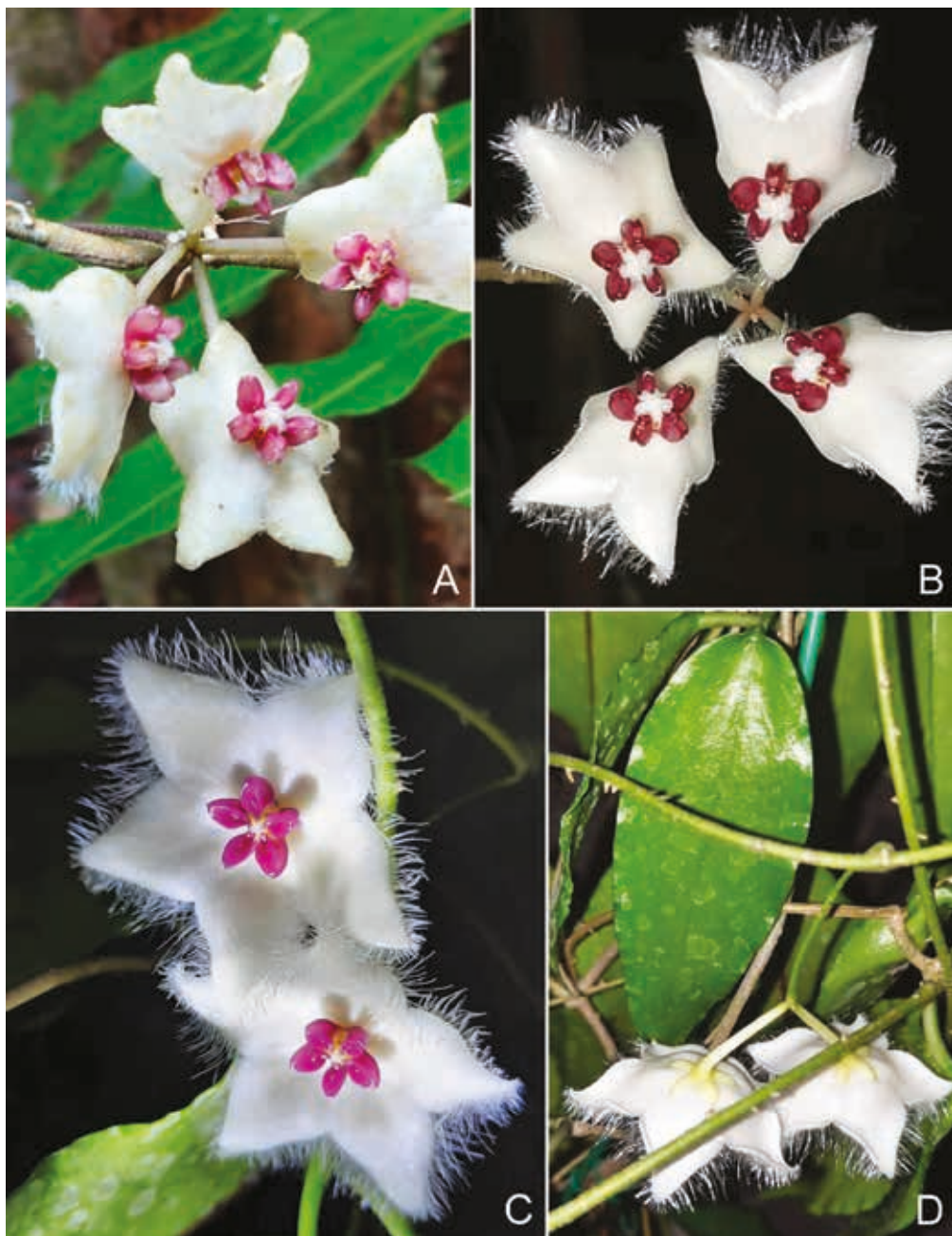


Fig. 11. *Hoya sangguensis* S.Rahayu & Rodda. A–C. Inflorescence (from below). D. Inflorescence (from underneath). A, B from *Rahayu 1353*; C, D from a cultivated plant in Kedah, Peninsular Malaysia. (Photos: A, B, Abdul Lalang; C, D, Faizal Azmi)

Climber, epiphytic, with white or yellow latex. **Stems** slender, cylindrical, up to 3 mm diam., sparsely pubescent when young, turning glabrescent with rough grey surface when mature, internodes (4–)7–10(–20) cm long. **Roots** adventitious produced all along the stem. **Leaves:** petiole terete, 1–1.5 cm long, 2–2.5 mm diam., green or purplish, glabrous; lamina elliptic, 9–20 × 4–7 cm, weakly succulent, apex acuminate, base round or cordate, margin entire or very slightly undulate, darker in colour compared to the rest of lamina, mid green turning red when exposed to the bright light, glabrous; venation pinnate, secondary veins 3–5 each side; basal colleters present, ovoid, c. 0.6 mm long. **Inflorescence** flat, consisting of (2–)4–10 flowers; **peduncle** extra-axillary, positively geotropic, terete, slender, 3–10 cm long, 1–1.5 mm diam., green to brown, pubescent, older peduncles forming a rachis from previous flowerings; **pedicels** 2–2.5 cm long, 1–1.5 mm diam., white or very pale pink-green, sparsely pubescent. **Calyx** lobes triangular, 4–5 × 2.5–3 mm, apex acute or narrowly rounded, sparsely pubescent outside, glabrous inside; basal colleters one at each calyx lobe sinus, narrowly triangular, c. 0.6 mm long. **Flowers** positively geotropic. **Corolla** rotate, ranging from shallowly campanulate (young flowers) to slightly reflexed with slightly curly lobes (older flowers), (2.5–)3–3.5 cm diam. when flattened (> 1.8 cm diam. when dry); **tube** 5–7 mm long, white to cream, glabrous to sparsely pubescent; **lobes** elliptic-ovate, 7–10 × 7–10 mm, margin flat to recurved, apex acuminate and revolute at the tip, inner surface white or slightly yellowish at the base, covered with dense white hairs, hairs longer at margin, to 3.5 mm long, outer surface cream, glabrous. **Gynostegium** subsessile. **Corona** staminal, 3–3.5 mm high, 5–8 mm diam., red; **lobes** ovoid, c. 3.5 × 2 mm, slightly translucent or glassy, inner process upcurved, apex acute, outer process upcurved, held at an angle of 30° to 80°, apex rounded, with basal revolute margins. **Style head** convex, white, covered by the anther appendages. **Anthers** triangular, membranous, appendage c. 2.8 × 1.5 mm. **Pollinia** subrectangular, c. 500 × 400 μm, with truncate apex and rounded base, pellucid margin not observed, **corpusculum** ellipsoid, c. 700 × 500 μm, **caudicles** short, attached towards the middle of the corpusculum. **Ovary** oblongoid, c. 1 mm long, c. 0.5 mm wide at the base. **Fruit** and **seed** not observed.

Distribution and ecology. This species is only known from lowland heath forest in Central Kalimantan (Buntok). It was found in an area where *Hoya mitrata*, *H. elmeri* and *H. scortechinii* have also been sighted. A living collection, shown in Fig. 11C, D (not yet vouchered) was made in Peninsular Malaysia, Kedah (Faizal Azmi, pers. comm.).

Etymology. The name *Hoya sangguensis* refers to the type locality in Sanggu, Buntok, Central Kalimantan.

Provisional IUCN conservation assessment. Data Deficient as it is known only from two localities more than 1500 km apart. In Sanggu the species was found in a local community forest. Plants were also spotted but not collected in nearby Ekeng and Majundre, all areas affected by logging. More exploration of suitable habitats in neighbouring areas and in Kedah, Malaysia is needed to better assess the distribution area and update the conservation assessment.

Notes. *Hoya sangguensis* belongs the *H. caudata* complex, also known as *Hoya* sect. *Peltostemma* Schlechter (Schlechter, 1916). The species in this group are generally characterised by upright corona lobes (forming a conical corona), long (often linear) anther appendages extending well above the style-head, and pollinaria with well-developed caudicle wings (Kidyoo, 2016; Rahayu & Rodda, 2021). *Hoya sangguensis* is however not a typical member of this group as it does not have particularly elongated anther appendages and the corona is not conical. The leaves are, however, almost indistinguishable from those of *Hoya caudata*, with a slightly undulate margin and covered in grey specks on the upper surface, the inflorescence is flat, like in all other members of *Hoya* sect. *Plocostemma*, the corolla is white with long hairs around the margins like in *H. caudata* and *H. flagellata* Kerr, and the corona is red, a colour predominant in the other species of *Hoya* sect. *Plocostemma*.

The corona lobes of *Hoya sangguensis* are quite variable in shape and angle, with the outer processes held at 30° (in the Kedah collection) to 80° angle (in the Kalimantan collection). This is likely just part of the species variation, as observed in other species such as *Hoya krusenstierniana* Simonsson & Rodda in New Guinea.

Hoya sangguensis can be separated from all other members of *Hoya* sect. *Peltostemma* because it lacks the elongated anther appendages and because its flowers are particularly large (> 2.5 cm diam.), whereas the second largest-flowered species, *H. caudata*, has flowers not more than 1.5 cm diam. when flattened.

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