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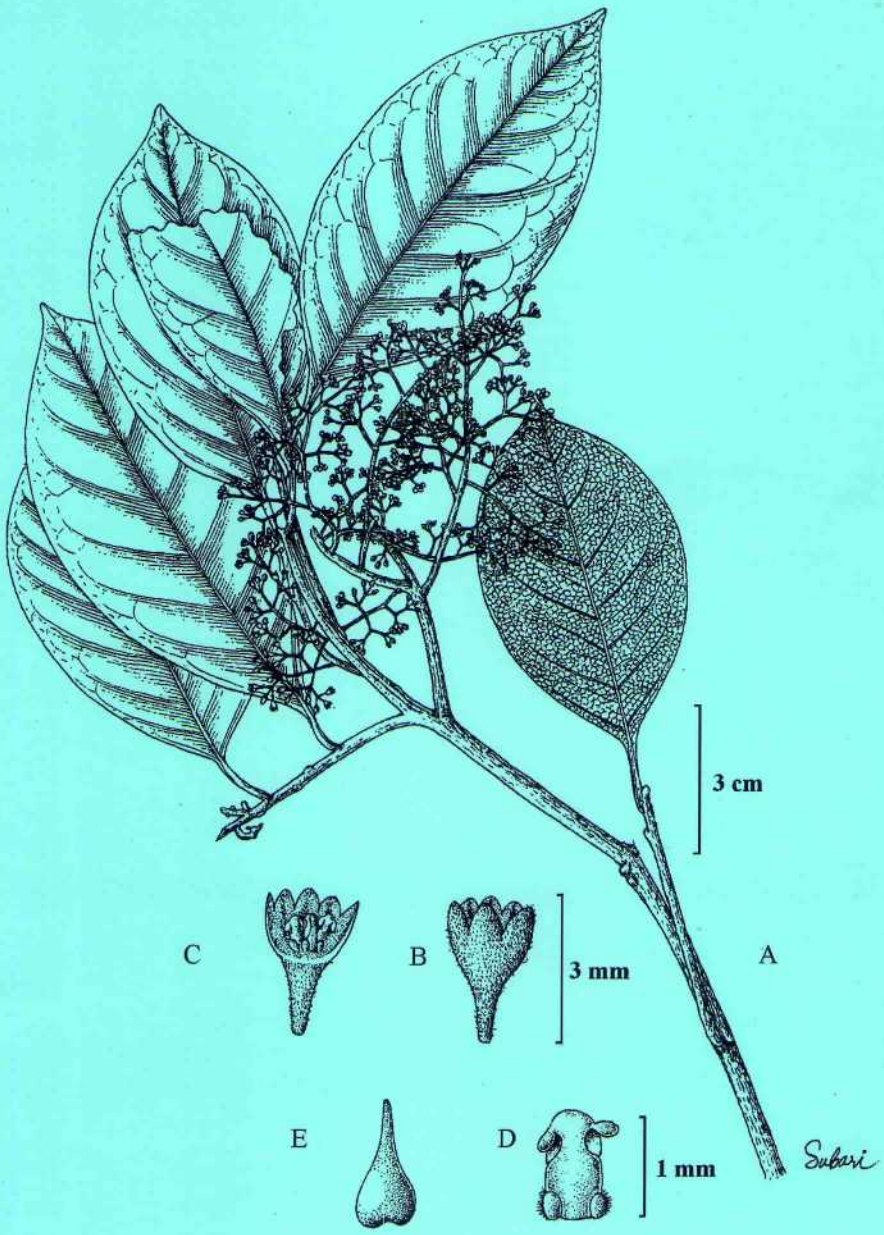

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HOYA (APOCYNACEAE: ASCLEPIADOIDEAE) DIVERSITY IN GUNUNG GEDE PANGRANGO NATIONAL PARK, WEST JAVA, INDONESIA

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ABSTRACT
RAHAYU, S. 2012. *Hoya (Apocynaceae: Asclepiadoideae)* diversity in Gunung Gede Pangrango National Park, West Java, Indonesia. Reinwardtia 13(4): 331-339. — A survey on the diversity of *Hoya {Apocynaceae: Asclepiadoideae)* species was conducted in Gunung Gede Pangrango National Park at different altitudes in four locations (Cibodas, Bodogol, Situgunung, and Selabintana). Ten *Hoya* species were found at elevations between 650 and 1500 m asl. Of these, two species were only found at elevations above 1000 m asl, while the other eight grow well below 1000 m asl. The inventory encountered *Hoya imperialis* Lindley and *H. micrantha* Wight ex Hook.f. as new records for Java. The highest diversity was found at the Bodogol Research Station. It shows that the genus is most diverse at relatively low altitudes.

Keywords: *Hoya, Apocynaceae,* species diversity, new record, Gunung Gede Pangrango National Park.

ABSTRAK
RAHAYU, S. 2012. Keanekaragaman *Hoya {Apocynaceae: Asclepiadoideae)* di Taman Nasional Gunung Gede Pangrango, Jawa Barat, Indonesia. Reinwardtia 13(4): 331-339. — Pencacahan keanekaragaman jenis *Hoya {Apocynaceae: Asclepiadoideae)* telah dilakukan di Taman Nasional Gunung Gede Pangrango pada berbagai ketinggian di empat lokasi (Cibodas, Bodogol, Situgunung, dan Selabintana). Sepuluh jenis Hoya ditemukan pada ketinggian 650 hingga 1500 m, dua jenis diantaranya hanya ditemukan pada ketinggian di atas 1000 m dpi. Hasil pencacahan menunjukkan *Hoya imperialis* Lindley dan *H. micrantha* Wight ex Hook.f. merupakan rekaman baru untuk Jawa. Keanekaragaman jenis tertinggi ditemukan di Bodogol. Hal ini menunjukkan bahwa *Hoya* lebih banyak terdapat di dataran rendah.

Kata kunci: *Hoya, Apocynaceae*, keanekaragaman jenis, rekaman baru, Taman Nasional Gunung Gede Pangrango.

INTRODUCTION

The genus *Hoya* is widespread in mainland Asia, much of Malesia, northern Australia and some islands of the Western Pacific. They are mainly epiphytic, shrubby or climbing plants, often with attractively marked foliage and brightly coloured flowers. Their general ease of cultivation has resulted in Hoyas *(Hoya* spp.: Apocynaceae: *Asclepiadoideae)* being popular as ornamental plants in Europe, USA and Australia (Wanntorp *et at,* 2006; Hodgkiss, 2007). Hoyas are also used as a source of medicines by indigenous people who live near the forest (Zachos, 1998). Many Hoyas are threatened by destruction of the habitat due to land clearing, and this together with an increase in uses by humans has, or will soon result in a decrease of the occurrence of many of the species in nature.

Indonesia has been predicted to have the highest *Hoya* species diversity in the world (Goyder, 2008; Kleijn & van Donkelaar, 2001); however, baseline inventories of the species throughout the Indonesian archipelago is still limited with most based on dated, limited data (Miquel, 1856: Indonesia (Netherland Indie), Koorders (1898: Minahasa-North Sulawesi, Backer & Brink Jr. (1965: Java Island).

A recent preliminary inventory on Indonesian *Hoya* (Rahayu, 1999) based on the results of botanical exploration of the Bogor Botanical Gardens, has been expanded for Sumatera (Rahayu, 2001) and Bukit Batikap, Central Kalimantan (Rahayu, 2006).

Reinventory for the island of Java is critically needed. One of the important localities to be surveyed is Gunung Gede Pangrango National Park in West Java. Gunung Gede Pangrango National Park is a Biosphere Reserve (Indonesian National Committee for MAB Unesco Program, 2010) and the area has been extended recently to lowland areas below 1000 m above sea level (asl). As such, this large National Park encompasses a range of rainforest habitats and presents a significant remnant of the biological diversity of Java. Previously only two *Hoya* species were recorded from the National

Park (Sunaryo & Rugayah, 1992) at elevations above 1000 m asl. *Hoya* species diversity has been assumed to be higher at low elevation (Rintz, 1980; Schlechter, 1914), so the current inventory was focused especially on the new extended area of lowland forest in the national park.

MATERIALS AND METHODS

The occurrence *of Hoya* species in Gunung Gede Pangrango National Park was undertaken by vertical belt transects (Cox, 2002) at different elevations, from 650 to 2000 m asl. The sampling was done at four different sites (research stations) as follows: (i) Cibodas (1400 m asl); (ii) Bodogol (650 m asl); (hi) Situ Gunung (1000 m asl); and Cugenang/Gede (900- 1500m asl).

Hoya species were recorded and collected as herbarium specimens and for the living collection were planted at the Bogor Botanical Gardens. The specimens were identified by using published descriptions, comparison with type specimens at BO and/or consultation with *Hoya* experts.

RESULTS AND DISCUSSION

Taxonomy *of Hoya*

Hoya R.Br., Prodr. Fl. Nov. Holland. 1810. Hook, f, Fl. Brit. India 4 (1885): 52. — Type: *Hoya carnosa* R.Br. in Prodr. Fl. Nov. Holland. (1810) 460.

Plants epiphytic, epilithic, rarely rooting in the ground, creeping, climbing, pendent, left-twining, rarely shrubby, latex white, rarely clear. *Roots* fibrous. *Stems* terete, sparsely branched, glabrous to pubescent. *Leaves* decussate, alternate at seeding stage, rarely imbricate, petiolate; lamina lanceolate to obcordate, entire, leathery, fleshy to succulent. *Inflorescence* racemose, occasionally with part inflorescence, lateral or rarely terminal, 1- to many flowered, globose, flat or concave, rarely with a peduncle > 10 cm long. *Flowers* 5 - merous, actinomorphic. *Pedicels* uniform and straight or length variable within an inflorescence and bent. *Corolla* waxy fleshy, star shaped and spreading, campanulate or urceolate, outside glabrous, inside rarely glabrous, lobes revolute, recurved or reflexed. *Staminal corona* 5 - merous, fleshy and waxy, horizontal or not, sometimes bicoloured. *Pollinaria* 5 pairs, each comprising a pair of pollinia on a corpusculum; pollinia elliptic to oblong. *Fruits* a follicle, terete, acuminate, smooth. *Seeds* comose, ovate or linear oblong; coma 1-3 cm long, white or fawn-white.

Note. According to Forster (1991), the first published name for *Hoya carnosa* (L.) R. Br. as type species for the genus was in Prodr. Fl. Nov. Holland (Brown, 1810), not in Mem. Wern. Soc. (Brown, 1811) which incorrectly cited in 1809.

Hoya Species found in the Gunung Gede Pangrango National Park

Key to ten species of *Hoya* in Gede Pangrango National Park (GPNP)

1. a. Stem twining 2
   b. Stem not twining ..... 8. *H. multiflora*
2. a. Leaves thin and chartaceous 3
   b. Leaves thick or fleshy 4
3. a. Upper surface of leaves glossy; corolla star shaped ..... *2.H. coriacea*
   b. Upper surface of leaves dull; corolla campanulate ..... \.*H. campanulata*
4. a. Leaves hard, pubescens at below ..... 3. *H. imperialis*
   b. Leaves fleshy, glabrous 5
5. a. Leaves narrow (1-3 cm width); corolla lobes revolute 6
   b. Leaves wide (3-10 cm width); corolla star shaped, lobes spreading 8
6. a. Leaf margin revolute; pedicels 0.2-5 cm long ..... *l.H. micrantha*
   b. Leaf margin entire or ridged; pedicels 0.5-2 cm long 7
7. a. Leaf venation invisible; corolla dark light brown ..... 4. *H. kuhlii*
   b. Leaf venation visible; corolla creamy white .... *5.H. lacunosa*
8. a. Leaves oblong with prominent reticulate venation ..... 10. *H vitellinoides*
   b. Leaves almost cordate with prominent palmate venation 9
9. a. Inflorescence multipeduncled, corolla 0.8 cm in diam ..... 6. *H latifolia*
   b. Inflorescence single peduncled, corolla 1.5 cm in diam ..... 9. *H purpureofusca*

Species descriptions

1. HOYA CAMPANULATA Blume, Bijdr. Fl. Ned. Ind. 16:1064. 1826. Syn: Physostelma campanulatum (Blume) Decne., DC. Prod. VIII, 633. — Type: Java, *Blume sn.* (L!) . — Fig. 1A.

Stem glabrous with floriferous branches, *ca.* 30 cm long. *Leaves* thin and chartaceous; lamina elliptical, up to 12 cm long by 6 cm wide, upper surface dull (not glossy). *Peduncle* reflexed, rigid, 1-6 cm long. *Umbel* convex, 1-30 flowered, open 8 days. *Pedicels* flexuous, uniform, 4-5 cm long. *Corolla* campanulate, nearly glabrous inside, up to 2.5 cm

diameter by 1.5 cm deep, creamy white. *Corona* white or cream, occasionally with a deep red stripe at the base. *Follicles ca.* 16 cm long by 7 mm diam.; dark green striped.

Locality. Bodogol Research Station.

Distribution. India, Malay Peninsula, Sumatra, Java, Borneo.

Habitat and Ecology. Along riverside at 650 m asl.

Notes. *Hoya campanulata* is characterized by the thin leaves and campanulate corollas.

2. HOYA CORIACEA Blume, Bijdr. Fl. Ned. Ind. 16 (1926):1061.— Type: not seen. —Fig. IB.

Stem glabrous. *Leaves* coriaceous; lamina elliptical, up to 12 cm long by 6 cm wide, glossy on upper surface. *Peduncle* reflexed, rigid, up to 8 cm long. *Umbel* convex, 1-40 flowered, open 4 days. *Pedicels* uniform, 4-5 cm long. *Corolla* lobes densely tomentose with long yellow hairs inside, star shaped, *ca.* 1.5 cm diam. *Corona* lobes acute at apex, red or purple at the base otherwise white. *Follicles ca.* 12 cm long by 1.5 cm diam.

Locality. Bodogol Research Station.

Distribution. Malay Peninsula, Borneo, Java, Thailand, India.

Habitat and Ecology. Slopes, open areas, below 1000 m.

Notes. Easily confused with *H. campanulata* vegetatively, but more robust and without short, floriferous branches. *Hoya coriacea* is characterized by the thick, not fleshy, coriaceous leaves.

3. HOYA IMPERIALIS Lindley, Bot. Reg. 32t. 68 (1846). —Type: Borneo, *Blume sn.* (K!). —Fig. 1C.

Stems very thick and smooth, *ca.* 8 mm diam.

Fig. 1. A. *H. campanulata* **Blume; B.** *H. coriacea* **Blume; C.** *H. imperialis* **Lindley; D.** ***H. kuhlii*** **Blume. (Bar length = 1 cm)**

Leaves thick, lamina oblong with obtuse or shallowly cordate bases, up to 16 cm long by 5-6 cm wide. *Peduncle* pendant, 10-12 cm long. *Umbel* convex, 1 -10 flowered. *Pedicels* flexuous, uniform, *ca.* 8 cm long. *Corolla* lobes spreading, fleshy, campanulate shaped, very finely pubescent inside, 3-5 cm diam., deep red. *Corona* lobes massive with blunt tips and conical process at the base; entirely yellow or creamy. *Corpusculum* wide, clavate. *Follicles ca.* 23 cm long by 2.5 cm diam.

Locality. Bodogol Research Station.

Distribution. Sumatra, Malay Peninsula, Borneo, Philippines.

Habitat and Ecology. Slopes, semi open areas.

Notes. *Hoya imperialis* is characterized by its large flowers (3-5 cm diam.). This species is new record for Java.

4. HOYA KUHLII (Blume) Korders, Exkurs. Fl. Java 3 (1912) 103. Basionym: *Acanthostemma kuhlii* Blume, Rumphia 4 (1848) 29. — Type: Java, *Blume s.n.* (L!). —Fig. ID.

Leaves fleshy; lamina elliptical with long attenuate bases and rigid margins up to 8 cm long by 4 cm wide. *Peduncle* reflexed, rigid, 5-10 cm long. *Umbel* concave with 1-25 flowers. *Pedicels* rigid and curved, 5- 30 mm long. *Corolla* lobes revolute outward, pubescent inside *ca.* 8 mm diam., pale or dark brown. *Corona* lobes upcurved, red at center.

Locality. Cibodas.

Distribution. Java.

Habitat and Ecology. Mountain forest, above 1000 m.

Notes. *Hoya kuhlii* is characterized by the small size and brownish revolute corollas.

5. HOYA LACUNOSA Blume, Bijdr. Fl. Ned. Ind. 16 (1926) 1063. — Type: Java, *Blume sn.* (L!). — Fig. 2A.

Stems thin. *Leaves* fleshy; lamina of two forms, one form ovate, thick, up to 3 cm long by 2.5 cm wide the other form oblanceolate up to 7 cm long by 3 cm wide, margin ridged. *Peduncle* reflexed, rigid, up to 5 cm long. *Umbel* concave, 1-30 flowered, open 4 days. *Pedicels* rigid and curved, 5-25 mm long. *Corolla* lobes revolute outward, pubescent inside with long thick hairs, *ca.* 8 mm diam., white. *Corona* base upcurved, solid, entirely white. *Follicles* 5-6 cm long by 5 mm diam.

Locality. Gedeh Cugenang, Bodogol Research Station.

Distribution. Sumatra, Malay Peninsula, Borneo, Thailand, Java.

Habitat and Ecology. Common in lowland and hill forest especially along rivers.

Notes. *Hoya lacunosa* is characterized by the small leaves and small white revolute flowers.

6. HOYA LATIFOLIA G. Don, Gen. Hist. PI. IV (1838) 127. — Type: not seen. — Fig. IF. Syn: *H. macrophylla* Wight, Contr. 38 (1834); *H. polystachya* Blume, Mus. Bot. Lugd. Bat.I (1849) 45,T.9. Fig. 2B.

Stem deep red when young. *Leaves* fleshy; lamina ovate, bases cordate with a pair of veins parallel to the midrib; up to 25 cm long by 15 cm wide; upper surface glossy green, lower surface pale green or red. *Inflorescences* multipedunculate. *Peduncle* produced successively on paired racemes, 3-6 cm long. *Umbel* convex, 1-40 flowered. *Pedicels* rigid, uniform, *ca.* 2 cm long. *Corolla* lobes spreading, star shaped, finely pubescent inside, *ca.* 8 mm diam., pale pink or brown outside, creamy inside. *Corona* lobes acute at apex, white with pink at centre.

Locality. Gedeh Cugenang, Bodogol Research Station.

Distribution. Sumatra, Malay Peninsula, Borneo, Java, S Thailand.

Habitat and Ecology. Twining on large tree especially along the river.

Notes. *Hoya latifolia* is characterized by the multipeduncled inflorecences.

7. HOYA MICRANTHA Wight ex Hooker fil. * Fl. Brit. Ind 4 (1889): 55. — Type: Malaysia, Malacca, *Maingay 1127* (K!). — Fig. 2C.

Stem twining, terete, thin, glabrous. *Leaves* fleshy; petiole *ca.* 4 mm long; lamina elliptic, 8 x 4 cm, glabrous, acuminate, base acuminate, margin strongly revolute. *Peduncle* up to 10 cm long, pendent. *Umbel* 1-30 flowered, concave. Pedicels 0.2 -5 cm, strongly bent. *Corolla* lobes strong revolute outward, button (round) shaped, 5 mm diam., pale

pink, inside finely weakly pubescent. *Corona* lobes elliptic, ascending, base acuminate, tips bifid, white or pale pink with pink at centre.

Locality. Bodogol Research Station.

Distribution. S Burma to Thailand, Malay Peninsula.

Habitat and Ecology. Slopes, semi open area.

Notes. *Hoya micrantha* is characterized by the small and orange revolute corollas. This species is new record for Java.

8. HOYA MULTIFLORA Blume, Cat. Gew. Buitenzorg 49 (1823) — Type: Java, *Blume s.n.* (L!). — Fig.2D.

Stem non twining with branches only at the base, up to 2 m long. *Leaves* chartaceous, elliptical, apically cuspidate, up to 18 cm long by 3-7 cm wide. *Peduncle* reflexed, rigid, up to 5 cm long. *Umbel* convex, 1-40 flowered, open 5-7 days. *Pedicels* flexuous, uniform, 4-7 cm long. *Corolla* star shaped, lobes finely pubescent inside, strongly reflexed, *ca.* 2 cm diam., white with pale orange tips and occasionally with scattered pale purple spots. *Corona* stalked, with long reflexed lobes, both lobes white. *Follicles ca.* 20 cm long by 6 mm diam.

Locality. Bodogol Research Station.

Distribution. Sumatra, Malay Peninsula, Borneo, Phillipine.

Habitat and Ecology. Common but not abundant, many encountered on ridges between 700-900 m asl.

Fig. 2. A. *H. lacunosa* Blume; B. *H. latifolia* G. Don.; C. *H. micrantha* Wight; D. *H. multiflora* Blume. (Bar length = 1 cm)

Fig. 3. A. *H. purpureofusca* Hook.f. B. *H. vitellinoides* Bakh.f. (Bar length = 1 cm).

Notes. *Hoya multiflora* is characterized by the arrowhead shaped flowers. There was morphological variation according to various habitat types in Bodogol (Rahayu *et ah*, 2010a).

9. HOYA PURPUREO-FUSCA Hooker, Companion Bot.Mog. 76 (1850): t. 4520. —Type: Java. *Lobb s.n.* (K!). —Fig. 3A.

Stems terete, glabrous. *Leaves* fleshy; petiole *ca.* 15 mm long, very thick, brownish; lamina ovate, 10 -12.5 x 7.5-10 cm, acute to acuminate, base rounded. *Peduncle* up to 8 cm long, pendent. *Umbel* many flowered, semi globose (covex). *Pedicels* thin and uniform, *ca. 2* cm long. *Corolla* star shaped, *ca.* 1.5 cm diam., dark pink to dark purple, inside glabrous or pubescent to villose, margin slightly involute. *Corona* flat, lobes ovate, acute, dark pink to strongly purple-brown, upper surface keeled and depressed in the middle, lower face convex.

Locality. Cibodas, Situgunung.

Distribution. Sumatra, Malay Peninsula, Borneo, Phillipine.

Habitat and Ecology. Wet and shaded area.

Notes. *Hoya purpureo-fusca* is characterized by the purple color of the corolla and corona.

10. HOYA VITELLINOIDES Bakh.f, Blumea 6 (1950): 381. —Type: Java, West, Ciampea, Mt. Tjiputih, alt. 800 m, *Bakhuizen van den Brink 4181* (holotype: L, isotype: BO!). —Fig. 3B.

Stem terete, glabrous. *Leaves* thick and fleshy; lamina broadly oblong up to 16 cm long by 6.5 cm wide, venation reticulate darker than the background at the upper surface. *Peduncle* horizontal, rigid, 2-5 cm long. *Umbel* convex, 1-20 flowers. *Pedicel* uniform, *ca. 2* cm long. *Corolla* spreading, finely and sparsley pubescent inside and out, *ca.* 1 cm diam., pale green or yellow. *Corona* entirely white.

Locality. Bodogol Research Station.

Distribution. Java (rare), Sumatra at high elevation.

Habitat and Ecology. River bank, humid and shaded area.

Notes. *Hoya vitellinoides* is characterized by the darker venation at the upper surface of leaves.

Altitudinal distribution and habitat diversity

Rintz (1980) and Schlechter (1914) considered that most *Hoya* species occur on lower altitudes and this is also reflected here. Out of the ten species from this study are found below 1000 m. Only two species, *i.e. Hoya purpureo-fusca* Hook. f. and *H. kuhlii* Blume were found at elevations of above 1000 m (Table 1). Beside altitudinal distribution, the occurrence of the species depends on specific habitat types and is especially influenced by areas of high humidity such as along rives banks, steep slopes, or hill tops (Table 1).

DISCUSSION

Ten species of *Hoya* were found in the Gunung Gede Pangrango National Park. Two of them were new records for Java (Backer & Brink Jr., 1965), *i.e. Hoya imperialis* Lindley and *H. micrantha* Hook. f. *Hoya imperialis* was formerly known in Sumatra, Borneo, Malay Peninsula and the Philippines (Rintz, 1978). This is an interesting species with large red flowers. *Hoya micrantha* was formerly known from Burma, Thailand and Malay Peninsula (Rintz, 1978; Thaitong, 1996). According to specimen observation in BO shows that this species is also found in Sumatra. There are several reasons that can be argued for these new records. The species may have dispersed from Sumatra by seed dispersal. *Hoya* species have plumed parachute like seeds and mainly dispersed by wind or anemochory (Armstrong, 1999) and ants (Rahayu & Sutrisno, 2007). Rahayu *et al.* (2010b) concluded that there are two main modes for the seed dispersal in *Hoya multiflora* in Gede Pangrango National Park, *i.e.* long distance and short distance dispersal. In long distance dispersal (more than 10 km) the seeds are transported over long distances via wind dispersal and establish new populations, as part of a greater metapopulation. In short distance dispersal means the seeds are transported only a small distance from their mother plant and within the same population. This kind of dispersal is via wind and ants.

The increased number of species to be found in Java was not unexpected. Most of the new findings were from the newly extended area of conservation areas, *i.e.* at Bodogol resort at elevations of 650-800 m. The Bodogol resort is the only area of the Gunung Gede Pangrango National Park which is situated at low elevation (below 1000 m). The distribution of epiphytes depends on dispersal model and available habitats (Lobel & Rydin, 2009). There was separation in species distribution according to elevation. Two species, *H. purpureofusca* and *H. kuhlii* were only found at elevation of above 1000 m in Cibodas, Situgunung and Gunung Putri. This may be the result of plant adaptation to the temperature zone as mentioned by van Steenis (2006) in his thermo-ecology schematic concept. In this concept, plants were divided into three groups *i.e. megatherm, mesotherm* and *microtherm. Megatherm* plants are adapted to warm tropical conditions and are concentrated at the Equator line/zone at low elevations (below 1000 m; colline zone). *Mesotherm* plants are adapted to cool tropical conditions and are concentrated at higher altitudes (1000-2400 m; submontane and montane zones) in mountainous areas. *Microtherm* plants occur at high elevations (above 2400 m; subalpine and alpine zones) in the tropics where they may adaptive to cold temperatures, even snow.

Habitat heterogeneity presumably influences the distribution of epiphytes, whether it is seedling germination percentage or recruitment success (Winkler *et al.*, 2005). The major factors which limit epiphytic distribution and thus may become stressors are light, water and mineral nutrition (Benzing, 2008; Luttge, 2008). In general *Hoya* species occur in areas of high humidity, but often in niches that are quite dry for extended periods. According to Zotz & Heitz (2001) water is the main factor affecting growth of epiphytes. *H. campanulata, H. lacunosa, H. latifolia, H. forbesii, H kuhlii* and *H. purpureofusca* are invariably found in the most humid places while *H. coriacea, H. imperialis*

Table 1. *Hoya* species distribution at Gunung Gede Pangrango National Park at different altitude and habitat

No.	Species	Alt 1< 1000 m asl			Alt 1000-1500 m asl		
		RiverBank	Slope	TopHill	RiverBank	Slope	TopHill
1.	*H campanulata* Blume	+	+	-	-	-	-
2	*H. coriacea* Blume	+	+	-	-	-	-
ɹ	*H. imperialis* Lindle	-	+	+	-	-	-
4	*H. kuhlii* Blume	-	-	-	+	+	+
5	*H. lacunosa* Blume	+	+	+	-	-	-
6	*H. latifolia* G. Don	+	+	+	-	-	-
7	*H. micrantha* Wight ex Hook.f.	-	+	-	-	-	-
8	*H. multiflora* Blume	-	+	+	-	-	-
9	*H. purpureo-fusca* Hook.f.	-	-	-	+	+	+
10	*H. vitellinoides* Bakh.f.	+	+	-	-	-	-

and *H. micrantha* are found in more open and semi open areas.

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Freycinetia minahassae **Koord. (Photo:** Theo Lasut)

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