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RAFFLESIA LAWANGENSIS (RAFFLESiaceae), A NEW SPECIES FROM BUKIT LAWANG, GUNUNG LEUSER NATIONAL PARK, NORTH SUMATRA, INDONESIA

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ABSTRACT

MAT-SALLEH, K., MAHYUNI, R., SUSATYA, A. & VELDKAMP, J. F. 2010. *Rafflesia lawangensis* (Rafflesiaceae), a new species from Bukit Lawang, Gunung Leuser National Park, North Sumatra, Indonesia. *Reinwardtia* 13(2): 159–165. — *Rafflesia lawangensis* (Rafflesiaceae), a new species from Bukit Lawang, Gunung Leuser National Park, North Sumatra is described. The species was previously recorded as either *R. arnoldi* or *R. atjehensis*, but it is distinguished by the absence of windows, the large undulating exterior annulus, the short pubescence on the upper surface of perigone lobes, and the very wide of diaphragm opening. A key to species of Sumatran *Rafflesia* is provided.

Key words: Aceh, *Rafflesia*, Rafflesiaceae, ramenta, Sumatra

ABSTRAK

MAT-SALLEH, K., MAHYUNI, R., SUSATYA, A. & VELDKAMP, J. F. 2010. *Rafflesia lawangensis* (Rafflesiaceae), jenis baru dari Bukit Lawang, Taman Nasional Gunung Leuser, Sumatera Utara, Indonesia. *Reinwardtia* 13(2):159–165. — *Rafflesia lawangensis* (Rafflesiaceae) adalah jenis baru dari Bukit Lawang, Taman Nasional Gunung Leuser, Sumatera Utara. Jenis ini sebelumnya dikenal sebagai *Rafflesia arnoldi* ataupun *R. atjehensis* tetapi dapat dibedakan dari keduanya berdasarkan tidak adanya jendela, anulus luaran yang besar bak gelombang, rambut kecil dan tebal pada permukaan atas lobus perigon dan bukaan diafragma yang lebar. Kunci identifikasi untuk *Rafflesia* di Sumatera ditampilkan.

Kata kunci: Aceh, *Rafflesia*, Rafflesiaceae, ramenta, Sumatera.

INTRODUCTION

The Gunung Leuser National Park, located between Aceh and North Sumatra provinces, is well-known for its high floristic diversity. Four taxa of *Rafflesia* R. Br. (Rafflesiaceae) have been reported from the Park and its surroundings (Meijer, 1997) i.e. *R. arnoldi* R. Br. var. *arnoldi*, *R. arnoldi* var. *atjehensis* (Koorders) Meijer, *R. micropylora* Meijer, and *R. rochussenii* Teijsm. & Binn.

Rafflesia micropylora was first found in 1914 near Sungai Jernih, Aceh, by Heer F.W. J. Brewer. Koorders (1918) on his identification label provisionally called it *R. gibbosa* (p. 108: “spec. 3”)

but this name was never published. Later, Meijer (1984) published it as *R. micropylora* based on the Koorders specimen. The presence of this species was also reported in 1972 by De Wilde and De Wilde-Duyfjes at Ketambe Gunung Leuser National Park. *Rafflesia rochussenii* is found in north Sumatra in Mt. Leuser and further south in Tapanuli (Meijer, 1984; 1997) but has a disjunct distribution in West Java in the Gede Pangrango National Park (Zuhud *et al.*, 1998) and Mt. Salak (Zuhud *et al.*, 1994).

Both *R. arnoldi* var. *arnoldi* and *R. arnoldi* var. *atjehensis* had been found in Sungai Jernih, Lokop,

Aceh (Meijer, 1984; Nais, 2001). *Rafflesia arnoldi* var. *atjehensis* was reported, but not documented, to also occur near Bohorok, close to the boundary of the Gunung Leuser National Park. *Rafflesia arnoldi* var. *atjehensis* was first described by Koorders as *R. atjehensis* based on a mature male bud collected by Terhaar in Lokop, Serbodjadi, Aceh (Koorders, 1918), but Meijer (1997) reduced it to a variety of *R. arnoldi*. However, based on the ramenta structure, Susatya (2007) agreed with Koorders and treated it as a distinct species. The types of ramenta and their distributions on the inner surface of the perigone tube are distinguishing characters for both species, despite their physical similarities in colour and wart pattern on the upper surface of the perigone lobes. *Rafflesia atjehensis* is distinguished by the ca. 2 cm wide glabrous and smooth zone at the base of the perigone tube with scattered and comparatively short tuberculate ramenta (about 3–6 mm long). On the other hand, *R. arnoldi* has filiform ramenta (6–10 mm long) scattered all over the inner surface of the perigone tube up to the lower part of the inner surface of the diaphragm (Meijer, 1997; Susatya, 2007). Hereafter, we will refer to *R. arnoldi* var. *atjehensis* as *Rafflesia atjehensis*.

Bohorok, Bukit Lawang, was not previously known as the habitat of *Rafflesia*. Yet, it was Meijer in 1997 who suspected that *R. arnoldi* var. *atjehensis* might possibly occur there which might be correct, because Gunung Leuser National Park has a floristic composition close to that of Lokop. Since then, the presence of a *Rafflesia* species there has been frequently reported from Bohorok. All reports are referred as either *R. arnoldi* or *R. atjehensis*. Unfortunately, no herbarium material as well as picture of this species was actually collected and documented. Until 2005, when Ms. Ewa Kamila Grzelczak took a photograph of a bizarre blooming *Rafflesia* from Bukit Lawang and sent it to Universiti Kebangsaan Malaysia. After long discussions, reviews of the existing information of all known *Rafflesias* and identification of specimens, we came to the conclusion that this was neither *R. arnoldi* nor *R. atjehensis*, but a new species to science, which is described here.

Rafflesia lawangensis Mat-Salleh, Mahyuni & Susatya, *spec. nov.* — Fig. 1, 2.

Ab omnibus Rafflesiiis sumatranis perigonii aliquot lobis supra pubescentia brevissima densissima, diaphragmate sine verrucis infra sine fenestris, apertura latissima, annulo exteriore grandi undulato distinguenda. — Typus: Indonesia, North Sumatra, Bohorok, 5 September 2006, *Ridha Mahyuni, Kamarudin Mat-Salleh, Donna Jackson. Rdh-001* (BO, Holotype in spirit

collection-male specimen).

Male mature bud 29–30 cm in diameter. Full blooming *female flower* 58–63 cm in diameter. *Perigone lobes* 24–25 by 19–25 cm, upper surface with a dark orange to reddish brown background; warts reddish white, irregular, 1–5 by 1–5 mm, upper surface with a very short and dense pubescence. *Diaphragm* orbicular, ca. 6 cm wide, 31–33 cm in diameter, pale orange, paler than the perigone lobes, without white warts, lower surface covered with ramenta. *Ramenta* filiform, sometimes branched, dark orange, distributed all over the inner surface of the perigone tube and diaphragm, becoming shorter towards the perigone base, 3–12 mm long. *Diaphragm aperture* 25–27 cm in diameter, ratio of the opening and its diameter at least 0.8. *Windows* absent. *Disc* 7.7–10.7 cm diameter, rim 0.3–0.6 cm high, pale orange and upper part with smooth hairs. *Column* 3.8–4 cm high, 9–9.5 cm in diameter; with a groove running down from the anthers cavity to the interior annulus. *Processes* mostly simple, flattened cones, arranged into 3 concentric rings: outer, mid and inner rings; *male flower* 30–32 consisting of 15 or 16 outer, 10 or 11 mid, 4 or 5 inner rings; *anthers* 27 or 28, in hairy cavities; *pollen* ca. 17–18 μm diameter; *female flower* 35 arranged into 16 outer, 11 mid, and 8 inner rings; *annuli* well developed, the interior annulus 0.3–0.4 cm wide and the exterior annulus larger than the interior one, 0.7–1 cm wide.

Distribution. Indonesia, Sumatera Utara, Bohorok (Gunung Leuser National Park). Bukit Lawang. Host plant: *Tetrastigma coriaceum* (DC.) Gagnep.

Specimen examined. North Sumatra, Bohorok, 5 September 2006, Lawang, *Ridha Mahyuni, Kamarudin Mat-Salleh, Donna Jackson. Rdh-001* (BO).

Notes. This species is named after Bukit Lawang, where the type specimen was collected. In a number of morphological features *R. lawangensis* is distinctly different from *R. atjehensis*, which was assumed as the identity of individuals sighted in this region previously. It is also different from the other species of *Rafflesia* found in the surrounding area of Gunung Leuser National Park such as *R. arnoldi*, *R. micropylora*, and *R. rochussenii* and from the other known species in Sumatera.

Rafflesia atjehensis is known to have a restricted geographical range, and has only been recorded from Lokop, Aceh and possibly near Bohorok (Meijer, 1997; Zuhud *et al.*, 1998). Meijer (1997) considered *Rafflesia atjehensis* as a variety of *R. arnoldi*. Due to this treatment, almost all

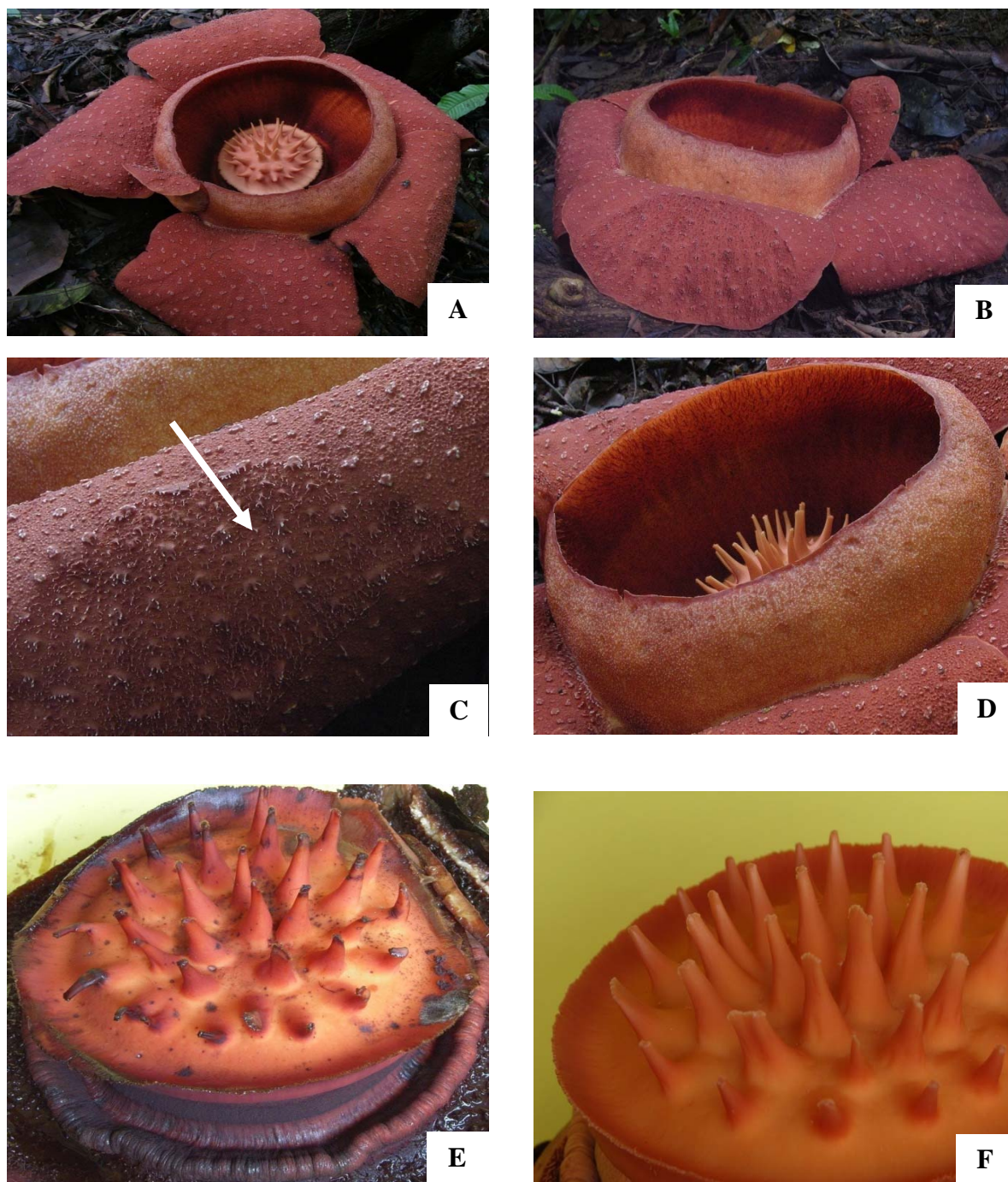


Fig. 1. A & B *Rafflesia lawangensis* in full bloom. C. Pubescence on perigone lobes D. Diaphragm (A, B, C & D, Female Flower). E. Column and disc. F. Processes (E & F Male Flower). Photo: R. Mahyuni & K. Mat-Salleh.

collections of *Rafflesia* found in this area have been referred to either *R. arnoldi* or *R. atjehensis*, when they did not show the distinctive morphological characters of *R. micropylora* or *R. rochussenii*. However, *R. lawangensis* is not likely to be confused with *R. atjehensis* or any other species.

Among all Sumatran species of *Rafflesia*, only *R. rochussenii* and *R. lawangensis* have no windows in the lower surface of the diaphragm. These morphological features combined with the absence

of warts on the upper surface of the diaphragm, the large undulating exterior annulus, and the short pubescence on perigone lobes distinguish *R. lawangensis* from *R. atjehensis* and all the other *Rafflesia* species. Furthermore, the relative size of the diaphragm opening is more than 80% of its diameter, and considered the widest among Sumatran *Rafflesia* but relatively similar to *R. leonardi* of northern Luzon in the Philippines (Barcelona *et al.*, 2008; Barcelona *et al.*, 2009b).

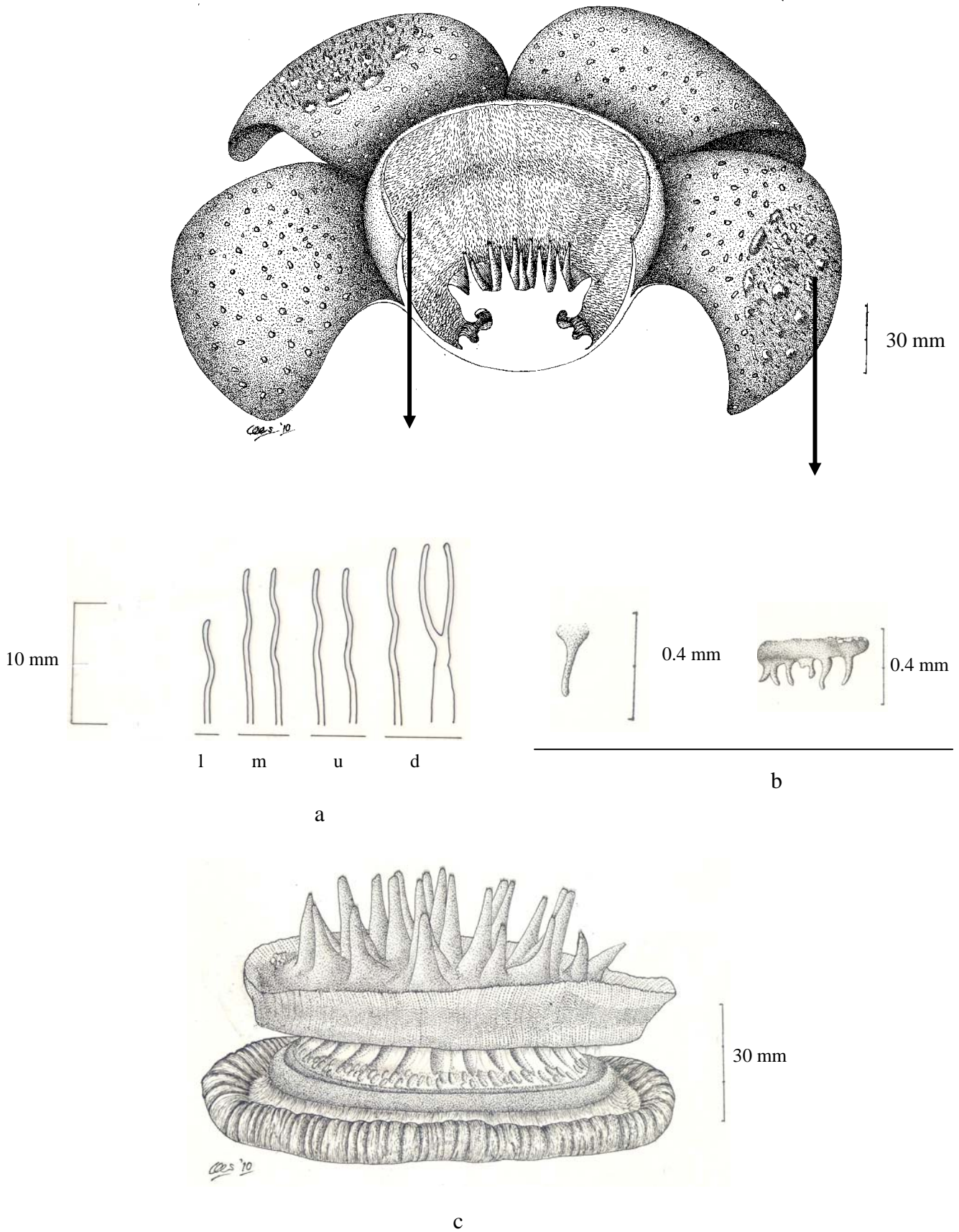


Fig. 2. *Rafflesia lawangensis* Mat-Salleh, Mahyuni & Susatya. a). Ramenta at (l) lower, (m) middle, and (u) upper parts (d) of the inner surface of perigone tube and lower part of inner surface of diaphragmn. b). Pubescence on perigone lobes. c). Column and disc.

Rafflesia lawangensis has an overlapping ecological distributions with *R. micropylora* and *R. rochussenii* in the north westernmost part of the Bukit Barisan Mountains which include the Gunung Leuser National Park (Figure 3). Each of the species has a combination of distinctive characters by which they can be differentiated from each other. The fully expanded flower of *R. micropylora* can reach a diameter of 40–60 cm, and is easily recognized by its very small diaphragm opening (Meijer, 1997). *Rafflesia rochussenii*, on the other hand is regarded as “small-flowered” with a size ranging from 14–40 cm. It has a disc without processes, or sometimes with less than 8. This very unique feature is also very similar to *R. leonardi* can be used to differentiate both from the other *Rafflesia* species (Meijer, 1997; Nais, 2001).

Rafflesia lawangensis also shows very distinctive features compared to the rest of the Sumatran *Rafflesia* species such as *R. gadutensis* Meijer, *R. hasseltii* Suringar, *R. patma* Blume, and the recently described *R. bengkuluensis* Susatya, Arianto & Mat-Salleh. *Rafflesia gadutensis* and *R. hasseltii* have distant geographical ranges from *R. lawangensis*. The former is restricted to a small area in West Sumatra near Padang on the Bukit Gadut and the M. Hatta Forest Garden and possibly in Northern Bengkulu (Meijer, 1997). *Rafflesia hasseltii* has a more extensive geographical distribution, ranging from the Kerinci-Seblat National Park in the West Sumatra, Jambi, Bengkulu and South Sumatra Provinces (Susatya, 2007). Meanwhile, *R. bengkuluensis* and *R. patma*

have been recorded to occur on the Southeastern parts of Bukit Barisan Mountains (Meijer, 1997; Susatya, 2007). The ramenta type together with pattern on the upper surfaces of the perigone lobes are the major differentiating characters between *R. lawangensis* and *R. hasseltii* as well as *R. gadutensis*.

Rafflesia hasseltii is considered to have a “mid-sized” flower as the diameter of the open flower is 30–50 cm (Solms-Laubach, 1910; Meijer, 1997) and may reach up to 80 cm in a colder habitat (Susatya, 2007). *Rafflesia gadutensis* and *R. hasseltii* are characterized by both the claviform and toadstool-shaped ramentas. The latter species has white and very large, but few warts on a red maroon background on the upper surface of its perigone lobes. The length of the claviform ramenta varies from 9 to 15 mm, and is considered the longest among species with similar types of ramenta. Claviform ramenta becomes the dominant type at the mid inner surface of the perigone tube, while the toadstool type is only found in the upper inner surface of the perigone tube (Susatya, 2007).

Smaller than *R. hasseltii*, *R. gadutensis* is also considered as a mid-sized *Rafflesia* with a flower size of 40–46 cm. It was previously thought to represent a form of *R. arnoldi*, until it was described as a distinct species by Meijer in 1984 (Meijer, 1984; 1997; Nais, 2001). Its warts are pale orange, much smaller but more numerous than those of *R. hasseltii* (Susatya, 2007). All ramenta types of *R. gadutensis* rarely exceed 15 mm. They are simple and branched crateriform on the inner surface of the

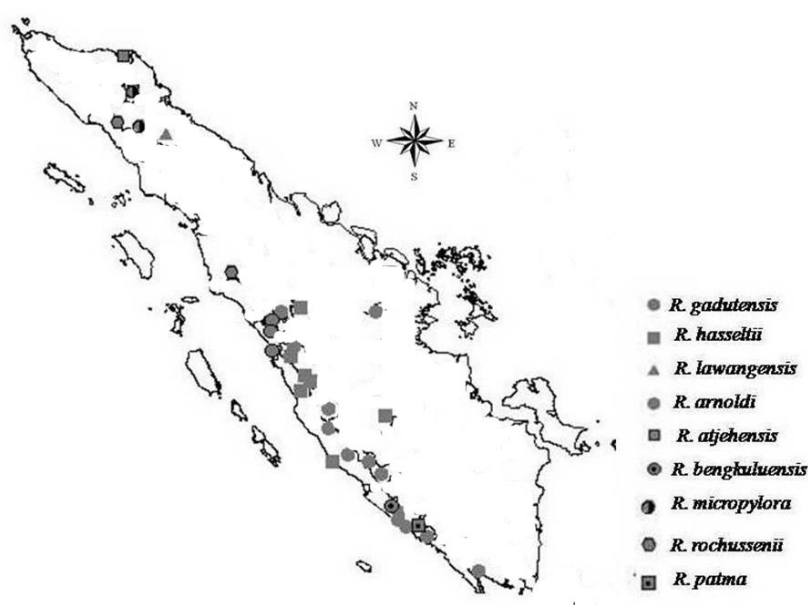


Fig. 3. Map of *Rafflesia* distribution in Sumatra

perigone tube. The simple ones are abundant on the lower part, while the crateriform are dominant on mid to upper part of the perigone tube. Toadstool-shaped ramenta are not found in the inner surface of the perigone tube, but only on the lower part of the inner surface of diaphragm (Susatya, 2007).

Both *R. bengkuluensis* and *R. patma* have tuberculate ramenta less than 4 mm long (Hidayati *et al.*, 2000; Meijer, 1997; Susatya *et al.*, 2005). *Rafflesia bengkuluensis* has numerous dark orange warts on both the reddish brown perigone and diaphragm surfaces. Simple tubercled only occupy a *ca.* 1.5 cm wide zone in the middle part of the perigone tube, while lobed tubercles are only found in the lower part of the diaphragm. The other parts of the inner surface of the perigone tube have a glabrous surface with no ramenta (Susatya *et al.*, 2005). The presence of ramenta in the perigone tube is also a distinguishing character between *R. bengkuluensis* and *R. patma*. The ramenta of *R. patma* are only found on the lower surface of diaphragm, while the inner surface of perigone tube is glabrous (Hidayati *et al.*, 2000; Meijer, 1997).

Rafflesia arnoldi is known to have the largest geographical distribution among Sumatran *Rafflesia*, and occurs along the Bukit Barisan Mountains from the Aceh to Lampung Provinces (Meijer, 1997). *Rafflesia arnoldi*, in general, is described as species with the large flower ranging from 70–100 cm, the largest among *Rafflesia*. Its perigone lobes have dark orange background color. Numerous white to yellowish warts interspersed by smaller ones are found in the upper surface of its perigone lobes. Fifteen warts are generally found across its lobe median. Small white to yellowish warts are scattered in the upper diaphragm surface, and form 3–4 distinct concentric rings. Diaphragm aperture is similar size to the diameter of disc. Disc has milky white color at base, and its rim has dark orange to brown. Its processes are 38–44, and arranged into 3–4 concentric rings. Its window extends up to 2/3 of the inner surface of the diaphragm from the rim, and consists of white blots of 6–8 mm arranged into 4–5 discontinued concentric rings (Susatya, 2007).

Of the 27 known *Rafflesia* species, only *R. aurantia* Barcelona, Co & Balet (Barcelona *et al.*, 2009a), *R. baletaei* Barcelona & Cajano (Barcelona *et al.*, 2006), *R. leonardi* Barcelona & Pelsler (Barcelona *et al.*, 2008), *R. mira* Fernando & Ong (Fernando & Ong, 2005), *R. speciosa* Barcelona & Fernando (Barcelona & Fernando, 2002), *R. tengku-adlinii* (Mat-Salleh & Latiff, 1989), *R. rochussenii* Teijsm. & Binn, and *R. lawangensis* lack of windows. Among these species, *R. lawangensis* has the largest size of its open flower (58–63 cm), is followed by *R. mira* (46–60 cm), and *R. speciosa*

(45–56 cm). The others of windowless species of *Rafflesia* have less than 40 cm of their open flowers. It is interesting to note that the first five species are recently described from the Philippines, and four of them have similar tuberculate ramenta (Barcelona *et al.*, 2009b). *Rafflesia aurantia* is very resembled to *R. tengku-adlinii* of Sabah. Both are differentiated by the ramenta size and its distribution in the lower surface of diaphragm. The former has the longer ramenta (7–10 mm), is sparsely distributed in the diaphragm, but absent near the aperture rim, while the latter has smaller ramenta (3–5 mm), and its ramenta extendedly distributed to the aperture rim (Barcelona *et al.*, 2006). Moreover, *R. lawangensis* has filiform ramenta, while both *R. rochussenii* and *R. tengku-adlinii* are characterized by crateriform ramenta. Ramenta type is considered as a good morphological character to differentiate among the species of *Rafflesia* due to their consistency and thus high diagnostic value (Mat Salleh, 1991; Meijer, 1997; Nais, 2001; Susatya, 2007).

KEY TO THE SPECIES OF RAFFLESIA IN SUMATRA

- 1a. Ramenta tuberculate2
- b. Ramenta not tuberculate.....4
- 2a. Inner surface of the perigone tube with tuberculate ramenta.....3
- b. Inner surface of the perigone tube without tuberculate ramenta.....*R. patma*
- 3a. Open flower 70–100 cm diameter; ramenta 3–6 mm long, covering the inner surface of perigone tube, except to 2 cm wide plain and smooth zone at the base of the perigone tube.....*R. atjehensis*
- b. Open flower 50–55 cm diameter; ramenta 1.5–3 mm long, only in the mid inner surface of the perigone tube.....*R. bengkuluensis*
- 4a. Ramenta filiform5
- b. Ramenta not filiform6
- 5a. Flowers 70–120 cm diameter; perigone lobes medium to dark orange, warts large and pale orange interspersed by small ones, upper surface without pubescence; diaphragm aperture 44–47 cm diameter, *ca.* 0.67 as wide as the diameter of the diaphragm, covered with numerous pale orange warts; ramenta up to 10 mm long, simple or forked, with flattened apices, distributed all over the inner side the flower tube and the lower part of the inner surface of diaphragm; processes 20–50; windows present; anthers 36–40.....*R. arnoldi*
- b. Flowers 58–63 cm diameter; perigone lobes reddish brown, warts varied, irregular, reddish white, upper part with a very short and dense pubescence; diaphragm aperture 31–33 cm diameter, *ca.* 0.8 as wide as the diameter of the diaphragm, warts absent; ramenta 3–12 mm long, sometimes branched distributed all over the inner surface of both the flower tube and diaphragm; processes 30–35;

- windows absent; anthers 27–28.....*R. lawangensis*
- 6a. Ramenta crateriform only7
- b. Ramenta crateriform and toadstool-shaped.....8
- 7a. Flowers 30–60 cm diameter; perigone lobes 16–18 cm long, warts varied, larger warts interspersed with smaller ones, light orange; diaphragm aperture 3–9 cm diameter, 0.15 of the diaphragm width; processes 15; anthers 40*R. micropylora*
- b. Flowers 15–30 cm diameter; perigone lobes 6–9 by 8–9 cm, warts small, pale orange; diaphragm aperture 5–7 cm, 0.5 of the diaphragm width; processes absent or when present up to 8; anthers 15–20*R. rochussenii*
- 8a. Toadstool ramenta present at the upper part of perigone tube and the lower part of the inner surface of diaphragm; crateriform ramenta found in the lower and middle parts of the perigone tube; perigone lobes red maroon; fewer and larger white warts on the upper perigone lobes sometimes merged, 4–5 large warts across median; anthers 20; flowers 38–70 cm.*R. hasseltii*
- b. Toadstool ramenta absent at the perigone tube, but present only at the lower part of inner surface of diaphragm; only crateriform ramenta found in the lower, middle, and upper parts of the inner surface of the perigone tube; perigone lobes red brick color; pale orange wart on the upper perigone lobes sometimes merged, 10–12 large warts across median; anthers 30; flowers 40–46 cm.....*R. gadutensis*

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ERRATUM
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Please change the existing incorrect content of Table 5 with the following:

Table 5. Ten leading tree species according to the basal area (BA) in a one-hectare plot of a lowland forest at Bodogol, GGPNP; (*) lowland forest species, (**) lowland-montane forest species)

No.	Species	Basal Area (m ²)
1	<i>Schima wallichii</i> (**)	2.27
2	<i>Neesia altissima</i> (*)	1.50
3	<i>Luvunga sarmentosa</i> (*)	1.20
4	<i>Altingia excelsa</i>	1.13
5	<i>Pternandra caerulescens</i> (*)	1.13
6	<i>Maesopsis emini</i> (**)	1.03
7	<i>Villebrunea rubescens</i>	0.98
8	<i>Radermachera gigantea</i> (*)	0.93
9	<i>Ficus ribes</i> (**)	0.85
10	<i>Orophea hexandra</i> (**)	0.84
	Total	11.84 (52.53 %)

INSTRUCTION TO AUTHORS

Reinwardtia is a scientific journal on plant taxonomy, plant ecology, and ethnobotany. Manuscript intended for a publication should be written in English represent an article which has not been published in any other journal or proceedings. Every manuscript will be sent to two blind reviewers.

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Map, line drawing illustration, or photograph preferably should be prepared in landscape presentation to occupy two columns. Illustration must be submitted as original art accompanying, but separated from the manuscript. On electronic copy, the illustration should be saved in jpg or gif format at least 350 pixels. Legends or illustration must be submitted separately at the end of the manuscript.

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