THE INITIAL IDENTIFICATION OF RAFFLESIA IN THE ANAMBAS ISLANDS, RIAU ISLANDS PROVINCE, AND THE CALL FOR PROTECTION

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THE INITIAL IDENTIFICATION OF RAFFLESIA IN THE ANAMBAS ISLANDS, RIAU ISLANDS PROVINCE, AND THE CALL FOR PROTECTION. *Rafflesia* sp., which was found in the Bukit Batu Tabir Production Forest area on Siantan Island, Anambas Islands Regency, Riau Island Province, became the starting point for further research. However, its existence in relatively unprotected Production Forests carries a risk of damage from human behavior because the presence of *Rafflesia* sp. has been known to the public since 2014. Based on the Direction Letter from the Riau Islands Provincial Environment and Forestry Office No. 13/070/1268.1/DLHK-04/2023 Medco E & P Natuna Ltd. together with the Center for Coastal and Marine Resources Studies IPB University, and the Production Forest Administration (KPHP) Unit VI of the Anambas Islands conducted an initial survey to identify species and surrounding habitats and build discussions with multi-stakeholders at the local level for the protection of *Rafflesia* sp. and their habitat. The research used morphological and observation methods, secondary data references, and discussions with related parties and Tarempa Selatan Village's government. The research indicated that the species in Bukit Batu Tabir, Siantan Island, is the *Rafflesia haseltii* species. This is a new finding of R. *haseltii* in the archipelagic landscape. Previous findings of R. *haseltii* were found on the mainland of Sumatra and Kalimantan Island. The interviews and discussions with the parties indicated that there are initiatives to protect *Rafflesia* sp. and its area in a collaborative scheme using the Social Forestry Village Forest mechanism. However, further studies are still required to determine the precise species based on microstructure studies and to strengthen the model of protection and management

Keywords: *Rafflesia* sp., *Rafflesia haseltii*, Anambas Islands, protection.

IDENTIFIKASI AWAL RAFFLESIA DI KEPULAUAN ANAMBAS, PROVINSI KEPULAUAN RIAU, DAN SERUAN UNTUK PERLINDUNGAN. Rafflesia sp. yang ditemukan di kawasan Hutan Produksi Bukit Batu Tabir di Pulau Siantan, Kabupaten Kepulauan Anambas, menjadi titik awal penelitian lebih lanjut. Namun, keberadaannya di Hutan Produksi yang relatif belum terlindungi memiliki risiko kerusakan akibat ulah manusia karena keberadaan Rafflesia sp. telah diketahui oleh masyarakat sejak tahun 2014. Berdasarkan Surat Arahan dari Dinas Lingkungan Hidup dan Kehutanan Provinsi Kepulauan Riau No. 13/070/1268.1/DLHK-04/2023 Medco E&P Natuna Ltd. bersama dengan Pusat Kajian Sumberdaya Pesisir dan Lautan IPB University dan Kesatuan Pengelolaan Hutan Produksi (KPHP) Unit VI Kepulauan Anambas melakukan survei awal untuk mengidentifikasi jenis dan habitat di sekitarnya serta membangun diskusi multipihak di tingkat daerah untuk perlindungan Rafflesia sp. dan habitatnya. Penelitian ini menggunakan metode morfologi dan observasi, referensi data sekunder, serta diskusi dengan pihak-pihak terkait dan pemerintah Desa Tarempa Selatan. Hasil penelitian menunjukkan bahwa spesies yang ditemukan di Bukit Batu Tabir, Pulau Siantan, adalah spesies Rafflesia haseltii. Ini merupakan temuan baru R. haseltii di lanskap kepulauan. Temuan R. haseltii sebelumnya ditemukan di daratan Sumatera dan Kalimantan. Hasil wawancara dan diskusi dengan para pihak mengindikasikan adanya inisiatif untuk melindungi Rafflesia sp. dan kawasannya dalam skema kolaboratif dengan

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menggunakan mekanisme Hutan Desa Perhutanan Sosial. Namun demikian, masih diperlukan kajian lebih lanjut untuk menentukan spesies yang tepat berdasarkan kajian struktur mikro dan memperkuat model perlindungan dan pengelolaannya.

Kata kunci: Rafflesia sp., Rafflesia haseltii, Kepulauan Anambas, perlindungan

I. INTRODUCTION

Rafflesia, a parasite that infects tropical vines in jungles across Brunei, Indonesia, Malaysia, the Philippines, and Thailand is threatened. By up to 42 species: 25 as 'Critically Endangered', 15 as 'Endangered', and two as 'Vulnerable,' and over two-thirds (67%) are not protected by regional or national conservation initiatives (Malabrigo et al., 2023). Nonetheless, Rafflesia faces challenges from habitat loss caused by deforestation, agriculture, mining, logging, and urbanization. Rafflesia relies on its host vines for existence; hence any disturbance to the vines also affects Rafflesia. Climate change may also influence the distribution and availability of pollinators and host vines, potentially reducing Rafflesia's reproductive success and genetic diversity. Another serious hazard to Rafflesia is human exploitation for medicinal or ornamental purposes, harvesting host vines for timber or fuel, and even tourism (Mozter, 2023; Malabrigo et al., 2023; Mahyuni et al., 2024). Kusuma et al. (2025) prompted conservation efforts to investigate its taxonomic integrity and naturalness

Until 2022, there were 13 species of Rafflesia found in Indonesia out of a total of 48 species that have received names in the world or accepted name status (WFO, 2023) in-situ and ex-situ. All species of the Rafflesiaceae family are declared as nationally protected plants according to Government Regulation No. 7 of 1999, and most species in this family are in Critically Endangered status (IUCN World Conservation Congress, 2020). Based on Indonesian national regulations in the Minister of Environment and Forestry Regulation No. P.160 of 2018 (second amendment to Ministry Regulation No. 20/2018) on protected species of animals and plants, 13 species declared protected are R. *arnoldii*, R. *bengkuluensis*, R. *gadutensis*, R. *haseltii*, R. *lawangensis*, R. *meijeri*, R. *micropylora*, R. *pricei*, R. *roschussenii*, R. *Tuan-Mudae*, R. *zollingeriana*, R. *patma*, and R. *kemumu*.

The number of Rafflesia species in Indonesia is the same as the *Rafflesia* sp. species found in Malaysia. *Rafflesia* sp. also grows in other Southeast Asian regions such as Brunei Darussalam, Thailand, and the Philippines (Barcelona et al., 2006). In general, the Rafflesiaceae family grows and develops in wet tropical forest landscapes, lowland and mountain forests, primary forests, or secondary forests adjacent to primary forests (Meijer, 1997). *Rafflesia* sp. becomes a parasite on *Tetrastigma* sp. with a growing period of 6 months to 4.5 years and a flower blooming period of only about 4-8 days but is expected to be able to grow throughout the year and even more (Hidayati & Walck, 2016; Mohd Elias et al., n.d.; Mursidawati et al., 2014; Susatya, 2011, 2020; Suwartini et al., 2008).

Rafflesiaceae is a holoparasite that cannot photosynthesize, so it relies on the host for growth, water supply, and nutrient intake (Renjana et al., 2022). As many as 11 species of *Tetrastigma* sp. are hosts for Raffleciaeae growth which also rely on large trees for climbing media. The relationship between Rafflesiaceae, hosts, and large trees still depends on the habitat. It is estimated that complex physiological conditions affect the vitality of Rafflesiaceae and its host, causing *Rafflesia* sp. to be susceptible to damage (Sulistiawati at el., 2022). Another pressure comes from anthropogenic factors either due to ignorance or irresponsible utilization (Mozter, 2023). Until now, Sumatra Island is a geographical area that has the most collection of *Rafflesia* sp. by ten species, which are spread along the Bukit Barisan Mountain Range from Aceh Province to Lampung Province (Susatya, 2011). Other locations are in the Bukit Tigapuluh National Park area in Jambi and Riau Provinces (Sofiyanti et al., 2007) and Gunung

Leuser National Park, Southeast Aceh (Asri, 2011).

From the search for national and international publications before this research, no scientific publications were found regarding the Rafflesia species in the Anambas Islands, Riau Islands Province. The latest new record on Rafflesia was published by Susatya et al. (2023) at Banyuwangi on R. *zollingeriana*, which is already listed in the Ministerial Regulation 2018, locally known as "kembang banyu." Thus, our research also marks the first finding of *Rafflesia* sp. in the archipelagic landscape, while previously, this flora only existed in the main islands, particularly on three geographical landscapes: lowland forest, upland forest, and lowland (Kusuma et al., 2025). Based on information from the local government, local communities, and the Anambas Nature Enthusiast Community (KOMPAS), in 2014, a type of *Rafflesia* sp. was found in the Production Forest area in Batu Tabir, Tarempa Selatan Village, Siantan District. It was also conveyed that the knob of this flora was used as a herbal medicine.

According to KPHP VI Anambas, until 2023, nine locations of *Rafflesia* sp. have been recorded, with the main location being in Batu Tabir, which is a production forest area (Permanent and Limited Production Forest), but does not rule out the possibility that it is located outside the forest area. Local people identify it as *Rafflesia patma*, but from observations and physical comparisons as well as initial morphological characteristics, there are indications that the species that grows is a type of *Rafflesia haseltii*, such as those found in Bukit Tigapuluh, Riau-Jambi Province and West Kalimantan (Sari et al., 2019; Sofiyanti et al., 2007, 2008). As described by Susatya (2011), the species of R. *haseltii* is very easy to recognize and distinguish from its maroon perigone lobes, which have wide, dominant, and irregular rectangular white warts. In one lobe of perigone, the number of these warts ranges from 4-6 and can reach 70 cm in diameter when blooming. The R. *haseltii* complex is characterized by two types of ramenta: crateriform and toadstool. R. *haseltii* is a very rare and beautiful species (Susatya, 2011).

However, species conservation cannot be based just on one sector because Rafflesia habitat is broad and has other uses other than forestry. So, the conservation that is supported in Batu Tabir, combine conservation with collaborative management. In the context of resource management, collaborative management refers to the division of power and responsibility between the state and user groups in a resource management system (Pinkerton, 1989). According to Borrini-Feyerabend et al. (2000), collaborative management is a situation in which two or more players negotiate, define, and ensure the equitable sharing of management tasks, rights, and responsibilities over a specific area, region, or collection of natural resources. Ideally, co-management entails power sharing to make collaborative decisions. Thus, the paper seeks to convey the findings as initial material for further studies regarding the microstructure, morphology, and behaviour of *Rafflesia* sp. in Anambas. In addition, this study also aims to identify a model of management and protection based on collaboration between business entities, the government, and local village communities so that the existence of *Rafflesia* sp. and its habitat can be properly managed and protected before obtaining a firmer protection status.

II. MATERIAL AND METHOD

A. Study Location

The study location that has been mapped was an area of 49.95 hectares in the Bukit Batu Tabir area, Tarempa Selatan Village, Siantan District, Anambas Islands Regency, Riau Island Province. This area includes the core distribution zone of *Rafflesia* sp., the points of which have been plotted, as well as the buffer and utilization zones if they are to be managed as one of the protected ecotourism locations. Officially, Bukit Batu Tabir is included in the Production Forest area, which is under the management of the Riau Islands Provincial Forestry Office,

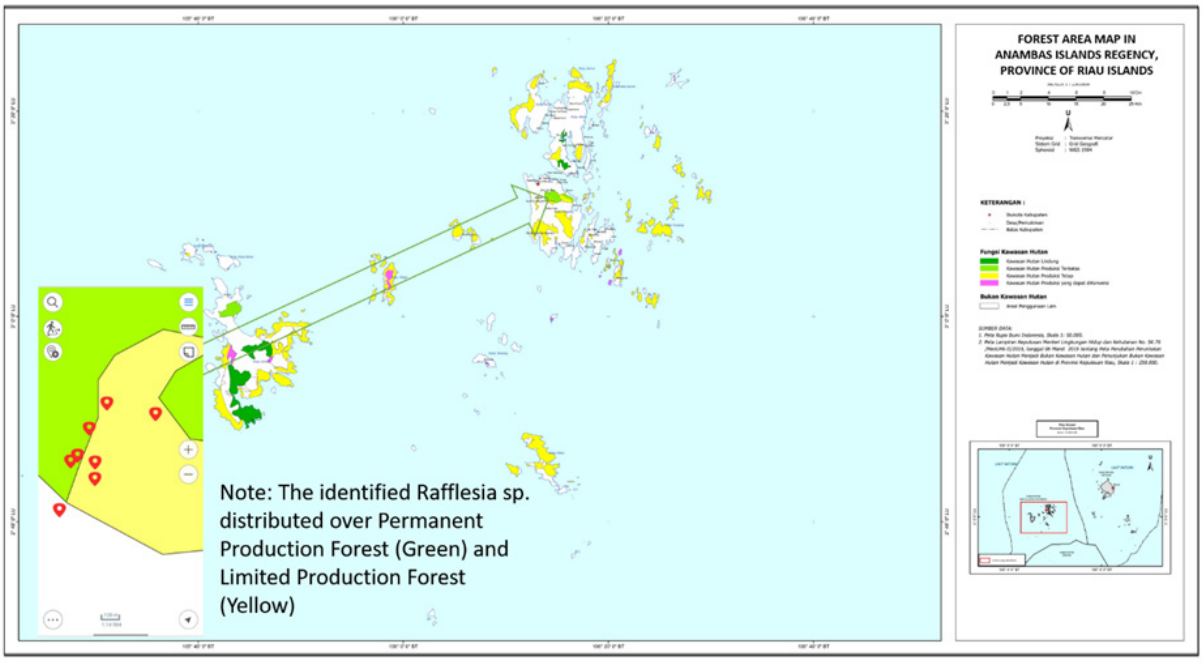


Figure 1. Map of Identified *Rafflesia* sp. in Anambas Islands (Source: KPHP VI 2023)

where at the site level, it is the responsibility of the Production Forest Administration Unit (KPHP) VI of the Anambas Islands.

B. Methods

Data regarding Rafflesia species at the Siantan Island location were collected from secondary data from previous expert studies, as well as observations and morphological identification of *Rafflesia* sp. flowers at the location. The results of this morphological identification will be compared with the physical characteristics found by previous experts. Rafflesia's taxonomy is still based on the shape and morphological structure of the flower. The distinguishing character of the Rafflesia species used in this study is based on the classification of (Meijer, 1997), which has been modified by (Nais, 2001):

a) The size of the diameter of the flower when it blooms.
b) Diaphragm aperture (hole in the middle of the flower)
c) Number of processes (sticks out like thorns in the middle of the flower)
d) Number and size of warts covering the perigone lobe and the diaphragm (from the opening of the hole to the edge of the diaphragm).
e) Number of anthers
f) The length and structure of the ramenta (the hair-like structures that grow on the walls of the diaphragm) and their location.
g) Number of annuli at the base of the perigone (petals).

However, for this study, only morphological observations were made on the outer side of the flower, so only four parameters were used: the diameter of the flower when blooming, the diameter of the diaphragm aperture (the hole in the center of the flower), the number of processes (a thorn-like protrusion in the middle of the flower), and the number and size of warts that are scattered covering the perigone lobes. The other three characters were left for further research.

Meanwhile, social and institutional information and data were collected through interviews with 22 parties who had interacted with *Rafflesia* sp. in Batu Tabir, such as the Anambas Islands Production Forest Administration (KPHP VI), the Anambas Nature Enthusiast Community (KOMPAS), and the Village Government and forest conservation community groups of Tarempa

Selatan Village, where the *Rafflesia* sp. is located. Other supporting data are the results of the initial mapping conducted independently by the related parties above and the supporting secondary data. All the collected data and information were analysed descriptively.

III. RESULT AND DISCUSSION

A. Result

The existence of *Rafflesia* sp., which grows in village locations and forest areas, encourages the initiation of communication and collaboration between the Provincial Forestry Service and the Village Government. Medco E&P Natuna Ltd., with its technical partner CCMRS IPB, is a third party that voluntarily develops a model for managing the area while protecting the habitat of *Rafflesia* sp. in the Anambas Islands. This tripartite collaboration is an effort to be initiated to protect the endangered species of *Rafflesia* sp. while at the same time providing opportunities for the benefit of the local community and opportunities for conservation education for the public around the habitat area of *Rafflesia* sp.

The initial exploratory study of the Rafflesia flower found 37 Rafflesia individuals, consisting of three blooms and 34 knobs (Rafflesia flower candidates). The Rafflesia flower blooms, and the knobs are scattered at four points. At the first location, there were two individuals, which is an individual flower that had bloomed and a large knob with a diameter of about 7 cm in an area of 31 m^2. In the second location, there is one large Rafflesia knob in an area of 37.95 m^2, while in the third location, there are two large and one small Rafflesia knob in an area of 97 m^2. The highest population of Rafflesia blooms was found in the fourth location, where as many as two Rafflesia flowers were blooming, one rotted Rafflesia flower, and 12 knobs (Rafflesia in this area is spread over an area of 459.46 m^2 in moderate slopes site. Further observations also found that the host of Rafflesia was assessed to be a *Baccaurea* sp. species that grows around the site.

The fifth location is the habitat of Rafflesia, which is most frequently visited by the community during their visit to Bukit Batu Tabir. Around the *Rafflesia* sp. growing area has been fenced with bamboo to protect the population from being damaged and stepped on. Rafflesia's knobs are usually hidden behind the litter on the forest floor, so the knobs may be stepped on and died. A total of 17 Rafflesia flower knobs were found, but during field observations, no flowers were found blooming in this area. The detailed distribution points can be seen in Figure 3.

a. *Rafflesia* sp. when blooming at Location One

b. Rafflesia's Knob at Second Location

c. Rafflesia's Knob at Third Location

d. Rotted Rafflesia at Fourth Location

e. Rafflesia's Knob at Fourth Location

f. Rafflesia's Knob at Fifth Location

Figure 2. The condition of the *Rafflesia* sp flower at the observation location

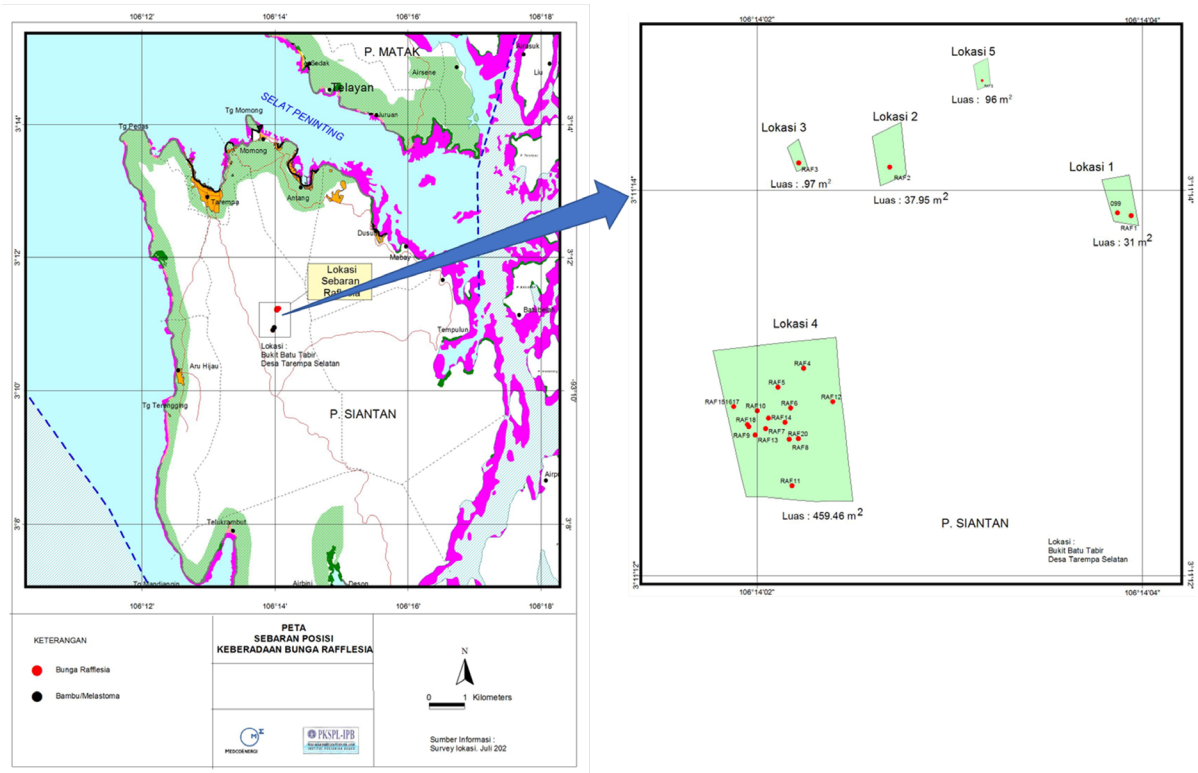


Figure 3. The distribution points of *Rafflesia* sp. in the study location (processed data)

Table 1. Morphology of *Rafflesia hasseltii* in Siantan Island

Flower number	Perigone lobes	Mature flower diameter (cm)	Number of warts in the Perigone lobe	Diaphragm diameter (cm)	Diaphragm form	Diaphragm aperture (cm)	Diaphragm nodule	Processes number
R 1	5	25.68 and 30.16	10-19	14.97 and 13.44	Hexagonal rounded	5.86 and 5.33	60	13
R 2	5	29.48 and 38	26-33	17.24 and 17.29	Hexagonal rounded	7.44 and 6.18	40	17
R 3	5	28.85 and 36.18	17-21	18.33 and 18.13	Hexagonal rounded	6.6 and 7.7	56	15

Table 2. Comparison of R.*hasseltiii* morphology on Siantan Island to previous studies

Morphology character	***R. hasseltii* in Siantan Island***	***R. haseltii* (Puad et al., 2020)**	***R. haseltii* (Sari et al., 2019)**	***R. haseltii* (Sofianti et al., 2007)**	***R. hasseltii* (Zuhud et al., 1999)**	***R. hasseltii* (Meijer et al., 1997)**
Flower Size	26-38 cm	47-53 cm	35 cm	33–35 cm	28.5 cm	38-50 cm
Number of perigone lobes	5 lobes	5 lobes	5-6 lobes	5 lobes	N/A	5 lobes
Size of perigone lobes	11-18 cm x 7-13 cm	13.5–16 cm long x 17.5–22 cm wide, apex rounded, margin entire. Reddish-orange with whitish-pinkish warts	11.3–14 × 7–11 cm	10–12×11–14 cm, bright red brick	N/A	11.5–13 × 15–17 cm
Blotches pattern on perigone lobes	The blotches are randomly scattered across the surface of the perigones. Their color varies, ranging from light orange to pinkish.	coalesced, large, ranging from 1.2–16 cm long x 0.7–9.2 cm wide	Each perigone displays 10 blotches, distributed sporadically on the perigone's surface. The color of these blotches ranges from light orange to pinkish.	Coverage ranges from 46.23% to 60.15%, and the density varies between 2 to 12, appearing whitish in color.	N/A	5 prominent pustules are arranged horizontally. The size of each pustule 5 × 3 to 10 × 1 cm
Diameter of diaphragm	13-18 cm, round or irregular shape, light orange to reddish, and ultimately darker when dying	20–27 cm whitish with a brownish zone near the diaphragm rim, diaphragm rim entire	12-12.5 cm, round or slightly hexagonal, light orange in color.	4-7 cm, mostly pentagonal	4.2 cm	N/A. The diaphragm has a light whitish or yellowish color with a dark brown area near its rim. Additionally, it features a ring of rounded or elongated dark brown warts at its base
Shape and diameter of diaphragm aperture	5-8 cm, circular and angular	6.5–12.1 cm; diaphragm aperture suboval, ratio diaphragm/ aperture 1.7:1.0	4.8 cm		N/A	N/A

Morphology character	*R. hasseltii* in Siantan Island*	*R. haseltii* (Puad et al., 2020)	*R. haseltii* (Sari et al., 2019)	*R. haseltii* (Sofianti et al., 2007)	*R. hasseltii* (Zuhud et al., 1999)	*R. hasseltii* (Meijer et al., 1997)
Number of warts at diaphragm	40-60 warts	42–59, round to oval, white with red/orange circular at the base	N/A rounded or elongated, reddish brown to light brown	21-30 rounded and sometimes elongated, bright red, and distinctly visible	N/A	N/A
Number of processes	10-22	23–24, orange color at the base, gradually becoming darker brown towards the apex, 1.8–2.3 cm long x 0.3–0.5 cm wide	15-21, height ranges from 1.5 to 1.8 centimeters, and the tips are spathulate with a wavy edge, featuring bristles along the margin.	13–17, with height around 1.5–1.7 cm, not flattened, styliform	15	15–24 cm, 15–24, colored resembling the disk, appearing light yellowish overall, but it becomes dark brown at the apex. Unlike some other species, it is not flattened in shape.

*Study of Rafflesia in Siantan Island 2023

R1 R2 R3

Figure 4. *Rafflesia hasseltii* found in the study on Siantan Island

The morphological characteristics of the three flowers are examined in the following discussion. A detailed set of individual observations is presented in Table 1, and the comparison of R. *hasseltiii* morphology on the Siantan Island to previous studies is provided in Table 2.

Perigone lobes

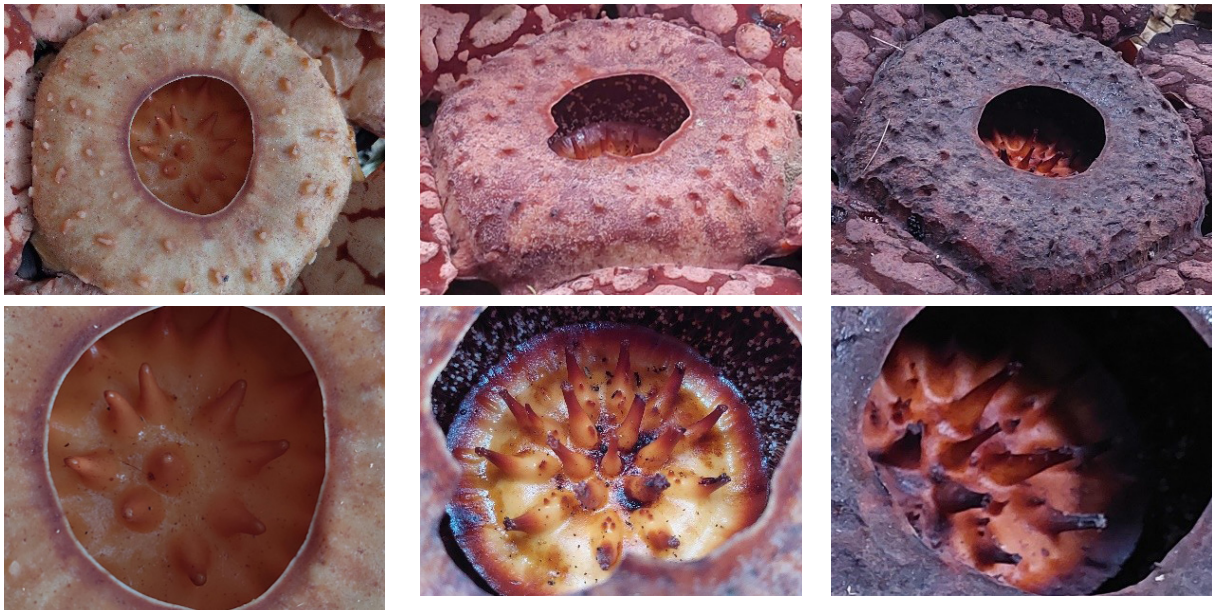
The number of perigone lobes in the three Rafflesia individuals was five. The upper surface of the perigone lobes was soft, reddish-orange in color, and covered in large, coalescent patches. The lobes were slightly rough in texture, white, light orange, to pale pink in color. Warts that were scattered on the lobes have the shape of separate, wide dots, and some spots were elongated. The shape of the perigone lobes in flowers can be seen in Figure 4.

Diaphragm

The shape of the diaphragm of *Rafflesia hasseltii* on Siantan Island resembles a pentagon with nodules on the surface. The vertical and horizontal diaphragm diameters for individual 1 (R1) were 14.97 cm and 13.44 cm, individual 2 (R2) were 17.24 cm and 17.29 cm, and individual 3 (R3) were 18.33 cm and 18.13 cm, respectively. The upper surface of the diaphragm has a soft texture, with a thick skin, and is rather hard (Figure 5).

Diaphragm aperture

The diaphragm apertures found in *Rafflesia* sp. are circular (Figure 5: R1 and R3) or irregular



R1 R2 R3

Figure 5. Diaphragm, diaphragm aperture, and diaphragm nodule

(circles have corners (see Figure 5: R2). There was a white circular line around the hole and a thin, finely textured margin, with the color of the hole line being blackish orange (darker) than the color of the other top surface of the diaphragm.

Diaphragm nodules

Diaphragm nodules are structures in the form of small dots with an embossed and hard texture, scattered circularly on the surface of the diaphragm. Irregular-shaped nodules, orange to reddish in color and black in color on Rafflesia, have started to wither and die (Figure 5).

Processes

The process is a conical structure on the disc surface. The surface is very smooth and sleek. Generally, the process is in the form of a single cone, but sometimes, cones that are attached are also found. The number of processes varies. Based on the counting of the three bloomed Rafflesia and the condition of the procession which is still quite intact, indicating that the number of processes of the three bloomed Rafflesia ranges from 13-17 stems. The stem is cylindrical with a wider base than the apex. The ends of the process are very sleek and blunt and break easily). The color ranges from pale creamy yellow to reddish-orange and darker. The process attaches to a surface called a disc, which is located in the center of the flower. The surface of the Rafflesia flower disk can be flat (Figure 5: R1 and R3), convex at the bottom where the process attaches (Figure 5: R2), and concave (no concave disc shape was found on *Rafflesia hasseltii* at the study site).

Rafflesia hasseltii Suringar was initially documented in 1879, having been collected from Sumatra (Latiff & Mat-Salleh, 2001). Subsequently, it has been discovered in various other areas in Indonesia, spanning three provinces in Sumatra: West Sumatra, Riau, and Jambi (Meijer, 1997; Zuhud et al., 1998), as well as in two locations in Sarawak, in Samunsam, Malaysia (Nais, 2001) and Tanjung Datu (Ong, 2004), the most recent sighting of *Rafflesia hasseltii* in Sambas, West Kalimantan, which marks the first-ever record of this species in Kalimantan.

The team identified the characteristics of Rafflesia from the parameters of the number of perigone warts, flower diameter, number and pattern of warts, the diameter of the diaphragm, the diameter of the diaphragm aperture, the number of nodules on the diaphragm, and the number of processes. The rafflesia study

conducted on Siantan Island showed that there was an alleged similarity of the species with *Rafflesia haseltii* from the morphological characteristics of the flower. The *Rafflesia hasseltii* found in the study had flower width, number of perigone lobes, size of perigone lobes, and wart patterns on perigone lobes that were almost the same as previous expert findings.

However, in terms of the diaphragm diameter, R. *hasseltii* on Siantan Island has a larger diaphragm diameter compared to R. *hasseltii* in Jambi and Riau (Sofiyanti et al., 2007; Zuhud et al., 1998), but smaller than R. *hasseltii* which discovered in Sarawak by Puad et al. (2020). The shape and size of the diaphragm aperture diameter in populations on Siantan Island are also almost the same as in populations on Kalimantan Island (Sari et al., 2019) and Sarawak (Puad et al., 2020). Warts in the Siantan Island population are very similar to those in Sarawak, with 40-60 warts per individual of R. *hasseltiii*. The number of processes in the population on Siantan Island also has similarities with the populations in the other four study locations in Sarawak, Kalimantan, Jambi, and Riau, with a range of the number of processes of at least 13 stems and a maximum of 24 processional stems. In contrast, the number of processes on Siantan Island ranges from 10 -22, which in this case is still within that number range. Meanwhile, if seen from the appearance of the R. *hasseltii* image, the population on Siantan Island is similar to the population in Tanjung Datu, Sarawak (Ong, 2004; Sofiyanti et al., 2007).

Based on the morphological characteristics of the three Rafflesia that have bloomed, this initial study concluded that the species on Siantan Island, the Anambas Islands, is the *Rafflesia hasseltii*. Although at first glance it has a resemblance to R. *cantleyi*, a study of *Rafflesia cantleyi* conducted by Solms-Laubach (1910) shows that the white wart pattern on R. *cantleyi* only has a small and separate pattern, while R. *hasseltii* has a larger and merged pattern. The study of Sofiyanti et al. (2007) stated that the morphological characters of *Rafflesia hasseltii* are indeed diverse, especially the variations in warts on the perigone which sometimes make identification difficult. However, the main distinguishing character is the warts that dominate the perigone lobes up to 60.15%, which is only found in R. *hasseltii*. However, as an interim report, the author still considers that further studies are needed involving experts to ensure that this type of Rafflesia can gain international recognition in time.

Ecosystem conditions

Climate data from Tarempa Meteorological Station for 2010-2021 shows an annual average rainfall of 3,872.53 mm/year. The average ratio of dry months to wet months is 0.2529 or 25.29%. Thus, according to the Schmidt and Ferguson climate classification, the climate type around the Anambas includes climate type B with relatively few dry months compared to the number of wet months. The highest monthly average rainfall is found in December at 401 mm/month; months with high rainfall are found in July, November and December. Low rainfall is found in February-April.

Based on its physical soil, the forest ecosystem around the habitat for the rare flower *Rafflesia* sp. is a red-yellow podzolic soil with its bedrock containing granite, alluvial soil, organosol soil, and gley humus. Changes in wind direction strongly influenced the climate at the study site. The dry season usually occurs from March to July.

The survey showed that there were three main families in the study area: Myrtaceae, Euphorbiaceae, and Dipterocarpaceae. The Dipterocarpaceae family seems to dominate the ecosystem type in this area. The species found during the survey were *Syzygium aemum*, *Shorea gibbose*, *Lithocarpus reflexus*, *Shorea acuminata*, and others. Bukit Batu Tabir Forest in Tarempa Selatan Village, in general, is a hilly secondary forest with production forest status. The *Rafflesia hasseltii* species grows on *Tetrastigma* spp. The tree vegetation found in this forest is Dipterocarpaceae, Dilleniaceae, Fabaceae, and Lauraceae families. In this forest, there were

a. Protective fence for *Rafflesia hasseltii* at fifth location

b. Spesies Baccaurea sp. near first location

Figure 6. Vegetation conditions around the *Rafflesia* sp. on Bukit Batu Tabir Forest

also *Baccaurea* sp., *Campnosperma auriculatum*, *Canarium littorale*, *Macaranga* spp., *Syzygium lineatum* and *Shorea acuminata*.

The highest tree density in the study area was relatively below the standard range for the number of tree species in wet tropical forests. However, because no vegetation analysis has been carried out in all areas, the available data was inadequate and did not represent tree density conditions in the study area. The distribution and presence of vegetation types in the forest at the study site were still low. The low tree species richness in the study area is likely due to limited habitat, which only allows for the survival of certain species. Forest structure and tree species composition in the study area may also be influenced by several other factors, such as the location and position, as well as the shape and size of the forest ecosystem.

B. Discussion

a. Five important issues in the conservation of *Rafflesia* sp. and the habitat

According to the Indonesian Conservation Strategy and Action Plan of *Rafflesia arnoldii* document 2015-2025, the Rafflesia has a very high risk of extinction in nature if it is not anticipated soon. Naturally, the reproduction of *Rafflesia* sp. is relatively slow, with a high mortality rate, and is highly dependent on specific conditions involving the host and other tall trees. Other threats come from habitat destruction, natural predation, fungi, and climates that are too wet. Anthropogenic factors, damage caused by unmanaged tourist visits, misuse of herbal medicine, hunting, and land conversion are the causes of damage to Rafflesia and its habitat. In Indonesia, *Rafflesia* sp. occupies a space of less than 500 km^2 with populations or subpopulations whose numbers fluctuate extremely (Susmianto et al., 2015).

So far, the conservation of *Rafflesia* sp. has been carried out in two ways: in-situ conservation and ex-situ conservation (Latiff, 2018), and continues to be promoted so that it runs in an integrated manner throughout the world (IUCN World Conservation Congress, 2020). In-situ conservation is a form of protection and prevention of species damage in the original location where the species grows and interacts with dynamic local systems, while ex-situ conservation focuses on efforts to preserve their genetic material (Dulloo et al., 2010; Mursidawati, 2017). Seeing the limitations in the Rafflesiaceae conservation efforts, the existence of initiatives from the community on Rafflesiaceae species that are outside the forest area needs to get support from the policy. One of the voluntary in-situ conservation that has been carried out is the designation of a 2000-hectare area for R. *arnoldii* conservation in the Educational Forest belonging to the Muhammadiyah University of Bengkulu with legitimacy from the Indonesian Minister of Environment and Forestry (Purwanto, 2017).

This paper specifically only discusses in-situ protection schemes in the form of area or habitat management as a conserved area. The conservation approach implemented in the *Rafflesia* sp. in Batu Tabir emphasizes efforts to reduce pressure on species due to natural and anthropogenic factors as well as maintaining

ecological processes and life support systems, maintaining genetic diversity, and ensuring the sustainable use of species and ecosystems in a biosphere. The scope of this effort follows the national Rafflesia Conservation Action Plan/SRAK 2015 (enacted by Minister of Environment and Forestry No. P71 Year 2015), which will focus on conservation management programs through development research, preparation of management rules and policies, partnerships and cooperation, communication and public awareness; and fundraising (Susmianto et al., 2015). From the conservation aspect, the SRAK 2015 is a good response from the government to plan for the protection of Rafflesia, although it is not enough.

According to Widyatmoko (2019), the existence of Indonesia's rare plants faces five threats: habitat loss, over-use, invasive species, pollution, climate change, and biological factors. On the experience in Kelantan, Fauzan et al. (2021) stated that there are several challenges as well as opportunities in protecting Rafflesia: large-scale agricultural development, formulation of a management plan, scientific research on *Rafflesia* sp., ecotourism, involvement of local community and funding. Almost the same challenges are also experienced by Indonesia. From the results of observations at the site, efforts to protect *Rafflesia* sp. in Batu Tabir place five important issues as the future conservation research agenda: the need for collaboration between government-community-private in managing and utilizing *Rafflesia* sp.; the need for physiological and morphological scientific studies to ascertain the species in the Anambas Islands; the need for an integral management plan based on scientific data; stipulation of delineation for area protection; and responsible use to meet conservation, economic and social welfare needs.

There are at least two main challenges to protecting Rafflesiaceae in Indonesia today. First, there is no accurate data regarding the location, type, and distribution of Rafflesiaceae in conservation areas or outside conservation forest areas. This condition has implications for the possibility that Rafflesiaceae will disappear before being identified because it is located outside a conservation area that is not protected and managed. The need for scientific studies regarding the physiology, morphology, and behavior of Rafflesiaceae species and the protection of forest areas are two things that cannot be separated. The second challenge is the absence of derivative policies that are integral and applicable as well as cross-sectoral with adequate funding to carry out the Rafflesia Conservation Strategy and Action Plan that has been prepared.

We can take a precedent for mangrove management that has legitimacy with Presidential Decree No. 73 of 2015 on the Implementation of Coordination of Coastal Areas and Small Islands in one window at the Ministry of Marine and Fisheries, which is the legal basis for the Ministry of Marine and Fisheries (MoMaF) and Ministry of Environment and Forestry (MoEF) to allocate their respective resources to protect mangrove ecosystems on the coast. It is appropriate that a species as important as Rafflesia and its habitat can obtain strong legality so that cross-agency and multistakeholder work have a legal basis. Designation of protected areas in areas and with collaborative management applications such as Social Forestry can be an opportunity to turn sites of high conservation value into conservation sites. The site itself is part of The Indicative Map of Social Forestry (PIAPS) have been designated by the government.

b. Utilization of the area within the framework of collaborative management at the site level

Departing from national directives for Rafflesia conservation and learning from other countries, Medco E&P Natuna Ltd., together with the Center for Coastal and Marine Resources Studies of IPB University, trying to develop a development scheme for the utilization of the *Rafflesia* sp. protected area collaboratively. This effort is a voluntary

multistakeholder initiative with the main actors being the Riau Islands Provincial Forestry Office as the manager of the production forest area, the village government of Tarempa Selatan, and Medco E&P Natuna Ltd. as a corporation operating in the Anambas Islands Regency by providing its resources to implement habitat conservation and Rafflesia species sustainably. Based on the results of the initial study, what has become the focus of national conservation efforts is also found in the Batu Tabir location in the Anambas Islands.

From the interviews conducted during the field study of the village government, representatives of nature activists groups, and KPHP VI, there was a commitment that all parties wanted to protect the *Rafflesia* sp. flower as well as other types of endemic vegetation in the Bukit Batu Tabir area and the ecosystems in it. From the regional spatial planning aspect, the Bukit Batu Tabir area is declared a water catchment area, so it has the status of an essential area that is vulnerable if it is not managed properly (see Regional Regulation of Anambas Regency Number 03 of 2013 on Anambas Islands Regency Spatial Plan 2011-2031, Article 37 (b)). Seeing the suitability of the space, the structure of the person in charge, and the existing effective management, there is a common vision that the scheme to be used is the Village Forest Scheme, which will be utilized as an Ecotourism location. This means that sustainable use can be conducted on a village basis (village government as the responsible holder) without reducing the carrying capacity of the environment for the benefit of environmental education and conservation.

The Village Forest Scheme is included in the Social Forestry management system under the Directorate of Social Forestry Area Preparation, Directorate General of Social Forestry and Environmental Partnerships (PSKL), which aims to enable communities to access benefits from the forest. By definition, a Village Forest (HD) is a forest area in a protected forest area or production forest that has not been burdened with permits. These forests are allocated to village institutions to be managed or utilized according to their function for the realization of a prosperous community and sustainable forest. HD management approval will be given at the request of the village for a period of 35 years and can be extended. It is written in the Regulation of the Minister of Environment

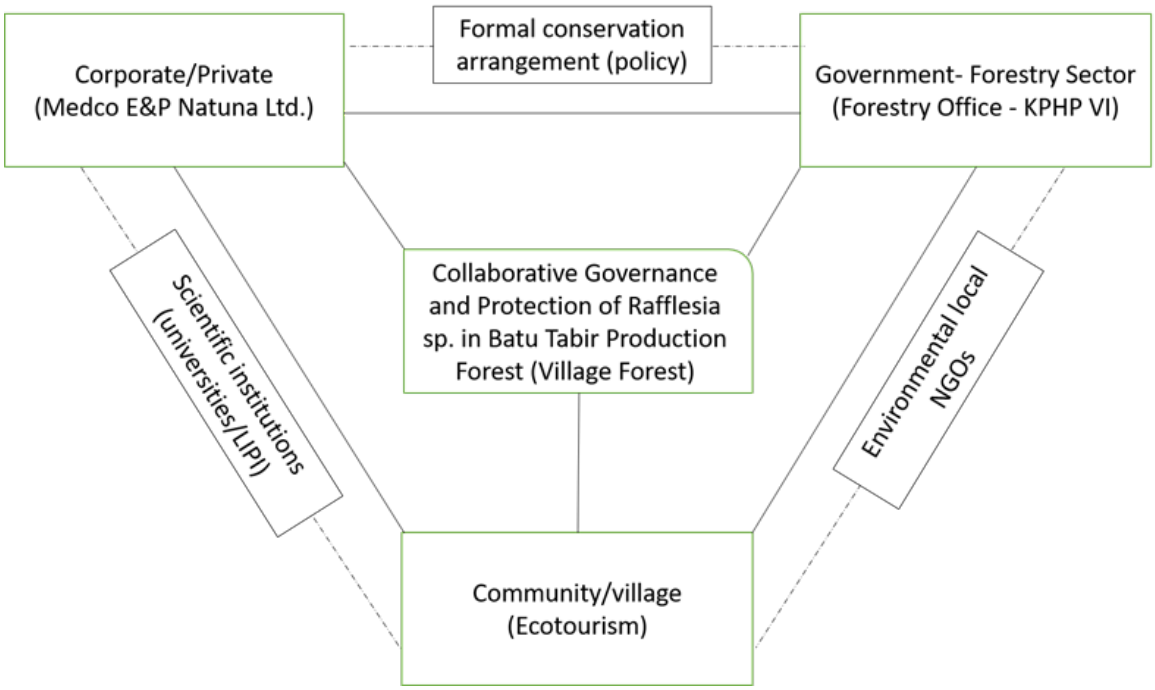


Figure 7. Scheme of the Collaborative Rafflesia Management Plan in the Anambas Islands.

and Forestry No. 9 of 2021 on Social Forestry Management (Direktorat Jenderal, 2021).

c. Future agenda

Departing from the types of challenges and opportunities for Rafflesiaceae conservation above, several follow-ups are still needed by various groups, both government, academics, the public, and business entities, to cover the deficiencies in the conservation of this rare flower. The future agenda consists of three parts: the research agenda, the partnership agenda, and the policy agenda. On the research agenda, science-based institutions and universities are expected to continue studies to determine the types, behavior, and sensitivity levels of Rafflesiaceae in Indonesia. The agenda for the partnership is to increase the number of applications to pool resources and share responsibility for the protection of Rafflesiaceae. Every Rafflesiaceae finding should receive major attention to be followed up immediately with the consolidation of many parties to determine the form of protection for Rafflesiaceae and its habitat as soon as possible. Meanwhile, the policy agenda is to formulate guidelines and legitimacy for many parties to implement conservation in various official management schemes. Applied regulations after the SRAK 2015 can be provided so that each party has guidelines for taking the stages of protection and management without having to conflict with certain laws and authorities.

Since the finding of *Rafflesia* sp. in the Anambas Islands from 2014 to 2025, there has not been a single form of scientific report or publication from an academic institution that explains the morphology, physiology, behavior, and level of sensitivity of *Rafflesia* sp. in the Anambas Islands. Likewise, no partnership steps have been initiated at the site level. Institutions such as the Forestry Office, NGOs, the community, the village government, and the Natural Resources Conservation Agency (BKSDA) have not been on the same platform. It is suggested they can be more organized in the long term to protect Rafflesiaceae and its habitat in Bukit Batu Tabir. In general, conservation may be carried out in a Conservation Area or Protected Area scheme so that its effectiveness can be measured (Mat Salleh et al., 2006). However, until now, there has been no official and accurate record of how much Rafflesia habitat is in conservation areas or outside conservation areas.

Of the various policies regarding conservation, the policy that has opportunities to manage and protect Rafflesiaceae is the Village Forest scheme because the location of Rafflesiaceae is in a Production Forest Area. However, the resources owned by the community and village government are not sufficient to develop a utilization framework in the form of Village Forest or Social Forestry. Social Forestry in the form of Village Forests is the first step to protect and conserve Rafflesiaceae more comprehensively through a series of environmental education and conservation management. The collaborative scheme offered by Medco Natuna E&P Ltd. is a voluntary effort from the business entity to support communities in managing their natural resources while protecting endangered species and their habitats. There are four emphases in the collaboration scheme: Further scientific study of the species found in Bukit Batu Tabir; Assistance in the process of submitting and establishing Village Forests; Preparation of the *Rafflesia* sp. ecotourism master plan; and Operationalization of eco-education-based conservation of *Rafflesia* sp. so that Rafflesia can become a special tourist destination that is integrated into the Anambas Islands Regency tourism agenda.

IV. CONCLUSION

From the initial observations results based on the physical characteristics of the flower, *Rafflesia* sp. in Tarempa Selatan Village, Siantan District, Anambas Islands Regency is a species of *Rafflesia haseltii* as found previously in Kalimantan and Riau on Sumatra Island. Rafflesia in the Bukit Batu Tabir Production

Forest Area is the first finding of Rafflesiaceae in Anambas Islands Regency, which lives in a wet secondary forest ecosystem with moderate shade levels. The host for *Rafflesia haseltii* is *Tetrastigma* sp. vines on the Bacauceae tree. Approximately 50 hectares of the area is a production forest area that has minimal disturbance from agricultural activities and has the opportunity to be managed collaboratively between the village government, the Riau Islands Provincial Environment and Forestry Office, and corporate parties.

The findings of this initial investigation have various implications: a) Contribute to the documentation of Rafflesiaceae in Indonesia and around the world; b) Invite parties to complete the study of species and habitat characteristics in the vicinity; c) Invite local governments and policymakers in the fields of forestry and natural resource conservation to develop protection mechanisms; and d) Educate and involve local communities in protecting Rafflesia species and forest habitat areas. The recommendation we can offer to policymakers and other parties is continuing the study of *Rafflesia* sp. under multiparties and experts. The second recommendation is preparing requirements for managing the Rafflesia protected area in the Village Forest scheme.

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We realize that the findings and analysis in this paper are not final yet, so this publication is an attempt to invite many parties to protect and manage *Rafflesia haseltii* in Batu Tabir. With all humility, we would like to thank the Environment and Forestry Office of the Riau Islands Province for granting permission to survey the Batu Tabir Production Forest. We are also grateful to the Production Forest Administration (KPHP) Unit VI of the Anambas Islands, who accompanied the team during the field survey. Also to Medco E&P Natuna Limited for facilitating us to conduct a field study. We also thank the ranks of the Tarempa Selatan Village Government, as well as all institutions and individuals in the Anambas Islands, who have provided the team with valuable information during the information gathering.

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