

***Rafflesia kerrii* Meijer in Kelantan and the role of
Gunung Stong State Park in the conservation of *Rafflesia*
in Malaysia**

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Abstract : *Rafflesia* is rapidly becoming a prominent symbol for conservation efforts. From 20 currently recognised species in Malesia, only three species are found in Peninsular Malaysia. Although *Rafflesia* is rare and vulnerable, populations of *Rafflesia kerrii*, the largest species in the Malay Peninsula, are found in forests around Gunung Stong, Kelantan. This species appears to be confined to the Main Range in Kelantan with the exception of those found near Pengkalan Hulu, Perak on the Bintang Range. The proposed Gunung Stong State Park is important in the conservation of *Rafflesia kerrii* because this area is the only accessible protected area for the species in the Peninsular Malaysia. Several populations are found near the headwater of Sg. Somuliang in rocky granitic hills, and very popular as tourist destination. Another population was found near Projass Hydrostation along the bank of Sg. Kenerong. Other easily accessible populations of *Rafflesia kerrii* in Kelantan are those at Pos Brooke and Pos Hendrop which are in the statelands and are under threat from unsustainable tourism practices. The proposed Gunung Stong State Park is important in the conservation of *Rafflesia* in Peninsular Malaysia to complement the National Park and The Royal Belum State Park as the safe heavens for all the three species of the *Rafflesia* in Peninsular Malaysia.



Abstrak : *Rafflesia* sedang menjadi suatu simbol yang terpenting dalam usaha pemuliharaan. Daripada 20 spesies yang diiktirafkan kini di Malesia, hanya tiga spesies dijumpai di Semenanjung Malaysia. Walaupun *Rafflesia* adalah langka dan mudah terancam, populasi *Rafflesia kerrii*, spesies yang terbesar di Tanah Melayu, telah dijumpai di hutan di sekitar Gunung Stong, Kelantan. Spesies ini nampaknya terhad kepada Banjaran Titiwangsa di Kelantan melainkan populasi yang wujud juga dekat Pengkalan Hulu, Perak di Banjaran Bintang. Taman Negeri Gunung Stong yang dicadangkan adalah penting bagi pemuliharaan *Rafflesia kerrii* kerana kawasan ini ialah satu-satu kawasan yang terlindung yang boleh dimasuki di Semenanjung Malaysia. Beberapa populasi telah dijumpai dekat hulu sungai Sg. Somuliang atas bukit batu granit, dan sangat popular sebagai destinasi pelancong. Satu lagi populasi telah dijumpai dekat Stesyen Hidro Projass di tebing Sg. Kenerong. Populasi yang senang dimasuki lain bagi *Rafflesia kerrii* di Kelantan ialah di Pos Brooke dan Pos Hendrop yang berada dalam tanah negeri dan berada dalam ancaman daripada amalan pelancongan yang tidak lestari. Taman negeri Gunung Stong yang dicadangkan adalah sangat penting bagi pemuliharaan *Rafflesia* di Semenanjung Malaysia bagi mengiringi usaha yang sama di Taman Negara dan Taman DiRaja Belum sebagai tempat selamat bagi ketiga-tiga spesies *Rafflesia* di Semenanjung Malaysia.

INTRODUCTION

Rafflesia is a rare and unique plant in our tropical rainforests of South East Asia. This plant has been a fascinating subject since its first discovery in Java by Louis Deschamps in 1797 and subsequent report by Raffles and Arnold in his famed expedition of May 1818. Since the first introduction of *Rafflesia arnoldii* by Robert Brown in 1821, more than 28 names of species of *Rafflesia* have been described by various botanists but only 20 of those are recognised as valid species (Nais 2001, Mat-Salleh et al. 2005). These include *Rafflesia tengku-adlinii* from Sabah which was published by Mat-Salleh & Latiff (1989), *Rafflesia speciosa* from Panay Island in the Philippines by Barcelona and Fernando (2002) and the latest *Rafflesia azlanii* from the Royal Belum by Latiff and Wong (2004). Most of these species may be at the brink of extinction and conservation of the Rafflesias has been given highest priority.

All the eight known species of *Rafflesia* in Malaysia are exceptionally outstanding, and some of those are hyper-endemics in very small localized area. In the Malay Peninsula, three known species, viz. *R. cantleyi* Solms-Laubach, *R. kerrii* Meijer and *R. azlanii* Latiff & Wong, are restricted to a very some small area in Perak, Kelantan, Pahang and Terengganu and most of those are outside the fully protected areas (Mat-Salleh et al. 2005).

Rafflesia kerrii, the largest amongst the three species, was first thought to be found only in Thailand. Originally discovered in Ban Lam Lieng (Khleng Phlao National Park) and in Khao Pho Ta Luang Kaeo (Khleng Nakha Wildlife Sanctuary) in the district of Ranong, South Thailand, it was later found in Khao Pho Ta Chong Dong



(also in Ranong), Song Phi Nong and Khao Sok National Park in Surat Thani. Currently *R. kerrii* has been recorded in less than 10 localities in Thailand, from Prachnab Khirkhan southwards to Ranong to Khao Sok to the Yala-Betong Halabala Forest Reserve.

Rafflesia kerrii is named in honour of Dr. A. F. G. Kerr, who was the first to collect it in Ban Lam Lieng on 3rd February 1929. His specimens were deposited in the Herbarium BKI, with duplicates in Kew Gardens (K) and British Museum of Natural History (BM). Kerr was an Irish, a medical doctor by profession but later became the first forest botanist in the Thai Forest Service. According to Wong and Gan (2003), for years, Kerr's specimens were left undescribed until it was discovered and described by Dr. Willem Meijer as one of the four new species of *Rafflesia* in Malesia. In 1981, Meijer examined Kerr's specimens in Kew while preparing a revision of Rafflesiaceae for Flora Malesiana, and realized that they were as yet an undescribed species. In 1983, Meijer went to Khao Sok National Park in search of Kerr's species in the wild and managed to find a fresh bud and remnants of a flower. He was confident that Kerr's rafflesia was a new species even though a few details were still uncertain. Nevertheless in the following year, Meijer published his description of *R. kerrii* (Meijer 1984) and six years later, with Stephen Elliott he published an updated account of *R. kerrii* with some taxonomic and ecological data (Meijer & Elliott 1990). Further studies on the *Rafflesia* was carried out by Dr. Hans Banziger, an entomologist from Chiang Mai University and he published several papers on the pollination of *R. kerrii* in south Thailand (Banziger 1991).

RAFFLESIA KERRII IN PENINSULAR MALAYSIA

The occurrence of *R. kerrii* in north Peninsular Malaysia had been long suspected. In 1935, H. Witkamp, a mining engineer, collected a bud of *Rafflesia* in Bukit Tephuh (295 m), which is located at the Kelantan-Thailand border. The bud was said to be having all the attributes of *R. kerrii*. The specimen was deposited in Bogor, Indonesia and was neglected. The non-existence of any specimen had resulted the presence of *R. kerrii* in Malaysia was being ignored until its discovery in Gunung Chamah (2173 m), near the border of Kelantan-Perak on 12 February 1992. The finding was reported in *Malayan Naturalist* by Forest Gan (Gan 1993). In November 1992, other populations were found in Pengkalan Hulu in Kroh, Perak (near the border of Perak-Kedah) by the General (R) Adam Abu Bakar and Matthew Wong (Wong & Latiff 1994).

In recent years, several new populations were reported from three different localities in Pos Brooke in Lojing Highlands and Hutan Simpan Kekal Sg. Bells, in Kelantan (Wong & Gan 2003). This was, in addition to populations in Gunung Stong found several years earlier by Nik Maseri (then with the Malaysian Nature Society) along the Sungai Semuliang in 1997. This area is now known as the end of Trail Stong 4. Later surveys has indicated that two populations were found along Sg. Ber and Sg. Lob near Pos Hendrop in Lojing (Lau 2003).



Based on our current knowledge of the species, the distribution of *R. kerrii* appears to be confined to the Main Range in Kelantan with the exception of those found near Pengkalan Hulu, Perak on the Bintang Range. Reports on the occurrence of this species around Baling, Kedah has neither been supported by any pictorial evidence nor recorded specimen from known sites within Kedah.

BIOLOGY AND ECOLOGY OF *RAFFLESIA KERRII*

Rafflesia kerrii flowers rival the size of other large-sized Rafflesias such as *Rafflesia arnoldii* in Sumatera and *Rafflesia keithii* in Sabah. In 2002, a 3-day old flower was measured 97.5 cm in diameter at Pos Brooke, probably a record size for the species then (vide Gan, *The China Press*, 16 April 2002). On 7th April 2005, another bloom was measured nearly 111 cm in diameter from the same area and setting yet another record size (Figure 1). Normal blooms however are about 65–85 cm in diameter and this is considered larger as compared to more common *Rafflesia cantleyi* whose blooms are 30–50 cm. It was estimated that it will take some 10 to 12 months from small buds of about 1–2 cm in the cupule to mature buds measuring 25–35 cm in diameter (Figure 2). Studies in Pos Hendrop populations showed that some 44% of buds did not make it to anthesis. Once bloom, the perigone lobes were measured 20–30 cm long; and 25–34 cm wide dull red with brownish tinge and numerous and scattered wart, with 5–6 mm space between them. These warts are smallest compared with those of other species. The aperture is large, 16–25 cm across, upper face with 3–4 concentric rings of white spots surrounded by a dark red margin. Windows in the lower diaphragm are snow white, roundish to elliptic blots, up to 12 mm diameter. Processes are 30–50, up to 4 cm long, the colour gets darker with some having sharp tip and some without. Ramenta are mostly in lower perigone tube, and turned into lobed, and branched in the upper perigone tube, and the lower of diaphragm, and only slightly swollen at apex; upper type (near the diaphragm opening) about 12 mm long; lower type (near base of the perigone tube) about 6 mm long. The disk is 7.5 dm in diameter with 26–36 anthers. Ovules are numerous, attached on irregular pistil in ovary. Usually, the ovules are incomplete anatropous (Brown 1912; Bouman & Meijer 1994), that are inverted so that the microphyle face downward and situated near the base funiculus, but the apical part is not bound to the raphe. So that it makes a “J-shape” ovule. Fresh ovules are whitish in colour, it is divided into micropylar part, raphal part and funiculus. But sometime the border between raphal part and funiculus is not clear. The length of raphal part is about 176.66 μm and micropylar part is 153.33 μm . The mature seeds are brown in colour and have a chestnut shape, with a clear part of funiculus and raphal part at the distal and micropylar part at the proximal. Pollen grains are not in powder form but adhere to each other due to the presence of sticky yellow mush (Banzinger 1991). *R. kerrii* has inaperture spheroidal pollens; polar length is about 21.5 μm and equatorial length is 19.94 μm .

The species occurs in primary or logged over lowland and hill dipterocarp forest (Figure 2), normally dominated by bamboos, some 500–1000 m altitude, and often found



on the *Tetrastigma tuberculatum* (Blume) Latiff host lianas (Figure 3, 4, 5). This is somewhat different from the host of Thailand *Rafflesia kerrii*, as it was reported that it was found on *T. quadrangulum* Gagnep. & Craib. In Thailand, the species is reported to be seasonal in flowering during the driest periods of the year. However this is not the case in Malaysia where blooms were reported all year round.

RAFFLESIA KERRII AND ECO-TOURISM

The *Rafflesia* species have become a successful tourist attraction in Indonesia and Southern Thailand. In fact *Rafflesia kerrii* is being heavily promoted as the main attraction in Khao Suk. In Sabah and Sarawak, many privately run *Rafflesia* sites of *Rafflesia keithii* are open to public. These sites have been promoted as attractive ecotourism products which appear to have been accorded sound management. This was a result of *Rafflesia* Conservation Incentive Scheme (RCIS) promoted by the Sabah Park to protect *Rafflesias* outside protected areas around Mt. Kinabalu. The scheme is a two-way benefiting process, whereby the indigenous people living near the *Rafflesia* sites could earn some incomes collected from the tourists and observers and at the same time, the most important, conserving the vulnerable *Rafflesia* in their areas. According to Nais and Wilcock (1998), one *Rafflesia* bloom could raise between RM100.00 and RM 800.00 and if each site can produce up to 10 blooms per year, a total amount of RM8000.00 can be generated per annum.

In Peninsular Malaysia, however, *Rafflesia* eco-tourism is catching up in Hulu Geroh, Royal Belum – Temenggor Lake and Cameron Highlands (Figure 6). However, these activities need to be monitored very closely to ensure its sustainability. Many *Rafflesia* in the wild were badly trampled by too many inconsiderate visitors. Some *R. kerrii* populations in Pos Brooke and *R. azlanii* in Belum were slashed up and totally destroyed due to business rivalry and jealousy between the communities. There are numerous instances of wanton vandalism and littering, and to promote *Rafflesia* as a tourist attraction without proper management or supervision would only hasten the early demise and disappearance of these rare plants.

GUNUNG STONG STATE PARK AND THE CONSERVATION OF *R. KERRII*

The International Union for the Conservation of Nature (IUCN) New Red List Categories in 1997 listed *R. kerrii* as vulnerable. IUCN defines taxon as vulnerable when it is facing a high risk of extinction in the wild in the medium-term future due to 20% population reduction or extent of occurrence estimated to be less than 20,000 km² or area of occupancy estimated to be less than 2000 km² in severely fragmented or known to exist at no more than ten locations and continue to decline.

The proposed Gunung Stong State Park is important in the conservation of *Rafflesia* because this area is the only accessible protected area for the species in the



Peninsular Malaysia. Several populations are found in Trail 4 near the headwater of Sg. Somaliang, growing on somewhat rocky granitic hills, and very popular as tourist destination. Another small population was found near Projass Hydrostation along the bank of Sg. Kenerong. This alternative site is much easier to visit because of the access road to the station but this area is a restricted security facility. It is a blessing because this population is safer than others, which are exposed to threats from illegal collectors. Other easily accessible populations of *Rafflesia kerrii* in Kelantan are under threats, such as those in Pos Brooke and Pos Hendrop. These populations are in the stateland, often subject to several claims and counter-claims of ownership by local Orang Asli and who are under the control of tourist agencies in Cameron Highland. Several populations of *Rafflesia kerrii* such as the one in Gunung Hulu Sepat and Gunung Chamah in Kelantan-Perak border are not for the faint-hearted.

Protected populations in the State Park is useful for long-term monitoring. Many aspects of its biology can then be monitored and documented. There are many aspects of their attributes still unknown, such as growth and mortality rate, reproductive biology, sex ratio, flowering synchronization, pollination, seed germination, distribution and dispersal agents, ecological specialization, host dependency, physiological requirement and processes, as well as genetic diversity at population level. Some of these issues are being studied using modern techniques, at molecular as well as organismic level. Scanning electron micrographs of pollen and ovules of *Rafflesia kerrii* were recently obtained from one of these populations (Figure 7) and these photographs are images of previously unknown characters and part of detail investigation of taxonomic characters of *Rafflesia*.

In conclusion, Gunung Stong State Park is an important for the conservation of *Rafflesia* and would complement Taman Negara and The Royal Belum as the safe heavens for all the three species of the *Rafflesia* in Peninsular Malaysia. With regard to conservation purposes, the population attributes such as growth rate, model to estimate the day of anthesis, new bud recruitments, population structure, life cycle and the role of micro-climate on triggering anthesis must also be observed. This will be the basis for conservation management schemes.

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Figure 1. The largest ever recorded flower of *Rafflesia kerrii*, about 111 cm in diameter after the 3rd day of blooming, photographed at Pos Brooke, Lojing, Kelantan on 7 April 2005.



Figure 2. Mature bud of *Rafflesia kerrii*, one week before bloom, measuring 65 cm in diameter and 109 cm circumference



Figure 3. The habitat of *Rafflesia kerrii* with *Tetrastigma* vines



Figure 4. *Tetrastigma tuberculatum*, the host vine at Pos Brooke



Figure 5. The leaves of *Tetrastigma tuberculatum* host vine in Pos Hendrop



Figure 6. *Rafflesia kerrii* bloomings in Pos Brooke often attract many tourists to the site and one of the popular offerings for Cameron Highland's based agencies

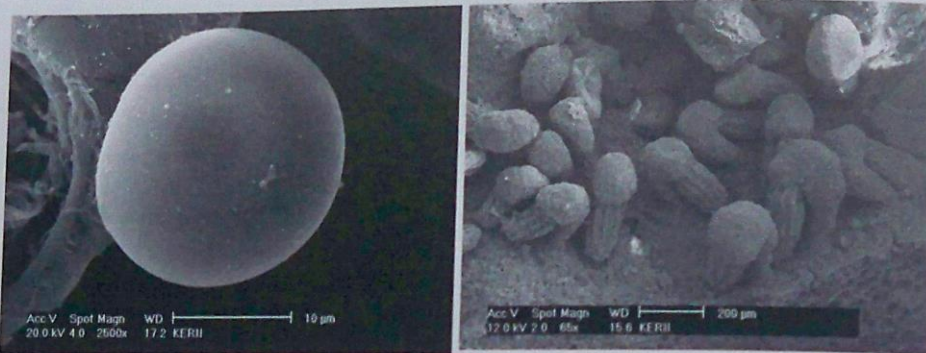


Figure 7. Scanning electron micrographs of pollen (top) and ovules (bottom) of *Rafflesia kerrii*. These photographs are images of previously unknown characters and part of detail investigation of taxonomic characters of *Rafflesia*, made possible from samples in protected areas where populations can be monitored.