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Viability of having the gigantic *Rafflesia* flowers in our park

Abstract

The genus *Rafflesia* which consists of ca. 24 species is confined to South-east Asia, mostly found in the Philippines, Borneo and Sumatera. It is a holoparasite on the stems of the vine genus *Tetrastigma* (*Vitaceae*). The iconic and gigantic flowers range from ca. 9 cm to more than a meter across and have been the envy of observers and tourists. The biology of the flowers has not been fully understood and poses conservation issues. Most enthusiasts and biologists dreamt of having the flowers either in the botanic garden, park or even in their vicinity. The viability of having the flowers in such localities is briefly discussed.

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Introduction

Rafflesia is said to be vulnerable to extinction because of its biological peculiarities.[1] Being unisexual and dioeciously, the male and female flowers need to bloom synchroniously in the same area for effective pollination by carrion flies to succeed. Without new seeds formed to be deposited onto the mature hosts, no one can guarantee that they will be there in the ecosystem forever. It is true that the parasite continues to multiple inside the host's tissue and later emerge in new colony but without out-crossing, inbreeding will ultimately genetically disastrous. With this innocent biological hick-up, and a specific host requirement, namely the *Tetrastigma* species (Vitaceae), made *Rafflesia* even more prone to extinction in the near future (Table 1). Its parasitic mode of life and specialized biological requirement also decrease *Rafflesia* survival rate in the wild. In its range of distribution, *Rafflesia* species are rare and their habits are geared towards a stable habitat. From the earliest bud stage in their life, when the flower appears as small tubercle covered by cupule derived from the tissue of the host plant, it will take about 4 to 9 months before the flower blooms fully. In some species it will take no less than 6-8 months. In the process, two-thirds of them die before reaching maturity and only a small number will reach blooming stage.

The flower will be aborted even when the bud is on the verge of blooming hence the rate of mortality is high. The consequences of its biological behaviour result in extremely low occurrence for *Rafflesia* bloom in the wild. It may take a very long time for populations to recover with this high mortality rate when once their ecosystem or habitat is disturbed. Any extra ecological pressure such as habitat disturbance due to forest clearance and uncontrolled tourism would easily push it over the brink. Although habitat lost and increasing threats from ecotourism is the main challenge to the survival of *Rafflesia*, the species have been documented to thrive once disturbance was minimized. *Rafflesia* face even greater risk as the forests are fragmented due to logging. They are more vulnerable because of direct exploitation of the flower buds as traditional medicine. In Peninsular Malaysia, the *Rafflesia* "cabbage-heads" stage is highly sought after by village medicine men for its purported medicinal attributes. The post-partum decoction prepared by boiling buds in water are taken by mothers recuperating from childbirth, in the belief that the liquid can help restore their health and strength. The *Rafflesia* flowers also suffer from over-collection by illegal souvenir hunters.

Approaches for conservation

To conserve *Rafflesia*, one has to deal with several important aspects such as maintaining viable population size, life cycle, reducing the pressure of human and wildlife activities, and managing their habitats. Such complicated attributes could lead the difficulty to predict the future of the *Rafflesia*. Therefore, we should consider all possible means to conserve the species. There are, at least, two major approaches to conserve the *Rafflesia*, *in situ* and *ex situ* approaches. The most promising approach is *in situ* conservation which should be based on the special ecological, environmental, biological characteristics and attributes of local habitat and social economics of surrounding villages where rafflesias occur. This approach can be differentiated into two major conservation managements, based on the where the *Rafflesia* are found. The first category is conservation scheme for *Rafflesia* within the protected forest areas, and the second is in any working scheme outside the protected forest areas, which can be in private lands. Many private land owners and parks wish to have these gigantic and iconic parasites growing in their vicinity, hence the question is herein posed, is it viable to have them in the garden or park. The *ex situ* approach that the propagation of *Rafflesia* outside their natural habitats is a possible mean to conserve the plants. Yet, there are two important aspects that should be taken into careful consideration, before applying this approach. First, the experiments in Bogor Botanical Garden were conducted through transplanting *Rafflesia* including their host plants into the garden.

Even if the host plant, *Tetrastigma* is common in the forests, this method should be conducted on rigid considerations, such as if the population size is much above the threshold of extinction, which is very rare for recent time, or if in some reasons, there is no other ways to protect the species population. For example, the forest where *Rafflesia* occurs, might be logged, or converted to plantations or other land-uses. It should be kept in mind that transplanting a single old stem of *Rafflesia* infested vine could mean transplanting the whole all flower buds from its wild into *ex situ* area. The unsuccessful transplantation means the disappearing of the whole local population. After all, it is hard to imagine that conservation can be done by destruction ways.[2] when reading the Teijsmanns' papers indicated that *R. patma* was transplanted in Bogor Botanical Garden in March 1850, subsequently *R. rochussenii* in July 1850, and latter on *R. arnoldii*. By 1886, those three species were flowering in the garden. The last report on flowering

of these domesticated species was in 1929 and none thereafter. Leiden Botanical Garden horticulturist conducted another success story, when he successfully inoculated seeds of *R. rochussenii* on *Tetrastigma rafflesiae* in 1924. Four year later, the *Rafflesia* flowered. Since then, there has been no report on the *Rafflesia* blooming in the garden. The second factor is the low reproductive success of *Rafflesia*.

Figure 1 Could a visitor to the park be photographed with a *Rafflesia* bloom by his side?

The inoculation of single seed of *Rafflesia* into the vine is very difficult, even if it occurs, then we do not know for certain whether the seed turns to a mature bud, and further, a flower. The Bogor Botanical Garden as well as Leiden Botanical garden experiments seemed to successfully inoculate and, to produce the flowering *Rafflesia*, for some early period of time, but they did not last long. The last report on flowering *Rafflesia* in both places was 1929. This could indicate that the low reproductive success of plants in experimental setting could not maintain enough population size for long period of time. The earliest records was attempt to cultivate *Rafflesia* were made in Bogor Botanical gardens in 1850 and succeeded in 1857.[3] Then in 2004 the infected stems of *T. scariosum* were transplanted and the buds of *R. patma* emerged in 2006 but failed to develop into a full bloom until 2010.[4,5] Dr. Jamili Nais claimed the successful germination of *R. keithii* on the stems of *T. diepenhorstii* by placing the artificially pollinated fruits, the seeds in a shallow incision of the host stems[6] also reported that to culture seeds *in vitro* through tissue culture also failed since 2001. In conclusion, we might have learnt from the above trials and experiments in both the Bogor Botanical Garden and Leiden Botanical Garden, including the success story as claimed and described but there was no certainty that it would last. Attempts to culture the seeds proved equally futile. The author believes field trials and laboratory experiments may be repeated and attempted but to have the blooming rafflesias in our garden in the near future is rather bleak.[7]

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Conflict of interest

The author declare that they have no conflict of interest.

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