НАУЧНЫЕ ЗАМЕТКИ
RESEARCH NOTES

EX SITU CONSERVATION OF *RAFFLESIA PATMA* (RAFFLESIACEAE) IN BOGOR BOTANICAL GARDENS (INDONESIA)

Sofi Mursidawati

Center for Plant Conservation Botanic Gardens, Indonesia
e-mail: sofi001@lipi.go.id

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This report presents some methods of cultivation and the inducing of flowering of *Rafflesia patma* in Bogor Botanical Garden (Indonesia). Many natural habitats of *Rafflesia* have disappeared through time. Therefore, gardening may contribute to the survival of these species. The grafting method has proven to be successful for the *ex situ* cultivation of *R. patma*. However, many biological and ecological aspects of this endangered plant are still unknown, while its habitat is disappearing rapidly. This needs a better understanding of the *Rafflesia* biology to establish appropriate conservation efforts.

Key words: Bogor Botanic Gardens, *ex situ* conservation, flowering, habitat disappearance, Indonesia, *Rafflesia*

The family Rafflesiaceae Dumort. houses species with the world's largest flowers. As a true parasite they are completely depending on members of the genus *Tetrastigma* K. Schum., belonging to the grape family (Vitaceae Juss.). They have not any roots or leaves and live unobserved inside woody stems and roots of their hosts except when they form flowers.

Indonesia is one of the diversity centres of the genus *Rafflesia* R. Br. ex Thomson. Around 15 *Rafflesia* species are distributed on limited areas in Indonesia, including Java, Sumatra and Kalimantan. The Indonesian *Rafflesia* species are *R. arnoldii* R.Br., *R. atjehensis* Koord., *R. bengkuluensis* Susatya, Arianto & Mat-Salleh, *R. borneensis* Koord., *R. ciliata* Koord., *R. gadutensis* Meijer, *R. haseltii* Suring., *R lawangensis* Mat-Salleh, Mahyuni & Susatya, *R. meijerii* Wiriad. & Sari, *R. micropylora* Meijer, *R. patma* Blume, *R. pricei* Meijer, *R. rochusenii* Teijsm. & Binn., *R. tuan-mudae* Becc., *R. witkampii* Koord. (Meijer, 1997; Matt Salleh et al., 2001; Nais, 2001; Latiff & Wong, 2003; Wiriadinata & Sari, 2010; Susatya, 2011). The occurrence in Indonesia of *Rafflesia borneensis*, *R. ciliata* and *R. witkampii* need confirmation (Meijer, 1997).

Only *R. magnifica* is categorised as Critically Endangered by the World Conservation Union (Madulid et al., 2008). However, concern should be given to all the other members of the genus *Rafflesia*, too, due to their restricted occurrence, extreme fluctuations in the populations' number and the threat of human activities for the species' habitat.

To date, only very few efforts have succeeded in cultivating the species *ex situ*. The main conservation measures have been efforts of its conservation *in situ.* The species have complex biological requirements. These are still only partly understood. That is why continuing conservation efforts (e.g. attempts to grow *Rafflesia* in culture) still remain problematically. *Rafflesia* species are entirely dependent on their hosts, *Tetrastigma* spp. (Vitaceae), receiving water and nutrients from it, as the parasitic plants have no photosynthetic capacities (Nais & Wilcock, 1991). Ultimately, factors affecting *Tetrastigma* will directly affect *Rafflesia*. However, the relationships between these two partners are still poorly understood.

Studies of *Rafflesia* have been carried out since 2004 with emphasis on *Rafflesia patma* (Fig. 1). Since 2004 attempts to grow *R. patma* have been conducted in the *ex situ* conservation area of the Bogor Botanical Gardens. At first, the focus has been placed on biological studies and applicative experiments. Demography, seed biology and anatomy of infected roots were studied with the aim to obtain useful information on biological characteristics of *R. patma* in the wild. In order to perform *ex situ* conservation, studies on *in vivo* and *in vitro* cultivation and conventional grafting methods were tested.

Fig. 1. *Rafflesia patma* Blume in Bogor Botanical Gardens.

After six year of studies, a *R. patma* flower was firstly registered *ex situ*. Of the two methods, grafting (cleft and veneer) on the host plant (*Tetrastigma scariosum* (Blume) Planch) has become successful for the growing of *R. patma* in the Bogor Botanical Garden. There flowering has occurred ten times since 2010 (eight female and two male flowers). The grafting method is a short way to the *Rafflesia* reproduction. Thus, when mature seeds are difficult to obtain or these are not available, the grafting method has become a successful alternative way for its cultivation (Mursidawati et al., 2015).

The grafting method gives new hope for the establishment of efforts of *ex situ* conservation of *Rafflesia.* However, the next step is much more difficult. The unisexual *R. patma* flowers are either male or female. The female flowers could not reach further maturity stage (fruiting) in *ex situ* cultivation, because there has no pollination been registered. The successful effort to grow *R. patma* in *ex situ* cultivation is a small step leading towards a larger scenario of a population's establishment. Experience obtained in this initial successful attempt provides the basis for more complex work. It implies carrying out of both human-induced and natural pollination experiments as an effort to establish a viable population.

Studies in conservation biology of *Rafflesia* still need to be continued as many biological and ecological aspects of these plants are still unknown, while their natural habitats are disappearing rapidly.

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EX SITU СОХРАНЕНИЕ *RAFFLESIA PATMA* (RAFFLESIACEAE) В БОТАНИЧЕСКИХ САДАХ БОГОРА (ИНДОНЕЗИЯ)

С. Мурсидавати

Центр сохранения растений Ботанических садов, Индонезия
e-mail: sofi001@lipi.go.id

Данное сообщение представляет некоторые методы культивирования и перевода в фазу цветения *Rafflesia patma* в Ботаническом саду г. Богор (Индонезия). Выращивание в саду может помочь существованию видов *Rafflesia*, потому что их места обитания со временем исчезают. Было показано, что метод прививки оказался успешным для культивирования *R. patma* методом *ex situ*. Тем не менее, многие биологические и экологические аспекты этого исчезающего растения все еще неизвестны в то время, как его местообитания быстро исчезают. Требуются лучшее понимание биологии *Rafflesia* для улучшения усилий по его сохранению.

Ключевые слова: *ex situ* сохранение, *Rafflesia*, Ботанические сады Богора, Индонезия, исчезновение местообитания, цветение