Jurnal Kejuruteraan dan Sains Kesihatan
Journal of Engineering and Health Sciences
Jilid 4 2020: 135 – 148

HABITAT VEGETATION OF *Rafflesia arnoldii* (RAFFLESIACEAE) IN PANORAMA BARU NGARAI SIANOK WEST SUMATRA

Syafroni Pranata*, Sulistijorini, Tatik Chikmawati

IPB University, Bogor 16680, Indonesia
**Ecology Division, Generasi Biologi Indonesia (Genbinesia) Foundation, Jl. Swadaya Barat No. 4, Gresik 61171, East Java, Indonesia*

Abstract

Rafflesia is a *holoparasitic* plant genus that only consists of generative organs. Rafflesia has habitat conditions that vary greatly in biotic and abiotic factors. Its population decreased due to habitat destruction or natural disturbances. The objective of this study is to analyze the habitat and ecological conditions of *Rafflesia arnoldii* in Panorama Baru Ngarai Sianok. Purposive sampling method was used to collect the data using circular plots for Rafflesia population and vegetation. Rafflesia population data includes the number and phase of development of each individual. Ecological data in the form of vegetation conditions and abiotic (physical) habitat. The Rafflesia species which found was *R. arnoldii.* Four populations were recorded in Ngarai Sianok consisting of 19 individuals. The identified host is *Tetrastigma leucostaphylum.* Vegetation within four populations was found a total of 255 individuals and 48 species consisting of 20 genus. Important Value Index (IVI) tree vegetation is dominated *by Ficus fistulosa (Moraceae)* with a value of 32.37%, belta and sapling dominated by *Coffea canephora (Rubiaceae)* 63.53% and *C. canephora (Rubiaceae)*141.24%. Abiotic factors that are positively correlated was environmental humidity (RH.l), soil pH (pH) and host tree diameter (DPi).

Keywords: Holoparasite, IVI, *R. arnoldii*, Vegetation

1.0 INTRODUCTION

Rafflesia is an unique plant that only consists of generative organs. It is well known as the largest giant flower in the world (Sofiyanti et al., 2007; Nikolov et al., 2013). *Rafflesia* lives as holoparasite whose survival is highly depend on its host plant (Barcelona et al.,2014). The host species of *Rafflesia* are specific from the genus *Tetrastigma* (Vitaceae) (Hidayati & Walck, 2016). Lack of public knowledge to recognize *Tetrastigma* is one of the major factors that threaten the survival of *Rafflesia* (Peters & Ting, 2016; Pranata et al.,2019). The tropical forest of West Sumatra comply the habitat characteristics needed for the survival of *Rafflesia*. Three species have been reported for this region, namely *R. arnoldii, R. gadutensis, and R. hasseltii* (Meijer, 1984; Nais, 2001). Panorama Baru Ngarai Sianok West Sumatra has a natural tropical rain forest with local wisdom known as Tanah ulayat (Pranata et al., 2019). In this region, previous study reported the presence of the *R. arnoldii* population (Rhahdhiyah, 2017). However, this area faces threats that can disturb the habitat and survival of *R. arnoldii*, for example, hunting activities and populations close to rivers that are potentially affected by flooding.

Population decline has been known to be indirectly caused by habitat destruction or natural disturbance. However, other causes are not known with certainty because *Rafflesia* is also very depend on its host (Nikolov et al., 2013; Hidayati & Walck, 2016). Besides, physical parameters such as temperature, humidity, and light intensity are necessary to know what environmental factors that influence the *R. arnoldii* habitat niche. Therefore, further observations are needed to study the habitats from two populations of *R. arnoldii* and the factors that support their survival. This research was conducted to analyze the habitat and ecological conditions of *R. arnoldii* in Panorama Baru Ngarai Sianok. Data obtained from this study are expected to be a source of information and policy-making in the conservation of *R. arnoldii* and their habitat in Panorama Baru Ngarai Sianok.

2.0 MATERIAL AND METHODS

2.1 Data Collection

The study was conducted in August 2018 to April 2019 in Panorama Baru, Bukit Tinggi, West Sumatra. *Purposive sampling* method was used in this research based on the presence of *R. arnoldii*, observations made in the form of nested circular plots (Priatna et al., 1989; Pranata et al., 2019). The size of the observation plot *R. arnoldii*, area 0,001 ha (r = 1,785 m) for seedlings, 0.01 ha (r = 5.65 m) for belta, 0.1 ha (r = 17.85 m) for trees. Vegetation composition

was observed in the form of trees, belta, and seedlings. Vegetation data collected in each plot are in the form of species and number of individuals.

Observation of abiotic data collected includes observations of microclimates such as air temperature, soil temperature, air, and soil humidity, wind speed, light intensity at the study site measured using 4 in 1, soil tester and thermometer. Topographic data collection such asheight and the distance of *R. arnoldii* habitat with the nearest water source is measured by the meter and *GPS* (*Global Positioning System*).

2.2 Data Analysis

Analysis of *R. arnoldii* data includes morphology, size, number and phase of development presented in the form of images, graphs, and descriptive analysis. Physical data on the abiotic environment, temperature, soil pH, humidity, light intensity, wind speed were analyzed by major components using *Cannoco 4.56 software* in the form of *Canonical Correspondence Analysis* (CCA) ordination. Plant vegetation data were analyzed quantitatively. The data obtained is the Importance Value Index (IVI) calculated by equation IVI = RF (i) + RDo (i) + RD (i), which is the sum of Relative Frequency (RF), Relative Domination (RDo), Relative Density (RD).

3.0 RESULT AND DISCUSSION

3.1 Population Conditions of *Rafflesia arnoldii* in Panorama Baru Ngarai Sianok

The species of *Rafflesia* found is *Rafflesia arnoldii* known as "Akar Paruik Babi", which infects the host tree, *Tetrastigma leucostaphylum*. The population of *R. arnoldii* found is exactly on the edge of a river (water source). Distribution of the population tends to follow the river flow downstream or upstream. *Rafflesia* is generally found in certain hosts near the water sources (Mursidawati & Irawati, 2017). It indicates that *R. arnoldii* in the upstream of the river could develop and grow to infect a host in the downstream because the seeds are brought by river currents. The assumption is caused by *R. arnoldii* seeds which are very small in size and can be carried by water currents (Mursidawati, 2012). There were four population of *R. arnoldii* found in Panorama Baru Ngarai Sianok which consists of 19 individuals. Four individuals were found dead and three of them were in the form of a blooming flower and one knop (Table 1). The diameter of the knop found is within a range of 4.14-26.11 cm.

Table 1: Individual conditions of *R. arnoldii* in Panorama Baru Ngarai Sianok

Populations	Individuals	Diameters (cm)	Grow Places in Host	Individuals Conditions
I	1	19,10	Roots	Knop covered with brachtea
	2	12,10	Roots	Knop covered with brachtea
II	3	11,14	Roots	Knop covered with brachtea
	4	9,55	Roots	Knop covered with brachtea
	5	6,36	Roots	Knop covered with brachtea
	6	4,77	Roots	Knop covered with brachtea
	7	26,11	Stem	Mature knop, brachtea begins to open, are squirrel bites on the top
	8	-	Roots	Knop dead
	9	-	Roots	Former flowers
III	10	13,69	Roots	Knop covered with brachtea
	11	8,91	Roots	Knop is broken at the top
	12	-	Roots	Former flowers
IV	13	13,69	Roots	Knop is broken at the top
	14	14,01	Roots	Knop covered with brachtea
	15	12,42	Roots	Knop covered with brachtea
	16	-	Roots	Former flowers
	17	5,09	Roots	Knop covered with brachtea
	18	4,14	Roots	Knop covered with brachtea

Individuals who grew in each population of *R. arnoldii* have varied development phases. The phase of its development indicate that the population of *R. arnoldii* were not uniform. The development of individual within population occured sustainably, due to the role of the diverse environment around the population (Krebs, 1989). Similarly with the growth conditions of *R. patma* in the Bojonglarang Nature Reserve in West Java Province wass classified as not uniform. It was characterized by different growth variations according to its development (Ali *et al*, 2015).

The young *R. arnoldii* that has just sprouted (young knop) was found growing at the root of the host, covered with soil. This condition causes the young knop to potentially be damaged in its development. It is because microorganisms on the soil surface and litter can damage the *R. arnoldii* knop. The death of *R. patma* knop whose diameter between 1 to 10 cm due to the growing location at the root and is buried by the soil has the potential to experience higher damage and death due to the presence of microorganisms or fungi (Triana *et al*, 2011). These internal disturbances are due to environmental damage and failure of pollination. It is a factor causing the death of *R. arnoldii*. There is a smaller bud size that leads to death. Besides, the presence of *the R. arnoldii* population right on the river's edge has the potential facing floods and landslides that threaten their survival (natural disaster).

3.2 Vegetation Conditions *Rafflesia arnoldii* in Panorama Baru Ngarai Sianok

The composition of plant vegetation in four populations of *R. arnoldii* in Panorama Baru Ngarai Sianok found a total of 255 individuals of 48 species consisting of 20 genus. Plant stands at the level of seedlings were found 44 individuals of 8 species dominated by the Rubiaceae family. Belta stands were found 96 individuals of 27 species predominantly Moraceae and Lauraceae. Standing trees were found 115 individuals belonging to 42 species dominated by the Moraceae and Euphorbiaceae genus. The dominance of the Euphorbiaceae family indicates that the population of *R. arnoldii* in this area is still classified as secondary forest. This is supported by previous research that reported, the Euphorbiaceae family acts as a pioneer plant in secondary forests that normally live in open areas and forest edges, one of which is the genus Macaranga (Macaranga sp.) (Rahma et al., 2017; Syafroni et al., 2019). The growth and development of *Rafflesia* are influenced by the composition of vegetation in plants around the population (Zuhud, 1987).

Vegetation composition of *R. arnoldii* populations in habitats tends to be influenced by host plants. The host plant which is a liana can wrap the surrounding plants so that it can make the strata and canopy of trees that are right in the population of *R. arnoldii* to become dense. The tendrils of the host are used to climb the trees around them. The results of observations in the population of *R. arnoldii* can be used as a basis for estimating that the role of surrounding plants affects the growth and development of *R. arnoldii* and its host *(Tetrastigma leucostaphylum*).

The results of the calculation of the Importance Value Index (IVI) on tree stands found the most dominant type of *Ficus fistulosa* (Moraceae) with IVI 32.37%. High IVI *Ficus fistulosa* indicates that this species affects the population of *R. arnoldii*. The next type that has the second-highest IVI is *Aglaia argantea* (Meliaceae) with a value of 23.33%. Belta and seedlings found *Coffea canephora* (Rubiaceae) is the main type that dominates with IVI 63.53% and 141.24%. The high IVI obtained from each type of stands indicates that this species was very important in the population of *R. arnoldii* in the Panorama Baru Ngarai Sianok. Importance Value Index is a quantitative parameter that can be used to express the level of dominance (level of mastery) of a type in a community (Ramadhani et al., 2017). Three types of plants that dominate in each stand type are presented in Table 2.

Table 2: Three species of plants the hight Important Value Index (IVI) in habitat *R. arnoldii*

Vegetations	**Nama Jenis**	**Family**	**IVI (%)**
Trees	*Ficus fistulosa*	Moraceae	32,37
	Aglaia argantea	Meliaceae	23,33
	Laportea stimulans	Urticaceae	21,18
Belta	*Coffea canephora*	Rubiacceae	63,53
	Laportea stimulans	Urticaceae	39,43
	Ficus fistulosa	Moraceae	20,49
Seedlings	*Coffea canephora*	Rubiacceae	141,24
	Laportea stimulans	Urticaceae	60,14
	Ficus septica	Moraceae	24,20

3.3 Environment Parameters Physical in *Rafflesia arnoldii* Populations

The physical parameters of the diverse population environment influence the survival of *R. arnoldii*. Altitude observation of the population of *R. arnoldii* in Panorama Baru Ngarai Sianok has a range of values from 729–804 m asl (Table 3). This condition can be classified as *R. arnoldii* population, including in the hilly area. In contrast to the population of *R. arnoldii* found in Rhino-Camp Resort Sukaraja Atas (TNBBS), the species grows at a lower altitude range from 490-558 m above sea level. Rafflesia arnolldi growing in Pandam Gadang West Sumatera in submountain conditions in altitude 800 – 1024 m asl (Pranata et al., 2019). In other *Rafflesia* species, a similar condition was found, namely *R. patma* in Bojonglarang Jayanti which was able to grow at a lower height of 0-

100 m asl (Ali et al., 2015). Each species of *Rafflesia* requires specific environmental conditions to support its development (Ali et al., 2017; Triatna et al., 2017). The same type of *Rafflesia* that grows in different habitat conditions tends to have different characteristics and environmental conditions.

The measurement of environmental temperature obtained the minimum value is 19 °C and a maximum of 24 °C, while the soil temperature is 19–22ºC. Humidity is obtained with a range of values from 79 to 96.3% and soil humidity with a range of 63.9 to 79%. The measurement of soil pH in each population is not much different, which is 7-7.4. This condition shows that the pH condition in the population is classified as neutral to basic. This condition is different from *R. patma* which can grow at quite an acidic pH with values below 7 (Ali et al., 2015).

Measurement of light intensity obtained the lowest value in the fourth population of 38-60 lux. The intensity of this light is classified as very low, this is because the light entering the forest floor is not much because of the blocking by a tight tree canopy. The highest light intensity was found in the third population with a value of 702 lux. The high light intensity is due to the rare canopy cover, so that light can reach the forest floor higher. Light is the most vital environmental factor for the survival of an organism, especially *R. arnoldii*. The results of observations of light intensity indicate that the low light intensity in the population of *R. arnoldii* has a link with the ability of the host to propagate and form strata that are dense enough, to reduce the amount of light reaching the forest floor. This condition is different from *R. arnoldii* which be able to grow 103-803 light intensity in Pandam Gadang West Sumatra (Pranata et al., 2019).

Table 3: Physical parameters *R. arnoldii* habitat in Panorama Baru Ngarai Sianok

Physical Factor (Abiotic)	**Populations**			
	1	**2**	**3**	**4**
Elevation (m asl)	780–785	724–729	800–804	730–735
Ambient temperature (°C)	19–21,8	20–22,9	20–23,3	20,7–24
Humidity (%)	80,3–86,4	90,2–96,3	80–83,29	79–84,4

Wind speed (m/s)	0	0	0	0
Land pH	7–7,2	7–7,2	7–7,3	7–7,4
Soil moisture (%)	66–73	63,9–79	63,9–78,9	66–72
Soil temperature ($^{\circ}$C)	19– 21,2	19–22	20–22,9	19–21
Light intensity (lux)	205–267	201–270	308–702	38–60
Distance population from the river (m)	18–18,9	11–11,2	13–13,2	9–9,4

The distance of population from the river (water source) in the four populations is found: the closest is 9 m and the farthest is 18.9 m. Population conditions close to water sources (river flow) can maintain the humidity and temperature of the environment of the population of *R. arnoldii* in Panorama Baru Ngarai Sianok. However, population distance that is relatively close to the source and topographic condition of the location that is quite flat to flat has the potential to be flooded. Hosts infected by *Rafflesia* are relatively always located right on the river's edge. besides, *Rafflesia* is a herbaceous plant so it grows more in shaded areas (Pranata *et al*. 2016; Mursidawati and Irawati 2017). Flooding is one natural disaster be able to threat about *R. arnoldii* population (Pranata et al., 2019)

Pollination of dioecious plant flowers requires intermediaries such as water, wind, and insects (Hikmat, 1988). It is different in *R. arnoldii* even though it is classified as a two-house plant. The role of water and wind cannot be ascertained directly as a pollinator, given the position of pollen sources from *R. arnoldii* which does not allow water and wind to carry. However, water and wind are thought to help in the spread of *R. arnoldii* seeds because of the small size of *R. arnoldii* seeds. The small size of the seeds allows the seeds to be carried by the flow of water and will infect the host injured by hoofed animals. This allows the carrying of *R. arnoldii* seeds which are relatively small in size through the flow of surface *runoff*.

3.4 Host Plant *Rafflesia arnoldii*

The species of host that was identified was *Tetrastigma leucostaphylum* (Vitaceae). Host (*T. leucostaphylum*) which is infected by *Rafflesia* and plays an important role in its genetic development (Pelser et al., 2017). besides *T. leucostaphylum* known its host *R. arnoldii* in Pandam Gadang West Sumatra (Pranata et al., 2019) *Tetrastigma leucostaphylum* is one of the seed plants with generative breeding. However, vegetative host development through stems and branches in young shoots of the host stem was found during field observations. The same thing was found in the host *T. leucostaphylum* infected by *R. patma* developing through the vegetative organs of the trunk (Ali et al., 2015). The host tree of *R. arnodii* was found *T. leucostaphylum* is specific, meaning that only certain types of *Tetrastigma* can be infected and grown by *Rafflesia*. The greater the host size, the greater the potential for *Rafflesia* infection (Mokhtar et al., 2016; Zakaria et al., 2016; Kedri et al., 2018; Pranata et al., 2019). The diameter of the host stems infected by *R. arnoldii* in Panorama Baru Ngarai Sianok. Host stem diameters were found to have a diameter range of 4.78 to 6.11 cm (Table 4).

The host plant supported by tree (*T. leucostaphylum*) is found in more than one species. The host plant has characteristic to climb trees in the population of *R. arnoldii.* Interaction between host trees and surrounding trees can affect the suitability of *Rafflesia* habitat because it can affect the microclimate under canopy cover (Pranata et al., 2019). From the observations, the light intensity and humidity in the habitat of the *R. arnoldii* population are influenced by the association between the host and the supporting tree.

3.5 Canonical Correspondence Analysis in Habitat *Rafflesia arnoldii*

The presence of *R. arnoldii* population in Panorama Baru of Sianok canyon based on Canonical Correspondence Analysis (CCA) has a close relationship with several surrounding environmental factors (Figure 1). Three environmental factors that are positively correlated are thought to influence the presence of *R. arnoldii*: host plant diameter (DPi), environmental humidity (RH.l) and soil pH (pH). Host diameter has the closest role to the presence of *R. arnoldii*, this is also related to the presence of host in its population. Previous research states that each environmental variable that influences the presence of a type can be seen from the resulting axis. The more pointed the variables show the relationships and roles in the presence of these types (Dolezal and Srutek 2002). The same thing was found in *R. arnoldii* in Pandam Gadang, which is positively correlated

which includes the distance of the population from the river (Jp), humidity (RH.l), and soil pH (pH) (Pranata et al., 2019).

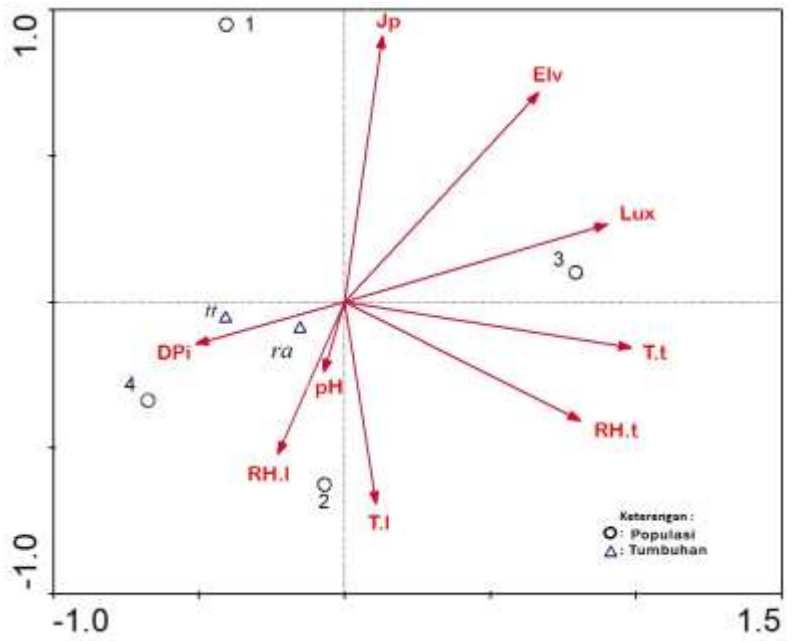

Figure 1: Ordinasi *Canonical Correspondence Analysis* (CCA) populations in Panorama Baru Ngarai Sianok (First and third axis). **Elv**: Elevation, **Dpi**: host plant diameter, **T.l**: environmental temperature, **RH.l**: environmental humidity, **pH**: soil pH, **T.t**: soil moisture, **T.t**: soil temperature, **Lux**: light intensity, **Jp**: distance of population from the river, **tt**: *T. leucostaphylum*, **ra**: *R. Arnoldii* **1.** First population. **2**. Second populations. **3.** Third population. **4**. Fourth population.

4.0 CONCLUSION

The species of *Rafflesia* found in the Panorama Baru Ngarai Sianok is *R. arnoldii* is known as the "Akar Paruik Babi", which infects the host, *Tetrastigma leucostaphylum*. Four populations were recorded in Panorama Baru Ngarai Sianok consisting of 18 individuals. The results of the analysis of vegetation in the population found a total of 255 individuals and 48 species consisting of 20 genus. Calculation of Important Value Index (IVI) found in tree vegetation dominated by *Ficus fistulosa* (Moraceae) with a value of 32.37%, belta

vegetation dominated by *Coffea canephora* (Rubiaceae) species with a value of 63.53%, and *C. canephora* seedlings with a value of 141, 24%. Analysis of the main components found three abiotic factors that positively correlated with the presence of *R. arnoldii* including environmental humidity (RH.l), soil pH (pH) and host tree diameter (DPi).

ACKNOWLEDGMENT

The author is grateful to the West Sumatra Provincial Government Office for National Unity and Politics, and the Natural Resources Conservation Center, which has given research permits. The author would like to thank the field survey team who helped during the investigation of Uda Ramdi, Ridho Affan, M S.Hut, Zulhendra, M.Si, and Bima Firmantara, S.Pd and also to given support Dr. Fitmawati.

REFERENCES

Ali, M.A., Agus H., & Zuhud, E.A. (2015). Kajian karakteristik habitat *Rafflesia* (*Rafflesia patma* Blume) di Cagar Alam Bojonglarang Jayanti, Cianjur, Jawa Barat. *Media Konservasi, 20*(1), 9-14.

Barcelona, J.F., Manting, M. M. E., Arbolonio, R. B., Caballero, R. B., & Pelser, P. B. (2014). *Rafflesia mixta* (*Rafflesiaceae*), a new species from Surigao del Norte, Mindanao, Philipines. *Phytotaxa, 174*(5), 272-278, doi: 10.11646/phytotaxa.174.5.3.

Dolezal, J,. & Srutek, M. (2002). Altitudinal Changes in Composition and Structure of Mountain-Temperate Vegetation: A Case Study from Western Carpathians. *Journal Plant Ecology*, *158*(16), 201-221.

Hidayati, S.N., & Walck, J. L. (2016). A Review of the Biology of *Rafflesia*: what do we know and what's next? *Buletin Kebun Raya, 19*(2), 67-78. doi: 10.1177/2F1940082918796011.

Hikmat, A. (1988). Kajian karakteristik lingkungan biotik *Rafflesia* (*Rafflesia zollingeriana* Kds) di Taman Nasional Meru Betiri Jawa Timur. *Skripsi*, Institut Pertanian Bogor. Bogor.

Kedri, F.K., Hamzah, Z., Sukri, N. S., Yaacob, S. H., Majid, N. K. S. A., Mokhtar, N., & Amir, S. F. (2018). Dsitribution and ecology of *Rafflesia* in Royal Belum State park, Perak, Malaysia. *International Journal of Engineering & Technology* 7, 292-296, doi: 10.14419/ijet.v7i2.29.13335.

Krebs, C. J. (1989). *Ecological methodology.* Harper & Row, New York.

Meijer, W. (1984). New species of *Rafflesia* (*Rafflesiaceae*). *Blumea 30*(1), 209-215.

Mokhtar, N., Zulhazman, H., Siti, M. M. Y., Wan, N. N., Wan, A., & Latiff, A. (2016). *Tetrastigma hookeri* (Laws.) Planch (*Vitaceae*), a host plant for *Rafflesia kerrii* Meijer in Peninsular Malaysia. *Malayan Nature Journal, 68*(1,2), 33-39.

Mursidawati, S. (2012). Morfologi buah dan biji *Rafflesia patma* dan *R. arnoldii*. *Buletin Kebun Raya, 15*(1), 20-29.

Mursidawati, S., & Irawati. (2017). *Biologi konservasi Rafflesia.* LIPI Press, Jakarta. Nais, J. (2001). *Rafflesia of the World*. Sabah Parks, Kota Kinabalu.

Nikolov, L.A., Endress, P. K., Sugumuran, M., Sasirat, S., Vassebutr, S., Kramer, E. M., & Davis, C. C. (2013). Developmental origins of the world's largest flower, *Rafflesiaceae*. *Proceedings of the National Academy of Sciences 46*(110), 18578-18583, doi: 10.1073/pnas.1310356110.

Pelser, P.B., Nickren, D. L., Gemmill, C. E. C., & Barcelona, J. F. (2017). Genetic diversity and structure in the Philipine *Rafflesia lagasacae* complex (*Rafflesiaceae*) inform its taxonomic delemitation and conservation. *Systematic Botany, 42*(3), 543-553.

Peters, R.F., & Ting, Y. Y. (2016). Protection of *Rafflesia* through the appreciation of the Dusun's indigenous knowledge; a preliminary case study at Poring-Sabah. *Journal of Tropical Biology & Conservation,* (13), 27-42.

Pranata, S., Sulistijorini, N., & Chikmawati T. (201). Ecology of *Rafflesia arnoldii* (Rafflesiaceae) in Pandam Gadang West Sumatra. *Journal of Tropical Life Sciences*, 9(3), 243-251, http://dx.doi.org/10.11594/jtls.09.03.05.

Pranata, S., Sofiyanti, N., & Fitmawati. (2016). Karakterisasi morfologi *Rafflesia* dan inangnya di kawasan Suaka Margasatwa Bukit Rimbang Bukit Baling Kabupaten Kampar Provinsi Riau. *Junal Riau Biologia, 1*(2), 107-112.

Priatna, D.R., Zuhud, E. A. M., Hadi, S. & Alikorda. (1989). Kajian ekologis *Rafflesia patma* Blume di Cagar Alam Leuweung Sancang Jawa Barat. *Media Konservasi, 2*(2), 1-7.

Rahma, Y., Arma, S. P., & Syamsuardi. (2017). Analisis vegetasi habitat *Rafflesia Gadutensis* Meijer. di Taman Hutan Raya Dr. M. Hatta, Kota Padang. *Journal of Biological Sciences, 4*(2), 196-201.

Ramadhani, D.N., Setiawan, A., & Master, J. (2017). Populasi dan kondisi lingkungan *Rafflesia arnoldii* di Rhino-Camp Resort Sukarajan atas Taman Nasional Bukit Barisan Selatan (TNBBS). *Jurnal sylva lestari, 5*(2), 128-141.

Rhadhiyah, A. (2017). Potensi biodiversitas Taman Panorama Baru di Kota Bukittinggi dan pengembangannya dalam ekowisata. *Tesis*, Universitas Andalas. Padang.

Sofiyanti, N., Mat-Salleh K., Purwanto, D., & Syahputra, E. (2007). The note on morpologhy of *Rafflesia haseltii* Suringar from Bukit Tiga Puluh National Park, Riau. *Biodiversitas, 1*(9), 257-261.

Triatna, A.E., Hikmat, A., & Basuni, S. (2017). Populasi *Rafflesiam patma* di Leuweung Cipeucang Geopark Ciletuh Sukabumi. *Media Konservasi, 22*(2), 196-204.

Zakaria W.N.F.N., Puad, A. S. A., Geri, C., Zainudin, R., Latiff, A. (2016). *Tetrastigma diepenhorstii* (Miq.) Latiff (*Vitaceae*), a new host of *Rafflesia tuan-mudae* Becc. (*Rafflesiaceae*) in Borneo. *Journal of Botany* (2016), 1-6.

Zuhud, E.A.M. (1987). Flora langka *Rafflesia* sp. dan upaya pelestariannya. *Media Konservasi 1*(3).