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Scientific Article

POPULATION ATTRIBUTES OF THE VERY RARE *Rafflesia bengkuluensis* AT KAUR REGENCY, SOUTHERN BENGKULU

Atribut Populasi dari Tanaman Langka *Rafflesia Bengkuluensis* di Kabupaten Kaur, Bengkulu Selatan

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Abstrak

Kajian populasi jenis-jenis *Rafflesia* sangat jarang dilakukan, meskipun kajian tersebut sangat penting untuk kepentingan konservasi. *R. bengkuluensis* merupakan salah satu jenis *Rafflesia* yang mempunyai ukuran populasi yang paling kecil. Setelah didiskripsikan sebagai jenis baru pada tahun 2005, populasi jenis tersebut mengalami kepunahan secara lokal. Baru tahun 2014, sekelompok penduduk lokal menemukan populasi baru di tempat yang tidak jauh dari populasi awal. Riset kami dimaksudkan untuk mengkaji atribut populasi yang meliputi mortalitas, pertumbuhan kuncup, ukuran populasi pada populasi yang baru ditemukan dan membandingkannya dengan atribut populasi 2007dan 2002. Kami mendefinisikan subpopulasi sebagai jumlah total kuncup di dalam satu inang, sedangkan populasi adalah semua subpopulasi di dalam satu lokasi. Tiap tiap kuncup dipetakan, diukur diameter nya setiap bulan selama empat bulan. Hasil penelitian menunjukkan bahwa rata-rata sub populasi memiliki 4 .75 kuncup dan tidak pernah melebihi 8 kuncup. Struktur populasi didominasi oleh kuncup dengan ukuran kecil atau kurang dari 6 cm diameter. Selama penelitian, jumlah kuncup turun sampai dengan67%. Diantara sebelas subpopulasi yang tercatat, lima diantaranya mengalami 100 % kematian. Sebagian besar kematian terjadi pada kuncup d engan ukuran kurang dari 6 cm. Pola dinamika populasi di atas, juga dialami pada pengamatan populasi oleh Susatya (2007) dan Rahman (2002). Perbandingan dua kelas diameter kuncup memperlihatkan bahwa kelas diameter yang lebih besar mempunyai pertumbuhan kuncup lebih dari 2 x dibandingkan dengan kelas diameter yang lebih kecil. Masa depan populasi *R. bengkuluensis* ini masih tidak jelas, apakah mereka dapat bertahan atau tidak. Untuk mengetahui hal tersebut, maka penelitian yang terperinci dan jangka panjang perlu dilakukan.

Kata kunci : tunas, pertumbuhan , kematian, populasi, *R. bengkuluensis*

Abstract

Population studies of *Rafflesia* are not commonly conducted, although they are a necessary foundation for conservation purposes. *R. bengkuluensis* is a species that has the smallest population sizes among *Rafflesia*

species. Soon after it was first described in 2015, the population was disappeared, until it was rediscovered in 2014 by a small group of villagers. Our research focused on population attributes consisting of mortality, the growth of flower buds, and also on comparisons of the attributes with data collected in 2002 and 2007. We defined a sub-population as all the flower buds on a particular host plant, and a population was all the sub-populations in a single habitat. Each flower bud was documented, mapped, and its diameter measured every month for four months. The results indicated that sub-population consisted of 4.75 flower buds in average and never exceeds 8 buds, and that the population structure was dominated by small sized buds (less than 6 cm in diameter). Over the period of study, the population of flower buds declined by 67%. Among eleven recorded sub- populations, five suffered 100 % loss of their flower buds. Most of the mortality occurred in the small sized buds (<6 cm). Similar patterns were found by Susatya (2007) and Rahman (2002). The comparison between two consecutive diameter classes indicated that the larger class hadan almost double growth rate (195%) than that of its previous class. The future fate of the population was very uncertain whether it would survive. More detailed research on population dynamics should include observations on the recruitment of buds and long term trends.

Keywords: bud, growth, mortality, population, *R. bengkuluensis*

INTRODUCTION

The study of population dynamics on *Rafflesia* species is rarely carried out, even though it has been recognized as foundation for the conservation schemes of the species. Early studies on the population of *Rafflesia* were carried out by Syabudin et al. (1979), Nais (1997), Nais (2001), Hikmat (2006), Musidawati et al (2014), and Wan Arifin (2015). *Rafflesia bengkuluensis* has a very restricted ecological distribution, and has the smallest population size and the highest mortality rate among *Rafflesia* species (Susatya 2011). All existing records of species distribution showed that it had been only found in young secondary forest or abandoned agricultural lands owned privately in the Talang Tais area. Soon after the description of the species in 2005 (Susatya et al. 2005), the Talang Tais population had disappeared, and never recovered. In 2014, a small group of villagers found flowering *Rafflesia* in the coffee plantation of the Padang Guci Valley about 15 km to the northwest of the TalangTais site, and it was later identified as *R. bengkuluensis.* This became a new record of the species, and since then the blooming *Rafflesia* had regularly been reported (Kompala Rafflesia, 2015). The focus of our current research was to determine whether the population attributes of the species were consistent across sites through studying on mortality and growth of the flower bud of these newly recorded populations, and by comparing the population attributes with similar observations carried out by Rahman (2002), and Susatya (2007).

MATERIALS AND METHODS

The recent research was carried out in Padang Guci Hulu, Kaur Regency (Figure 1). The site was 75 m above sea level, and located in a steep slope dominated by old belukar vegetation of Coffea plantation. Local people considered the slope as infertile soil, and call it *Napal.* Local people generally avoided cultivating any agriculture crops in this slope, and let *belukar* and other vegetations to dominate the landscape. Dominant trees on the site was *Ficus variegata, Aglaia oligophylla, and Villebrunea rubescens.* The climatic data from the nearest climatic station, Muara Tetap, indicated that the site was considered as wet tropics, with the average of annual rainfall reached 3194 mm and the average of montly rainfall was 266 mm. Dry months or months with less than 100 mm were rarely observed, and occured from Mei to September.

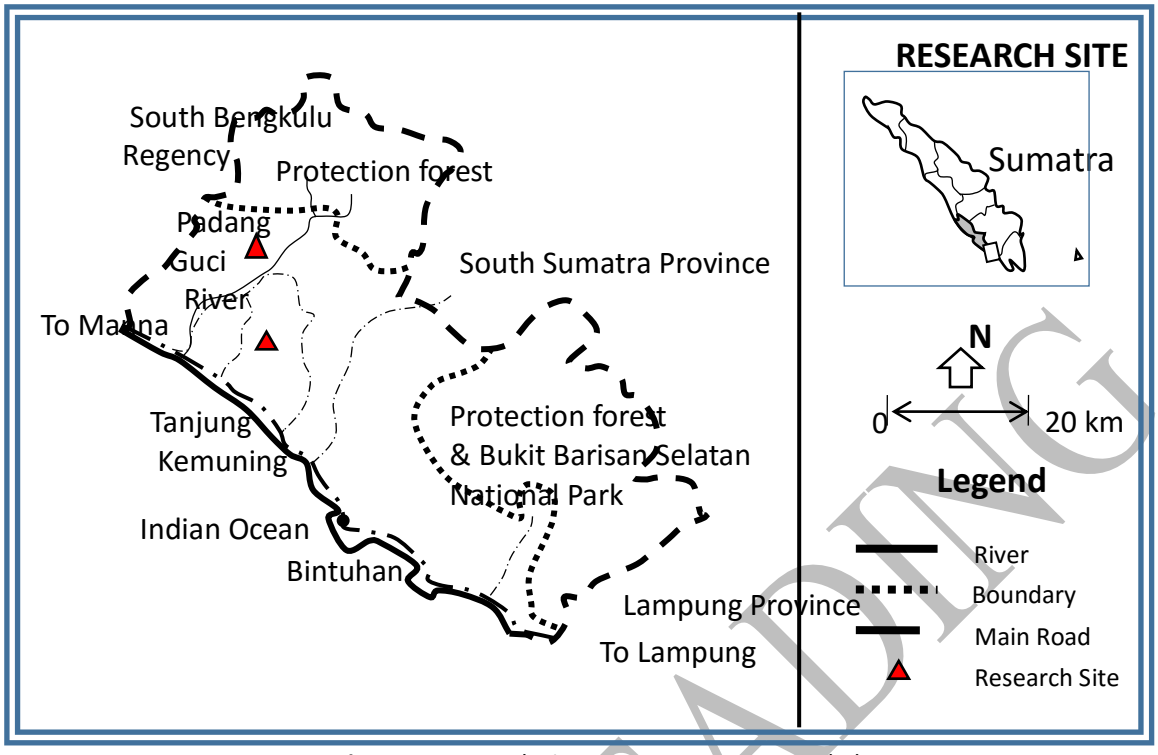

Figure 1. Research site at Kaur Regency, Bengkulu.

Observations and Analyses

We defined a sub-population as all the flower buds on a single host plant, and a population as the total of sub-populations found in the research area. In each sub-population, flower buds were mapped their coordinates, measured its diameter by using caliper, and recorded their fates every month from January to May 2015. This duration of the observation was set up because of the remoteness of the site, and was considered to long enought to capture population dynamics for the short time of period. The mortality rate was determined by the percentage of died buds to the initial population size. The population size was defined as the total number of buds found during the research period. The bud growth rate was defined as the average growth between two consecutive measurements of buds. Data collected by Rahman (2002) and Susatya (2007) were used to compare population attributes of the species. Both Rahman (2002) and Susatya (2007) conducted similar measurements on flower buds to the recent observations, but at different locations at the same area of Padang Guci Valley.

RESULTS AND DISCUSSIONS

Four sub-populations were found in the research sites, with variations in size. The sub-population size ranged from 3 to 8 flower buds with the average size of 4.75 flower buds per sub-population. This was larger than that was found by Rahman (2002) and Susatya (2007). Rahman (2002) found 5 sub-populations. They ranged from 2 to 7 flower buds with the average sub-population size was 3.8 flower buds. Susatya (2007) found only two sub-populations, one with two and the other with three buds. The size of sub-populations of *R. bengkuluensis* were smaller than those of *R. arnoldii* (Susatya 2007), *R. kerrii* (Lau, 2003), *R. keithii* (Nais, 2001), *R. patma* (Hidayati *et al.,* 2000), *R. pricei* (Awang, 2004), and proved that it was the smallest size among the recorded *Rafflesia* species. The population structure was dominated by small flower buds (Figure 2). Buds less than 6 cm in diameter contributed 46 % to 80 % of the total buds. Buds of these sizes were

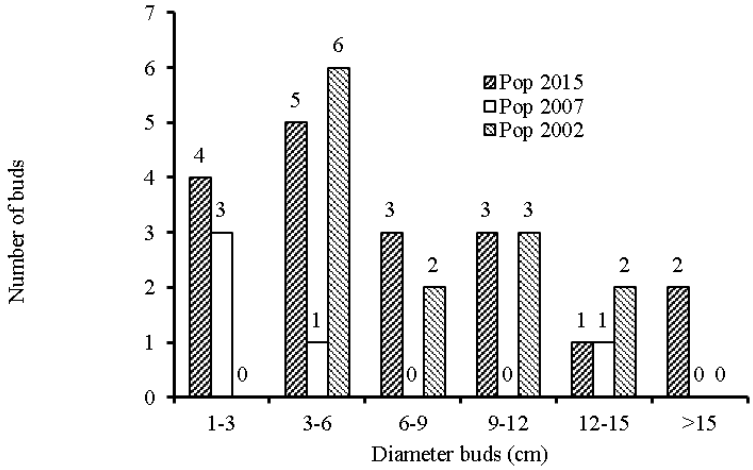

Figure 2. The population sizes of *R. bengkuluensis*. Pop 2015, Pop 2007, and Pop 2002 respectively referred to research carried out by the current research, Susatya (2007), and Rahman (2002).

considered as copula or early bract stages. This skewed pattern of the population structure toward small bud size appears to be common among *Rafflesia* and could be found at *R. arnoldii, R. pricei, R. keithii,* and *R. tengku-adlinii* (Susatya 2007).

During the course of the research, all sub populations suffered high mortality rates, ranging from 12 % to 100 % per month (Figure 3). Prandeka (2016) showed that the average of the mortality per month of *R. bengkuluensis* was 34.72 %, but varied according to sub-populations. Eventually, over the four months observation period, sub-populations were lost an average of 65 % of their total flower buds. Two sub-pulations suffered the highest loss (100%) (Figure 3). At the end of the four month observations, sub-populations had retained only one to three flower buds. The comparison of mortality across sub-populations from different periods indicated that it was common for the sub-population to suffer the high mortality of flower buds. Almost all sub-populations from three different research periods had more than 50 % of the flower bud losses. It was shown by the fact that five of the recorded eleven sub-populations were lost all their buds within less than four months (Figure 4). The maximum mortality had also been observed in one population study of the other species, *R. arnoldii,* in which its four sub-populations suffered the total loss of the flower buds (Susatya 2007). Based on flower bud diameter, mortality in our study occured at buds with the smaller diameters. The diameter class 3-6 cm showed 44 % mortality, the highest among the diameter classes, followed by the diameter class 1-3 cm (30 %), and then 12-15 cm (27%) (Figure 3). Prandeka (2016) showed that 50 % mortality occured at copule phase. A similar pattern was also found in the population study of *R. arnoldii* (Susatya 2007). Susatya (2007) also reported that after exceeding 8 cm in diameter, the buds generally suffered low mortality. All buds of *R. arnoldii*with diameter > 15 cm eventually flowered. In the earlier research, It was also shown that 75 % and 73 % of *R. arnoldii*(Susatya 2007), and *R. bengkuluensis* buds (Susatya et al. 2005) with diameter more than 8 cm were respectively survived and flowered.

We did not know the long term fate of these *Rafflesia* populations; whether they were able to maintain their bud populations and survive through time, or decline and undergo local extinction. There was no conclusive finding on that matter. Batang's Palupuh population of *R. arnoldii* had been able to maintain healthy populations for long periods of time (50 years) (Syabudin *et. al*., 1979; Susatya, 2007). Meijer (1997), based on various source of recorded materials, also reported that *R. patma, R. rochussenii,*

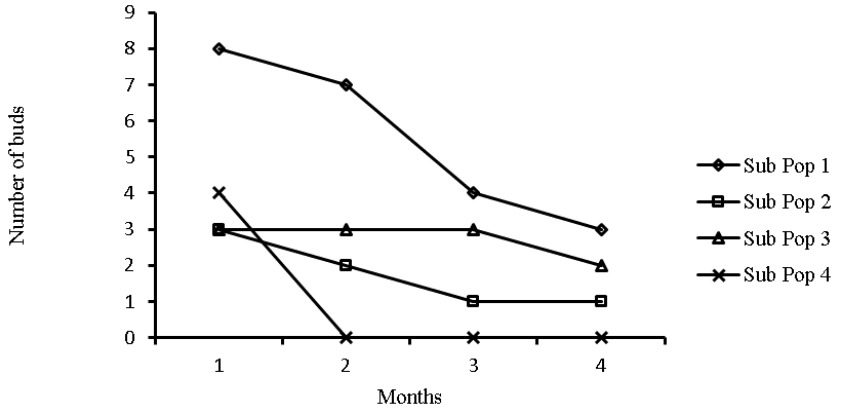

Figure 3. Population dynamics throughout four months observation of four new sub-populations of *R. bengkuluensis.*

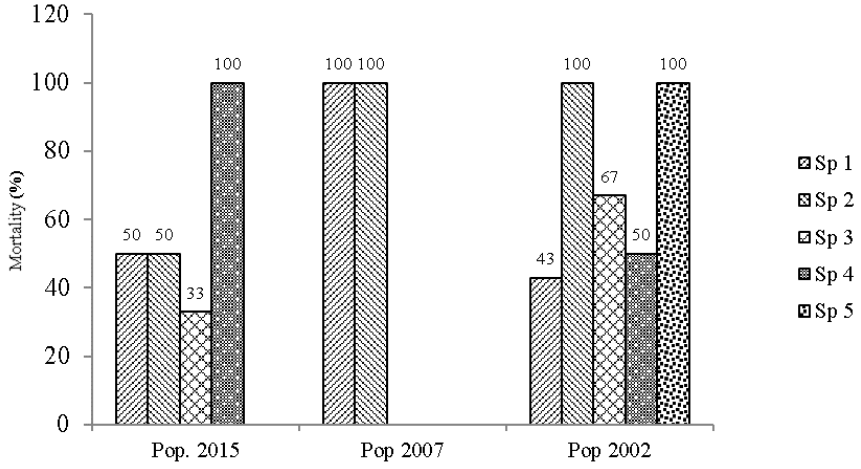

Figure 4. The flower bud mortality of sub-populations (Sp) of *R. bengkuluensis*. Pop 2015, Pop 2007, and Pop 2002 respectively referred to research carried out in the current research, by Susatya (2007), and Rahman (2002).

and *R. arnoldii* transplanted to Bogor Botanical Garden from their original sites could survive for long time. However, Susatya (2011) recorded that many populations of *R. arnoldii* in Bengkulu and *R. bengkuluensis* had disappeared in a short time period.

The growth rate (cm/month) varied according to the bud size. The bigger bud sizes showed the faster rates. The diameter bud class of 1-3 cm had the lowest rate (0.73 cm/month), while the class of > 12 cm showed the highest rate (4.63 cm/month) (Figure 5). The growth rate was almost double (195%) from a certain diameter class to its immediate next class. The growth seemed to follow an exponential model, in which a bud would grow very slow when it was small, and grow exponentially faster as the diameter increased. Susatya (2007) reported a similar model in *R. arnoldii,* and postulated that different sites and hosts could have different growth rates.

We did not intend to know the role of climate or external factors to bud's growth diameter, mortality, and flower initiation in this research, because of the lack of incidences of flowering Rafflesia during the research. Susatya (2007), however, indicated that in addition to the population size, the bud load on a host plant could influence the mortality. The more bud per host plant, the higher rate of mortality would be. Susatya (2011) also speculated the crack on bud because of predations could triger rottening tissues which leaded the bud mortality. Susatya and Yansen (2016) also indicated

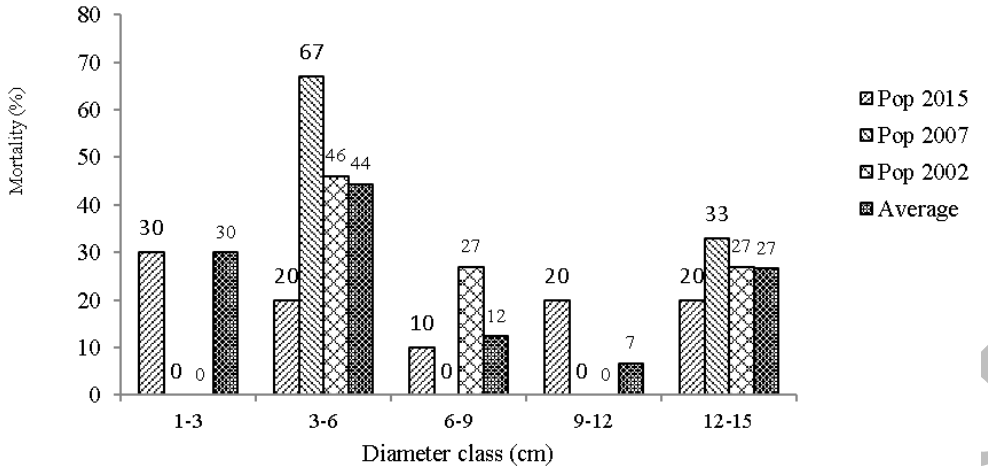

Figure 5 : Mortality according to diameter class. Pop 2015, Pop 2007, and Pop 2002 respectively referred to research carried out by the current research, by Susatya (2007), and by Rahman (2002). The average value was the mean mortality at a given diameter class.

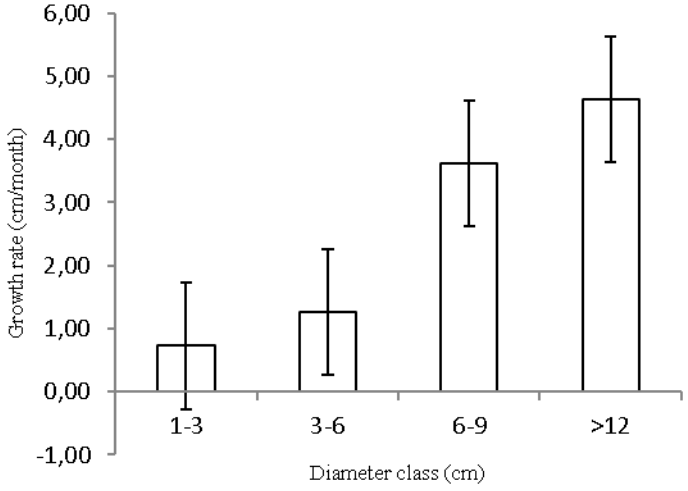

Figure 6: The growth rate (cm/month) of flower buds of *R. bengkuluensis* based on their diameter classes for all three different studies.

that rainfall appeared to have significant effects on the growth of trees, but we did not know whether it could also influence to the growth of the bud. What we could speculate that in addition to climate, the bud load, as well as the phisiological conditions of the host plant would be of importance to influence the growth.

CONCLUSIONS

The population attributes consisting of population size, mortality and the growth of the flower bud of *R. bengkuluensis* were consistent through time. The sub-populationsof *R. bengkuluensis* were very small size with the average size of 4.75 flower buds and never exceeded to eight buds, and considered the smallest among *Rafflesia.* Population structure was dominated by small size buds (less than 6 cm). Among eleven recorded sub-populations from three different studies, five of them suffered 100 % of the flower bud losses. The smaller buds experienced to the higher mortality, than the larger ones. We did not know whether the existing population was able to maintain its viable population for the long term. Growth rate (cm/month) varied according to the bud size, and fitted an exponential growth model. More detailed population studies including studies on recruitment rate and the factors influencing the population dynamics were suggested to be carried out to predict the future fate of *Rafflesia.*

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