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Population Distribution of *Amorphophallus* at Several Altitudes in Mount Poteng, Raya Pasi Nature Reserve, West Kalimantan

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ABSTRACT

Amorphophallus is a protected and endangered plant. Some *Amorphophallus* species can only grow in certain environmental conditions. Differences in environmental conditions could cause differences in morphology and distribution of *Amorphophallus*. This study aimed to obtain the morphological characteristics of *Amorphophallus* and study the distribution of its population at several altitudes in Mount Poteng, Raya Pasi Nature Reserve, West Kalimantan. The study used an exploratory survey following the river's flow at the Raya Pasi Nature Reserve, especially in Mount Poteng. The results found three species of *Amorphophallus*: *Amorphophallus borneensis* (109 individuals), *Amorphophallus gigas* (9 individuals), and *Amorphophallus hewittii* (27 individuals), showing clustered distribution patterns with a Morista index of > 1. The similarity index of six comparisons for each altitude showed five altitudes with similar categories and one altitude with a very different category. The results revealed that the *Amorphophallus* distribution positively correlated with air temperature and soil temperature but negatively correlated with air humidity. However, all correlations were weak. The morphological differences of the three *Amorphophallus* species were in the forms of the stem pattern, stem height, and fruit shape. The distribution of *Amorphophallus* can be found at an altitude of 200 – > 500 masl, which is not far from the river flow.

1. Introduction

Nature reserve has the uniqueness of plants, plant diversity, natural phenomena, and ecosystems that need to be protected and preserved so that their existence and development can occur naturally (KLHK 2020). One of the nature reserves in West Kalimantan is the Raya Pasi Nature Reserve. The nature reserve has a total area of 3,700 ha, located in Singkawang City and Bengkayang Regency, West Kalimantan Province. The Raya Pasi Nature Reserve management is under the Conservation Unit III Singkawang, Natural Resources Conservation Agency (BKSDA) of West Kalimantan. Raya Pasi Nature Reserve consists of 10 mountains, including Mount Poteng, with an altitude of ± 725 masl. Mount Poteng has many unique and protected flora and fauna, such as bunga bangkai (*Amorphophallus*). Based on Government Regulation (PP) of the Republic of Indonesia Number P.106 of 2018, *Amorphophallus* is listed as a protected plant. *Amorphophallus*, known as bunga bangkai, is also one of the rare flora in Indonesia, which is currently threatened and is under conservation status. *Amorphophallus* was categorized as vulnerable (V) by the 1997 edition of the IUCN Red List of Threatened Species, but in 2002, it was removed from the IUCN Red List of Threatened Species (Arianto et al. 2018; Yuzammi et al. 2014). To date, the research on the presence and population of *Amorphophallus* in Mount Poteng, Raya Pasi Nature Reserve, West Kalimantan is still lacking.

The morphological characteristics of *Amorphophallus* found in Mount Poteng can be distinguished from the stem pattern, stem height, and fruit. The morphology of the *Amorphophallus* can change due to environmental factors of its habitat and growth place, so it is necessary to know its morphological characteristics in Mount Poteng. *Amorphophallus* can be distinguished by the stem color, stem pattern, surface color of the tuber, and leaves color (Aisah et al. 2017). *Amorphophallus* requires specific environmental conditions. Hence, the species is rarely found because it only grows in locations with a certain altitude. Altitude affects the population of *Amorphophallus* on Mount Poteng, so it is necessary to know the distribution of *Amorphophallus* at each altitude. Altitude is one of the environmental factors related to where plants grow, the difference in altitude will affect the growth of a plant related to temperature, humidity, and light intensity. Research by Saragih et al. (2015) said that the *A. hewittii* species could be found at an altitude of 101–200 masl. Therefore, *Amorphophallus* can be found on Mount Poteng at an altitude of 200–500 masl and decreases above it to the peak (725 masl). In contrast, the research results of Heriyansyah et al. (2017) showed that the altitude range for *Amorphophallus* is 50–846 masl.

The population of *Amorphophallus* has decreased from year to year. For example, Yuzammi et al. (2015) found that in Kapahiang, Bengkulu Regency, the *Amorphophallus* population was less than 50 individuals, with a population distribution growing in groups. If this situation is ignored without any attention from relevant parties, it could cause the extinction of *Amorphophallus* in nature. However, there is still no information on studies that reported the distribution of *Amorphophallus* at several altitudes. In particular, the distribution of *Amorphophallus* at several altitudes in Mount Poteng. It is hoped that knowing the distribution pattern of *Amorphophallus* can provide input for further conservation management so that the extinction does not occur. Therefore, this study aimed to obtain the morphological characteristics of *Amorphophallus* and study the distribution of its population at several altitudes in Mount Poteng, Raya Pasi Nature Reserve, West Kalimantan.

2. Materials and Methods

2.1. Study Area

The study was carried out from July to August 2020 in Mount Poteng at an altitude of 200 to > 500 masl in the Raya Pasi Nature Reserve area, West Kalimantan (**Fig. 1**). The study used an exploratory survey following the river's flow at the Raya Pasi Nature Reserve, especially in Mount Poteng. Field observations of *Amorphophallus* were conducted based on an altitude of 200 – <300 masl, 300 – < 400 masl, 400 – < 500 masl, and > 500 masl, starting from the boundaries of the Raya Pasi Nature Reserve in Mount Poteng and following the Poteng River stream.

2.2. Data Collection

Observations and data collection were carried out on the species and number of *Amorphophallus* found in each altitude group. Then, environmental data were collected at every point where *Amorphophallus* was found. The environmental data were measured, including light intensity, air temperature, air humidity, soil solum thickness, soil temperature, and soil pH. Air temperature and humidity were measured using a thermohygrometer. The light intensity was measured using a lux meter, soil temperature was measured using a soil thermometer, soil pH was measured using a pH meter, and soil solum thickness was measured using a scaling pole.

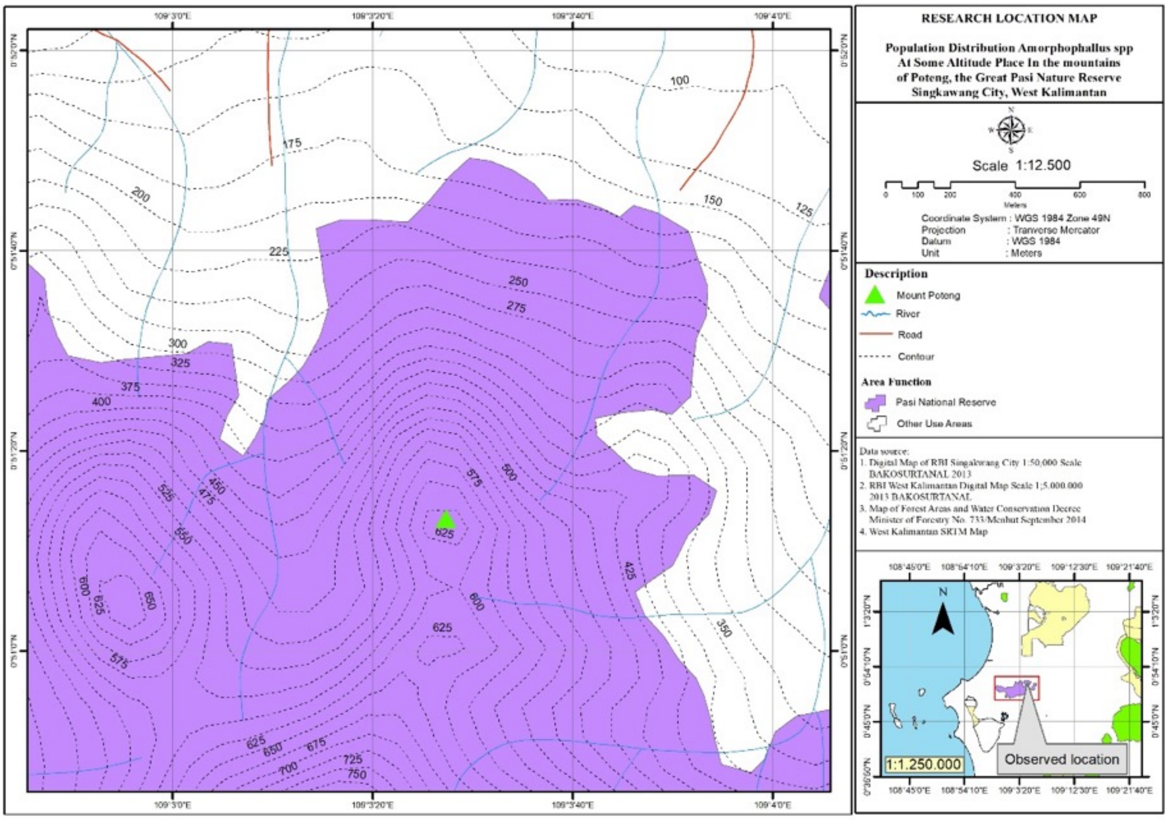

Fig. 1. Research location in Mount Poteng, Raya Pasi Nature Reserve, West Kalimantan.

Data collection of *Amorphophallus* was started from the boundaries of the Raya Pasi Nature Reserve with an altitude of 200 masl, from the left of the Poteng River by drawing the river's width with a radius of 20 m (**Fig. 2**). After reaching 20 m, the direction of the path was then pulled up until it was reached the altitude of 533 masl. The direction of the 20 m path was divided into two 10 m each to facilitate the accuracy of data collection. After finishing on the left of the Poteng River, it was continued on the right side of the Poteng River with the same conditions.

2.3. Data Analysis

2.3.1. Morista index

The Morista index formula was used to determine the distribution pattern of the *Amorphophallus* species and calculated using the following equation (Khairil et al. 2015).

$$I_\delta = N \frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x} \quad (1)$$

where N is the total number of samples and x is the number of individuals. If I_δ of 1 = random distribution, $I_\delta < 1$ = uniform distribution, and $I_\delta > 1$ = group distribution.

In addition, to determine the distribution pattern of *Amorphophallus* at each altitude of Mount Poteng, the data were presented spatially in the form of a distribution map per height. The distribution map was developed by entering the coordinates from the Global Positioning System (GPS) tracker into the base map (Map of Mount Poteng, Raya Pasi Nature Reserve).

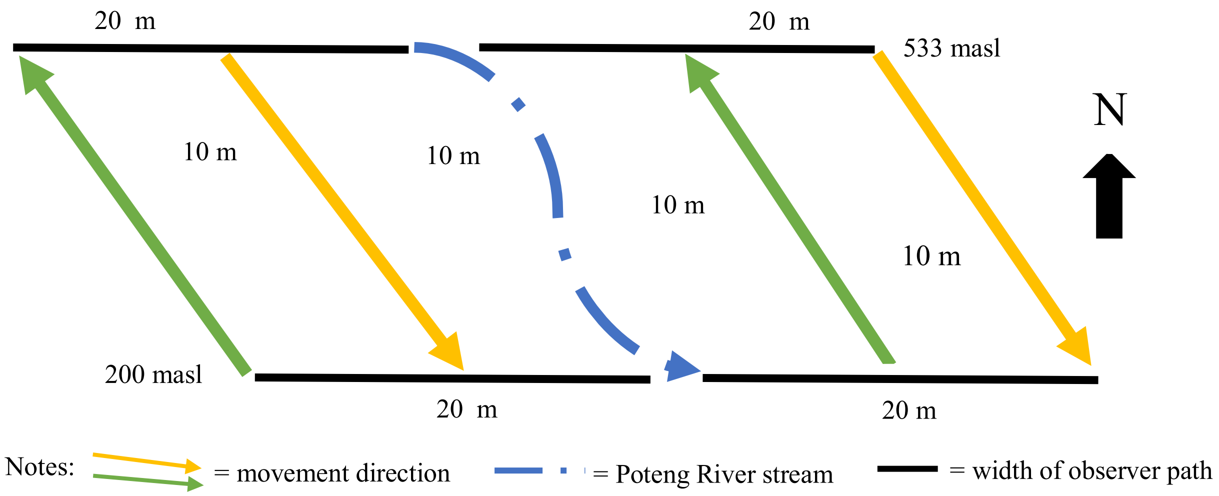

Fig. 2. Research path scheme.

2.3.2. *Similarity index*

The similarity index (*SI*) was used to compare among altitudes using the Sorensen formula (Tarida et al. 2018).

$$SI = \frac{2C}{A + B} \times 100\% \quad (2)$$

where *C* is the same number of species found in both communities, *A* is the number of species in community *A*, and *B* is the number of species in community *B*.

2.3.3. *Relationship of environmental factors with Amorphophallus*

The relationship between environmental factors and the distribution of *Amorphophallus* was determined by comparing the distribution of *Amorphophallus* with the results of measurements of environmental factors such as light intensity, air temperature, air humidity, soil pH, soil temperature, and soil solum from several altitudes. The data were then analyzed to find the correlation value using the IBM SPSS Statistics application.

3. Results and Discussion

3.1. *Amorphophallus Species in Mount Poteng*

The results found three *Amorphophallus* species at several altitudes of Mount Poteng, Raya Pasi Nature Reserve, namely *Amorphophallus borneensis, Amorphophallus gigas,* and *Amorphophallus hewittii*. The morphological differences of the three *Amorphophallus* were in the forms of the stem pattern, stem height, and fruit shape.

A. borneensis has a height of up to 180 cm. The young saplings have leaf buds that are still rolling, which will later bloom and be divided into three branches with a maximum height of 90 cm (**Fig. 3a**). The color of the leaves is light green to dark green with an oval leaf shape, pinnate leaf blade, pointed leaf tip, and compound leaves (**Fig. 3b**). The stem grows upright above the tuber in the ground, so it is called a single stem or pseudo-stem. Adult stems are divided into three branches and then subdivided into 2-3 sub-branches, light green to dark green in color, smooth surface and has a mottled pattern of white, round, pale green to dark which covers the surface of the trunk with various shapes (**Fig. 3c**). The fruit is a compound fruit, green when young and reddish yellow when old, oval-shaped fruit that varies in size and has a black butt at the end of the fruit (**Fig. 3d**).

Fig. 3. Morphology of *A. borneensis*: (a) young leaves and tillers, (b) leaves, (c) stem pattern, and (d) fruits.

The results showed that *A. borneensis* in Mount Poteng had similar morphology with *A. paeoniifolius* in the Palu Valley in the forms of the stems, leaves, and fruit. *A. paeoniifolius* could reach a height of 1.5–2 m, pseudo-stem is round in shape, light green to dark green, and has white spots. The surface is speckled, and the stem is divided into three branches. The leaves of *A. paeoniifolius* are light to dark green, and the tips are tapered. The fruit is green to orange when unripe, which turns to red when ripe, and inside of the fruit, there are 1–2 seeds with oval shape (Jintan et al. 2015). Hidayat (2019) stated that *A. paeoniifolius* is a strong herbal plant with 1.0–1.5 m high.

A. gigas has a height of up to 250 cm and a smooth stem surface patterned with small greenish-white stripes that vary on each stem surface (**Fig. 4a**). *A. gigas* has compound leaves, light green to dark green color, wide with oval leaves, pinnate leaf blades, and has pointed leaf tips (**Fig. 4b**). The large stem is dark green, and the stem is a pseudo-stem that grows on tubers in the ground. The stem has three branches and is further divided into 2–3 sub-branches (**Fig. 4c**). The morphology of *A. gigas* in Mount Poteng has similarities with *A. titanum* in terms of the morphology of the stem, which has a length of up to 5 m with a smooth stem surface, green or dark green color with oval to rounded spots varying in size and shape, pale green, and the leaves are ellipse, green, and pointed at the tip (Yuzammi et al. 2015).

A. hewiitti found at Mount Poteng has a height of up to 180 cm, the color of the stem is green, and the surface of the stem is slightly rough with small greenish-white stripes with various shapes covering the surface of the stem (**Fig. 5a**). The leaf of *A. hewiitti* is compound leaves, oval shape, lined blades, pointed tips, and has light green to dark green color (**Fig. 5b**). The adult stem is divided into three branches divided into 2-3 sub-branches, while the saplings have three-leaf branches and a maximum height of 100 cm (**Fig. 5c**). The fruit is round in shape, and it is green when young and yellow when ripe, with a black tip at the end of the fruit (**Fig. 5d**).

Fig. 4. Morphology of *A. gigas:* (a) stem pattern, (b) leaves, and (c) mature plant.

Fig. 5. Morphology *A. Hewittii*: (a) stem pattern, (b) leaves, (c) tillers, and (d) fruits.

Saragih et al. (2015) also found *A. hewittii* species at an altitude of 101 - 200 masl, showing the stem height of up to 180 cm, rough stems with green and purple color, and small white spots covering the entire stem surface. The cubs have three green leaf branches with white spots with a maximum height of 100 cm, while the adults have a height of 180 cm with three main leaf branches and are further divided into 2-3 leaf branches. The fruit is green when it is not ripe and yellow when ripe. The leaves are green, oval in shape, and the tip of the leaf is pointed.

3.2. Distribution of Amorphophallus at Each Altitude

Based on the distribution map of *Amorphophallus* at several altitudes on Mount Poteng, it shows that the distribution of *Amorphophallus* can be found from an altitude of 200 - > 500 masl with a distance not far from the river stream (**Fig. 6**). The distribution map of *Amorphophallus* found in Mount Poteng shows that *A. borneensis* is more common than *A. gigas*. It might be due to *A. borneensis* is one of the endemic *Amorphophallus* species of West Kalimantan. Therefore, it has the best adaptability among the three *Amorphophallus* species. This tendency proved that *A. borneensis* could adapt to forest environmental conditions at different altitudes. Aji et al. (2018) explained that *Amorphophallus* spp. can grow in all soil conditions except on swampy or brackish soils and grows well in soils that contain high organic matter with a pH of 6–7.5. Meanwhile, *A.*

gigas was the least in number because *A. gigas* was included in the endemic *Amorphophallus* species of Sumatra, so it had poor adaptability compared to the three *Amorphophallus* species. Data on the number of *Amorphophallus* individuals based on altitude on Mount Poteng is shown in **Table 1**.

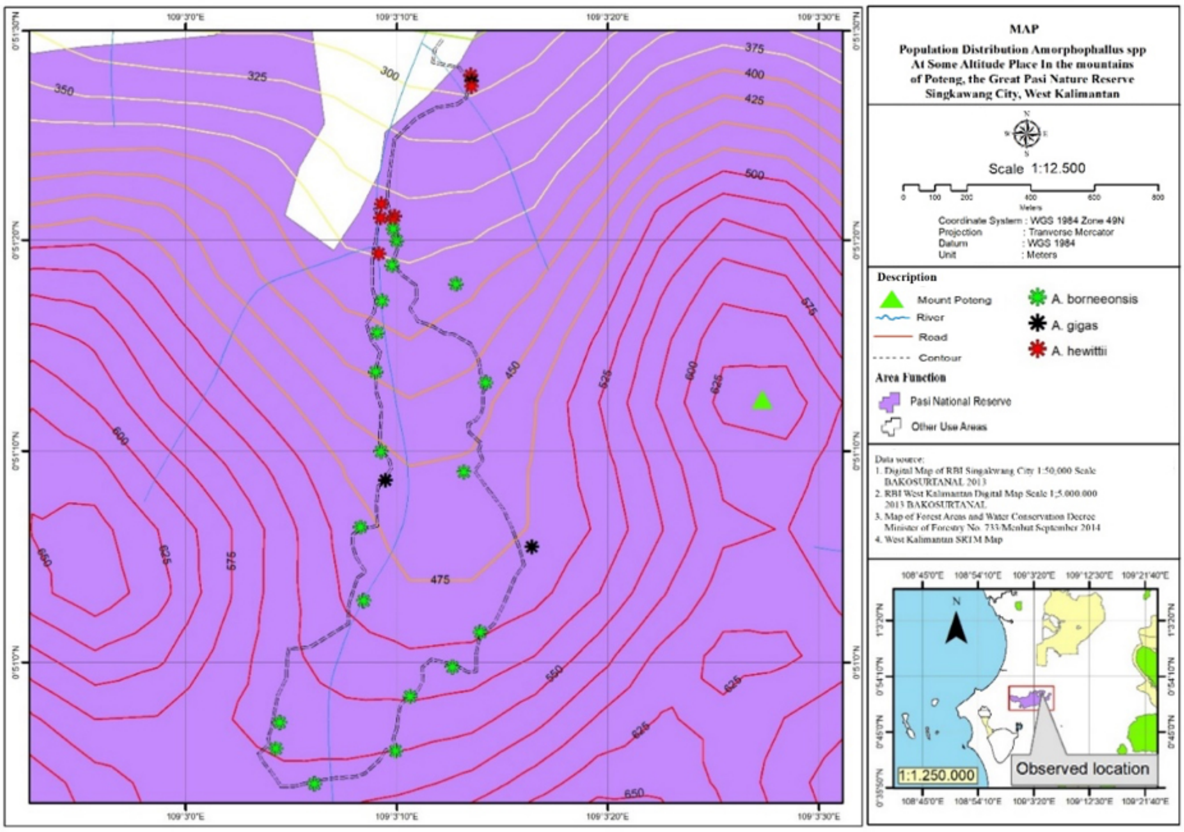

Fig. 6. *Amorphophallus* distribution at each altitude.

Table 1 shows that *Amorphophallus* was most commonly found at an altitude of 300 - < 400 masl (72 individuals) and the least at an altitude of > 500 masl (6 individuals). It might be due to the lack of water sources with the increase in altitude. All *Amorphophallus* found at an altitude of 300 - < 400 masl are not far from the river stream compared to *Amorphophallus* at an altitude of > 500 masl, which is far from the river stream and lots of rocks. According to Nursanti et al. (2019), the population of *A. titanium* was always found not far from water sources because a good hydrological cycle was an essential factor for the growth of *Amorphophallus*. The pH of the soil at an altitude of > 500 masl is classified as acidic pH (pH 5.38) and the lowest compared to other altitudes. Therefore, *Amorphophallus* plants grow well in soils with a pH of 6.0–7.5 (Supriati 2016). However, according to Aji et al. (2018), *Amorphophallus* spp. can grow in all soil conditions except swamp or brackish soil and grows well in soils with high organic content.

Table 1. Number of *Amorphophallus* species based on altitude in Mount Poteng

Species	Altitude (masl)				Total
	200 - < 300	300 - < 400	400 - < 500	> 500	
Amorphophallus borneensis	-	57	46	6	109
Amorphophallus gigas	7	-	2	-	9
Amorphophallus hewittii	12	15	-	-	27
Total	19	72	48	6	145

3.3. Morista Index

The Morista index was used to determine the distribution pattern of a species, whether it is classified as random, clustered, or uniform. The value of the Morista index of three *Amorphophallus* species at several altitudes is presented in **Table 2**.

Table 2. Morista index (I_δ) of *Amorphophallus* species at several altitudes

Species	Altitude (masl)				Number	I_δ
	200 - < 300	300 - < 400	400 - < 500	> 500		
A. borneensis	-	57	46	6	109	1.79
A. gigas	7	-	2	-	9	2.44
A. hewiitti	12	15	-	-	27	1.95
Total	19	72	48	6	145	

Table 2 shows that the results of the morista index calculation for the three *Amorphophallus* species found in the research location have a value of more than one ($I_\delta > 1$). Therefore, the distribution pattern was categorized as clustered. Our result was in line with the previous studies (Arianto et al. 2018; Nursanti et al. 2019; Saragih et al. 2015), stating that the distribution of *Amorphophallus* is clustered. The clustered distribution pattern is common in nature. The condition of clustered distribution illustrated that *Amorphophallus* has a relatively similar growth place. Group dispersal also occurred because of the earth's gravity and water flow on the forest floor, which carries *Amorphophallus* flower seeds to the forest floor (Arianto et al. 2018). Porang (*Amorphophallus muelleri*) grows wild in several areas in the Jember district from a clustered or random distribution pattern because Porang grows naturally (Sari et al. 2013).

3.4. Similarity Index

The similarity index value shows the similarity of the *Amorphophallus* individual number from different altitudes compared. The results showed that the overall altitude comparisons have similar values of similarity index, except one altitude comparison (200 - < 300 and > 500) has a very different category value (**Table 3**). This is because the number of individuals from species that are not found at the altitudes compared and the environmental factors present at each altitude is different, allowing for the spread of species that are not always present at all altitudes but at different altitudes. Fitria et al. (2019) also reported that the differences in the communities were due to the different environmental factors in the two locations being compared. Destaranti et al. (2017) stated that the species similarity index value is affected by the number of individuals of the same species between the two communities being compared.

Table 3. The similarity index values at each altitude

No	Altitude (masl)	Similarity index (%)
1	200 - <300 and 300 - <400	50.00
2	200 - <300 and 400 - <500	50.00
3	200 - <300 and >500	0.00
4	300 - <400 and 400 - <500	50.00
5	300 - <400 and >500	66.67
6	400 - <500 and >500	66.67

3.5. Habitat and Growth Place of Amorphophallus

The height and the amount of vegetation and the altitude of a place, light intensity, humidity, and air temperature can affect the spread and growth of *Amorphophallus* itself. Altitude is closely related to environmental factors. The difference in altitude causes variations in the habitat in the form of differences in temperature and humidity. This difference will affect the mosses and cyanobacteria that give the appearance of the pseudo-stem of *Amorphophallus*. Thus, in this study, the same species, namely *A. gigas*, was found at different altitudes, showing slightly different stem patterns (**Fig. 7**). The mimicry of mosses and cyanobacteria causes the stem pattern in *Amorphophallus*. Claudel et al. (2019) explained that in moist habitats, cyanobacteria and mosses are commonly found to grow together on tree trunks. Their coloration and pattern on leaf stalks with a visual resemblance to tree trunks surrounded by similar cyanobacteria and leaf stalk appearance are often bluish-green or brownish-red. These morphological differences can also occur in different species.

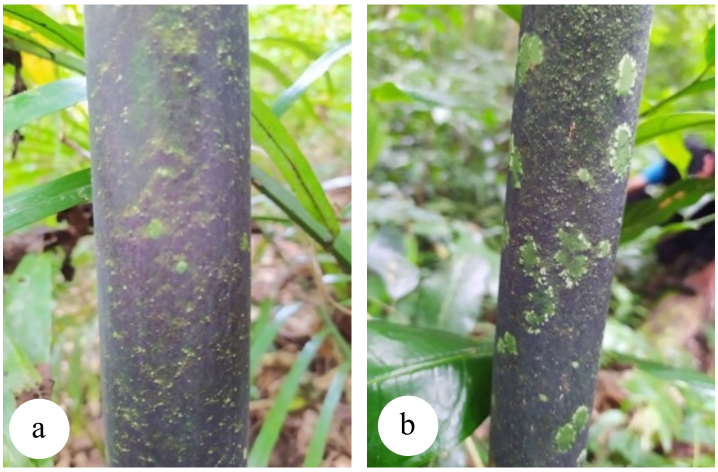

Fig. 7. Stem pattern of *A. gigas:* (a) 200 - < 300 masl, and (b) 400 - < 500 masl.

The growth places of *Amorphophallus* in the research location were on the forest floor, forest edges, river flows, and rocky areas. However, it was found more dominant around the river. Hidayat (2019) said that the population of *A. paeoniifolius* is mostly clustered along forest edges, vacant land, riverbanks, or conservation forest edges. So naturally, *Amorphophallus* sp. was spread in the Sumatran rain forest as understorey canopies on calcareous soils. However, *Amorphophallus* sp. was also found in open areas of secondary forests, roadsides, riverbanks, or forest edges (Latifah and Purwantoro 2015).

3.6. Environmental Factors of Amorphophallus Growth Place

A natural succession process naturally causes the number of *Amorphophallus*. The environmental conditions of its growth place also affect the population distribution in Mount Poteng. The measurements at the research location show that the environmental factor that increases with every increase in altitude is air humidity, while air temperature decreases with every increase in altitude (**Table 4**).

Table 4 shows that air temperatures tended to decrease with the increase of altitude, showing an average air temperature ranging from 24.43–25.90°C. This is because the condition of the area is slightly covered by vegetation, and the weather conditions were cloudy at the time of the study, so only less sunlight entered the forest floor. Another study also said that *A. titanum* sites in Muara Hemat Village have an average temperature of 24–25°C (Nursanti et al. 2019), while *A. hewittii* sites have an average temperature of 24.20–27.20°C (Saragih et al. 2015). The relative humidity showed a different tendency, showing an increase of relative humidity with the increase of altitude. This is because the area is covered by vegetation, resulting in less light intensity entering the forest floor. The relative humidity in this area is between 86.57–90.10% (**Table 4**). In contrast, Nursanti et al. (2019) stated that the relative humidity of *A. titanium* is between 80-83%.

Table 4. The results of the average measurement of environmental factors at several altitudes

Environmental Factors	Altitude (masl)			
	200 - <300	300 - <400	400 - <500	>500
Light intensity (lux)	181.00	318.08	301.56	144.00
Air temperature (°C)	25.90	25.61	24.82	24.43
Relative humidity (%)	86.57	88.28	89.71	90.10
Soil solum (cm)	6.33	6.31	6.00	6.75
Soil pH	6.03	5.42	5.48	5.38
Soil temperature (°C)	25.67	24.77	24.67	25.00

3.7. Relationship of Environmental Factors and Amorphophallus Distribution

The relationship between environmental factors and *Amorphophallus* determines the direction of the close relationship between two variables, whether positive or negative. **Table 5** shows the highest correlation value obtained from each environmental factor that affects *Amorphophallus* distribution. The overall results of correlation analysis of the three *Amorphophallus* species showed that the correlations are within a weak category.

Table 5. The correlation analysis results on the number of *Amorphophallus* distribution

Species	R-squared	Regression equation
A. borneensis	0.035	$Y = -24.43 + 1.12X$
A. gigas	0.358	$Y = -27.87 + 1.13X$
A. hewittii	0.414	$Y = 62.38 - 0.69X$

The relationship between air temperature and *A. borneensis* distribution shows an R-squared value of 0.035. It can be interpreted from the regression equation ($Y = -24.43 + 1.12X$) that for every 1% addition of air temperature, the number of *A. borneensis* will increase by 1.12 (1%). The regression coefficient is positive, so it can be said that the direction of the influence of the variable X on Y is positive. The average air temperature ranges from 24.43–25.9°C, which decreases with every increase in altitude. Saragih et al. (2015) reported that *A. hewittii* was found at 24.2–27.2°C. Because air temperature does not dominate the distribution of *A. borneensis*, the interaction with abiotic factors such as river flow might affect *A. borneensis* distribution as the plants are mostly found not far from the river stream compared to those far from the river stream. Another study reported that the population of *A. titanum* was mainly found not far from water sources because a good hydrological cycle is an essential factor for the growth of *Amorphophallus* (Nursanti et al. 2019).

The relationship between soil temperature and *A. gigas* distribution shows an R-squared value of 0.035, meaning that 36% of the distribution was influenced by soil temperature; the rest were other factors. The regression equation ($Y = -27.87 + 1.13X$) states that for every 1% increase in soil temperature, the amount of *A. gigas* will increase by 1.13 (1%). The regression coefficient is positive, so it can be said that the direction of the influence of the variable X on Y is positive. The mean soil temperatures at an altitude of 200 - < 300 masl and 400 - < 500 masl where *A. gigas* was found were 25.67°C and 24.67°C, respectively (**Table 4**). In contrast to the soil temperature, the soil pH decreased with each increase in altitude, while soil solum showed inconsistent tendency with the increase of altitude. Supriati (2016) stated that *Amorphophallus* grows well in soils with a pH of 6.0–7.5. In addition, Aji et al. (2018) stated the optimal soil temperature for *Amorphophallus* spp. ranges from 22–30°C.

The relationship between relative humidity and *A. hewittii* distribution shows an R-squared value of 0.414, meaning that 40% of the total distribution was influenced by relative humidity and other factors. The regression analysis results with the equation $Y = 62.38 - 0.69X$ stated that every 1% increase in relative humidity would reduce 1% the number of *A. hewittii*. The regression coefficient is negative because *A. hewittii* can grow well in low humidity. The altitude of a location is closely related to light intensity, air temperature, and humidity. Mulyati et al. (2017) stated that physical factors such as temperature, soil pH, humidity, and light intensity strongly influenced the survival of *Amorphophallus*. Saragih et al. (2015) stated that the growth and distribution of *A. hewittii* were influenced by a combination of tree-level and pole-level vegetation and the altitudes of the location.

4. Conclusions

The differences in morphological characteristics of the three *Amorphophallus* species found in Mount Poteng were in the forms of the stem pattern, stem height, and fruit shape. Based on the altitude on Mount Poteng, the distribution of *Amorphophallus* can be found at an altitude of 200 – <500 masl, which is mainly not far from the river stream. The distribution pattern is all clustered. The species similarity index of six comparisons for each altitude showed five altitudes with similar categories and one altitude with a very different category. This study also revealed that *Amorphophallus* distribution positively correlated with air temperature and soil temperature but negatively correlated with air humidity.

References

Aji, L. M. I., Wahyuningsih, E., and Patoni, P. 2018. Identifikasi Hasil Hutan Bukan Kayu Genus *Amorphophallus* di Desa Satong Kecamatan Kayangan Kabupaten Lombok Utara. *Jurnal Belantara* 1(2): 107-114. DOI: 10.29303/jbl.v1i2.71

Arianto, W., Zuhud, A. M. E., Hikmat, A., Sunarmito, T., and Siregar, I. Z. 2018. Populasi dan Struktur Kompoisi Vegetasi Habitat Bunga Bangkai (*Amorphophallus titanum* [Becc] Becc.EL Arcang) di Kawasan Hutan Bengkulu. *Journal of Natural Resources and Environmental Management* 9(2): 241-257. DOI: 10.29244/jpsl.9.2.241-257

Aisah, N. B., Soegianto, A., and Basuki, N. 2017. Identifikasi Morfologi Dan Hubungan Kekerabatan Tanaman Porang (*Amorphophallus muellery* Blume) di Kabupaten Nganjuk, Madiun dan Bojonegoro. *Jurnal Produksi Tanaman* 5(6): 1035-1043.

Claudel, C., Yadun-Lev, S., Hetterscheid, and Schultz, M. 2019. Mimicry of Lichens and Cyanobacterial on Tree-Sized *Amorphophallus* Petioles Results in Their Masquerade as Inedible Tree Trunks. *Botanical Journal of Linnean Society of London* 190: 192-214. DOI: 10.1093/botlinnean/boz014

Destaranti, N., Sulistiyani, and Edy, Y. 2017. Struktur dan Vegetasi Tumbuhan Bawah pada Tegakan Pinus di RPH Kalirajut dan RPH Baturraden Banyumas. *Scripta Biologica* 4(3): 155-160. DOI: 10.20884/1.sb.2017.4.3.407

Fitria, F., Widodo, P., and Widyastuti, A. 2019. Keanekaragaman Tumbuhan Bunga Liar di Cagar Alam Batarbolang Pamalang Jawah Tengah. *Jurnal Ilmiah Biologi Unsoed* 1(2): 8-16.

Heriyansyah, F., Soetopo, L., and Sapradi, D. 2017. Eksporasi dan Identifikasi Karakter Morfologi Anaman Suweg (*Amorphophallus campanulatus* BI) di Jawa Barat. *Jurnal Produksi Tanaman* 5(3): 377-382.

Hidayat, S. 2019. The Study of Suweg (*Amorphophallus paeoniifolius*) and Other Undergrowth Species in Teak Plantation Forest of Temengeng, Blora, Indonesia. *Biodiversitas* 20(1): 37-42. DOI: 10.13057/biodiv/d200105

Jintan, Yuzammi, Suwastika, I. N., and Pitopang, R. 2015. Studi Beberapa Aspek Botani *Amorphophallus paeoniifolius* Dennst. Nicolsom (Araceae) di Lembah Palu. *Journal of Natural Science* 4(1):17-31. DOI: 10.22487/25411969.2015.v4.i1.4008

Khairil, M., Dewantara, I., and Widiastuti, T. 2015. Studi Keanekaragaman Kantong Semar (*Nepenthes* spp.) di Kawasan Hutan Bukit Beluan Kecamatan Hulu Gurung. *Jurnal Hutan Lestari* 3(2): 259-264. DOI: 10.26418/jhl.v3i2.10389

Kementerian Lingkungan Hidup dan Kehutanan (KLHK). 2020. *Vandemecum Kehutanan Indonesia 2020*. KLHK. Jakarta.

Latifah, D., and Purwantoro, R. S. 2015. Seed Germination of the Corpse Giant Flower *Amorphophallus titanum* (Becc.) Becc. Ex Arcang: The Influence of Testa. *Berita Biologi* 14(1): 39-48. DOI: 10.14203/beritabiologi.v14i1.1861

Mulyati, M., Djufri, D., and Supriatno, S. 2017. Analisis Vegetasi Naungan Bunga Bangkai (*Amorphophallus peoniifolius* (Dennts.) Nicholson) di kawasan Padang Tiji Kabupaten Pidie. *Jurnal Ilmiah Mahasiswa Keguruan dan Ilmu Pendidikan Unsyiah*. 2(1): 98-106.

Nursanti, N., Wulan, C., and Felicia, M. R. 2019. Bioekologi Bunga Bangkai (*Amorphophallus titanum* (Becc.) Becc.) di Desa Muara Hemat Resort Kerinci Selatan Taman Nasional Kerinci Seblat. *Jurnal Silva Tropika* 3(2): 162-174.

Saragih, S. E., Astiani, D., and Sisillia, L. 2015. Sebaran Populasi dan Kondisi Tempat Tumbuh Bunga Bangkai (*Amorphophallus* sp.) di Kawasan Hutan Kota Gunung Sari Kota Singkawang. *Jurnal Hutan Lestari* 4(3): 282-291. DOI: 10.26418/jhl.v4i3.15816

Sari, R. W., Azrianingsih, R., and Rahardi, B. 2013. Peta dan Pola Persebaran Porang (*Amorphophallus Muelleri* Blume) pada Beberapa Area di Kabupaten Jember. *Biotropika* 1(4): 144-148.

Supriati, Y. 2016. Keanekaragaman Iles-Iles (*Amorphophallus* spp.) dan Potensinya untuk Industri Pangan Fungsional, Kosmetik, dan Bioetanol. *Jurnal Litbang Pertanian* 35(2): 69-80. DOI: 10.21082/jp3.v35n2.2016.p69-80

Tarida, T., Pribadi, R., and Pramesti, R. 2018. Struktur dan Komposisi Gastropoda pada Ekosistem Mangrove di Kecamatan Genuk Kota Semarang. *Jurnal of Marine Research* 7(2): 106-112. DOI: 10.14710/jmr.v7i2.25899

Yuzammi, Witono, J. R., and Hetterscheid, W. L. A. 2014. Conservation Status of *Amorphophallus discophorus* Backer & Alderw. (Araceae) in Jawa, Indonesia. *Reinwardtia* 14(1): 27-33. DOI: 10.14203/reinwardtia.v14i1.392

Yuzammi, Mursidawati, S., Asikin, D., Sugiarti, Gunawan, H., Nugroho, A., and Rahmat, U. M. 2015. *Strategi dan Rencana Aksi Konservasi Bunga Bangkai* (*Amorphophallus titanum*) 2015-2025. Direktorat Jenderal Konservasi Sumber Daya Alam dan Ekosistem Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia. Jakarta.