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## Epiphytic Host Tree Identification In Samarinda Botanical Garden

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**Abstract.** Epiphytes are one of the most diversiform plants, which its species richness peak in the tropic and subtropics. The objective of this study is to explore the different types of phorophyte. This research used the single plot method, as many as 100 plots, each measuring 10m x 10m, randomly distributed in Main Protected Zone of the Samarinda Botanical Garden. In each plot, the following data recorded the species name and individual numbers of phorophytes. The phorophyte in the old secondary forest area to the amount of 66 trees are consisting of 30 species of 29 families. The number of phorophytes is mostly in the diameter class between 21-38 cm. The Family of Dipterocarpaceae and species of *Borassodendron borneensios*, being the phorophyte which has got the most one in which each 8 species and 9 trees are existed in the forest.

### 1. Introduction

The tropical forests of Indonesia are a habitat for flora and fauna whose abundance is unmatched by any country in the world with the same area<sup>[1]</sup>, no less than 35 000 species of animals, 28 000 species of plants and 10 000 species of microbes and is still growing because every scientific expedition that is carried out always produces new species, with the existence of various major biographic areas and an extra ordinary diversity of habitat types. It is recognized as a very unique natural resource with a very close and in separable relationship with each other<sup>[2][3][4]</sup>.

In an area of 1 hectare of forest in Kalimantan, more than 150 species of trees may be found, not including plant communities that have certain characteristics, including palms, shrubs, climbers, stranglers, parasites and ephiphytes including orchids and ferns<sup>[5]</sup>. Epiphytes are organisms that develop on host plant surfaces and frequently affix with powerful roots. They get nutrients from the garbage surrounding them and moisture from the air. Several colonies and epiphytic ferns in an ecosystem can only be found in certain tree species or in certain parts of the tree, otherwise they can also be found in every tree species and in every part of the tree. It is because of its dependence on the condition of the forest stand in a habitat. The function of the host plant is only to get a place exposed to sunlight, so that all of its life needs for nutrients and water can only be obtained high above the tree. The fulfillment of nutrient needs is mainly obtained from rain water containing dissolved materials, partly from the accumulation of air particles and partly from the weathering of bark or other plant parts of phorophyte<sup>[6][7][8]</sup>.

The distribution and abundance of epiphytic species vertically on trees are grouped into 3 (three), namely: a) Epiphytic that grows and develops at the base of the trunk; b) Epiphytic that grows and develops on the trunk; c) epiphytic that develops on the crown of the tree which includes branches and twigs. In each type of forest, epiphytic habitat can be grouped into 4 (four), namely: a) At the base of the tree, with shade-tolerant epiphytes; b) Branch-free trunks, characterized by the very poor presence of epiphytes; c) In the crown, is the most common habitat for epiphytes; and d) outside the crown (the outer most twigs of the crown), this habitat is dominated by epiphytes<sup>[9, 10][11,12,13]</sup>.

Each of the trees that epiphytes grow on is referred to as a phorophyte, these trees have different canopy architecture, chemical and physical bark characteristics. Their phorophyte will influence the presence and diversity of epiphytes. In their natural habitat, a wide variety of epiphytic plants are found attached not to all types of phorophyte, but only to a few types of host trees. Epiphytes are essential in a tropical forest ecosystem. Epiphyte abundance and diversity are positively correlated with host species diversity. Therefore, it is very important to study the type and number of phorophyte, which also indicate the level of stability and characteristics of tropical forests<sup>[6][7][9, 10][14]</sup>

### 2. Materials and Methods

This research was conducted in Main Protected Zone of the Samarinda Botanical Garden with the assumption that it is old secondary forest area that is relatively undisturbed by direct and indirect community activities. This research used the single plot method which covers a total area of measuring 1 hectares, then divided into 100 randomly placed sub plots, each measuring 10m × 10m. Observations of phorophytes included identification of tree species and dimensions. Identification of phorophytes



obtained will be carried out at the Mulawarman University Forest Conservation Laboratory and East Kalimantan Dipterocarp Forest Ecosystem Research and Development Centre.

### 3. Results And Discussion

#### 3.1. Research Location

Since 1997 the Samarinda Botanical Garden (SMG) has developed into a natural recreation area of ± 65 hectares (from an area of about 300 hectares) funded by the Japan Bank for International Cooperation (JBIC) Loan No.IP-459 Project The Overseas Economic Cooperation Fund - Japan International Cooperation Agency (OECF- JICA) project.

This area generally has a hilly topography and a few plains with an altitude of 40–50 meters above sea level. Some of the hills there are small rivers and on the plains in addition to small rivers there are puddles. The soil in this area is of the type yellow red podzolic. This type is red to yellow, cloddy to angular clods, firm, acid, low base saturation. Physical and chemical properties soil are moderate to poor.

The study area has a tropical climate type where there is no clear distinction between the rainy and dry seasons. According to the Schmidt-Ferguson climate classification, the climate in the research area is classified as type B with an average value of dry months (2 months) compared to the average value of wet months (9 months) which is equal to 17,5%. Supporting data obtained from field, namely the average air temperature of 27°C and air humidity of 60-90%.

#### 3.2. Host Tree Identification

Overall, the number of trees (woody and non-woody) at the pole and tree level (> 10 cm in diameter) in Main Protected Zone the Samarinda Botanical Garden covering an area of 1 hectares (100 research subplots) found as phorophyte was 72 individual trees or 10.8% of all vegetation > 10 cm in diameter. The phorophyte found included 35 species from 24 genera belonging to 18 families. Phorophyte from the Dipterocarpaceae family were found with the highest number of individuals, namely 8 individuals or 19.4% of all individuals (2.1% of 667 trees > 10 cm in diameter in 10 research subplots which included 2 host tree species or 5.4% of all phorophyte species, namely *Borassodendron borneensios* and *Arenga sp.*

Table 1. The top 15 families with the most host tree species

No.	Family	Number of individual
1	Dipterocarpaceae	8
2	Lauraceae	5
3	Moraceae	5
4	Bombaceae	4
5	Sapotaceae	4
6	Thymelaceae	4
7	Myristicaceae	4
8	Melastomataceae	3
9	Dilenaceae	3
10	Sterculiaceae	3
11	Theaceae	3
12	Myrtaceae	3
13	Thymelaceae	3
14	Burseraceae	2
15	<u>Aracaceae</u>	<u>2</u>

Species from the Dipterocarpaceae family were found to be the most common phorophytes because they have a distinctive canopy structure, with many web-like structures wrapping leaves in the form of leaf buds (or, when weathered, known as fibers) at the base of the leaf midrib. Hence, the base of petiole can be discovered leaves debris or others. In addition, this part can cause moisture and has suitable micro-environment for the growth of epiphytic flora<sup>[1][16]</sup>. Although the base of the midrib itself is generally quite wide (almost half of the trunk circumference for each leaf), it is also a good place to collect litter, in addition to the general rough, bumpy and cracked nature of the host tree.<sup>[6][17]</sup> Explains that the bark cracks allow epiphytic bryopsida and mineral nutrients to "get stuck", species richness on this type of bark is higher than on smooth-textured bark. These trees generally have an outer bark structure that is compatible with most phorophytes

The bark of every type of tree has physical and distinctive characteristics. Several of them influence the presence of epiphytic plants, such as stability, roughness, hardness, ability to capture water, neutral acidity and the presence of nutrients in the bark. Tree bark that is stable is more favored by epiphytes as a place to live because stable bark is more able to withstand mass and is more solid as a place to attach. In unstable bark trees, few epiphytes are found because unstable bark is easily weathered, which causes the bark to peel off easily, making it unable to maintain the presence of epiphytes. These phorophytes in the logged-over forest are trees in relatively good physical condition (umbrella-shaped crowns with intact branching and not too dense), including those from the Dipterocarpaceae family<sup>[8][15][18]</sup>. This was due to the tree's tall, large, multi-branched stature and its age reaching decades, allowing the substrate deposited on the surface of the bark to be thick. This greatly affects the storage of water and nutrients. Furthermore, this tree is known as a native plant of the local ecosystem and is friendly to the surrounding vegetation, by not producing toxic exudates<sup>[1][4]</sup>. For vascular epiphytes, the presence of a host plant is essential for the establishment and persistence of their populations. However, due to differences in host characteristics, not all plants provide the same conditions for the formation and growth of epiphytic orchids and pteridophytes<sup>[19][21]</sup>. For example, the rough texture of tree bark can affect seed capture. Rough and scaly shells help seeds adhere better than smooth shells<sup>[6][9,10][20]</sup>, while the seed's ability to retain and release water has can promote seed germination. The bark has a higher water holding capacity and a slower release rate promotes seed germination<sup>[7][15]</sup>. This will reduce the adverse effects of rain drops and water flow, as well as facilitate the attachment of epiphytes<sup>[6][9,10]</sup>. Moreover, the relatively large size and branching structure (sometimes almost the same as the diameter of the stem) and relatively horizontal will allow the collection and formation of humus, and so that epiphytic seeds are not easily washed away by water through crown flow or stem flow<sup>[20][22]</sup>.

Tabel 2. Most common host tree species in a 1-hectare plot at the Samarinda Botanical Garden.

No	Species	Family	Number of individuals
1	<i>Borassodendron borneensios</i>	Aracaceae	9
2	<i>Arenga</i> sp.	Aracaceae	5
3	<i>Hopea mengarawan</i>	Dipterocarpaceae	4
4	<i>Durio acutifolius</i>	Bombaceae	4
5	<i>Payena lucida</i>	Sapotaceae	3
6	<i>Scima wallichii</i>	Theaceae	3
7	<i>Pternandra glabra</i>	Melastomataceae	3
8	<i>Myristica maxima</i> .	Myristicaceae	3
9	<i>Artocarpus kemando</i>	Moraceae	3
10	<i>Aquillaria malaccensis</i> Lamk.	Thymelaceae	3

The most common of the 10 host tree species was *Borassodendron borneensios* (9 individuals or 12.5% of all host tree individuals) and *Arenga sp* (Table 2). The most common trees found as phorophytes generally have rough, cracked bark, many grooves that allow the flow of water from the crown that carries humus and litter, as well as fog to bond and collect more easily. *Borassodendron borneensios* and *Arenga sp* as a species that lives in secondary forests and is home to epiphytes, it has characteristics that make it very practical and beneficial for the growth of epiphytes. These characteristics are the ability to retain dust particles due to the rough shell and the ability to retain water after rain. These characteristics allow the formation of a microclimate suitable for the growth of many epiphytic plant species<sup>[23]</sup>. According<sup>[20]</sup>the presence of epiphytic plants on phorophytes is determined by branches containing humus and moisture substrate that are accumulated from other epiphytic plants such as fern. So that not only epiphytes use it as a place to attach but also ferns and mosses, even climbing plants (lianas). Similarly, *Borassodendron borneensios*, despite its smaller trunk size, has very effective branching for the growth of epiphytic species<sup>[23]</sup>.

<sup>[24]</sup>study in Jobolarangan, however, found 23 species of epiphytes on the trunk of this tree. Perhaps its monoculture as a reforestation plant in industrial plantations reduces the opportunity for epiphytes to invade. An observation made by <sup>[25]</sup>on a large number of trees of various species in tropical forests showed that almost all species of higher epiphytes, including orchids, ferns and seed plants, grew mostly in cracks in the bark, grooves in the tree and large branching sites. More mature trees will have rougher bark, more crevices and larger branches than younger trees, although this does not necessarily mean that older trees of the same species will have more abundant epiphytes. It has also been observed by<sup>[26]</sup>that the spread of epiphytes is strongly influenced by the condition of the substrate (phorophyte bark) which includes the slope and roughness of the bark and litter accumulation.

Epiphytes attach to the outer bark of stems, branches, and twigs or leaves<sup>[18]</sup>explains that the distribution and abundance of epiphytes are influenced by substrate characteristics. Substrate characters can be interpreted as stem diameter (DBH), bark pH, and bark texture. However, the presence of epiphytes on their phorophytes is tightly related to the amount of sunlight penetration into the interior of forest stands, which are the main controlling factor in the vertical spread of epiphytes on their host trees<sup>[14][15]</sup>. However, according to<sup>[7][12,13,15]</sup> in addition to the influence of environmental conditions, in particular climatic elements, the type and size of the host tree also affect the abundance and distribution of epiphytes, specifically epiphytes that have a form of body structure (growth) hanging (non vascular pendant epiphyte). For this reason, within forest communities, the distribution of epiphytes is often irregular in terms of both type and arrangement and stratification.

The bark color of phorophytes associated with epiphytes is basically brown. This brown color is quite varied from one tree to another, such as brown, dark brown, light brown, blackish brown, and yellowish brown. Differences in bark color can occur due to age, environmental conditions around the tree, and the intensity of sunlight shining on the tree. From the obtained data, all tree bark has a brown color and no green color which indicates that the epiphytes grow on the surface of the bark of trees that are mature or old<sup>[4][15]</sup>.

In this research, epiphytes are mostly found on tree species whose bark is not gummy. More epiphytes were found on trees with non-gummy bark, suggesting that epiphytes are less fond of tree bark with sap. This is because the sap may contain substances that are harmful to their survival. The observations of the tree bark structure can be observed anatomically from the cross section of the tree bark in general the tree bark consists of two layers of periderm tissue and secondary phloem. This multi-layered arrangement increases the thickness of the bark, causing cracks and deep fissures, but the bark remains stable. The bark that is deeply fissured and stable is very good for epiphytic root attachment. Unstable bark is less able to maintain the position of epiphytic plants attached to the bark, so that the types of epiphytes attached to this type of tree are epiphytes with small sizes such as *Eria retusa* and *Pholidota carnea*<sup>[1][27]</sup>. The diameter of the trunk, which broadly indicates age, seems to be associated with the number of epiphytes attached to a phorophytes. Regardless of species, genus and family, the

relatively large diameter phorophytes tend to have more epiphytes, both in number of species and number of individuals<sup>[9,10]</sup>. Generally, trees with large diameters have bark conditions that are favourable for epiphyte growth, because generally the bark is rough, cracked and has many grooves, and the holes of broken or decayed scars are inhabited by humus, which will make it easier for epiphytes to attach. This however does not mean that every large-diameter tree, even of the same species, will always have more epiphytes; in fact, some trees do not have epiphytes at all, such as in *Koompassia excelsa* and *Agathis borneensis* (or similar species with damaged, deciduous, and almost bare crowns), and never in pioneer trees<sup>[12,13][6]</sup>

The number of phorophytes in the Main Protected Zone forest of Samarinda Botanical Garden is mostly in the diameter class between 21-38 cm, because the trees in the diameter range are in a condition of mutual protection so that the humidity between the trees is relatively higher than the general air humidity. <sup>[6][12,13]</sup> in the low land Dipterocarpa forest of the Malinau watershed showed that stem diameter seems to be closely related to the number of species and abundance of epiphytes, out of 3933 trees (diameter > 10 cm) recorded only 387 trees (9.84%) that were covered by epiphytes. Without distinguishing the type, large diameter trees tend to be more covered by epiphytes both in terms of the number of species and their abundance.

While tree diameter generally indicates age, it also determines the number of individuals and types of epiphytes attached. This also corresponds with the observations of <sup>[4][10][13]</sup> who showed that regardless of the type of epiphyte and where they live at the base of the tree, trunk, branches, or on tall twigs, the abundance and clustering of the number and type of attached epiphytes are generally more often influenced by the age of the host tree. <sup>[9,10]</sup> The findings suggest that the causes of differences in the composition and vertical distribution of epiphytes in each tree species or similar trees are extensive, which makes the vertical stratification of epiphytes in a tree difficult to classify, although the presence and distribution of epiphytes are commonly found on branches and twigs, especially on branches and twigs that grow relatively flat or sloping at various heights of the tree crown, and only a few can be found on parts of the tree (branches, limbs, or twigs) that grow perpendicular to the ground. The extent of bark exfoliation and branch fragility can lead to differences in mortality rates due to epiphyte fall<sup>[8][30]</sup> and the nutritional quality of the stem and tip line can affect the growth and fertility of epiphytic orchids (higher nutrient intake can improve growth and fertility<sup>[6][31]</sup>).

Furthermore, the characteristics of phorophytes may not only influence epiphytes directly but also indirectly by providing different microclimatic conditions for mycorrhizal fungal communities, necessary for their growth germ of orchid seeds. Moreover, according to <sup>[26][16]</sup>, specific differences in the need for environmental conditions or epiphytic tolerance to the environment in the form of inherent height of the host tree or differences from one tree to another are very diverse, so there is no-significant relationship between the epiphyte species and its host tree<sup>[6][23][29]</sup>

#### 4. Conclusion

From the overall research results, the following conclusions, the diameter tree is the most important parameter explaining the abundance and species richness of epiphytes, especially from the Dipterocarpaceae family, and *Borassodendron borneensios*. Phorophytes generally in the diameter class between 21-38 cm have relatively horizontal branches with rough and cracked bark, and have the ability to accommodate litter and heavily over grown on their leaf midribs for Aracaceae. Accordingly tree age is likely an important indicator for epiphyte diversity. Increasing tree age enhances the tree attributes such as diameter, bark rugosity and canopy cover.

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