



Vascular Epiphytes Diversity at Pusat Sejadi, Kawang Forest Reserve, Sabah Malaysia

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Abstract

Vascular epiphyte category as well as diversity of epiphytic was studied in Pusat Sejadi, Kawang Forest Reserve Papar Sabah. Five randomly sampling plots of 50m x 40m (0.2 ha) were presented for 1 ha of the forest for the purposed of data collection. The result showed that 3 types of phorophytes (host tree) on which the vascular epiphyte attached to: standing tree, dead standing tree and fallen tree (deadwood). The standing and dead standing tree were subdivided into 3 zones which known as basal part, trunk and canopy to analyse the species richness. A total of 137 numbers of individual species with 2 groups (Angiosperm and Pteridophyte), 7 families and 15 species were found growing epiphytically on the phorophytes. According to the Shannon – Weiner biodiversity index analysis, it showed (H') was 0.98 which the vascular epiphytes were diverse, although they were not equally abundant based on the calculated value of Evenness Index ($E=0.36$). The species richness also less with $I_{Margalef} = 2.8$. Pteridophytes (ferns) contributed more significantly to species diversity. Vascular epiphytes were more diverse in standing and fallen tree. In standing tree, fewer species were found on the tree trunk (4 species) than in the basal (5 species) and crown or canopy (5 species). Aspleniaceae and Polypodiaceae were 2 families consisted of more species which each of it had 4 species. Four species were found presented on all types of phorophytes: *Asplenium nidus*, *Nephrolepis spp*, *Arcypteris irregularis* and *Microsorium musifolium*. *Asplenium nidus* was the commonest species presented in all plots with good adaptations in any conditions of the forest whether in shady, partially or fully sun.

Keywords: Vascular epiphytes, Diversity, Shannon–weiner, Pusat sejadi and kawang forest reserve

1. Introduction

There are in fact up to 25000 species of vascular epiphytes alone that occur mainly in tropics (Zotz and Hietz, 2001). Epiphyte forms a major component of the diversity of tropical forests (Gentry and Dodson 1987; Kelly *et al.*, 2003). The shrub layer epiphytes are normally dependant on large mature trees that have upon them an abundant epiphyte community, which feeds the shrub layer below with seeds and asexual plant material, whose role it is to colonise the sub strata (Goddings *et al.*, 2006). Vascular epiphytes share few qualities beyond occurrence in tree crowns that identify them as a single ecological type, primarily because their phylogenetic origins and life styles in forest canopies are diverse (Benzing, 1987).

Epiphytes are extremely important elements of the flora (they represent about 10% of all plant species globally), (Neider and Barthlott, 2001). Epiphytes are responsible for much of the biotic diversity that makes humid tropical forests the most complex of all the world's terrestrial ecosystems (Gentry and Dodson, 1987). The aims of this study are to determine the category type of vascular epiphytes species found at Pusat Sejadi, Kawang Forest Reserve and to analyse the diversity of vascular epiphytes species at three different host trees: standing tree, dead standing tree and fallen tree.

1.1 Study Site

Pusat Sejadi, Kawang Forest Reserve is located in Kinarut Papar, Sabah which is approximately 30 km from Kota Kinabalu city. The topography of this forest is about 6 m to 610 m asl and with approximately 1550 ha large in area and its terrain is hilly with slopes sometimes reaching 25°. The main vegetations of this forest reserve are 19% of primary forest which the floras consist the mixture of dipterocarp species, 69% of secondary forest, 8% for shrubs and another 4% of open spaces area (Joseph *et al.*, 1998).

The study site for the preliminary survey of vascular epiphyte was only took place in the area of Pusat Sejadi, Kawang Forest Reserve which is mark by a black box on the Kawang Forest Reserve map on the Figure 3.1 above. Approximately 80% of Pusat Sejadi's forest is secondary forest and its geographical is pretty hilly.

2. Methods

A sampling plot of 50m x 40m (0.2ha) was developed. Five (5) randomly selected plots were established to cover spatial variability. These plots covered a hectare (1 ha) of the area of Pusat Sejadi. All vascular epiphytes species that found in each plot were recorded either epiphyte that found in standing tree, dead standing tree or fallen tree (deadwood). A binocular was used to identify species that was located high above the tree. This method is described by Gradstein (1992), Ground Base Inventory (GBI) using binoculars and sampling of fallen branches, is inadequate to assess the diversity of the epiphyte communities.

All the vascular epiphytes species that were found in Pusat Sejadi were divided into its group or category type to achieve the first objective of the study and the recorded data were computed by using three indices (Shannon – weiner diversity index, Evenness index and Margalef's diversity index) to calculate the diversity of vascular epiphyte that attached to the types of phorophytes and respecting to the zones of the standing and dead standing trees.

3. Results

3.1 Category type of vascular epiphytes species

There were 36 totals of host trees (phorophytes) which represent the 1 ha area of the forest. The hosts of standing trees are 18 trees, 4 trees of dead standing trees and 14 phorophytes for fallen trees. Upon completion of the survey, however, a total of 137 numbers of individual species of vascular epiphytes representing 7 families (with one is unidentified) were found growing epiphytically on the trees either in standing trees, dead standing trees or fallen trees. Based on the collected data, it showed a variation in the appearance of vascular epiphytes in all plots.

There were two categories or groups of vascular epiphytes that had been collected and analysed and those were Angiosperm and Pteridophytes. Two families of Angiosperm; Araceae and Orchidaceae while five families in the group of Pteridophytes which one of it was unidentified. Those families were Aspleniaceae, Blechnaceae, Oleandraceae and Polypodiaceae.

3.2 Composition of vascular epiphytes species

Family of Aspleniaceae and Polypodiaceae took a big portion of the percentage of composition or communities of vascular epiphytes species present in Pusat Sejadi, Kawang Forest Reserve. While Araceae and Blechnacea had the lowest percentage of species present.

3.3 Diversity

According to the results of three indices (Shannon – Weiner index, Evenness index and Margalef's index) that had been calculated in all types of different trees, it shows that standing trees had the highest value of H' and E , while fallen trees had the highest value of I_{Margalef} and for dead standing trees it had the lowest value of all three of the indices.

The values of the three indices were obviously different between the zones of the standing and dead standing trees especially in the canopy zone. The result on Figure 5 shows that the diversity (H') and the evenness (E) values are the highest at the canopy zone of standing trees but had the lowest value of I_{Margalef} . The species richness of vascular epiphytes is less at canopy zone even though its diversity is high.

The results below show that at the canopy zone, there are no values of the three indices and these make the major difference of the diversity of vascular epiphytes in the canopy of standing trees and dead standing trees.

4. Discussion

4.1 Diversity of vascular epiphytes at different types of phorophytes

The study revealed the vascular epiphytes communities dominated by the division of Pteridophyta especially the two families of ferns: Aspleniaceae and Polypodiaceae. They were the commonest species that can be found in the three different categories of host trees. *Asplenium* species have been noted for their abundance in tropical forest throughout the world (Ellwood and Foster, 2004). Polypodiaceae was also the most diversified family in the tropical rain forest (Zapfack *et al.*, 1996).

The vascular epiphytes at Pusat Sejadi, Kawang Forest Reserve were more diverse and distributed more equally at the standing trees rather than at dead standing trees and fallen trees but at the fallen trees, the species richness of vascular epiphytes were highest than the other two of phorophytes. Based on the datasheet of all plots, it showed that in Plot 3 and Plot 4, more number of individual species of vascular epiphytes presence. Both of these plots contain many of large trees which diameter is greater than 60cm and also a lot of fallen trees were present to these plots. Tree size relates to several factors that contribute to epiphyte establishment and growth.

Larger trees are likely, on average, to be older, allowing more time to capture spores (Cummings, 2006). In Pusat Sejadi, Kawang Forest Reserve, the large tree that rich with vascular epiphytes attached to it was *Kompassia excelsa*. Plot 4 and Plot 5 were rich in fallen trees which these phorophytes may be suitable habitat for most of vascular epiphytes that can be found in Pusat Sejadi Kawang Forest Reserve. Vascular epiphytes that preferred to the shady and moderate sunlight were mostly grow in the fallen trees because the surround areas of which these fallen trees lied are covered by the canopy layers which the sunlight indirectly reach to the surface of forest floor.

4.2 Comparison between the canopy zone of standing and dead standing tree

The values of the three indices were obviously different between the zones of the standing and dead standing trees especially in the canopy zone. The species richness of vascular epiphytes is less at canopy zone even though its diversity is highest and according to Kelly *et al.*, (2004) during his study at La Montana, vascular species richness was sharply reduced in the upper zones.

Even though the species richness is less, still the vascular epiphytes communities were very abundant in the canopy zone rather than at base and trunk of standing trees based on the present of number of individual species in the canopy of standing trees. This is because the presence of branches in the canopy layer, it may result accumulation of dusts which encouraging epiphytic plants to grow. Large branches and crotches at the bases of reiterated trunks provide platforms for debris accumulation (Sillette, 1999).

There were less of vascular epiphytes attached at the canopy zone of a dead standing tree rather than the standing tree. This may be the reason of the absent of foliages of the dead phorophyte which discourage the accumulation of humus and subsequently prevent the formation of the vascular epiphyte and besides, a dead standing tree is not as efficient as a standing tree in up taking water resources which water is the major component for vascular epiphytes to grow.

5. Conclusion

All 15 species of vascular epiphytes present in Pusat Sejadi, Kawang Forest Reserve are *Asplenium nidus*, *Arcypteris irregularis*, *Nephrolepis spp*, *Philodendron martianum*, *Stenochlaena milnei*, *Asplenium tenerum*, *Asplenium spp.1*, *Asplenium spp.2*, *Dendrobium crumenatum*, *Dendrobium anosmum*, *Bulbophyllum careyanum*, *Platyserium superbum*, *Microsorium musifolium*, *Pyrrosia lanceolata* and Species 1 is unidentified. According to the calculation of Shannon – Weiner index, the vascular epiphytes in Pusat Sejadi, Kawang Forest Reserve were diverse with the value of 0.98. The epiphytic plants were not equally abundant according to the value of Evenness index 0.36 and the species richness was less which it was only 2.5 value of Margalef^o index.

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Table 1. Systematic partitioning of species of vascular epiphytes

GROUP	FAMILY	SPECIES NAME	No. of ind.sp
ANGIOSPERMS	Araceae	<i>Philodendron martianum</i>	2
	Orchidaceae	<i>Bulbophyllum careyanum</i>	2
		<i>Dendrobium anosmum</i>	5
		<i>Dendrobium crumenatum</i>	18
PTERIDOPHYTES	Aspleniaceae	<i>Asplenium nidus</i>	43
		<i>Asplenium spp. 1</i>	5
		<i>Asplenium spp. 2</i>	3
		<i>Asplenium tenerum</i>	1
	Blechnaceae	<i>Stenochlaena milnei</i>	2
	Oleandraceae	<i>Nephrolepis spp</i>	18
	Polypodiaceae	<i>Arcypteris irregularis</i>	12
		<i>Microsorium musifolium</i>	7
		<i>Platyserium superbum</i>	5
		<i>Pyrrosia lanceolata</i>	10
Unidentified	<i>Species 1</i>	4	

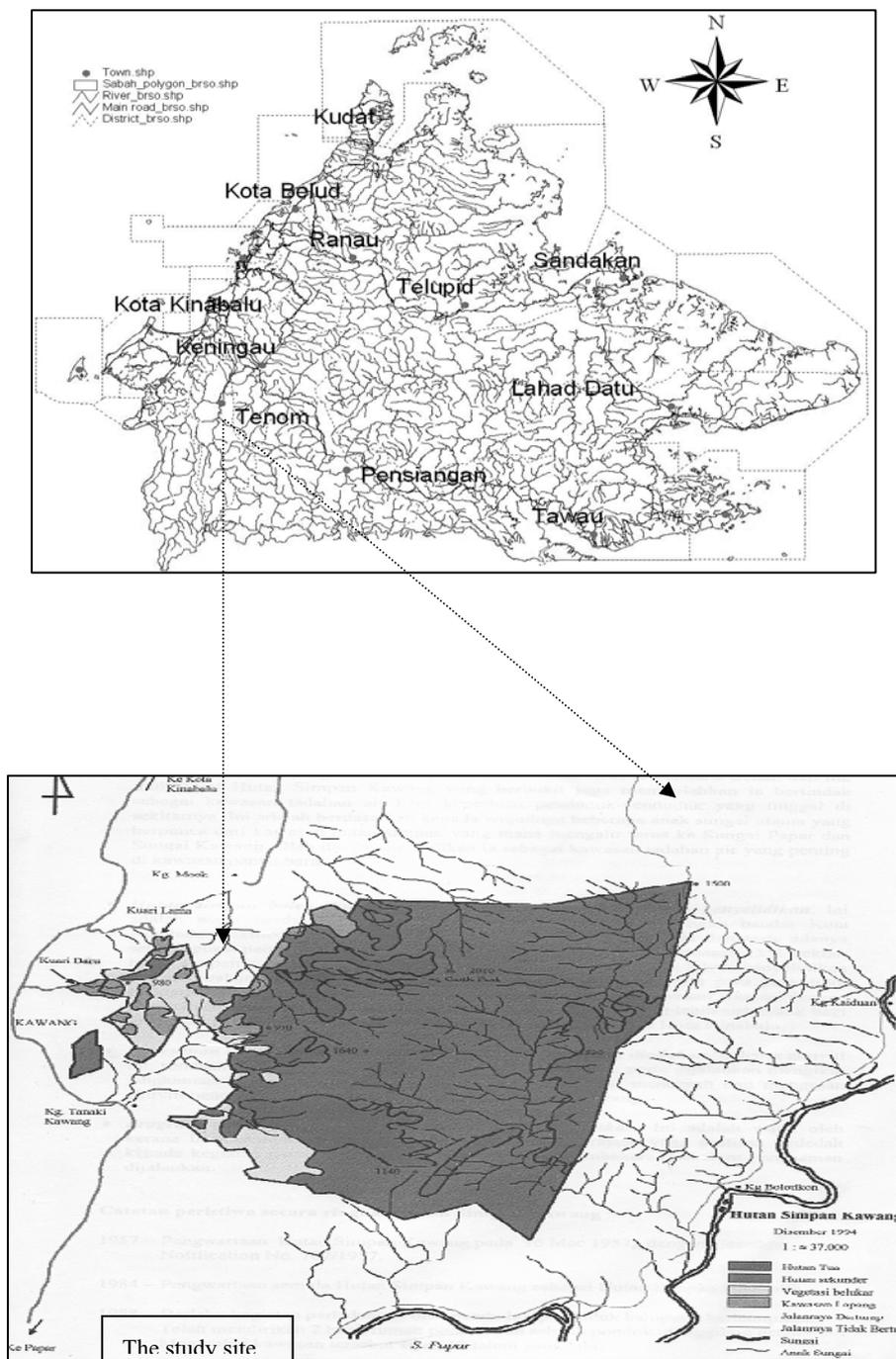


Figure 1. Kawang Forest Reserve map

(Source: Joseph *et al.*, 1998)

The host trees (phorophytes) of standing and dead standing tree were subdivided into three zones.

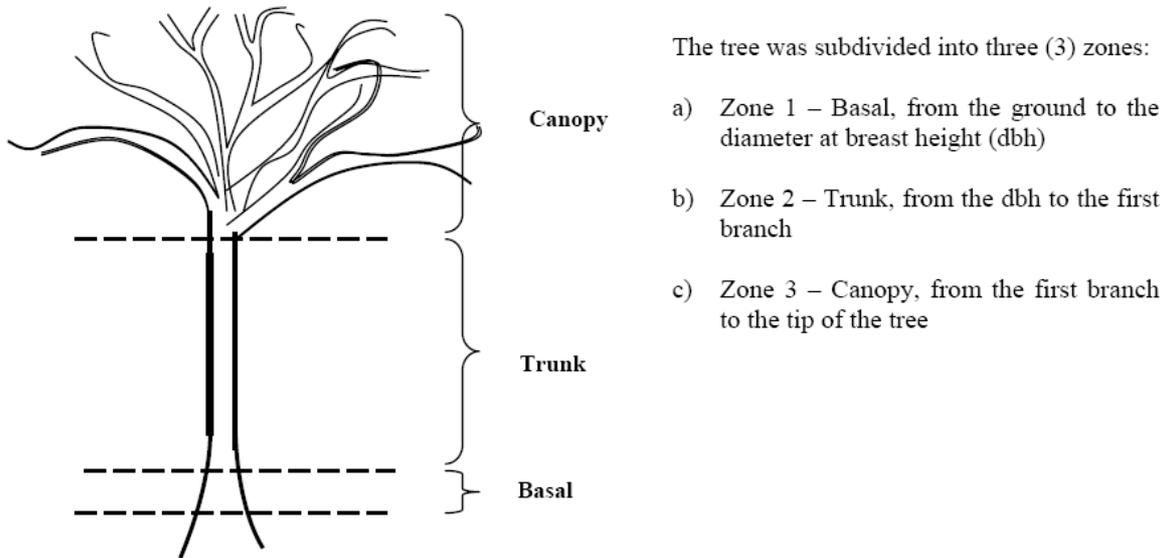


Figure 2. Subdivision of the phorophyte into vertical zones

Source: Kelly *et al.*, (2003), modified

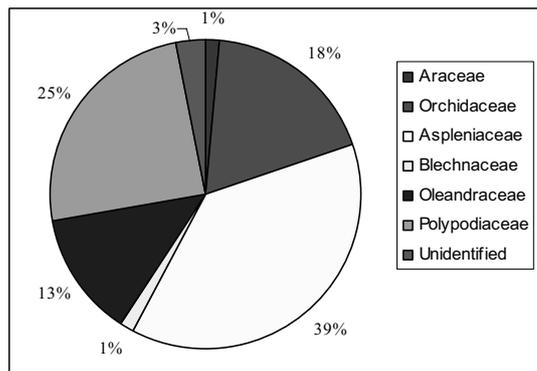


Figure 3. Percentage distribution of vascular epiphytes composition

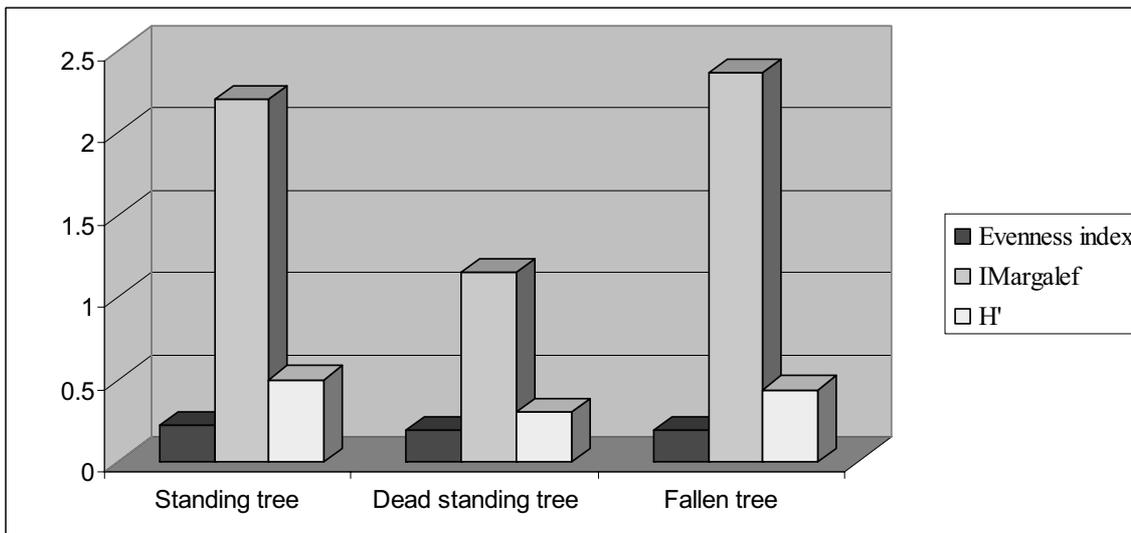


Figure 4. The result of three indices of diversity respecting to three zones of standing tree

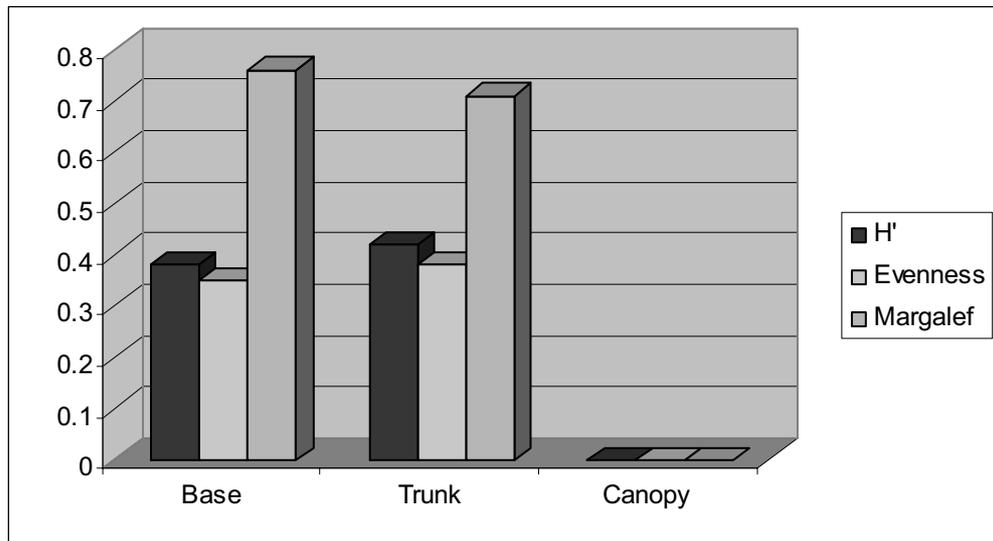


Figure 5. The result of three indices of diversity respecting to three zones of dead standing tree