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# A Phytosociological Study on the Community of *Palaquium gutta* (Hook.f.) Baill. (Sapotaceae) at Ayer Hitam Forest Reserve, Selangor, Malaysia

(Suatu Kajian Fitososiologi ke atas Komuni *Palaquium gutta* (Hook.f.) Baill di Simpan Ayer Hitam, Selangor)

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ABSTRACT

*A phytosociological study on the flora and vegetation community of* Palaquium gutta *(Hook.f.) Baill. was carried out in Compartment 13 of Ayer Hitam Forest Reserve, Selangor. The main objectives of this study were to identify, characterize and classify the* P. gutta *community which is naturally distributed in Ayer Hitam Forest Reserve. A total of 10 plots (30×30 m in size) were constructed according to the line transect method. The vegetation sampling and data analysis were done according to the Braun-Blanquet approach. The results showed that there were 59 species belonging to 54 genera and 34 families in the form of herbs, shrubs, understorey trees and also canopy tree layers. The most common species in the study area were* P. gutta *and* Endospermum diadenum *(Miq.) Airy Shaw. The phytosociological study identified a community of* Palaquium gutta-Endospermum. diadenum *along with two sub-communities known as* Dracaena *sp. sub-community and* Streblus elongatus *sub-community. The results also showed that most of the species belong to the Euphorbiaceae. This indicates that the forest is a secondary forest.*

*Keywords: Braun-Blanquet;* Endospermum diadenum; Palaquium gutta; *phytosociology; vegetation community*

ABSTRAK

*Suatu kajian fitososiologi ke atas flora dan komuniti vegetasi* Palaquium gutta *(Hook.f.) Baill, telah dijalankan di petak 13 Hutan Simpan Ayer Hitam, Selangor. Objektif utama kajian ini ialah untuk mengenal pasti, menciri dan mengelaskan komuniti* P. gutta *yang tersebar secara semula jadi di Hutan Simpan Ayer Hitam. Sejumlah 10 plot (30×30 m) telah dibina mengikut kaedah transek garisan. Pensampelan vegetasi dan analisis data telah dilakukan mengikut pendekatan Braun-Blanquet. Keputusan menunjukkan terdapat 59 spesies dan 54 genus serta 34 famili herba, pokok renek, pokok lapisan bawah dan juga lapisan pokok kanopi. Spesies paling kerap dijumpai di kawasan kajian ialah* P. gutta *dan* Endospermum diadenum *(Miq.) Airy Shaw. Kajian fitososiologi telah mengenal pasti satu komuniti iaitu* Palaquium gutta-Endospermum diadenum *ass. nova diikuti dengan dua subkomuniti dikenali sebagai subkomuniti* Dracaena *sp. dan subkomuniti* Streblus elongatus. *Keputusan juga menunjukkan bahawa kebanyakan spesies adalah daripada Euphorbiaceae. Ini menunjukkan bahawa hutan tersebut adalah hutan sekunder.*

*Kata kunci: Braun-Blanquet;* Endospermum diadenum; *fitososiologi; komuniti vegetasi;* Palaquium gutta

## INTRODUCTION

Phytosociology involves plant communities within the same environment, their floristic composition and development and the social relationships between them. A phytosociological study gives information on the distribution of species as well as affinities between species or groups of species, resulting in a valuable evaluation of the vegetation within the study area (Frenedozo-Soave 2003). A phytosociological system is a system for classifying these communities. Phytosociology provides useful basic data for ecology, geography, landscape science, conservation and environmental science because the data represent integrated units in vegetation systems (Fujiwara 1987).

According to Enright and Nuñez (2013), Braun-Blanquet pioneered the classification of vegetation into units (associations) based on floristic composition and the identification of characteristics species. The advantages and problems, associated with the phytosociological approach to vegetation analysis pioneered by Braun-Blanquet have been reviewed many times, and inevitably will continue to do so as the vegetation science community increasingly becomes a globalised one.

*Palaquium gutta* is known locally as 'Nyatoh Taban Merah' and is from the Sapotaceae family. *Palaquium* species can be found in primary lowland forest about 300 m below and also on hill forest in Peninsular Malaysia. *Palaquium* species have been recorded in all states of Malaysia except Perlis, Kedah and north of Terengganu (Roche & Dourojeanni 1984). According to Prakash et al. (2005), *Palaquium* species are natural inhabitants of Southeast Asia, particularly in Malaysian and Indonesian archipelago. Gutta-percha is a dried coagulated extract from several *Palaquium* species including *P. gutta*. The gutta-percha yielding tree is a medium to tall trees, in which a series of cuts (concentric or v-shaped cuts) is

made to obtain the latex. The inertness of gutta-percha to biodegradation makes them useful as an impermeable coating for undersea cables and gutta-percha is still used in dentistry as a filling material (van Beilen & Poirier 2012). Ayer Hitam Forest Reserve is a lowland dipterocarp forest which contains valuable wood, medicinal and economic plants and is also suitable for recreation. It had been selectively logged from 1936 to 1965 (Faridah-Hanum 1999). The main silvicultural operations in the 1950's were associated with timber extraction. Anthropogenic disturbances such as logging operations, construction of new roads, land development, shifting cultivation and uncontrolled deforestation are believed to be the major causes in the decline of biodiversity. Logging operations in the tropical forest impairs the ecological balance and devaluates the original forest. Lack of care during partial felling operations resulted in the damage to residual stand and young trees. Logging could also affect the watershed areas. Some 3.15 million ha of the total natural forest in hilly areas are protected as water catchment areas (Zakri 1995).

The main objectives of this study were to identify, characterize and classify the *P. gutta* community which is naturally distributed in Ayer Hitam Forest Reserve. An excellent way to conserve this valuable tropical tree species would be to know its composition and the ecological relationship between the species within its community and this could be achieved with a phytosociological study. Furthermore, the knowledge gained from this phytosociological study will contribute to the mass planting of *P. gutta* and this indirectly could help in the past or future logging issues in Ayer Hitam Forest Reserve. Knowledge on the floristic composition (phytosociology) of *P. gutta* at natural forest in Malaysia is literally unknown and an empirical botanical documentation provides a main stimulus for the present study.

## Materials and Methods

### Study site

This study was conducted at Compartment 13 of Ayer Hitam Forest Reserve. Its latitudes is between 2°57'N and 3°04'N and longitudes between 101°38'E and 101°41'E. The forest is a lowland dipterocarp forest and is known as a secondary disturbed forest due to the previous logging activities since 1930. Currently, the total forest area is 1248 ha.

The mean annual temperature is 25.2°C with a maximum temperature at 27.6°C and minimum at 22.9°C. The rainy season occurs in January-March and June-September and the average annual rainfall is 2178 mm. The topography of the forest is rather undulating with 15 and 233 m above sea level. The soil type in Ayer Hitam Forest Reserve is alluvium-colluvium soil which reshaped from metamorphic rock with sandy clay loam soil texture. There are three major rivers in the study area which are Sungai Rasau, Sungai Bohol and Sungai Biring.

### Field surveys and data collection

Field surveys and data collection were done based on the techniques described in detail by Braun-Blanquet (1964) and Fujiwara (1987). A total of 10 plots with 30×30 m in size were constructed according to the line transect method. The size of the plot was estimated by means of a 'minimal area' which was 900 $m^2$ for each plot. The plots were located at various altitudes, expositions, inclinations and reliefs. An effort was made to achieve high ecological and physiognomic homogeneity within each the plot. Every plot was georeferenced with a Garmin GPS.

Scientific names of each vascular plant species in each plot were identified. Cover or abundance data of all vascular plant species for each plot were verified. All vascular plant species in each plot with a trunk diameter at breast height (DBH) ≥5 cm were marked and numbered and their diameter and height were recorded. Trunk perimeter measurement was taken using a metric tape and tree height was estimated with the aid of a clinometer. Lastly, these samples were classified in a phytosociological table according to their floristic composition. The vegetation layers in the forest were divided into five layers as shown in Table 1.

### Data analysis

As for the numerical analysis, the cover or abundance values on the scale of Braun-Blanquet were transformed into the 1-9 ordinal scales of van der Maarel (1979). With the goal of identifying the floristic composition of these groups, this synthetic phytosociological table was elaborated by scoring species in percentage or constancy classes according to Braun-Blanquet's scale. Lastly, the associations of the species were described based on all the 10 plots.

## Results

### Community structure and floristic composition

A total of 59 species belonging to 54 genera and 34 families were identified in all the 10 plots. The most dominant life forms were trees, followed by herbs and shrubs. A new community *Palaquium gutta-Endospermum diadenum* and two sub-communities known as *Dracaena* sp. sub-community and *Streblus elongatus* sub-community were determined in this study and these associations were shown in the association table (Table 2).

TABLE 1. Types of vegetation layers

| Vegetation layers | Height | Symbol |
|---|---|---|
| Super tree | ≥30m | ST |
| Canopy tree layer | 10-25m | T1 |
| Understory tree layer | 6-9m | T2 |
| Shrub layer | 2-5m | S |
| Herb layer | 0.1-2m | H |

TABLE 2. Association table

| Plot reference number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Original plot number in field | 1 | 5 | 4 | 6 | 2 | 3 | 9 | 10 | 8 | 7 |
| Number of species | 35 | 31 | 31 | 34 | 22 | 24 | 27 | 18 | 21 | 24 |
| Character and differential species of *Palaquium gutta-Endospermum diadenum* community | | | | | | | | | | |
| *Palaquium gutta* | 4 | r | 3 | 3 | 2 | 2 | 3 | + | 2 | + |
| *Endospermum diadenum* | 2 | r | + | r | 2 | 2 | 2 | + | + | + |
| *Agrostistachys longifolia* | 4 | 3 | 4 | 4 | . | 2 | 4 | 2 | 4 | + |
| *Gonystylus* sp. | 3 | 2 | 1 | + | 2 | 2 | + | r | + | + |
| *Blumeodendron calophyllum* | 1 | + | + | . | 1 | r | + | + | + | r |
| *Calamus* sp. | 4 | 1 | 4 | 3 | 3 | . | 2 | r | 3 | 4 |
| *Diospyros argentea* | 3 | r | + | r | 3 | + | r | . | r | r |
| *Knema* sp. | 2 | 1 | 2 | r | 2 | 1 | r | . | + | . |
| *Phyllanthus pulcher* | 3 | 3 | . | + | 3 | 3 | 2 | 1 | 3 | 2 |
| *Rothmannia macrophylla* | 4 | + | 3 | 2 | . | 2 | + | + | r | + |
| *Canarium* sp. | 3 | r | + | r | . | . | + | + | + | + |
| *Calophyllum* sp. | 2 | r | r | + | 2 | r | . | r | r | . |
| *Dipterocarpus crinitus* | r | + | r | r | + | 1 | r | . | . | . |
| *Elateriospermum tapos* | 2 | 2 | 2 | r | 1 | . | r | . | + | + |
| *Eugeissona tristis* | 4 | . | 1 | 3 | 4 | . | + | 4 | 4 | + |
| *Knema hookeriana* | 2 | r | . | r | 2 | + | + | r | r | r |
| *Pavetta* sp. | 4 | + | + | + | 2 | 1 | r | . | . | + |
| *Pellacalyx saccardianus* | 3 | r | 1 | + | . | . | 2 | 1 | 3 | + |
| *Scaphium macropodum* | 2 | 1 | + | + | . | . | + | r | r | r |
| *Shorea macroptera* | + | . | . | r | + | + | + | r | r | r |
| *Syzygium* sp. | 2 | r | 2 | + | 2 | 1 | r | . | . | + |
| Differential species of *Dracaena* sp. sub-community | | | | | | | | | | |
| *Dracaena* sp. | 3 | . | 2 | 1 | . | . | . | . | . | . |
| *Polyalthia* sp. | 3 | r | r | . | . | . | . | . | . | . |
| *Artocarpus* sp. | 2 | . | + | . | . | . | . | . | . | . |
| *Anisophyllea griffithii* | 3 | + | . | r | . | . | . | . | . | . |
| *Lijndenia laurina* | 2 | . | + | r | . | . | . | . | . | . |
| *Ochanostachys amentacea* | 3 | 2 | . | . | . | . | . | . | . | . |
| *Barringtonia racemosa* | 2 | . | 2 | . | . | . | . | . | . | . |
| *Oncosperma horridum* | . | + | . | + | . | . | . | . | . | . |
| *Selaginella intermedia* | 4 | 4 | . | 3 | . | . | . | . | . | . |
| *Cyathea latebrosa* | . | 3 | . | . | . | . | . | . | . | . |
| *Pternandra echinata* | . | . | 3 | + | . | . | . | . | . | . |
| *Semecarpus curtisii* | r | r | . | r | . | . | . | . | . | . |
| *Melastoma malabathricum* | . | . | + | 1 | . | . | . | . | . | . |
| *Chassalia chartacea* | 1 | . | . | + | | | | | | |
| Differential species of *Streblus elongatus* sub-community | | | | | | | | | | |
| *Streblus elongatus* | . | . | . | . | 1 | + | . | . | . | . |
| *Durio zibethinus* | . | . | . | . | . | . | r | . | . | r |
| *Lasianthus oblongus* | . | . | . | . | 2 | 2 | . | + | . | + |
| *Macaranga triloba* | . | . | . | . | + | . | r | . | r | . |
| *Pandanus* sp. | . | . | . | . | . | . | + | . | . | + |
| *Vitex vestita* | . | . | . | . | + | r | . | . | . | . |
| *Macaranga gigantea* | . | . | . | . | + | . | . | . | + | + |
| Companion species | . | . | . | . | . | . | . | . | . | . |
| *Shorea parvifolia* | r | . | r | . | . | r | . | . | r | . |
| *Acrotrema costatum* | . | . | . | . | . | r | . | . | . | . |
| *Artocarpus elasticus* | . | r | . | . | . | . | r | . | . | r |
| *Dillenia indica* | . | . | r | r | . | r | . | r | . | . |
| *Shorea laevis* | . | r | . | . | . | . | . | . | . | . |
| *Bouea oppositifolia* | . | . | . | . | . | . | + | . | . | . |
| *Bauhinia integrifolia* | + | . | . | . | . | . | . | . | . | . |
| *Aglaia* sp. | . | . | + | . | . | . | . | . | . | . |
| *Garcinia nervosa* | . | . | r | . | . | . | . | . | . | . |
| *Hopea beccariana* | . | . | . | r | . | . | . | . | . | . |
| *Trema cannabina* | 2 | . | . | . | . | r | . | . | . | . |
| *Gironniera nervosa* | . | + | . | . | . | . | . | . | . | r |
| *Lithocarpus wallichianus* | . | . | r | . | . | r | r | . | . | . |
| *Mischocarpus pentapetalus* | r | . | . | r | . | r | + | . | . | . |
| *Palaquium maingayi* | . | . | r | . | + | . | . | . | . | . |
| *Campnosperma auriculatum* | . | r | . | r | . | . | . | r | . | . |
| *Porterandia anisophylla* | | r | . | r | . | . | . | . | . | . |

A total of 21 species belonging to 21 genera and 13 families were found in the *Palaquium gutta-Endospermum diadenum* community. This community was characterized by *P. gutta* and *E. diadenum* as the dominant tree species. Other characteristics and differential species of the community were *Agrostistachys longifolia, Gonystylus* sp., *Blumeodendron calophyllum, Calamus* sp., *Diospyros argentea, Knema* sp., *Phyllanthus pulcher, Rothmannia macrophylla, Canarium* sp., *Calophyllum* sp., *Dipterocarpus crinitus, Elateriospermum tapos, Eugeissona tristis, Knema hookeriana, Pavetta* sp., *Pellacalyx saccardianus, Scaphium macropodum, Shorea macroptera* and *Syzygium* sp. This community consisted of all four forms of layers which were herbs, shrubs, understory trees and canopy tree layers. The highest layer was 25 m while the lowest layer was below 2 m with the thickness of litter layer at 5.2 cm in average.

A total of 14 species belonging to 13 genera and 10 families were found in *Dracaena* sp. sub-community. The characteristic and differential species of this sub-community were *Dracaena* sp., *Polyalthia* sp., *Artocarpus* sp., *Anisophyllea griffithii, Lijndenia laurina, Ochanostachys amentacea, Barringtonia racemosa, Oncosperma horridum, Selaginella intermedia, Cyathea latebrosa, Pternandra echinata, Semecarpus curtisii, Melastoma malabathricum* and *Chassalia chartacea*. Meanwhile, the *Streblus elongatus* sub-community consisted of seven species belonging to seven genera and seven families. The characteristics and differential species of this sub-community were *Streblus elongatus, Durio zibethinus, Lasianthus oblongus, Macaranga triloba, Pandanus* sp., *Vitex vestita* and *Macaranga gigantea*.

SPECIES RICHNESS COVERAGE

Plot 2 had the highest coverage of herbs layer which was 65% of total coverage and followed by plot 5 with 50% of total coverage (Figure 1). Plots 1, 3, 9 and 10 had 45% total coverage of herb layer and this was followed closely by plots 4, 6, 7 and 8 with 40% total coverage of herb layer. For shrub layer, plot 6 had the highest percent of total coverage 35% and followed closely by plot 8 with 30% total coverage of shrub layer. Plots 5, 9 and 10 had a 25% total coverage of shrub layer. Meanwhile, plots 1, 4 and 7 had 20% total coverage of shrub layer, leaving plot 2 with 15% total coverage and plot 3 with 10% total coverage of shrub layer.

For the T2 layer, both plots 3 and 7 had the highest percentage of total coverage 30% and followed by plots 1 and 4 with 25% total coverage. Plots 8, 9 and 10 had 20% of T2 layer coverage and plots 2, 5 and 6 had 15% total coverage of T2 layer.

For T1 layer, plot 10 had the highest percentage of total coverage 20%, followed by plots 3 and 4 with 15% total coverage of T1 layer. Plots 1, 5, 6, 8 and 9 had 10% of total coverage and plots 2 and 7 had the lowest total coverage of T1 layer (5%).

All the plots showed that herb layer had the highest percentage of coverage followed closely by shrub layer. Meanwhile, both T1 and T2 layers had the lowest percentage of total coverage compared to shrub and herb layers.

The trees in the study area could not regain its original height due to the slow regeneration caused by previous logging and other anthropogenic disturbances. Thus, this has resulted to the absent of ST (trees with height above 30

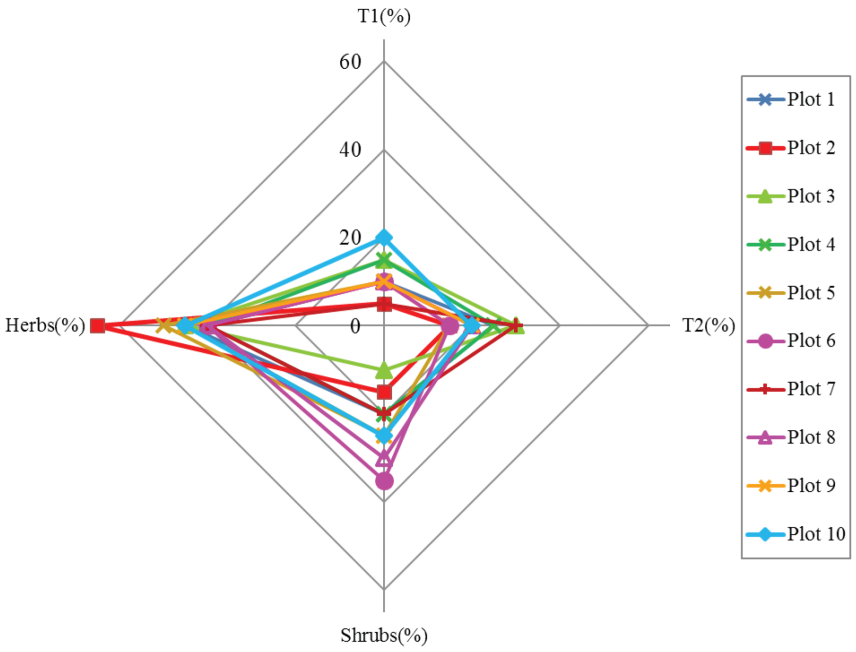


FIGURE 1. Species-richness polygon of all the 10 plots in Compartment 13, Ayer Hitam Forest Reserve

m) and the low coverage of T1 and T2 layers in the study area.

## Discussion

The present study has recorded a total of 59 species belonging to 54 genera and 34 families from all the 10 plots at Ayer Hitam Forest Reserve. Meanwhile, previous study by Faridah-Hanum and Khamis (2004) recorded a total of 430 species of seed plants belonging to 203 genera and 72 families from all parts of Ayer Hitam Forest Reserve. Understanding the species composition and diversity can enlighten our knowledge of newer species as well as their behaviour in a particular forest type (Mardan et al. 2013). The environmental gradient in particular the soil gradient plays an important role in influencing the distribution of vegetation communities of a particular forest ecosystem (Nurfazliza et al. 2012).

This study has shown that *P. gutta, E. diadenum, A. longifolia* and several other species can be found in all the four vegetation layers and in a several plots. Most of these species grew in colonies or were in certain population. Thus, it is feasible that trees of some species could grow as a group and spread across several plots (Kwan & Whitmore 1970). The lesser known wood species (LKS) such as Mahang (*Macaranga* sp.), Sesenduk (*E. diadenum)* and Terap (*Artocarpus* sp.) emerged in large quantity in secondary forest and could become as potential alternative supply of raw material for wood based industries (Ang et al. 2014).

Previous logging affected the nutrient in soil and contributed to the slow regeneration of the trees. Thus, the trees could not regain its original height which has resulted to the absence of emergent strata (trees with height above 30 m) and the low coverage of T1 and T2 layers in the study area. The slow regeneration of the trees in Ayer Hitam Forest Reserve suggests that the area was actually recovering from the past disturbance (Roland 2000). Disturbance would reduce the potential height of trees from 25 to 50% (Ng 1983).

Furthermore, anthropogenic disturbances such as visitor frequentation and adjacent land use create the habitat for exotic species. Anthropogenic disturbances, including coverage (rubbishes and tiles), trampling (paths, visitors coming from different adjacent lands and the distance to edge) and deforestation (anthropogenic caves and stumps) and indirect anthropogenic disturbances (terrain such as slope and aspect) might have integrated effect on composition and plant diversity of forest (Wang et al. 2012). High anthropogenic disturbances might increase similar non-native herb species in urban area and low disturbances might promote co-existence of wood species in suburban area (Li et al. 2012).

Trees from the family Euphorbiaceae were also common in the study area. The frequent occurrence of members of family Euphorbiaceae may indicate that the forest in the study area is disturbed (Ekarelawan 1995). Secondary forest is usually characterized by species such as *Macaranga* sp., *Melastoma malabathricum* and zingiberaceous plants (Miyagi et al. 1988).

Despite the existence of some species commonly distributed, this study has also shown several species that have occurred only once or twice in all the plots. This factor suggests that the tropical forest consists of many aggregated species and small numbers of randomly distributed species (Hubbell 1979; Masaki et al. 1992; Tanouchi & Yamamoto 1995; Yamamoto et al. 1995). The distribution of 73% of tree species in a 52 ha forest dynamics plot in Bornean mixed dipterocarp forest were significantly aggregated on one of the four soil types which were sandy loam, loam, fine loam and clay (Russo et al. 2005).

With the present rapid rate of clearing and logging, it is predicted that there will be fewer primary or virgin forests exist in the future, and most of what available then will be disturbed, logged-over or secondary forests (Lajuni & Latiff 2013). Biologists are concerned that disturbed, logged-over and secondary forests are not as good as primary forests in term of species diversity, composition, biomass and structure.

## Conclusion

Based on the high percentage of herbs, the *P. gutta* community in Ayer Hitam Forest Reserve is actually a secondary forest and is evolving into a primary forest. Restoration of *P. gutta* will become more feasible with all the basic information on the *P. gutta* community obtained in this study. The composition and distribution of species in this study were influenced by environmental factors such as natural forest gap, soil mineral viability, altitude and the topography. This study is only a preliminary research, thus, further research should be conducted on those mentioned factors especially the altitude. This study provides information on the growth response of the mixed dipterocarp forest for development of proper forest management.

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