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Tree Species Composition and Distribution in Sungai Lalang Forest Reserve, Selangor, Malaysia

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Abstract

Species richness, species composition, height, diameter class structure and tree species diversity were examined in a 1 plot in lowland tropical rain forest in Sungai Lalang forest reserve, Selangor, Malaysia. However, some of trees with diameter of breast height (DBH) of 5 cm and above were measured and recorded to be analyzed. As a result, all species at the study site were compared with some results which were found equaled abundant according to Evenness Index that gave a value of 0.922; Margalef's Index reflected a value of 17.01. *Chaetocarpus castanocarpus* (Euphorbiaceae) was the most important species with an IVI (Important Value Index) of 4.643%, while Euphorbiaceae was the dominant family for the study area with IVI of 14.02%. The recommendation are the study area should be managed and protected in the right way to ensure the continued existence and conservation of Malaysia natural resource

Key words: Species Composition, Species Diversity, Selangor, Malaysia.

INTRODUCTION

For thousands of years forest provides the need of communities living within and close to forest environment. Forest dependent communities use natural resources for their food and good needs, and they sell forest products for cash income. Forest and its environs provide the bases for the continuity of their culture, beliefs and identity. However, the quest for modern life and development driven by monetary gains has increasingly affected resources, ecological functions and fauna and flora of forest. Construction of roads, settlements, and tourism activities into the forest frontier has indirectly and directly opened the public appetite for more such business; many years of random and unsustainable forest utilization in Malaysia have led to huge forest destruction that in turn leads to declining revenue and conversion of forest into other land use (Hirsch 1987, Pasuk & Chris 1995). All these galvanized Primack & Corlett (2005) to stat that the primary cause of the loss of biological diversity is not direct human exploitation or malevolence, but the habitat destruction that inevitably results from the exploitation of human population and human activities, when a habitat is degraded or lost, the animals, the plants and other organisms living there will have nowhere to go and will just die off (Biggs *et al*. 2005).

Nowadays Malaysia still has about half of its primary habitats and has established extensive protected areas as Bangi Permanent Forest Reserve which received its reserve status on December 31, 1906 and The Krau Wildlife Reserve which established on 9th June1923, but the forces of habitat destruction and degradation continue because of human (Primack & Corlett 2005). Malaysia as it stands now is fully aware of the importance of the wealth of biological diversity presently available within its shores and is therefore making every effort with full commitment to preserve and sustainably utilize them such that this wealth is ensured to perpetuity. The National Policy on Biological Diversity for Malaysia was developed and launched in 1998. This national policy aims to provide direction for the nation to implement strategies, action plans and programmes on biological diversity for the conservation and sustainable utilization of the resources (Soepadmo & Wong 1995).

Many places in Malaysia were opened understudied; there have been several studies on various forest types carried out to document flora diversity in Malaysian forests (e.g. Lajuni (1996); Faridah-Hanum et al. (1993) with clear data on biodiversity in Malaysia and this help the relevant authorities including the Forestry Department of Selangor to have better knowledge and understanding of the nation's biological resources. With better knowledge and understanding, the relevant authorities can create a plan or improve certain areas in conservation biology management strategies.

MATERIALS AND METHODS

The forest reserve in Hulu Langat District consists of Sungai Lalang Permanent Forest Reserve (SLFR) and Hulu Langat Forest Reserve (HLFR). About 16.712 ha had been reserved in SLER while HLFR was gazetted later in 1915 with 13,132 ha. These forest reserves are important as water catchment for Langat and Semenyih Dams, timber, rattan, and recreational area and also important as ecological balance such as climate regulation, nutrient cycling, flood control, and biodiversity. Dam in the HLFR and Semenyih Dam in the SLFR were completed in 1976 and 1984, respectively, for the purpose of water supply and storage. These dams supply water for people in the Hulu Langat district and Klang Valley areas. These dams are also important for generation of hydroelectric power (Shahwahid et al. 1997). Originally this area was a virgin forest with few settlements of native people. However, due to various development activities, the land-use slowly changed into agriculture and residential area. In 1997, the total acreage of SLFR was reduced to 13,592 ha, due to clearance of forest for housing and agriculture purposes. The fast development of the land use has an effect on the water quality in this area. The local community living in this area consists of indigenous people from the Temuan tribe who live adjacent to the HLFR, Malay villagers are found a few miles downstream of several rivers and Chinese residents are at the town of Simpang Balak (Shahwahid et al. 1997). Some of the rivers, such as Sg. Chongkak, Sg. Gabai and Sg. Tekala are popular as forest recreation areas and heavily visited during weekend and holiday seasons. This forest is characterized as lowland and hill dipterocarp forest that is dominated by Shorea species (Noor Farikhah *et al*. 2005). There is one study have been contacted in this forest by Elbushari (2000) and this May a chance to do more studies to provide substantial evidence for the forestry department in Selangor to take action.

A one-hectare permanent plot of 200 m x 50 m was established at the Sungai Lalang Forest Reserve. The plot was divided into 10 plots, measuring 50 m x 20 m each which total to 1 ha. Later each plot was divided into several subplots to assess the species composition and the similarities including seedlings in subplot of 2 m x 2 m, saplings in subplot of 5 m x 5 m and tree > 5 cm diameter at DBH enabling the data to be colleted. The target trees with 5.0 cm diameter at breast height (DBH) and above were selected and manually measured using the diameter tape at 1.3 m above the ground. Later all the specimens of each tree (i.e. leaves. fruit. and sometimes twigs) were sent to Kebangsaan Malaysia Herbarium (UKMB) laboratory to be prepared according to voucher specimens and to be identified using keys of the Tree Flora of Malaya (Whitmore, 1972, 1973; Ng, 1978, 1989).

Later all the specimens which harvested from the study area were ready to be analized data using Excel software to determine the basal area, the density and the frequency of each speciment.

The above ground biomass was calculated based on Kato Et Al (1978):

Total above ground biomass

$= W_S + W_B + W_L$ (kg)

W_S = Stem dry weight per tree = $0.313(D^2H)^{0.9733}$

W_B = Branch dry weight = $0.136\ W_s^{1.070}$

W_L = Leaf dry weight

$= (1.25 \times 0.124\ W_S^{0.794}) / (0.124\ W_B^{0.794} + 125)$

Using Sorensen's similarity coefficient to detect the similarity of two samples or beta diversity, calculation based on following formula:

$$QS = \frac{2.\ C}{A + B}$$

Where A and B are the species numbers in sample A and B, respectively. Abundance parameters such as density, frequency and basal area are important parameters to describe the forest structure were calculated, other indices such as the Importance Value Index (IVI) and Shannon-Wiener Diversity,

Evenness Index (E) and Margalef Diversity Index (R) were detected using the formulas as:

Shannon-Weiner Diversity Index (H’): as Alpha diversity

$H' = -\sum (Pi)(\ln Pi)$, where

H’ = Symbol for the diversity in a sample of S species or kinds

Pi = relative abundance of the species or kinds measures = ni/N

N = Total number of individuals of all kinds

ni = number of individuals in the species *i*

ln = natural logarithm

Evenness Index (E):

$E = H' / \ln (S)$

Where: E = Evenness Index

H’ = Shannon Index

S = Sum of Species

Margalef Diversity Index (R’);

The index is the simplest measurement to calculate species richness in a study area. Richness can be expressed simply as the number of species. The value was calculated by using the following formula.

$R' = (S - 1) / \ln (N)$

Where, S= observed number of species

N= Observed total number of individual

In= the natural logarithm

THE RESULTS AND DISCUSSION

A total of 198 trees with diameter of breast height (DBH) of 5.0 cm and above were recorded in the one hectare study plot at Sungai Lalang Forest Reserve. Identification on all specimens revealed a total of 92 species and 59 genera from 29 families. The number of species per hectare found in this study agrees with the reports by Clark and Clark (1996) and Gentry (1990) who stated that the number of tree species in the tropical forests is extremely high, commonly passing 100 species per hectare. Based on the number of genera, the Euphorbiaceae comprises the highest number of 9 genera, According to Whitmore (1972) this is expected because Euphorbiaceae is one of the biggest families reported in Peninsular Malaysia. The highest subsequent families were indicated by the Sapotaceae, Leguminosae and Meliaceae with a total of 4 genera. The largest family based on the species number was also represented by the Euphorbiaceae with a total of 10 species or 10.86% of total species number. This was followed by the Dipterocarpaceae with 8 species (8.96%) and the Burseraceae of 7 species (7.60%). However, it is very interesting to note that there are six families presented by one genus, one species and one individual, i.e. *Trigoniastrum hypoleucum* (Trigoniaceae), *Pentace strychnoidea* (Tiliaceae), *Gonystylus maingayi* (Thymelaeaceae), *Symplocos* sp. (Symplocaceae), *Dyera costulata* (Apocynaceae), and *Alangium ebenaceum* (Alangiaceae).

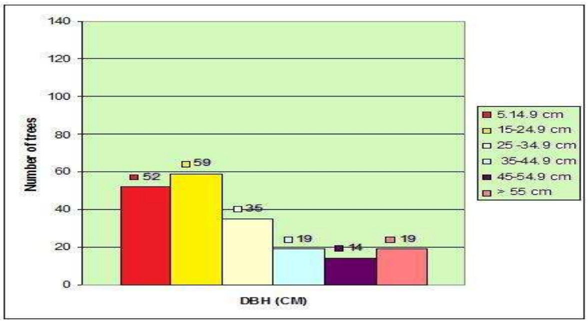
In the present study a total of 59 seedlings were recorded in the study site belonging to, 22 species, 19 genera, and 18 families. *Castanopsis schefferana* (Fagaceae) had the highest number of individuals with 7. *Syzygium griffithii* (Myrtaceae), Shorea macroptera (Dipterocarpaceae), and *Ixonanthes icosandra* (Ixonanthaceae) have 6 individuals and followed by *Meiogyne monosperma* (Annonaceae) with 4 individuals. A total of 53 saplings were recorded in the study area belonging to 21 species, 19 genera, and 15 families, and. The results have showed that *Cinnamomum mollissimum* (Lauraceae) has the highest number of individuals of 8 saplings, *Gonystylus maingayi* (Thymelaeaceae) with 6 individuals and *Xanthophyllum eurhynchum* (Polygalaceae) and *Symplocos sp.* (Symplocaceae) are presented with 5 individuals. For seedlings and saplings it is quite different of the mature trees, in P03 and P05 there are no any growth of the seedlings saplings, and this is evidence that the future for the trees in these areas under danger of extinction, whilst P08, P09, and P10 Containing the largest number of seedlings and saplings, the same result in areas of mature trees, but families are quite different. In figure 4.2 showed the distribution of seedlings and saplings in the study area.

Similarity between seedlings and saplings and mature tree areas was calculated using Sorensen’s index of community. In this study, it is used to detect the relation between mature trees and regeneration, results of species similarity index between seedlings and mature trees is 0.12, which means the most of the seedling species are not similar to those of tree category. Whilst the similarity index between seedlings and saplings is 0.27, this confirms the seedlings species are not similar to those of saplings, but for saplings and mature trees it is 0.53, which means the families and saplings species in the study area were more similar to those of the tree category. The results showed that the new generations was very active and very strong, but it dose not mean the trees will be saved in the future because most of the new generation did not match or did not belong to the same species of the mature trees, we can predict that the forest will be change in two or three decades. This may change the existing system in the forest, especially the nutrition cycle for some animals that depend on endemic trees. The absence of a new generation belongs to the mature trees may be due to wind or consumption of some endemic mammals or even some fires, because seedlings and saplings are very sensitive to such changes or maybe the reproductive process of mature trees is weak. The question now is how these generations that do not belong to the mature trees came to the study area?

The total basal area was estimated at 18.19 m2/ha, Basal area is not influenced by the number of individuals, where less number of individuals can represent a high value of basal area when its DBH are larger (Sharma 2004). The Dipterocarpaceae dominated the plot area with a total basal area of 7.82 m2/ha, this is expected because most of large trees with DBH of more than 55 cm are dipterocarp trees, and this contributes to the large basal area of this family. Nizam et al. (2006) in his study at Krau Wildlife Reserve, Pahang, Malaysia, stated that Dipterocarpaceae has the highest basal area of 12.00 m²/ha. In term of genus, Shorea was the leading genus with the basal area of 7.82 m²/ha. As for the species level, Shorea pauciflora (Dipterocarpaceae) contributed the largest basal area with 2.16 m²/ha. Frequency of occurrence reflects a widespread distribution of the species in the study plot. A total of 198 trees with diameter at breast height of 5 cm and above were recorded in 1 ha plot. Sapotaceae, Moraceae, Dipterocarpaceae recorded the highest frequency of 9%, Seven families reported in one subplot in the study location with frequency of 1% i.e. Trigoniaceae, Tiliaceae, Thymelaeaceae, Symplocaceae, Olacaceae, Apocynaceae, and Alangiaceae. This means their distribution is so low in the study location. At the genus level, Shorea reported as with the highest frequency of 9% whereby Shorea was found in 7 subplots of 10 subplots in the study area, and in term of density the Dipterocarpaceae indicated the highest number of individuals with a density of 33 ind/ha, As for genus level Shorea had the highest density with 33 ind/ha.

Calculation showed that the density for trees with diameter at breast height of 5 cm and above at the study area were 198 ind/ha, the Dipterocarpaceae indicated the highest number of individuals with a density of 33 ind/ha, followed by the Moraceae with a density of 28 ind/ha, Sapotaceae with a density of 18 ind/ha, Followed by Burseraceae with 19 ind/ha, Euphorbiaceae with 16 ind/ha and finally Leguminosae with 13 ind/ha. As for genus level, *Shorea* had the highest density with 33 ind/ha. The second highest density is *Artocarpus* with 15 ind/ha and *Streblus* with 13 ind/ha. The rest of genus present at the study site had less than 10 ind/ha, *Santiria* with 8 ind/ha, *Payena*, *Canarium,* and *Archidendron* showed same value of density of 7 ind/ha. . Species-wise, *Streblus elongatus* (Moraceae) shows the highest density of 13 ind/ha, whilst the second highest density indicated by Shorea longisperma (Dipterocarpaceae) with density of 8 ind/ha and the third one is Shorea macroptera (Dipterocarpaceae) with density of 7 ind/ha, respectively. Four species under four families showed same density of 7 ind/ha.

Most forest stand structure descriptors are traditionally based on measures easily obtainable from the ground level (e.g. diameter at breast height). Even measurements based from above canopy photography or sensing often imply a Ground-level bias. Furthermore, the ratio of various diameter groups in a population determines the reproductive status of the population and it indicates the future course of stability of forest communities (Odum, 1971). the study area was divided into six parts depending on the size of trees, starting from 5 cm up to over 55 cm. Figure 1.1 showed that the small trees were the dominated and have recorded the highest number in the entire plots, starting from size 5 cm until 25 cm, this result gives two impressions, first, the new tree regenerations or the small tress are active, healthy and give good support for the future of this forest. Second, the mature trees which recorded lower number and have illustrates the negative side of the forest and not encouraging economy. According to the figure 1 we can see that



Legend of figure 1. Tree with diameter below 25 cm dominate the forest structure with 111 individuals or (56%) from the total number of individuals.

The Chaetocarpus castanocarpus (Euphorbiaceae) was the most important species with an IVI of 4.64%, relatively; it was the most dominant species in the plot compared to other species, followed by the Payena lucida (Sapotaceae) with value of IVI of 3.37% and Streblus elongatus (Moraceae) with an IVI of 2.74%. Most of the species presented IVI less than 1.00% with low density, frequency and relative dominance.

In term of above ground biomass trees in forest come in various shapes and forms. Many large trees are with buttresses, where others are with multiple stems. Biomass, which is the dry weight of plant material, is used as a parameter in determining the primary productivity of a forest, ordinarily expressed in terms of tones per hectare or t/ha. Affirmed that the stem has higher biomass value compared to the other parts of trees as its biomass value is influenced by tree size, and the environment. This agrees with (NorAini et al 1997) who stated that the trees with big size will result in contributing large amount of biomass even if they are represented by the same number of individuals in particular area. In this study the above ground biomass consists of combined weight of all tree materials above the ground level.

The total biomass of tree with DBH of 5.0 cm and above was estimated at 268.83 t/ha, which contributed by biomass stems of 218.42 t/ha, biomass branches of 50.41 t/ha and biomass leaves of 0.03 t/ha. Based on 198 trees enumerated during the study, Dipterocarpaceae came out as the family with the largest biomass of 126.1 t/ha. Trailing behind was Moraceae with biomass of 34.35t/ha. Followed by Sapotaceae with biomass of 21.31 t/ha, then Leguminosae had the biomass of 14.76 t/ha. Genus-wise, Shorea contributed with the largest amount of biomass with 126.10 t/ha. This is not surprising because most large trees with DBH of more than 55 cm are dipterocarp trees, followed by Artocarpus with 21.15 t/ha, Pouteria with 13.19 t/ha. Many genera presented by one individual but they were recorded with a high biomass, for example Koompassia presented by one tree with biomass of 9.47t/ha whilst others recorded with more individuals but they showed less values of biomass. E.g. Castanopsis reported with biomass of 7.61 and presented by 5 trees. In terms of species, the Dipterocarpaceae was the highest contributor in total above ground biomass. Shorea longisperma had the highest biomass of 33.82 t/ha, the second highest was Shorea pauciflora with 26.38 t/ha, followed by Shorea bracteolata of 21.54 t/ha.

CONCLUSION

A plot size of 1-ha is sufficient to estimate tree species composition and distribution in Sungai Lalang forest reserve, Selangor, Malaysia. The study showed that the species composition is high since 92 species have been recorded and came from 29 families, depending on the diversity parameters i.e. Margalef Diversity Index, Evenness Index, and Shannon-Weiner Diversity Index, the species richness in Sungai Lalang forest reserve is high. A better understanding of biomass will provide useful information on the growth pattern of these species and families. Any way, the total above ground biomass of this study is distinctively lower when compared with previous studies in different parts of Peninsular Malaysia. The similarity in this study reflected that most of seedlings did not belong to the same species of saplings and nor mature trees and this is one of the concern of this study.

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