VEGETATION ANALYSIS OF HILL FOREST IN ULU MUDA FOREST RESERVE, BALING, KEDAH

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ABSTRACT

This paper emphasize on the quantitative analysis of trees of unlogged hill forest in Ulu Muda Forest Reserve. Two plots of 1-hectare size were established within the forest area and divided to 100 10x10m quadrates. Only trees with dbh more or equal to 5 cm been observed. The species name, dbh and tree height were recorded from the trees. A total of 1825 of individual trees were observed in the two 1-hectare plots with 43 family and 236 species. The most dominant and diverse species is *Mallotus kingii* with 195 individuals in the 2ha plot, total basal area 3.17m^2, relative basal area 5.87% and IVI 22.99. While the family Euphorbiaceae has the highest FVI (60.73).The most diverse plot is plot 2 with 976 individuals and 179 species.

Key words: hill forest, IVI, FVI and basal area

1.0 INTRODUCTION

Most forested area was used as production forest. The production forest focusing on timber production which is one of Malaysia main driving force in the wood-based industry. In 2010, timber sector contributed 3.2% of Malaysia total merchandise export.Forest areas usually used for production were lowland dipterocarp forest and hill forest. Due to lack of lowland forest resulting from deforestation for supporting the growing number of Malaysian citizen, hill forests have become the main production forest.Hill forest type occurs between elevations of 300m and 800m (Whitmore 1984). Many genera from lowland dipterocarp forest were represented in Hill forest

however the composition of species were different. Common dipterocarp species that occur in Hill Forest is *Shorea curtisii* (Seraya) where this species usually were found on ridges. Seraya were well adapted to the ridge that known for the low soil agricultural potential. The non-dipterocarp species such as *Swintonia spicifera* (merpauh) *also* take place frequently on the hill forest. Ultisols, oxisols and podzols were usually found as the soil type on the hill forest which indicates low agricultural potential of the area. The hill forests currently were the main productive forest estate.

2.0 METHODOLOGY

2.1. **Study Site**

The study were conducted in Compartment 35 of the Ulu Muda Forest Reserve, Baling, Kedah. This is an unlogged hill dipterocarp forest where majority of the stock are from dipterocarpaceae family. The fieldwork was conducted in February-September 2012.

2.2. Data collection

Two plots each size 1 hactare (ha) were established continuously within the hill forest. Both of the 1 ha plots were divided into 100 of 10x10m quadrates. Data were gathered from each quadrate and only data from trees were collected. Trees are identified as plants with diameter at breast height(dbh) equal or more than 5.0 cm. Parameters recorded were species name, diameter at breast height (dbh) and height. Dbh data were collected by using the diameter tape measured at 1.3m above the ground while the height of the trees were measured using laser hypsometer. Specimens were collected from the field and were brought to UPM herbarium for drying and identification process. Data gathered were recorded in database for statistical analysis.

2.3. Data Analysis

Data collected from the field were used to calculate density, frequency and basal area. Parameters such as density, frequency and basal area were required to seek the importance value index (IVI). Bambang & Ati(2006) stated that vegetation analysis is the best way to study species composition and vegetation structure in one ecosystem and IVI were calculated in vegetation analysis. According to Curtis and Mclntosh (1950), Importance Value Index (IVI) is the sum of relative density, relative dominance and relative frequency for a species and is calculated as follows;

IVI of sp. I = relative density of sp. I + relative frequency of sp. I + relative dominance of sp. I
where:

$$= \frac{(\quad .\qquad\qquad\qquad\qquad)}{} * 100$$

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Next, Family Value Index (FVI) also calculated. FVI is the sum of relative density, relative frequency and relative dominance for a family. The formula were the similar to the IVI, where species is substituted by family.

3.0 RESULTS AND DISCUSSION

Table 1 showed the total amount of trees in each diameter class for the 2 ha plots. Although the number of trees is high, the main diameter class is 5 - 9.9 cm with 755 individuals. Only 62 trees were in the diameter class category greater than 45 cm dbh.Figure 1 showed the distribution of dbh class that conform the reverse 'J' shape curve with a total of 1825 individuals. According to Kunwar & Sharma (2004), the reverse 'J' curve is typical of all types of forest where small trees tends to strive due to gap opening causes by many natural factors.

Table 2 showed the quantitative analysis for the trees recorded in the 2 ha plots. Altogether 236 species were observed from this study and the total number of individual is 1825. Looking at the diversity in can be determined that *Mallotus kingii, Polyalthia sp., Symplocos rubiginosa,* and *Archidendron ellipticum* were the four most diverse species. However, from the Importance Value Index (IVI), the three most important species are *Mallotus kingii, Polyalthia sp.,* and *Symplocos rubiginosa*. The most dominant species is *Mallotus kingii* with 195 individuals in the 2ha plot, total basal area 3.17m^2, relative basal area 5.87% and IVI 22.90. The co-dominant species is *Polyalthia sp.* with 68 individuals, total basal area 2.12m^2, relative basal area 3.92% and IVI 10.93. The highest frequency was also *Mallotus kingii* with relative frequency 6.44%

Welzen(2001)stated that*Mallotus kingii* were widely distributed in peninsular Malaysia and peninsular Thailand. *Mallotus kingii* also mainly appear in primary forest, on ridges, hillsides, low undulating terrain and along streams. It can appear up till 833m of altitude. According to Whitmore (1973) Mallotus is predominantly a genus of common, small trees of the lower part of primary rain forest and commonly mistaken for Macaranga but the differences between Mallotus and Macaranga can easily be distinguished. Furthermore, only few species of Mallotus inhabit secondary forest and this is a contrast with Macaranga.

Table 3 showed the quantitative analysis for Family Value Index (FVI) for the 2 hectare plot. The 5 most dominant family were Euphorbiaceae (FVI 60.73),Annonaceae (FVI 32.08),Symplocaceae (FVI 21.24),Dipterocarpaceae (FVI 19.58), andMeliaceae (FVI 16.83). The less dominant family was Lythraceae with FVI 0.12.

Referring to Figure 2, the dominance-diversity curve plotted between importance value index and species sequence for trees indicates a relationship between different species showing importance value in study site. Stated by Kunwar & Sharma (2004) species dominance refers to the availability of suitable niche and resource apportionment in a community has often been interpreted from the dominance diversity curve. At the beginning, the curve quite steep because there were several

species possess high IVI value than others species, but then the curve moving consistent with a gentle slope. The gentle slope of dominance diversity curve indicates steady growth of trees. The disturbance of a plot can be shown by the depression of the curve that represent small size classes of trees.

4.0 CONCLUSION

This study showed that Ulu Muda Forest Reserve were rich with biodiversity where 43 family and 236 species have been observed from the 2 ha plot. The most dominant plant in the study site is *Mallotus kingii* (Euphorbiaceae) while the less dominant species is *Ryparosa sp.* (Achariaceae). The most dense and diverse plot were represented by plot 2 which contribute to the highest number of species and individuals. The dominance of *Mallotus kingii* shows that the forest still need time to grow to it full productive potential.

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Table 1. No of trees by diameter class

diameter class	no. of trees
5-9.9	755
10-14.9	469
15-19.9	298
20-24.9	98
25.29.9	52
30-34.9	48
35-39.9	25
40-44.9	17
45-49.9	13
50-54.9	8
55-59.9	3
60-64.9	7

65-69.9	9
70-74.9	5
74.9-79.9	1
80-84.9	10
85-89.9	1
90-94.9	3
110-114.5	1
120-124.9	1
155-159.9	1

Table 2. Quantitative analysis of vegetation

Family	Species	D	F	BA	RD (%)	RF (%)	RBA (%)	IVI
Euphorbiaceae	*Mallotus kingii*	195	100	3.17	10.68	6.44	5.87	22.99
Annonaceae	*Polyalthia sp.*	68	51	2.12	3.73	3.28	3.92	10.93
Symplocaceae	*Symplocos rubiginosa*	56	43	2.67	3.07	2.77	4.94	10.78
Annonaceae	*Polyalthia cauliflorus*	35	24	1.77	1.92	1.54	3.29	6.75
Leguminosae	*Archidendron ellipticum*	49	39	0.70	2.68	2.51	1.30	6.49
Symplocaceae	*Symplocos cochinchinensis*	38	27	1.14	2.08	1.74	2.11	5.93
Annonaceae	*Monocarpia marginalis*	31	21	1.31	1.70	1.35	2.42	5.47
Olacaceae	*Ochanostachys amentacea*	22	19	1.57	1.21	1.22	2.91	5.34
Sapindaceae	*Pometia pinnata*	17	14	1.74	0.93	0.90	3.22	5.05
Fagaceae	*Lithocarpus sp.*	34	29	0.67	1.86	1.87	1.24	4.97
Symplocaceae	*Symplocos barringtoniifolia*	34	28	0.47	1.86	1.80	0.87	4.53
Dipterocarpaceae	*shorea curtisii*	16	16	1.31	0.88	1.03	2.42	4.33
Euphorbiaceae	*Mallotus mucronata*	36	28	0.26	1.97	1.80	0.48	4.25
Euphorbiaceae	*Macaranga triloba*	20	19	0.83	1.10	1.22	1.55	3.86
Ulmaceae	*Gironniera nervosa*	25	20	0.64	1.37	1.29	1.19	3.85
Polygalaceae	*Xanthophyllum griffithii*	27	25	0.31	1.48	1.61	0.58	3.67
Dipterocarpaceae	*Shorea parvifolia*	13	11	1.18	0.71	0.71	2.18	3.60
Lauraceae	*Litsea sp.*	18	15	0.66	0.99	0.97	1.22	3.17
Myrtaceae	*Syzygium sp.*	16	15	0.70	0.88	0.97	1.29	3.13
Elaeocarpaceae	*Elaeocarpus grandiflorus*	17	14	0.66	0.93	0.90	1.23	3.06
Actinidiaceae	*Saurauia nudiflora*	18	16	0.44	0.99	1.03	0.81	2.82
Dipterocarpaceae	*Shorea bracteolata*	10	10	0.88	0.55	0.64	1.63	2.82
Euphorbiaceae	*Macaranga hypoleuca*	20	16	0.32	1.10	1.03	0.60	2.72

Dipterocarpaceae	*Shorea macroptera*	10	9	0.70	0.55	0.58	1.30	2.43
Leguminosae	*Saraca declinata*	10	10	0.66	0.55	0.64	1.23	2.42
Euphorbiaceae	*Macaranga hosei*	16	15	0.29	0.88	0.97	0.54	2.38
Polygalaceae	*Xanthophyllum stipitatum*	13	12	0.48	0.71	0.77	0.88	2.37
Dipterocarpaceae	*Shorea macrophylla*	9	7	0.73	0.49	0.45	1.35	2.29
Rubiaceae	*Diplospora malaccensis*	11	9	0.59	0.60	0.58	1.10	2.28
Annonaceae	*Polyalthia cinnamomea*	11	11	0.48	0.60	0.71	0.89	2.20
Euphorbiaceae	*Mallotus subpeltatus*	16	12	0.30	0.88	0.77	0.55	2.20
Leguminosae	*Albizia splendens*	15	13	0.27	0.82	0.84	0.50	2.15
Myristicaceae	*Knema hookeriana*	15	15	0.20	0.82	0.97	0.37	2.15
Sapindaceae	*Pometia ridleyi*	15	14	0.22	0.82	0.90	0.40	2.12
Euphorbiaceae	*Mallotus macrostahyus*	14	12	0.29	0.77	0.77	0.55	2.09
Myristicaceae	*Knema intermedia*	15	15	0.15	0.82	0.97	0.28	2.07
Myristicaceae	*Horsfieldia sp.*	12	11	0.38	0.66	0.71	0.70	2.07
Polygalaceae	*Xanthophyllum ellipticum*	15	14	0.18	0.82	0.90	0.33	2.05
Annonaceae	*Cyathocalyx sp.*	10	10	0.46	0.55	0.64	0.85	2.04
Moraceae	*Ficus Vasculosa*	6	5	0.72	0.33	0.32	1.33	1.98
Dilleniaceae	*Dillenia grandifolia*	5	4	0.76	0.27	0.26	1.40	1.93
Meliaceae	*Aglaia malaccensis*	15	13	0.14	0.82	0.84	0.27	1.92
Sapotaceae	*Pouteria sp.*	14	12	0.21	0.77	0.77	0.38	1.92
Aquifoliaceae	*Ilex sp.*	12	10	0.32	0.66	0.64	0.59	1.89
Euphorbiaceae	*Mallotus sp.*	14	13	0.14	0.77	0.84	0.27	1.87
Burseraceae	*Canarium sp.*	13	12	0.20	0.71	0.77	0.37	1.86
Euphorbiaceae	*Epiprinus malayanus*	15	13	0.10	0.82	0.84	0.18	1.84
Ulmaceae	*Gironniera subaequalis*	12	12	0.21	0.66	0.77	0.38	1.81
Elaeocarpaceae	*Elaeocarpus petiolatus*	7	7	0.50	0.38	0.45	0.93	1.76
Elaeocarpaceae	*Elaeocarpus reticulatus*	12	11	0.20	0.66	0.71	0.36	1.73
Meliaceae	*Aglaia hiernii*	11	10	0.25	0.60	0.64	0.46	1.71
Rubiaceae	*Aidia densiflora*	10	10	0.28	0.55	0.64	0.51	1.70
Meliaceae	*Aglaia oligophylla*	8	8	0.39	0.44	0.51	0.72	1.67
Annonaceae	*Cyathocalyx olivaceus*	4	4	0.63	0.22	0.26	1.17	1.64
Actinidiaceae	*Saurauia pentapetala*	10	9	0.26	0.55	0.58	0.48	1.61
Euphorbiaceae	*Aporosa falcifera*	9	8	0.32	0.49	0.51	0.60	1.61
Sapindaceae	*Paranephilium macrophyllum*	10	10	0.22	0.55	0.64	0.40	1.59
Polygalaceae	*Xanthophyllum ecarinatum*	12	11	0.12	0.66	0.71	0.22	1.59
Lecythidaceae	*Planchonia valida*	11	10	0.18	0.60	0.64	0.33	1.58
Euphorbiaceae	*Mallotus griffithianus*	11	10	0.16	0.60	0.64	0.30	1.55

Euphorbiaceae	*Macaranga gigantea*	9	8	0.27	0.49	0.51	0.50	1.50
Elaeocarpaceae	*Elaeocarpus floribundus*	9	8	0.25	0.49	0.51	0.47	1.48
Dilleniaceae	*Dillenia indica*	3	3	0.60	0.16	0.19	1.11	1.46
Meliaceae	*Aglaia crassinervia*	7	7	0.31	0.38	0.45	0.58	1.41
Tiliaceae	*Microcos sp.*	6	6	0.38	0.33	0.39	0.70	1.41
Dipterocarpaceae	*Shorea assamica*	5	5	0.43	0.27	0.32	0.79	1.38
Meliaceae	*Toona sinensis*	4	4	0.49	0.22	0.26	0.90	1.38
Lauraceae	*Alseodaphne perakensis*	6	6	0.35	0.33	0.39	0.64	1.36
Euphorbiaceae	*Aporosa aurea*	9	9	0.15	0.49	0.58	0.28	1.35
Euphorbiaceae	*Omphalea malayana*	6	6	0.33	0.33	0.39	0.61	1.33
Sapindaceae	*Nephelium sp.*	9	8	0.17	0.49	0.51	0.31	1.32
Meliaceae	*Dysoxylum acutangulum*	2	2	0.58	0.11	0.13	1.07	1.31
Meliaceae	*Aglaia odorata*	8	8	0.18	0.44	0.51	0.34	1.29
Euphorbiaceae	*Aporosa frutescens*	9	8	0.15	0.49	0.51	0.28	1.29
Meliaceae	*Aglaia forbesii*	6	5	0.34	0.33	0.32	0.63	1.28
Malvaceae	*Neesia kostermansiana*	4	4	0.42	0.22	0.26	0.78	1.26
Elaeocarpaceae	*Elaeocarpus rifidus*	8	7	0.19	0.44	0.45	0.35	1.24
Dipterocarpaceae	*Shorea leprosula*	5	5	0.34	0.27	0.32	0.64	1.23
Ulmaceae	*Gironniera parvifolia*	8	7	0.17	0.44	0.45	0.32	1.21
Apocynaceae	*Kibatalia sp.*	6	6	0.26	0.33	0.39	0.47	1.19
Burseraceae	*Dacryodes sp.*	9	9	0.06	0.49	0.58	0.12	1.19
Dipterocarpaceae	*Hopea dyeri*	8	8	0.12	0.44	0.51	0.22	1.18
Anacardiaceae	*Buchanania sp.*	3	3	0.44	0.16	0.19	0.81	1.16
Annonaceae	*Goniothalamus sp.*	8	8	0.11	0.44	0.51	0.21	1.16
Flacourtiaceae	*Hydnocarpus filipes*	7	6	0.21	0.38	0.39	0.39	1.16
Euphorbiaceae	*Aporosa prainiana*	8	8	0.10	0.44	0.51	0.18	1.14
Euphorbiaceae	*Aporosa arborea*	9	8	0.06	0.49	0.51	0.11	1.12
Anacardiaceae	*Mangifera sp.*	8	8	0.08	0.44	0.51	0.15	1.11
Fagaceae	*Lithocarpus lucidus*	6	6	0.19	0.33	0.39	0.36	1.08
Myrtaceae	*Syzygium zeylanicum*	7	7	0.08	0.38	0.45	0.14	0.98
Lauraceae	*Cinnamomum sp.*	7	7	0.06	0.38	0.45	0.12	0.95
Meliaceae	*Chisocheton sp.*	6	6	0.13	0.33	0.39	0.24	0.95
Lauraceae	*Litsea penangiana*	5	5	0.18	0.27	0.32	0.34	0.94
Phyllanthaceae	*Glochidion sp.*	2	2	0.37	0.11	0.13	0.69	0.93
Moraceae	*Artocarpus sp.*	2	2	0.37	0.11	0.13	0.68	0.92
Ebenaceae	*Diospyros toposioides*	6	6	0.11	0.33	0.39	0.21	0.92
Anacardiaceae	*Pentaspadon motleyi*	4	4	0.23	0.22	0.26	0.43	0.90

Meliaceae	*Aglaia Argentea*	6	6	0.10	0.33	0.39	0.18	0.90
Dilleniaceae	*Dillenia sp.*	1	1	0.42	0.05	0.06	0.78	0.89
Elaeocarpaceae	*Elaeocarpus palembanicus*	6	6	0.08	0.33	0.39	0.14	0.86
Malvaceae	*Sterculia sp.*	3	3	0.26	0.16	0.19	0.48	0.83
Polygalaceae	*Xanthophyllum affine*	6	6	0.06	0.33	0.39	0.11	0.83
Polygalaceae	*Xanthophyllum amoenum*	7	5	0.06	0.38	0.32	0.12	0.82
Malvaceae	*Neesia sp.*	5	5	0.12	0.27	0.32	0.22	0.81
Euphorbiaceae	*Glochidion obscurum*	4	4	0.18	0.22	0.26	0.33	0.81
Fabaceae	*Intsia bijuga*	1	1	0.37	0.05	0.06	0.68	0.80
Rosaceae	*Prunus polystachya*	5	5	0.11	0.27	0.32	0.19	0.79
Sapotaceae	*Pouteria phyteria*	5	5	0.10	0.27	0.32	0.18	0.78
Burseraceae	*Santiria laevigata*	5	4	0.12	0.27	0.26	0.23	0.76
Meliaceae	*Aglaia edulis*	5	4	0.12	0.27	0.26	0.22	0.75
Tiliaceae	*Pentace grandiflorus*	5	5	0.08	0.27	0.32	0.15	0.75
Sapindaceae	*Paranephelium xestophyllum*	5	5	0.08	0.27	0.32	0.14	0.74
Melastomataceae	*Memecylon oligoneurum*	5	5	0.06	0.27	0.32	0.10	0.70
Myristicaceae	*Knema cinerea var. sumatrana*	5	5	0.05	0.27	0.32	0.10	0.70
Meliaceae	*Aglaia eximia*	4	4	0.11	0.22	0.26	0.20	0.68
Sapotaceae	*Palaquium sp.*	5	4	0.07	0.27	0.26	0.13	0.66
Moraceae	*Ficus fistulosa*	5	5	0.03	0.27	0.32	0.06	0.65
Melastomataceae	*Memecylon pubescens*	5	5	0.03	0.27	0.32	0.05	0.64
Euphorbiaceae	*Mallotus paniculatus*	5	5	0.03	0.27	0.32	0.05	0.64
Ebenaceae	*Diospyros pyrrhocarpa*	5	5	0.02	0.27	0.32	0.04	0.63
Myrtaceae	*Syzygium polyanthum*	2	2	0.21	0.11	0.13	0.39	0.63
Lauraceae	*Cryptocarya sp.*	5	4	0.05	0.27	0.26	0.09	0.63
Anacardiaceae	*Buchanania sessilifolia*	5	5	0.01	0.27	0.32	0.03	0.62
Meliaceae	*Reinwardodendron cinerium*	4	4	0.07	0.22	0.26	0.14	0.61
Rubiaceae	*Diplospora sp.*	4	4	0.07	0.22	0.26	0.14	0.61
Elaeocarpaceae	*Elaeocarpus angustiolius*	4	4	0.07	0.22	0.26	0.13	0.61
Fagaceae	*Lithocarpus cyclophorus*	3	3	0.13	0.16	0.19	0.23	0.59
Sapindaceae	*Nephelium lappaceum*	4	3	0.09	0.22	0.19	0.17	0.58
Sterculiaceae	*Scaphium macropodum*	4	4	0.05	0.22	0.26	0.10	0.57
Violaceae	*Rinorea sp.*	4	4	0.04	0.22	0.26	0.08	0.56
Lecythidaceae	*Barringtonia scortechinii*	4	4	0.04	0.22	0.26	0.08	0.56
Euphorbiaceae	*Glochidion macrostigma*	4	4	0.04	0.22	0.26	0.07	0.55
Myristicaceae	*Knema furfuracea*	4	4	0.04	0.22	0.26	0.07	0.55
Leguminosae	*Archidendron globosum*	3	3	0.10	0.16	0.19	0.19	0.55

Elaeocarpaceae	*Elaeocarpus stipularis*	4	4	0.04	0.22	0.26	0.07	0.54
Violaceae	*Rinorea anguifera*	4	4	0.03	0.22	0.26	0.06	0.54
Annonaceae	*Cyathocalyx pruniferus*	3	3	0.08	0.16	0.19	0.15	0.51
Ebenaceae	*Diospyros scortechinii*	4	4	0.01	0.22	0.26	0.03	0.50
Anacardiaceae	*Gluta sp.*	4	4	0.01	0.22	0.26	0.02	0.49
Sapotaceae	*Pouteria pyrifera*	4	3	0.03	0.22	0.19	0.05	0.46
Meliaceae	*Dysoxylum sp.*	3	3	0.05	0.16	0.19	0.10	0.46
Euphorbiaceae	*Macaranga constricta*	3	3	0.05	0.16	0.19	0.10	0.45
Clusiaceae	*Garcinia pyrifera*	3	3	0.04	0.16	0.19	0.07	0.43
Moraceae	*Ficus madurensis*	3	3	0.04	0.16	0.19	0.07	0.43
Fagaceae	*Lithocarpus gracilis*	1	1	0.16	0.05	0.06	0.30	0.42
Ixonanthaceae	*Ixonanthes icosandra*	3	3	0.03	0.16	0.19	0.06	0.42
Melastomataceae	*Memecylon dichotomum*	3	3	0.03	0.16	0.19	0.06	0.41
Malvaceae	*Neesia malayana*	3	3	0.03	0.16	0.19	0.06	0.41
Myristicaceae	*Ardisia lanceolata*	3	3	0.03	0.16	0.19	0.05	0.41
Euphorbiaceae	*Croton erytrostachys*	3	3	0.03	0.16	0.19	0.05	0.41
Euphorbiaceae	*Antidesma montanum*	3	3	0.03	0.16	0.19	0.05	0.41
Annonaceae	*Polyalthia rumphii*	3	3	0.02	0.16	0.19	0.05	0.40
Myrtaceae	*Syzygium anisosepalum*	2	1	0.12	0.11	0.06	0.22	0.40
Flacourtiaceae	*Flacourtia sp.*	3	3	0.02	0.16	0.19	0.04	0.39
Annonaceae	*Papowia sp.*	3	3	0.02	0.16	0.19	0.04	0.39
Guttiferae	*Garcinia bancana*	3	3	0.02	0.16	0.19	0.03	0.39
Fabaceae	*Koompassia excelsa*	1	1	0.15	0.05	0.06	0.27	0.39
Sterculiaceae	*Sterculia cuspidata*	3	3	0.01	0.16	0.19	0.02	0.38
Euphorbiaceae	*Endospermum diadenum*	3	3	0.01	0.16	0.19	0.02	0.38
Sapindaceae	*Xerospermum sp.*	3	2	0.05	0.16	0.13	0.09	0.38
Lauraceae	*Deehasia sp.*	2	2	0.07	0.11	0.13	0.13	0.37
Burseraceae	*Canarium Pseudosumatranum*	1	1	0.13	0.05	0.06	0.24	0.36
Moraceae	*Ficus uncinata*	2	2	0.06	0.11	0.13	0.12	0.35
Moraceae	*Artocarpus lanceifolius*	2	2	0.05	0.11	0.13	0.09	0.33
Sterculiaceae	*Pterospermum javanicum*	2	2	0.05	0.11	0.13	0.09	0.33
Flacourtiaceae	*Hydnocarpus malayanus*	2	2	0.05	0.11	0.13	0.09	0.33
Leguminosae	*Callerya atropurpurea*	2	2	0.05	0.11	0.13	0.09	0.32
Styracaceae	*Styrax serrulatum*	2	2	0.04	0.11	0.13	0.08	0.32
Meliaceae	*Aphanamixis polystachya*	2	2	0.04	0.11	0.13	0.08	0.32
Euphorbiaceae	*Blumeodendron subrotundifolium*	1	1	0.11	0.05	0.06	0.20	0.32
Dipterocarpaceae	*Vatica perakensis*	2	2	0.04	0.11	0.13	0.08	0.32

Rubiaceae	*Porterandia anisophylla*	2	2	0.04	0.11	0.13	0.07	0.31
Lauraceae	*Cinnamomum impressicostatum*	2	2	0.04	0.11	0.13	0.07	0.31
Burseraceae	*Santiria sp.*	2	2	0.04	0.11	0.13	0.07	0.31
Rubiaceae	*Urophyllum sp.*	2	2	0.04	0.11	0.13	0.07	0.30
Tiliaceae	*Schoutenia accrescens*	2	2	0.04	0.11	0.13	0.07	0.30
Euphorbiaceae	*Aporosa nigricans*	2	2	0.03	0.11	0.13	0.06	0.30
Clusiaceae	*Calophyllum sp.*	2	2	0.03	0.11	0.13	0.06	0.30
Euphorbiaceae	*Croton sp.*	2	2	0.03	0.11	0.13	0.05	0.29
Sapotaceae	*Palaquium gutta*	2	2	0.03	0.11	0.13	0.05	0.29
Myristicaceae	*Gymnancranthera farquhariana*	2	2	0.03	0.11	0.13	0.05	0.29
Leguminosae	*Callerya sp.*	2	2	0.02	0.11	0.13	0.05	0.28
Sapotaceae	*Pouteria filifera*	2	2	0.02	0.11	0.13	0.04	0.28
Annonaceae	*Xylopia ferruginea*	2	2	0.02	0.11	0.13	0.04	0.28
Tiliaceae	*Pentace sp.*	2	2	0.02	0.11	0.13	0.04	0.28
Melastomataceae	*Memecylon amplexicaule*	2	2	0.02	0.11	0.13	0.04	0.28
Leguminosae	*Saraca sp.*	2	2	0.02	0.11	0.13	0.04	0.27
Euphorbiaceae	*Cleistanthus sp.*	2	2	0.02	0.11	0.13	0.03	0.27
Clusiaceae	*Garcinia griffithii*	2	2	0.02	0.11	0.13	0.03	0.27
Achariaceae	*Hydnocarpus sp.*	2	2	0.02	0.11	0.13	0.03	0.27
Anacardiaceae	*Melanochyla angustifolia*	2	2	0.01	0.11	0.13	0.02	0.26
Rosaceae	*Prunus malayana*	2	2	0.01	0.11	0.13	0.02	0.25
Ebenaceae	*Diospyros areolata*	2	2	0.01	0.11	0.13	0.02	0.25
Anacardiaceae	*Mangifera foetida*	2	2	0.01	0.11	0.13	0.01	0.25
Meliaceae	*Heynea trijuga*	1	1	0.04	0.05	0.06	0.08	0.20
Lauraceae	*Alseodaphne intermedia*	1	1	0.03	0.05	0.06	0.06	0.18
Burseraceae	*Dacryodes Laxa*	1	1	0.03	0.05	0.06	0.05	0.17
Fagaceae	*Castanopsis sp.*	1	1	0.03	0.05	0.06	0.05	0.17
Annonaceae	*Alphonsea sp.*	1	1	0.03	0.05	0.06	0.05	0.17
Sterculiaceae	*Heritiera pterosperma*	1	1	0.02	0.05	0.06	0.04	0.16
Sterculiaceae	*Firmiana malayana*	1	1	0.02	0.05	0.06	0.04	0.16
Lauraceae	*Beilschmiedia dictyoneura*	1	1	0.02	0.05	0.06	0.04	0.16
Anisophylleaceae	*Anisophyllea griffithii*	1	1	0.02	0.05	0.06	0.04	0.16
Euphorbiaceae	*Blumeodendron calophyllum*	1	1	0.02	0.05	0.06	0.04	0.16
Euphorbiaceae	*Drypetes sp.*	1	1	0.02	0.05	0.06	0.03	0.15
Rhizophoraceae	*Pellacalyx axillaris*	1	1	0.02	0.05	0.06	0.03	0.15
Melastomataceae	*Memecylon oleifolium*	1	1	0.02	0.05	0.06	0.03	0.15
Tiliaceae	*Microcos antidesmaefolia*	1	1	0.01	0.05	0.06	0.03	0.15

Malvaceae	*Durio griffithii*	1	1	0.01	0.05	0.06	0.02	0.14
Moraceae	*Artocarpus elasticus*	1	1	0.01	0.05	0.06	0.02	0.14
Malvaceae	*Pentace curtisii King*	1	1	0.01	0.05	0.06	0.02	0.14
Leguminosae	*Intsia palembanica*	1	1	0.01	0.05	0.06	0.02	0.14
Leguminose	*Parkia Speciosa*	1	1	0.01	0.05	0.06	0.02	0.14
Euphorbiaceae	*Drypetes curtisii*	1	1	0.01	0.05	0.06	0.02	0.14
Apocynaceae	*Tabernaemontana corymbosa*	1	1	0.01	0.05	0.06	0.02	0.13
Fagaceae	*Lithocarpus maingayi*	1	1	0.01	0.05	0.06	0.01	0.13
Fagaceae	*Lithocarpus sundaicus*	1	1	0.01	0.05	0.06	0.01	0.13
Lauraceae	*Alseodaphne oblanceolata*	1	1	0.01	0.05	0.06	0.01	0.13
Myristicaceae	*Horsfieldia punctatifolia*	1	1	0.01	0.05	0.06	0.01	0.13
Annonaceae	*Xylopia sp.*	1	1	0.00	0.05	0.06	0.01	0.13
Burseraceae	*Canarium denticulatum*	1	1	0.00	0.05	0.06	0.01	0.13
Euphorbiaceae	*Macaranga conifera*	1	1	0.00	0.05	0.06	0.01	0.13
Ebenaceae	*Diospyros pilosanthera Ng var. chikusensis*	1	1	0.00	0.05	0.06	0.01	0.13
Dilleniaceae	*Dillenia ovata*	1	1	0.00	0.05	0.06	0.01	0.13
Euphorbiaceae	*Botryophora sp.*	1	1	0.00	0.05	0.06	0.01	0.13
Leguminosae	*Dialium laurinum*	1	1	0.00	0.05	0.06	0.01	0.13
Apocynaceae	*Kibatalia maingayi*	1	1	0.00	0.05	0.06	0.01	0.13
Euphorbiaceae	*Drypetes cockburnii*	1	1	0.00	0.05	0.06	0.01	0.13
Flacourtiaceae	*Flacourtia sp.*	1	1	0.00	0.05	0.06	0.01	0.13
Melastomataceae	*Pternandra echinata*	1	1	0.00	0.05	0.06	0.01	0.13
Olacaceae	*Strombosia Javanica*	1	1	0.00	0.05	0.06	0.01	0.13
Rubiaceae	*Aidia parvifolia*	1	1	0.00	0.05	0.06	0.01	0.13
Lythraceae	*Duabanga grandiflora*	1	1	0.00	0.05	0.06	0.01	0.12
Burseraceae	*Canarium pilosum*	1	1	0.00	0.05	0.06	0.00	0.12
Achariaceae	*Ryparosa sp.*	1	1	0.00	0.05	0.06	0.00	0.12
Rosaceae	*Prunus javanica*	1	1	0.00	0.05	0.06	0.00	0.12
	TOTAL	1825	1554	53.995	100	100	100	300

D = density, F = frequency, BA = basal area, RD = relative density, RF = relative frequency, RBA = relative dominance, IVI = Importance Value Index

Table 3. Quantitative analysis for Family Value Index

Family	D	F	BA	RD (%)	RF (%)	RBA (%)	FVI
Euphorbiaceae	454	331	7.86	24.88	21.30	14.56	60.73
Annonaceae	180	142	7.06	9.86	9.14	13.08	32.08
Symplocaceae	128	98	4.28	7.01	6.31	7.92	21.24
Dipterocarpaceae	78	73	5.73	4.27	4.70	10.61	19.58
Meliaceae	92	87	3.34	5.04	5.60	6.19	16.83
Leguminosae	86	74	1.85	4.71	4.76	3.42	12.90
Sapindaceae	63	56	2.55	3.45	3.60	4.73	11.78
Polygalaceae	80	73	1.21	4.38	4.70	2.24	11.32
Elaeocarpaceae	67	61	1.99	3.67	3.93	3.69	11.28
Myristicaceae	57	56	0.88	3.12	3.60	1.63	8.36
Lauraceae	48	44	1.47	2.63	2.83	2.73	8.19
Fagaceae	47	42	1.20	2.58	2.70	2.21	7.49
Ulmaceae	45	39	1.02	2.47	2.51	1.90	6.87
Olacaceae	23	20	1.57	1.26	1.29	2.92	5.46
Rubiaceae	30	28	1.02	1.64	1.80	1.89	5.34
Myrtaceae	27	25	1.10	1.48	1.61	2.05	5.13
Burseraceae	33	31	0.59	1.81	1.99	1.09	4.90
Anacardiaceae	28	28	0.79	1.53	1.80	1.46	4.80
Moraceae	21	20	1.28	1.15	1.29	2.37	4.81
Actinidiaceae	28	25	0.70	1.53	1.61	1.29	4.43
Sapotaceae	32	28	0.45	1.75	1.80	0.84	4.39
Dilleniaceae	10	9	1.78	0.55	0.58	3.29	4.42
Malvaceae	17	17	0.85	0.93	1.09	1.57	3.60
Tiliaceae	16	16	0.53	0.88	1.03	0.98	2.88
Ebenaceae	18	18	0.16	0.99	1.16	0.29	2.44
Melastomataceae	17	17	0.15	0.93	1.09	0.28	2.31
Lecythidaceae	15	14	0.22	0.82	0.90	0.41	2.14
Flacourtiaceae	13	12	0.28	0.71	0.77	0.52	2.01
Aquifoliaceae	12	10	0.32	0.66	0.64	0.59	1.89
Sterculiaceae	11	11	0.16	0.60	0.71	0.30	1.61
Apocynaceae	8	8	0.27	0.44	0.51	0.50	1.45
Rosaceae	8	8	0.12	0.44	0.51	0.22	1.17
Fabaceae	2	2	0.51	0.11	0.13	0.95	1.19
Violaceae	8	8	0.08	0.44	0.51	0.14	1.10

Clusiaceae	7	7	0.08	0.38	0.45	0.16	0.99
Phyllanthaceae	2	2	0.37	0.11	0.13	0.69	0.93
Ixonanthaceae	3	3	0.03	0.16	0.19	0.06	0.42
Guttiferae	3	3	0.02	0.16	0.19	0.03	0.39
Achariaceae	3	3	0.02	0.16	0.19	0.03	0.39
Styracaceae	2	2	0.04	0.11	0.13	0.08	0.32
Anisophylleaceae	1	1	0.02	0.05	0.06	0.04	0.16
Rhizophoraceae	1	1	0.02	0.05	0.06	0.03	0.15
Lythraceae	1	1	0.00	0.05	0.06	0.01	0.12
	1825	1554	53.99	100	100	100	300

D = density, F = frequency, BA = basal area, RD = relative density, RF = relative frequency, RBA = relative dominance, FVI = Family Value Index

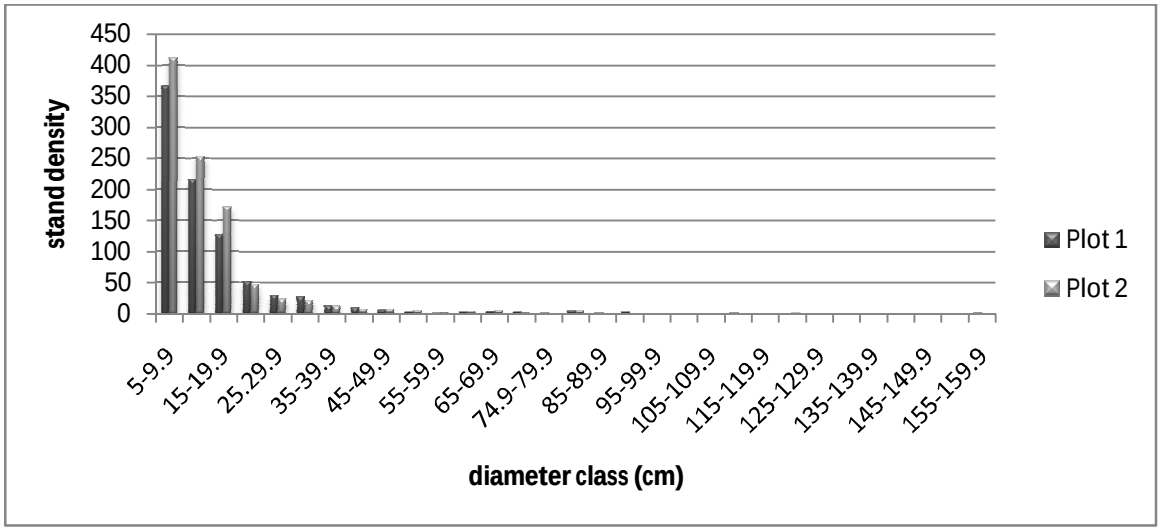

Figure 1. Distribution of trees in different size classes

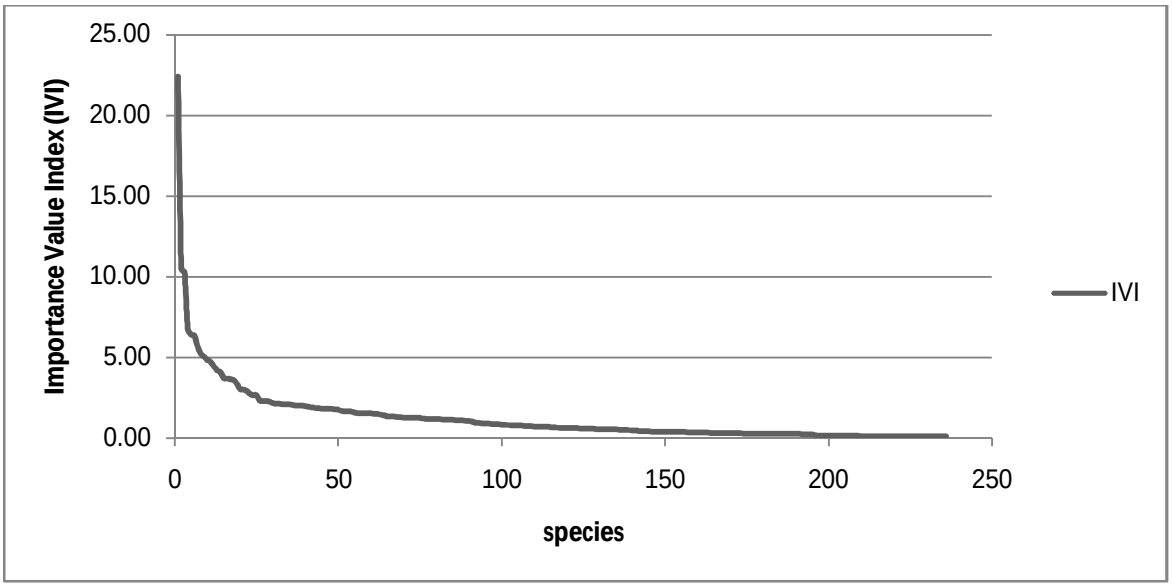

Figure 2. Dominance diversity curve

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