Vascular Plant Composition and Diversity of a Coastal Hill Forest in Perak, Malaysia

S. Ghollasimood (Corresponding author), I. Faridah Hanum, M. Nazre, Abd Kudus Kamziah & A.G. Awang Noor

Faculty of Forestry, Universiti Putra Malaysia

43400, Serdang, Selangor, Malaysia

Tel: 98-915-756-2704 E-mail: sghollassi@yahoo.com

Received: September 7, 2010 Accepted: September 20, 2010 doi:10.5539/jas.v3n3p111

Abstract

Vascular plant species and diversity of a coastal hill forest in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor at Perak were studied based on the data from five one hectare plots. All vascular plants were enumerated and identified. Importance value index (IVI) was computed to characterize the floristic composition. To capture different aspects of species diversity, we considered five different indices. The mean stem density was 7585 stems per ha. In total 36797 vascular plants representing 348 species belong to 227 genera in 89 families were identified within 5-ha of a coastal hill forest that is comprises 4.2% species, 10.7% genera and 34.7% families of the total taxa found in Peninsular Malaysia. Based on IVI, *Agrostistachys longifolia* (IVI 1245), *Eugeissona tristis* (IVI 890), *Calophyllum wallichianum* (IVI 807), followed *by Taenitis blechnoides* (IVI 784) were the most dominant species. The most speciose rich families were Rubiaceae having 27 species, followed by Dipterocarpaceae (21 species), Euphorbiaceae (20 species) and Palmae (14 species). According to growth forms, 57% of all species were trees, 13% shrubs, 10% herbs, 9% lianas, 4% palms, 3.5% climbers and 3% ferns. Diversity indices were higher along the stream side and species accumulation curve showed sampling area captured a high proportion of the species richness.

Keywords: Coastal hill forest, Diversity indices, Importance value index, Malaysia

1. Introduction

South-east Asian tropical rainforest with its unique and high proportions of endemic plants need greater effort in studying biodiversity. This unique flora result largely from millions years of independence evolution during the Tertiary, when wide oceanic barriers made dispersal between regions (Morely 2003), and have survived the convergence of New Guinea with Southeast Asia (Primack and Corlett 2005). Cataloguing total species richness in any country or region special in tropical and subtropical region is highly demanding (Villasenor *et al.* 2005) to provide information for managers, environmental planners, nature reserve designers and ecologists (Sang 2009) and a global map of plant diversity will powerfully inform biogeographical and conservation work in many ways. Bidin and Latiff (1995) estimated about 12500 species of the seed plants in the flora of Malaysia and Turner (1997) enumerated 8198 species in Peninsular Malaysia including 632 fern species, 27 Gymnosperms, 5529 Dicotyledons, 2010 Monocotyledons within 248 families and 1651 genera. Based on recent updates, the flora has over 8300 species (Kamarudin and Turner 2004, Latiff and Turner 2002a, 2002b, 2003). Most attempts to explain the variation in floristic composition of hill and lowland forest in Peninsular Malaysia have focused on woody stems (≥1 cm) (Abdul Hayat *et al.* 2010, Okuda *et al.* 2003, Condit *et al.* 1996, Awang Noor and Faridah Hanum 2008) rather than small individuals. Factor causing variation in species richness may differ between life forms of plants. A comparison of various life forms allows a finer resolution of precise casual factors. Thus, in the present study, we analysed the richness of different life forms along elevation gradient (45-350 m a.s.l.), floristic composition and diversity of vascular plants in a coastal hill forest from Pangkor Island in Perak, Peninsular Malaysia.

2. Materials and Methods

2.1 Study area

This study was performed in Sungai Pinang Permanent Forest Reserve. Pulau Pangkor (Fig 1) is an island located on the west coast of Peninsular Malaysia between 04° 13.0'N latitude and 100° 33.0′E longitude. It is one of the famous and well known islands in Malaysia with area of eight square kilometres and classified as

coastal hill forest with a high conservation. The climate is typically humid tropical and seasonal heavy rain (Meteorology site, Kuala Lumpur 2010), February and March are the driest months, mean annual rainfall is 1820.23 mm (2000-2010). The highest mean temperature is in February to May (average 27.65 °C) and the minimum occurs during September to December (average 26.8 °C) (data courtesy of Meteorology Office, Kuala Lumpur). The elevation of the study area ranges from 54 to 152 m above the sea level. The texture of topsoil is mainly sandy loam.

2.2 Methods and data analysis

Five plots of 1-ha (each 100 ×100m) were established and subdivided into 100 subplots of 10×10 m between 45 and 152 m above sea level. Each subplot was systematically surveyed by enumerating and identifying all vascular plants and measuring trees with height and diameter at breast height (DBH) ≥5 cm. tDuring the sampling, specimens of all plants groups were collected, fixed and brought back to the herbarium of Forestry Faculty, Universiti Putra Malaysia (UPM) and identified on the basis of regional Flora. In addition, local names and medicinal plants were recorded and the final verification was done at the Forestry Research Institute Malaysia (FRIM).The importance value index (IVI) was assigned to describe the species composition of the plots and was calculated as the sum of the following two variables (Curtis and McIntosh 1950): Relative density = (number of individuals of a species/total number of individuals) × 100

Relative frequency = (frequency of a species/sum frequencies of all species) × 100

ANOVA test was used to determine the differences in richness among plots according growth-forms**.** Linear regressions of species richness with altitude were also performed using SPSS (version 17.0). A variety of commonly used diversity indices were computed in order to measure alpha diversity for each plot. Species richness is the number of species in the community. Richness indices are based on the relationship between S and the total number of individuals observed, N, which increases with increasing sample size. Analysis was conducted using EstimateS (Statistical estimation of species richness and shared species from samples) version 8.2.0. (Colwell 2006). The following formulas were used to capture different aspects of species diversity and richness:

Simpson index (Krebs 1999):

$$1 - D = 1 - \sum_{i=1}^{s} \left\{ \frac{ni(ni-1)}{N\,(N-1)} \right\}$$

1 – D= Simpson's index of diversity

n_i = Number of individuals of species *i* in the sample

N = Total number of individuals in the sample

s = Number of species in the sample

The Shannon-Wiener index (Krebs 1999):

$$H' = \sum_{i=1}^{s} (\rho_i)(\log_2 \rho_i)$$

s = Number of species

ρ_i = Proportion of total sample belonging to *i*th species

Alpha Fisher's index of diversity (Magurran 2004):

$$S = \alpha \log\left(1+\frac{N}{a}\right)$$

S = Total number of species in the sample

N = Total number of individuals in the sample

α = Index of diversity

 ISSN 1916-9752 E-ISSN 1916-9760

In addition, we tested two more indices, the Chao and Jackknife estimators of species richness that are based on the incidence (presence/absence) of species.

The Chao index (Chao 1984):

$$C = S + \left(\frac{S1^2}{2S2}\right)$$

C = Chao index

S = Species number

S_1 = the total number of species represented by a single individual

S_2 = the total number of species represented by two individuals

And the jackknife index (Chao 1984):

$$J = S + \left\{\frac{S1\,(2N-3)}{N} - \frac{S2(N-2)^2}{N(N-1)}\right\}$$

S = species number

N = individual number

S_1 = the total number of species represented by a single individual

S_2 = the total number of species represented by two individuals

3. Results and Discussion

3.1 Floristic composition

In total 36797 vascular plants representing 348 species belong to 227 genera in 89 families were identified (Appendix 1), two could only be identified to genus, one climber and three herbs were remained unknown within five 1-ha of a coastal hill forest that comprises 4.2% species, 10.7% genera and 34.7% families of the total taxa found in Peninsular Malaysia. Plant density was 7358 individuals per ha. *Agrostistachys longifolia* (IVI 1245), *Eugeissona tristis* (IVI 890), *Calophyllum wallichianum* (IVI 807), followed *by Taenitis blechnoides* (IVI 784) were dominant species (Table 1, 2). The most speciose rich families were Rubiaceae having 27 species, followed by Dipterocarpaceae (21 species), Euphorbiaceae (20 species) and Palmae (14 species), while more than 23 families were singletons (represented by only one species)**.** Euphorbiaceae had the largest number of individuals (5.5% of plants), followed by Guttiferae (5%), and Dracaenaceae (4.8%). Table 3 shows the number of species and individuals according to growth form. Plants were distributed according to growth forms as follows: 57% of all species were trees, 13% shrubs, 10% herbs, 9% lianas, 4% palms, 3.5% climbers and 3% ferns. Evidently, trees show more equitable distribution of species across plots and most of them are economically important. Tree species like *Agrostistachys longifolia, Calophyllum wallichianum, Xanthophyllum affine* and *Swintonia floribunda* were the most populated species.

This island harbours 122 medicinal species (Burkill 1935) in 98 genus and 57 families; Rubiaceae (12 species), Guttiferae (10 species), Dracaenaceae (7 species), Euphorbiaceae (6 Sspecies), Araceae and Zingiberaceae (4 species each) were the most speciose medicinal families (Appendix 1). The dominant climber and liana species were *Scindapsus scortechinii* representing 35% of climbers (74% of individuals) and *Dalbergia parviflora* representing 26% of lianas (1.3% of individuals), respectively. Leguminosae, Connaraceae and Araceae were the most species rich climber families (woody and non-woody). Lianas are dependent on trees for their support, and thus the availability of suitably sized support is a major factor controlling the abundance and distribution of lianas (Putz and Holbrook 1991). The common species in herbaceous layer were *Globba variabilis* and *Etlingera metriocheilos*. *Eugeissona tristis* was a dominant palm, *Dracaena pendula* a dominant shrub, and *Taenitis blechnoides* was a dominant fern.

Table 4 also shows the percentage of medicinal and endemic species according to growth -forms. In Malaysia there is over 1000 medicinal species (Latiff *et al.* 1980) and about 13% of these species are found in this forest.

Species composition and number of individuals differed between plots (Figure 2). Distribution of plant species in natural vegetation is usually not stochastic. It occurs in patterns that are present at several spatial and temporal scales. Each species is expected to be most abundant where the environmental conditions are most favorable for it. In this study variation in plant community structure and composition were attributed to the characteristics of physical environment. The number of herbs in the first plot were higher than the other plots, simply the presence of stream was a factor that favoured higher values of diversity (Gazol and Ibanez 2010) and some species located in streamside environments.

Altitude is a factor which is correlated with resources and regulators of plant growth (Kazakis *et al.* 2007). In this study linear regression of plant richness against altitude was significant (Figure 3). Third plot showed a trend of decreasing richness for most growth forms with increasing altitude and the main reason is altitude. The negative influence of elevation on diversity has been widely reported in studies (Gazol and Ibanez 2010, Odland and Birks 1999, Körner 2002, Pickering *et al.* 2008, Wang 2006). Overall, elevation showed significant linear regression with herb, liana, fern and tree (Table 5). Although the number of trees reduced with increasing elevation, the number of trees with dbh ≥5 cm in higher altitude was noteworthy (the details on distribution of trees species will be published soon in a different paper).

Regression of elevation and palm, climber, epiphyte and shrub richness showed no significant relationship (Table 5). Daque *et al.* (2002), Ruokolainen and Vormisto (2000) and Ruokolainen *et al.* (2002) indicated that palms are less sensitive to environmental effect and more wide-spread than smaller plants.

Orchidaceae is the most speciose family in the flora of Malay Peninsula with 853 species (Turner 1997). In our study, however, this family was poorly represented (only 5 species) and most of them appeared in the second and third plots in upper canopy crowns to get maximum sea breeze.

3.2 Species accumulation curve

Hill and Hamer (2002) believed communities should be sampled adequately (usually assessed with species accumulation curve). Species accumulation curve shows how species richness increases until eventually the curve levels off with increasing sample size and the number of individuals inventoried. The graph suggests that our sampling area captured a high proportion of the species richness; the point at which the curve flattens indicates a minimum viable sample size on which a diversity or richness index should be based (Magurran 1988). Figure 4 shows the curve based on the area sampled stabilized in third plot. Tropical ecologists believe species richness reaches an asymptote at 1-3 ha (Gentry 1988, Tuomisto *et al.* 1995, McLaren, *et al.* 2005). Faridah Hanum *et al.* (2008) in a case study in a logged-over forest in Ayer Hitam Forest found out increasing the size of study area more than five hectare did not have any increment on species richness.

3.3 Species Diversity

A variety of diversity measures were computed to describe the heterogeneity of the plots. All diversity indices, including non-parametric estimators, increased with the number of individuals in a sample (Table 6). The majority of the 300 species (82% of total species) inventoried appeared in the first plot, and therefore this plot is characterized by high diversity (215, 146, 182, 154 species found in plots 2 to 5, respectively). The Fisher's alpha is low when the number of species is low. This index is less affected by the abundance rarest or commonest species diversity (α) range from 25.46 to 51.38 and the average for all plots is 35.23. The Shannon–Winner's index measures the average degree of ''uncertainty'' in predicting to what species individuals chosen at random will belong (Ludwig and Reynolds 1988). Uncertainty may be visualized as being synonymous with diversity (Krebs 1999), therefore, the higher the degree of uncertainty, the higher the diversity. Diversity index fell within high range (3.54 to 4.98) while the average for all plots gave H'= 3.99. Simpson index proposes that diversity is inversely related to the probability that two individuals picked at random from a sample belong to the same species. Simply stated, if the probability is high the diversity is low. Simpson's index varies from 18.09 to 45.43 and the average is 27.62. According to this index the first plot was more diverse than the others; this could be related to the relatively large number of abundant species. The evenness is considered high when it varies near value of 1. When all species are abundant, an evenness index would be maximum and decrease towards zero as the relative abundances increase. In this study area the average of Simpson's measure of evenness is low.

4. Conclusion

The quantitative inventory of a coastal hill forest helps to complete the description of biodiversity and plant composition. Our results indicate this forest with 55 endemics and 13% of medicinal species found in Malaysia is unique and offer numerous non-tangible benefits such as invaluable storehouse of genetic resources useful for

indigenous species. Diversity indices are still widely used in plant ecology to evaluate survey and conserve ecosystems and using richness estimators can improve our evaluation of diversity. Plant diversity is influenced by a multitude of environmental factors, but in this study area streamside was the main factor in determining diversity and majority of herb species were found near the stream.

Monitoring studies such as the current one are of utmost importance and provide insights into the responses of coastal hill forest to climate change and also because this island is a tourist's attraction place, the future inspection need to see the changes according to number of species.

References

Abdul Hayat, M. S., Kamziah A K, Faridah-Hanum, I., Awang Noor, A. G., Nazre, M. (2010). Assessment of plant diversity at Pasir Tengkorak Forest Reserve, Langkawi Island, Malaysia. *Journal of Agricultural Science,* Vol 2, No.1.

Awang Noor, A. G., Faridah-Hanum, I. (2008). Relationship between economic value and species diversity of timber resources in a hill forest in Peninsular Malaysia. *Journal of sustainable development,* Vol. 1, No.2.

Bidin, A. A. and Latiff, A. (1995). *The status of terrestrial biodiversity in Malaysia.* In: A. H. Zakri,. (Eds.). *prospects in biodiversity prospecting*. Genetic Society of Malaysia & Universiti Kebangsaan Malaysia. pp. 59-76.

Burkill, I. H. (1935). A dictionary of the economic products of the Malay Peninsula.s.

Chao, A. (1984). Nonparametric estimation of the number of classes in a population. *Scan J Statist,* 11, 265-270.

Colwell, R. K. (2006). *EstimateS* (Statistical estimation of species richness and shared species from samples). Purl.Oclc.org/estimates.

Condit, R., Hubbell, S. P., Lafrankinkie, J. V., Sukumar, R., Manokaran, N., Foster, R. B., Ashton, P. (1996). Species-area and species-individual relationships for tropical trees: a comparison of three 50-ha plots. *Journal of Ecology,* 84, 549-562. doi:10.2307/2261477, http://dx.doi.org/10.2307/2261477

Curtis, J. T. and McIntosh, R. P. (1950). The interrelation of certain analytic and synthetic phytosociological characters. *Ecology,* 31, 434-455. doi:10.2307/1931497, http://dx.doi.org/10.2307/1931497

Duque, A., Sanchez, M., Cavelier, J. & Duivenvoorden, J. F. (2002). Different floristic patterns of woody understorey and canopy plants in Colombian Amazonia. *Journal of Tropical Ecology,* 18, 499–525. doi:10.1017/S0266467402002341, http://dx.doi.org/10.1017/S0266467402002341

Faridah Hanum, I., Philip, L., Awang Noor, A. G. (2008). Sampling species diversity in Malaysian rainforest: the case of a logged-over forest. *Pak. J. Bot.,* 40(4), 1729-1733.

Gazol, A. and Ibanez, R. (2010). Variation of plant diversity in a temperate unmanaged forest in northern Spain. *Plant Ecology*, 207(1), 1-11. doi:10.1007/s11258-009-9649-5, http://dx.doi.org/10.1007/s11258-009-9649-5

Gentry, A. H. (1988). Changes in plant community diversity and floristic composition on environmental and geographical gradients. *Annals of the Missouri Botanical Garden,* 75, 1-34. doi:10.2307/2399464, http://dx.doi.org/10.2307/2399464

Hill, J. K. and Hamer, K. C. (2002). Using species abundance models as indicators of habitat disturbance in tropical forests. *Journal of Applied Ecology,* doi:10.1046/J.1365-2664. doi:10.1046/J.1365-2664, http://dx.doi.org/10.1046/J.1365-2664

Kamarurdin, M. S., Turner, I. M. (2004). Quaterly notes: New taxa andrecords of Malaysian vascular plants. *Folia Malaysiana,* 5(1), 65-68.

Kazakis, G., Ghosn, D., Vogiatzakis, I. N., Papanastasis, V. P. (2007). Vascular plant diversity and climate change in the alpine zone of the Lefka Ori, Crete. *Biodivers Conserv.,* 16, 1603–1615. doi:10.1007/s10531-006-9021-1, http://dx.doi.org/10.1007/s10531-006-9021-1

Körner, C. (2003). *Alpine plant life*. Springer, Berlin.

Krebs, C. J. (1999). *Ecological methodology.* Addison Wesley Longman.

Latiff, A., Ismail, G., Omar, M., Said, M. I., Kadri, A. (1980). A multivariate approach to the study of medicinal plants in Malaysia. *Journal Singapore Nationla Academy of Science,* 13, 101-113.

Latiff, A. and Turner, I.M. (2002a). Quaterly notes: New taxa and records of Malaysian vascular plants. *Folia Malaysiana,* 3(1), 67-68.

Latiff, A. and Turner, I.M. (2002b). Quaterly notes: New taxa and records of Malaysian vascular plants. *Folia Malaysiana,* 4(2), 129-132.

Latiff, A. and Turner, I.M. (2003). Quaterly notes: New taxa and records of Malaysian vascular plants. *Folia Malaysiana*, 4(3&4), 227-230.

Ludwig, J. A. and Reynold, J. F. (1988). *Statistical ecology: a primer on methods and computing*. New York: John Wiley & Sons.

Magurran A. E. (1988). *Ecological Diversity and Its Measurement*. Chapman and Hall, London, pp.179

Magurran, A. (2004). *Measuring biological diversity*. Blackwell Publishing, Oxford.

McLaren, K. P., McDonald, M. A., Hall, J. B., Healy, J. R. (2005). Predicting species response to disturbance from size class distributions of adults and saplings in a Jamaican tropical dry forest. *Plant Ecology,* 181, 69-84. doi:10.1007/s11258-005-3497-8, http://dx.doi.org/10.1007/s11258-005-3497-8

Morely, R. J. (2003). Interplate dispersal paths for megathermal angiosperms. *Perspectives in Plant Ecology and Evolution,* 6, 5-20. doi:10.1078/1433-8319-00039, http://dx.doi.org/10.1078/1433-8319-00039

MOSTE. (1997). *Biodiversity assessment in Malaysia*. Kuala Lumpur: Ministry of Science, Technology and environment.

Odland, A., Birks H. J. B. (1999). The altitudinal gradient of vascular plant richness in Aurland, Western Norway. *Ecography*, 22, 548–566.

Okuda, T., Suzuki, M., Adachi, N., Quah, E.S., Hussein, N. Z., Manokaran, N. (2003). Effect of selective logging on canopy and stand structure and tree species composition in a lowland dipterocarp forest in Peninsular Malaysia. *Forest Ecology and Management*, 175, 297-320. doi:10.1016/S0378-1127(02)00137-8, http://dx.doi.org/10.1016/S0378-1127(02)00137-8

Pickering, C., Hill, W., Green, K. (2008). Vascular plant diversity and climate change in the alpine zone of the Snowy Mountains, Australia. *Biodiversity Conservation,* 17, 1627–1644. doi:10.1007/s10531-008-9371-y, http://dx.doi.org/10.1007/s10531-008-9371-y

Primack, R. B. and Corlett, R. T. (2005). *Tropical rainforests*: *An ecological and biogeographical comparision*. Blackwell Science, Oxford.

Putz, F. E., Holbrook, N. M. (1991). *Biomechanical studies of vines*. In: F.E. Putz, and H.A. Mooney (Eds). The biology of vines. Cambridge University Press, Cambridge pp. 73–97.

Ruokolainen, K., Tuomisto, H., Vormisto, J. & Pitman, N. (2002). Two biases in estimating range sizes of Amazonian plant species. *Journal of Tropical Ecology*, 18, 935–942. doi:10.1017/S0266467402002614, http://dx.doi.org/10.1017/S0266467402002614

Ruokolainen, K. & Vormisto, J. (2000). The most widespread Amazonian palms tend to be tall and habitat generalists. *Basic and Applied Ecology,* 1, 97–108. doi:10.1078/1439-1791-00020, http://dx.doi.org/10.1078/1439-1791-00020

Sang, W. (2009). Plant diversity patterns and their relationship with soil and climatic factors along an altitudinal gradient in the middle Tianshan Mountain area, Xinjing, China. *Ecol Res*., 24, 303-314. doi:10.1007/s11284-008-0507-z, http://dx.doi.org/10.1007/s11284-008-0507-z

Tuomisto, H., Ruokolainen, K., Kalliola, R., Linna, A., Danjoy, W. and Rodriguez, Z. (1995). Dissecting Amazonian biodiversity *Science,* 269, 63-66. doi:10.1126/science.269.5220.63, http://dx.doi.org/10.1126/science.269.5220.63

Turner, I.M. (1997). A tropical flora summarized – a statistical analysis of the vascular plant density of Malaya. *Flora*, 192, 157- 163.

Turner, I. M. (1999). A catalogue of the vascular plants of Malaya. *The Gardens' Bulletin Singapore,* 47, 1-757.

Villasenor, J., Guillermo, I., Meave, J. A., and Eenrique, O. I. (2005). Higher Taxa as Surrogates of Plant Biodiversity in a Megadiverse Country. *Conservation Biology,* 19(1), 232–238. doi:10.1111/j.1523-1739.2005.00264.x, http://dx.doi.org/10.1111/j.1523-1739.2005.00264.x

Wang, W., Wang, Q., Li, S., Wang, G. (2006). Distribution and species diversity of plant communities along transect on the northeastern Tibetan Plateau. *Biodiversity and Conservation*, 15, 1811–1828. doi:10.1007/s10531-004-6681-6, http://dx.doi.org/10.1007/s10531-004-6681-6

WWW user survey. Retrived 20 November 20 from http://en.wikipedia.org/wiki/Malaysia/Geography#climate.

Table 1. The 20 most abundant species in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak according to increasing order of IVI

Family	Species	Growth Forms	RDE	RF	IVI
Olacaceae	*Strombosia javanica* Blume	Tree	178.09	4.8	182.89
Juglandaceae	*Engelhardtia serrata* Blume	Tree	194.91	5.29	200.2
Palmae	*Daemonorops calicarpa* (Griff.) Mart.	Palm	205.83	5.908	211.74
Ebenaceae	*Diospyros buxifolia* (Blume) Hiern	Tree	222	6.69	228.69
Leguminosae	*Dalbergia parviflora* Roxb.	Liana	229.36	7.26	236.62
Ulmaceae	*Girroniera parvifolia* Planch.	Tree	244.25	6.63	250.88
Dipterocarpaceae	*Shorea curtisii* Dyer ex King	Tree	274.83	8.27	283.1
Dracaenaceae	*Dracaena elliptica* Thunb.	Shrub	284.44	7.08	291.52
Dipterocarpaceae	*Vatica pauciflora* (Korth.) Blume	Tree	286.53	8.12	294.65
Palmae	*Calamus javensis* Blume	Palm	288.95	8	296.95
Aristolochiaceae	*Thottea corymbosa* (Griff.) Ding Hou	Tree	309.97	7.78	317.75
Leguminosae	*Fordia unifoliata* (Prain) Dasuki & Schot	Tree	328.21	9.87	338.08
Dipterocarpaceae	*Vatica perakensis* King	Tree	353.7	11.79	365.49
Anacardiaceae	*Swintonia floribunda* Griff.	Tree	434.96	15.15	450.11
Polygalaceae	*Xanthophyllum affine* Korthalsia	Tree	461.06	13.8	474.86
Dracaenaceae	*Dracaena graminifolia* Wall	Shrub	587.53	14.98	602.51
Dracaenaceae	*Dracaena pendula* Ridley	Shrub	749.32	20.8	770.12
Polypodiaceae	*Taenitis blechnoides* (Willd.) Sw	Fern	759.8	23.78	783.58
Guttiferae	*Calophyllum wallichianum* Planch.&Triana	Tree	785.78	21.05	806.83
Palmae	*Eugeissona tristis* Griff.	Palm	861	29.38	890.38
Euphorbiaceae	*Agrostistachys longifolia* (Wight) Benth.	Tree	1202	42.82	1244.82

Table 2. The 20 least abundant species in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak according to increasing order of IVI

Family	Species	Growth form	RDE	RF	IVI
Araceae	*Alocasia denudata* Endl.	Herb	0.32	0.007	0.327
Rubiaceae	*Argostemma oblongum* King	Herb	0.32	0.007	0.327
Zingiberaceae	*Globba pendula* Roxb.	Herb	0.32	0.007	0.327
Araceae	*Schismatoglottis brevipes* Hook.f.	Herb	0.32	0.007	0.327
Araceae	*Schismatoglottis wallichii* Hook.f.	Herb	0.32	0.007	0.327
Asteraceae	*Vernonia arborea* Buch. Hamrborea	Herb	0.32	0.007	0.327
Lauraceae	*Actinodaphne oleifolia* Gamble	Shrub	0.32	0.007	0.327
Ochnaceae	*Euthemis leucocarpa* Jack	Shrub	0.32	0.007	0.327
Olacaceae	*Olax imbricata* Roxb.	Shrub	0.32	0.007	0.327
Meliaceae	*Chisocheton pauciflorus* King	Tree	0.32	0.007	0.327
Meliaceae	*Chukrasia tabularis* Ridley	Tree	0.32	0.007	0.327
Celastraceae	*Euonymus javanicus* Blume	Tree	0.32	0.007	0.327
Moraceae	*Ficus aurata* Miq.	Tree	0.32	0.007	0.327
Rhizophoraceae	*Gynotroches axillaris* Blume	Tree	0.32	0.007	0.327
Sterculiaceae	*Pterospermum javanicum* Jungh.	Tree	0.32	0.007	0.327
Cardiopteridaceae	*Cardiopteris quinqueloba* (Hassk.) Hassk	Climber	0.32	0.007	0.327
Annonaceae	*Ellipeia cuneifolia* Hook.f. & Thomson	Liana	0.32	0.008	0.328
Anacardiaceae	*Gluta curtisii* (Oliv.) Ding Hou	Tree	0.32	0.008	0.328
Poaceae	*Schizostachyum latifolium* Gamble	Bamboo	0.42	0.009	0.429
Lauraceae	*Alseodaphne* sp.	Tree	0.42	0.009	0.429
Boraginaceae	*Cordia dichotoma* G. Forst.	Tree	0.42	0.009	0.429

RDE=relative density, RF= Relative frequency, IVI=Importance Value Index

Table 3. The number of species and individuals according to growth form in five 1-ha plot in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

Growth-forms	Species numbers	Plants numbers in 5 plots
Epiphyte	3	21
Climber	12	745
Herb	31	3420
Liana	32	1634
Terrestrial	12	2354
Palm	14	3546
Shrub	44	5477
Tree	200	19600
Total	**348**	**36797**

Table 4. The percentage of medicinal and endemic species between growth-forms in five 1-ha plot in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

Growth-forms	Medicinal Sp.	Percentage	Endemic Sp.	Percentage
Epiphyte	2	1.65%	1	1.8%
Climber	5	4.10%	1	1.8%
Herb	11	9.10%	7	12.7%
Liana	15	12.30%	4	7.3%
Terrestrial	4	3.30%	-	-
Palm	1	0.80%	6	10.9%
Shrub	24	20%	8	14.5%
Tree	59	49%	28	51%
Total	**127**	**100**	**55**	**100**

Table 5. The result of ANOVA and linear regression of growth-forms against elevation

	B_0			B_1				R^2
Growth-form	**Estimate**	**Std. Error**	**Confidence Interval (0.95%)**	**Estimate**	**Std. Error**	**Confidence Interval (0.95%)**	**P Value**	
Climber	8.047	30.847	106.215	0.129	0.276	1.008	0.67	0.067
Epiphyte	531.651	153.189	1019.165	-3.78	1.373	0.581	0.07	0.717
Herb	903.451	168.76	1440.54	-6.24	1.51	-1.42	0.02*	0.85
Liana	1509.91	312.95	2505.87	-8.995	2.8	-0.071	0.049*	0.774
Palm	2930.44	639.39	4965.27	-15.85	5.729	2.38	0.07	0.718
Shrub	760.501	348.46	1869.47	-1.351	3.123	8.58	0.69	0.059
Fern	8657.18	1350.96	12956.54	-59.99	12.10	-21.464	0.01*	0.891
Tree	15128.64	2396.95	22756.83	-84.50	21.479	-16.148	0.029*	0.838

Table 6. Species diversity indices based on five 1-ha sampling plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

Plot	Alpha Fisher	Shannon–Wienner	Simpson	Jack 2	Chao 2	Simpson evenness
Plot 1	51.38	4.98	45.43	329.67	303.11	0.71
Plot 2	35.11	4.01	30.52	234.79	214.73	0.19
Plot 3	25.46	3.54	19.48	167.84	152.22	0.21
Plot 4	30.55	3.84	24.58	208.9	189.84	0.2
Plot 5	33.67	3.57	18.09	161.13	147.66	0.17
Average	**35.23**	**3.99**	**27.62**	**220.46**	**201.51**	**0.3**

ISSN 1916-9752 E-ISSN 1916-9760

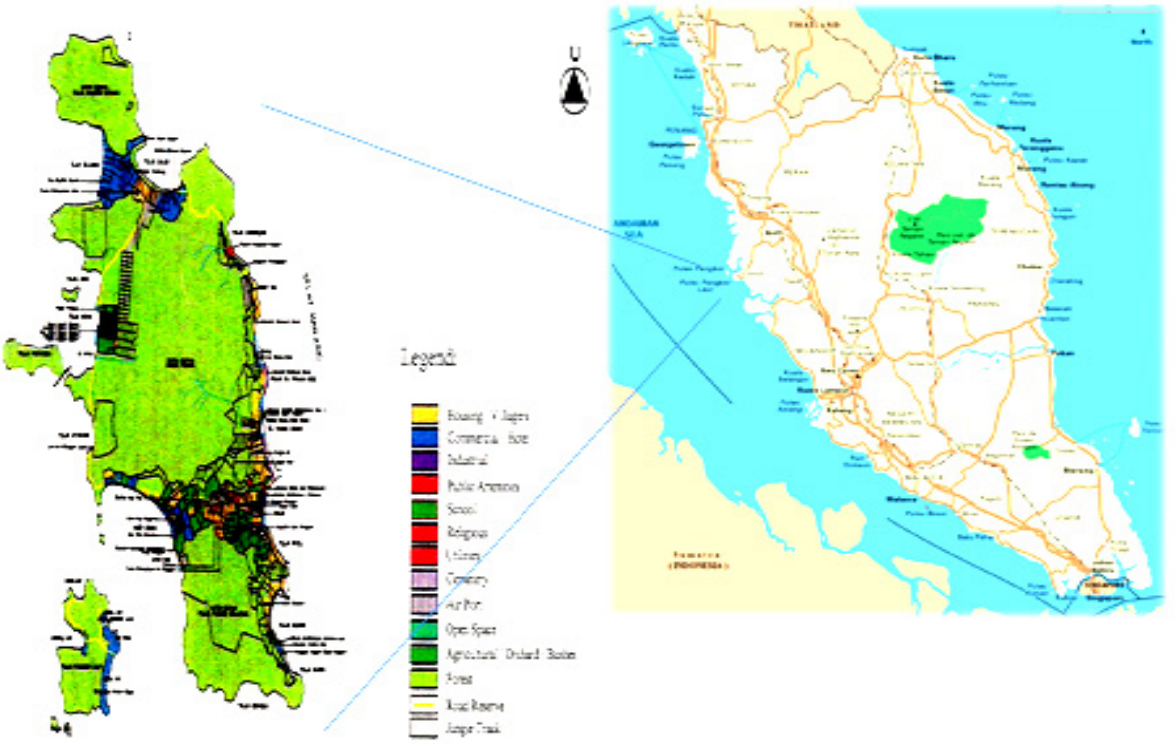

Figure 1. Map of Peninsular Malaysia and location of study area in Pulau Pangkor

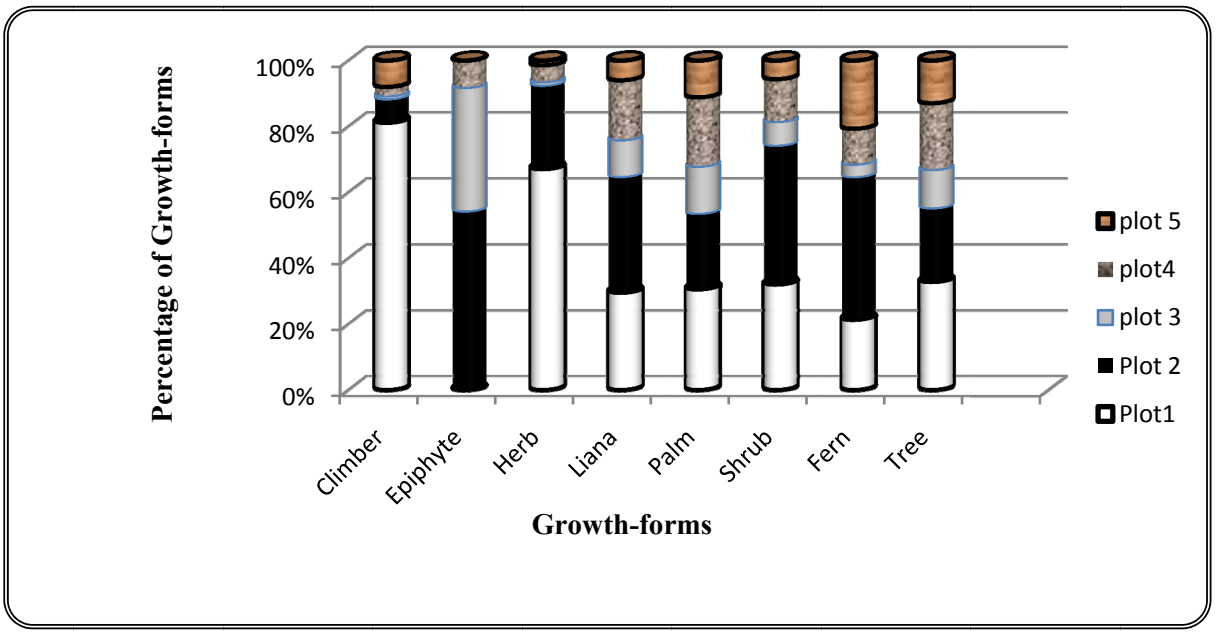

Figure 2. The percentage of growth-forms in five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

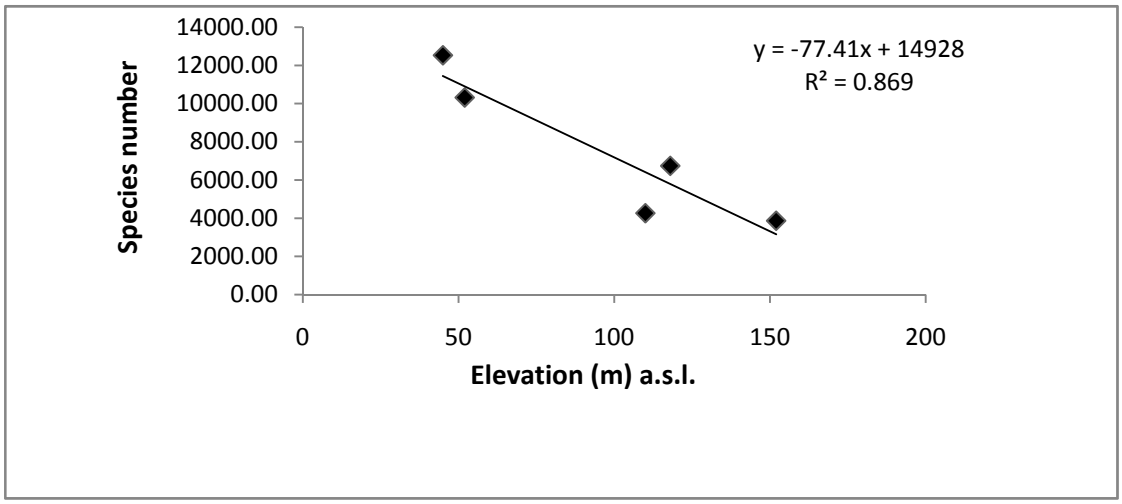

Figure 3. The regression of species number trend with elevation in Pulau Pangkor

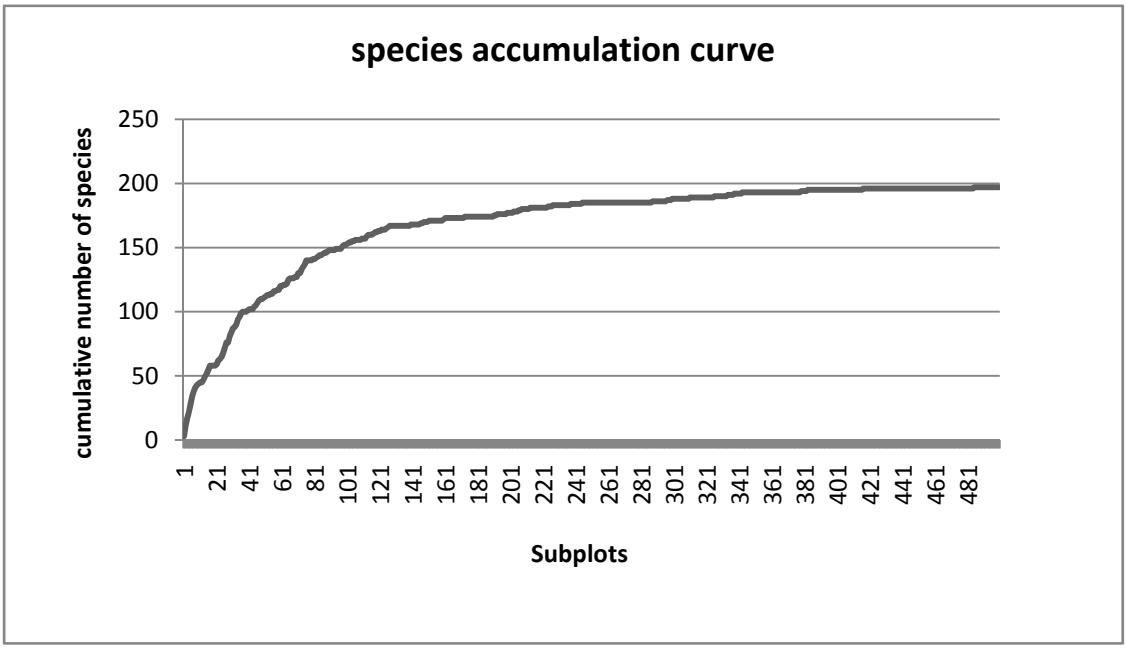

Figure 4. Species accumulation curve based on a cumulative species count in 10×10 m plots of a five 1-ha plot in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

ISSN 1916-9752 E-ISSN 1916-9760

Appendix 1. Total list of species in five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor, Perak

Family	Species	Growth–Form	ndemic Sp.	Medicinal Sp.
Acanthaceae	*Gymnostachyum decurrens* Stap	Herb		Medicinal
Acanthaceae	*Staurogyne merguensis* (T. Anderson) Kuntze	Herb		
Anacardiaceae	*Bouea oppositifolia* (Roxb.) Meisn.	Tree		Medicinal
Anacardiaceae	*Buchanania sessifolia* Blume	Tree		
Anacardiaceae	*Gluta curtisii* (Oliv.) Ding Hou	Tree		
Anacardiaceae	*Mangifera macrocarpa* Blume	Tree		Medicinal
Anacardiaceae	*Mangifera* sp.	Tree		Medicinal
Anacardiaceae	*Swintonia floribunda* Griff.	Tree	Endemic	
Anacardiaceae	*Swintonia spicifera* Hook	Tree		
Anisophylleaceae	*Anisophyllea grandis* (Benth.) Burkill	Tree	Endemic	
Anisophylleaceae	*Anisophyllea scortechinii* King	Tree		
Annonaceae	*Uvaria grandiflora* Roxb. ex Hornem	Climber	Endemic	
Annonaceae	*Artabotrys suaveolens* (Blume) Blume	Liana		Medicinal
Annonaceae	*Ellipeia cuneifolia* Hook.f. & Thomson	Liana		
Annonaceae	*Mitrella kentii (Blume)* Miq.	Liana		
Annonaceae	*Pyramidanthe prismatica* (Hook.f. & Thomson)	Liana		
Annonaceae	*Polyalthia glauca* (Hassk.) F. Muell	Tree		
Annonaceae	*Polyalthia hypoleuca* Hook.f. & Thomson	Tree		Medicinal
Apocynaceae	*Willughbeia edulis* Roxb.	Liana		
Apocynaceae	*Alstonia angustiloba* Miq.	Tree		
Apocynaceae	*Dyera costulata (Miq.) Hook.f.*	Tree		
Araceae	*Epipremnum giganteum* (Roxb.) Schott	Climber		
Araceae	*Pothos kingii* Hook.f.	Climber		Medicinal
Araceae	*Scindapsus perakensis* Hook.f.	Climber		
Araceae	*Aglaonema simplex* Blume	Herb		
Araceae	*Schismatoglottis brevipes* Hook	Herb		
Araceae	*Schismatoglottis wallichii* Hook.f.	Herb		
Araceae	*Homalomena humilis (Jack)* Hook.f.	Herb		Medicinal
Araceae	*Scindapsus scortechinii* Hook.f.	Liana		Medicinal
Araceae	*Alocasia denudata* Endl. var. *denudata*	Shrub		Medicinal
Araceaelidiaceae	*Aralidium pinnatifitidum* (Jungh. & de Vriese) Miq.	Small Tree		Medicinal
Araliaceae	*Schefflera ridleyi* (King) R. Vig.	Shrub	Endemic	Medicinal
Araliaceae	*Arthrophyllum diversifolium* Blume	Tree		
Araucariaceae	*Agathis borneensis* Warb.	Tree		
Aristolochiaceae	*Thottea corymbosa* (Griff.) Ding Hou	shrub		Medicinal
Asteraceae	*Adenostemma viscosum* J.R. Forst. & G. Forst.	Herb		
Asteraceae	*Vernonia arborea* Buch. Hamrborea	Tree		
Blechnaceae	*Blechnum finlaysonianum* Wall. ex Hook. & Grev.	Fern		Medicinal
Blechnaceae	*Blechnum orientale* L.	Fern		
Boraginaceae	*Cordia dichotoma G*. Forst.	Tree		Medicinal
Burseraceae	*Canarium littorale* Blume	Tree		
Burseraceae	*Canarium pilosum* Benn.	Tree		
Burseraceae	*Dacryodes laxa* (Benn.) H.J. Lam	Tree		
Burseraceae	*Santiria apiculata* Benn.	Tree		
Cardiopteridaceae	*Cardiopteris quinqueloba* (Hassk.) Hassk	Small Tree		
Celastraceae	*Bhesa paniculata* Arn.	Tree		
Celastraceae	*Euonymus javanicus* Blume	Tree		
Celastraceae	*Lophopetalum* sp.	Tree		
Combretaceae	*Combretum nigrescens* King	Liana		Medicinal
Combretaceae	*Combretum sundaicum* Miq.	Liana		Medicinal
Commelinaceae	*Commelina benghalensis* L.	Herb		
Connaraceae	*Agelaea borneensis* (Hook.f.) Merr.	Liana		
Connaraceae	*Connarus semidecandrus Jack*	Shrub		
Connaraceae	*Connarus ferrugineus* Jack	Small Tree	Endemic	
Connaraceae	*Connarus grandis* Jack	Small tree		

Connaraceae	*Cnestis palala* (Lour.) Merr.	Tree		
Connaraceae	*Rourea mimosoides (Vahl) Planch.*	Liana	Endemic	
Connaraceae	*Rourea rugosa Planch.*	Liana		
Cyperaceae	*Mapania cuspidata* (Miq.) Uittien	Herb		
Cyperaceae	*Mapania kurzii* C.B. Clarke	Herb		
Cyperaceae	*Mapania palustris* (Hassk. ex Steud.)	Herb		
Cyperaceae	*Cyperus haspan* L.	Herb		
Dichapetalaceae	*Dichapetalum laurocerasus* (Planch. ex Hook.f.)	Liana	Endemic	
Dilleniaceae	*Tetracera scandens* (L.) Merr.	Liana		
Dilleniaceae	*Tetracera indica* Merr.	Shrub		
Dioscoraceae	*Dioscorea bulbifera* L.	Climber		
Dipterocarpaceae	*Anisoptera costata* Korth.	Tree		
Dipterocarpaceae	*Dipterocarpus costulatus* Slooten	Tree		
Dipterocarpaceae	*Dipterocarpus fagineus* Vesque	Tree		
Dipterocarpaceae	*Dipterocarpus grandiflorus* (Blanco) Blanco	Tree		
Dipterocarpaceae	*Hopea beccariana* Burck	Tree		
Dipterocarpaceae	*Hopea dryobalanoides* Miq.	Tree		
Dipterocarpaceae	*Hopea dyeri* F. Heim	Tree		
Dipterocarpaceae	*Hopea latifolia* Symington	Tree		
Dipterocarpaceae	*Shorea balanocarpoides* Symington	Tree	Endemic	
Dipterocarpaceae	*Shorea collina* Ridl.	Tree	Endemic	
Dipterocarpaceae	*Shorea curtisii* Dyer ex King	Tree		
Dipterocarpaceae	*Shorea glauca* King	Tree	Endemic	
Dipterocarpaceae	*Shorea lumutensis* Symington	Tree		
Dipterocarpaceae	*Shorea maxwelliana* King	Tree		
Dipterocarpaceae	*Shorea multiflora* (Burck) Symington	Tree		
Dipterocarpaceae	*Shorea parvifolia* Dyer	Tree		
Dipterocarpaceae	*Vatica havilandii* Brandis	Tree		
Dipterocarpaceae	*Vatica lowii* King	Tree		
Dipterocarpaceae	*Vatica maingayi* Dye	Tree		
Dipterocarpaceae	*Vatica pauciflora* (Korth.) Blume	Tree		
Dipterocarpaceae	*Vatica perakensis* King	Tree		
Dracaenaceae	*Dracaena conferta* Ridl.	Shrub		
Dracaenaceae	*Dracaena elliptica* Thunb.	Shrub		
Dracaenaceae	*Dracaena graminifolia* Wall. ex Hook.f.	Shrub		
Dracaenaceae	*Dracaena pendula* Ridley	Shrub	Endemic	
Dracaenaceae	*Dracaena porteri* Baker	Shrub	Endemic	
Dracaenaceae	*Dracaena siamica* Ridl.	Shrub		
Dracaenaceae	*Dracaena umbratica* Ridl.	Shrub		
Droseraceae	*Drosera indica* Linn.	Herb		
Dryopteridaceae	*Tectaria crenata* Cav.	Fern		
Dryopteridaceae	*Tectaria decurrens* (C. Presl) Copel.	Fernl		
Ebenaceae	*Diospyros buxifolia (*Blume) Hiern	Tree		
Ebenaceae	*Diospyros diepenhorstii* Miq.	Tree		
Ebenaceae	*Diospyros pendula* Hasselt ex Hassk.	Tree		
Ebenaceae	*Diospyros pilosanthera* Blanco	Tree	Endemic	
Ebenaceae	*Diospyros rufa* King & Gamble	Tree	Endemic	
Elaeocarpaceae	*Elaeocarpus nitidus* Jack	Tree	Endemic	
Elaeocarpaceae	*Elaeocarpus rugosus* Roxb.	Tree		
Elaeocarpaceae	*Elaeocarpus stipularis* Blume	Tree		
Erythroxylaceae	*Erythroxylum cuneatum* (Miq.) Kurz	Tree		
Euphorbiaceae	*Alchornea rhodophylla* Pax & K. Hoffm.,	Shrub	Endemic	
Euphorbiaceae	*Breynia vitis-idaea* (Burm.f.) C.E.C. Fisch.	Shrub		
Euphorbiaceae	*Rothmannia macrophylla* (R.Br. ex Hook.f.)	Shrub		
Euphorbiaceae	*Agrostistachys gaudichaudii* Müll.Arg.	Small Tree		
Euphorbiaceae	*Agrostistachys longifolia* (Wight) Benth.	Small Tree		
Euphorbiaceae	*Antidesma velutinosum* Blume	Small Tree		
Euphorbiaceae	*Aporosa benthamiana* Hook.f.	Small Tree		
Euphorbiaceae	*Glochidion perakense* (Müll.Arg.) Airy Shaw	Small Tree	Endemic	

ISSN 1916-9752 E-ISSN 1916-9760

Euphorbiaceae	*Aporosa arborea* (Blume) Müll.Arg.	Tree		
Euphorbiaceae	*Aporosa nervosa* Hook.f.	Tree	Endemic	
Euphorbiaceae	*Botryophora geniculata* (Miq.) Beumée ex Airy	Tree		
Euphorbiaceae	*Cleistanthus glaucus* Jabl.	Tree	Endemic	
Euphorbiaceae	*Cleistanthus hirsutulus* Hook.f.	Tree		
Euphorbiaceae	*Cleistanthus macrophyllus* Hook.f.	Tree		
Euphorbiaceae	*Elateriospermum tapos* Blume	Tree		
Euphorbiaceae	*Endospermum diadenum* (Miq.) Airy Shaw	Tree		
Euphorbiaceae	*Macaranga hullettii* King ex Hook.f.	Tree		
Euphorbiaceae	*Mallotus penangensis* Müll.Arg.	Tree		
Euphorbiaceae	*Mallotus subpeltatus* (Blume) Müll.Arg.	Tree		
Euphorbiaceae	*Phyllanthus emblica* L.	Tree	Endemic	
Leguminosae	*Bauhinia kockiana* Korthalsia	Liana		
Leguminosae	*Dalbergia parviflora* Roxb.	Liana		
Leguminosae	*Spatholobus ferrugineus* (Zoll. & Moritzi) Benth.	Liana		
Leguminosae	*Millettia dasyphylla* (Miq.) Boerl.	Small Tree		
Leguminosae	*Adenanthera malayana* Kosterm.	Tree		
Leguminosae	*Callerya atropurpurea* (Wall.) Schot	Tree		
Leguminosae	*Dialium platysepalum* Baker	Tree		
Leguminosae	*Fordia unifoliata* (Prain) Dasuki & Schot	Tree		
Leguminosae	*Saraca indica* L.	Tree		
Leguminosae	*Fordia pauciflora* Dunn	Treetlet	Endemic	
Fagaceae	*Lithocarpus cantleyanus* (King ex Hook.f.) Rehder	Tree		
Fagaceae	*Lithocarpus wallichianus* (Lindl. ex Hance) Rehder	Tree		
Flacourtiaceae	*Casearia latifolia* Ridl.	Small Tree		
Flacourtiaceae	*Casearia velutinosa* Ridl.	Small Tree		
Flacourtiaceae	*Casearia clarkei* King	Tree	Endemic	
Flacourtiaceae	*Flacourtia rukam* Zoll. & Moritzi	Small tree	Endemic	
Flacourtiaceae	*Hydnocarpus curtisii* King	Tree		
Flacourtiaceae	*Ryparosa javanica* Kurz ex Koord.	Tree		
Flacourtiaceae	*Ryparosa kunstleri* King	Tree		
Gesneriaceae	*Cyrtandra cupulata* Ridl.	Herb	Endemic	
Gesneriaceae	*Didymocarpus platypus* C.B. Clarke	Herb		
Gesneriaceae	*Didymocarpus* sp.	Herb	Endemic	
Gesneriaceae	*Cyrtandra wallichii* (C.B. Clarke) B.L. Burtt	Shrub		
Gnetaceae	*Gnetum microcarpum* Blume	Liana		
Gnetaceae	*Gnetum gnemon* L.	Shrub		
Guttiferae	*Calophyllum calaba* L.	Tree		Medicinal
Guttiferae	*Calophyllum molle* King	Tree		Medicinal
Guttiferae	*Calophyllum wallichianum* Planch. & Triana	Tree	Endemic	Medicinal
Guttiferae	*Garcinia atroviridis* Griff. ex T. Anderson	Tree	Medicinal	
Guttiferae	*Garcinia griffithii* T. Anderson	Tree		Medicinal
Guttiferae	*Garcinia nigrolineata* Planch. ex T. Anderson	Tree		Medicinal
Guttiferae	*Garcinia scortechinii* King	Tree		Medicinal
Guttiferae	*Mesua daphnifolia* (Ridl.) Kosterm.	Tree		Medicinal
Guttiferae	*Mesua ferrea* L.	Tree		Medicinal
Hydrocharitaceae	*Enhalus acoroides* (L.f.) Royle	Herb		
Hypoxidaceae	*Molineria latifolia* (Dryand.) Herb. ex Kurz	Herb		
Ixonanthaceae	*Ixonanthes reticulata* Jack	Tree		
Juglandaceae	*Engelhardtia serrata* Blume	Tree		
Lauraceae	*Actinodaphne oleifolia* Gamble	Shrub		
Lauraceae	*Alseodaphne* sp.	Tree		
Lauraceae	*Cinnamomum iners* Reinw	Tree		
Lauraceae	*Dehaasia cuneata* (Blume) Blume	Tree		
Lauraceae	*Dehaasia polyneura* (Miq.) Kosterm	Tree		
Lauraceae	*Litsea myristicifolia* (Wall. ex Nees) Hook.f.	Tree		
Lauraceae	*Litsea nidularis* Gamble	Tree		
Lauraceae	*Persea declinata* (Blume) Kosterm.	Tree		
Lecythidaceae	*Barringtonia pendula* (Griff.)Kurz	Tree		

Linaceae	*Roucheria griffithiana* Planch.	Liana		
Loganiaceae	*Strychnos axillaris* Colebr.	Liana		
Loganiaceae	*Strychnos flavescens* King &Gamble	Liana		
Loranthaceae	*Scurrula parasitica* L. -	Shrub		
Melastomataceae	*Sonerila caesia* Stapf	Herb	Endemic	
Melastomataceae	*Clidemia hirta* (L.) D. Don	Shrub		
Melastomataceae	*Melastoma muticum* Ridl.,	Shrub		
Melastomataceae	*Lijndenia laurina* Zoll. & Moritzi	Small tree		
Melastomataceae	*Memecylon minutiflorum* Miq.	Tree	Endemic	
Melastomataceae	*Pternandra coerulescens* Jack	Tree		
Meliaceae	*Aglaia argentea* Blume	Tree		
Meliaceae	*Aglaia leptantha* Miq.	Tree		
Meliaceae	*Aglaia leucophylla* King	Tree		
Meliaceae	*Chisocheton pauciflorus* King	Tree	Endemic	
Meliaceae	*Chukrasia tabularis* Ridley	Tree		
Meliaceae	*Dysoxylum arborescens* (Blume) Miq.	Tree		
Meliaceae	*Dysoxylum rigidum* (Ridl.) Mabb.	Tree		
Meliaceae	*Pseudoclausena chrysogyne* (Miq.) T.P. Clark	Tree		
Meliaceae	*Sandoricum koetjape* (Burm.f.) Merr	Tree		
Meliaceae	*Toona sureni (*Blume) Merr.	Tree		
Meliaceae	*Walsura pinnata* Hassk	Tree		
Menispermaceae	*Coscinium blumeanum* Miers ex Hook.f. & Thomson	Liana		
Menispermaceae	*Coscinium fenestratum* (Gaertner) Colebr.	Liana		
Menispermaceae	*Diploclisia kunstleri* (King) Diels	Liana		
Menispermaceae	*Fibraurea tinctoria* Lour.	Liana	Endemic	
Menispermaceae	*Tinomiscium petiolare* Hook.f. & Thomson	Liana		
Moraceae	*Ficus bracteata* Wall. ex Miq.	Liana		
Moraceae	*Ficus punctata* Thunb	Liana		
Moraceae	*Ficus aurata* Miq.	Shrub		
Moraceae	*Artocarpus lanceifolius* Roxb.	Tree		
Moraceae	*Artocarpus nitidus* Trécul	Tree		
Moraceae	*Streblus elongatus* (Miq.) Corner.	Tree		
Moraceae	*Streblus ilicifolius* (Vidal) Corner	Tree		
Myristicaceae	*Horsfieldia polyspherula* (Hook.f.) J. Sinclair	Tree		
Myristicaceae	*Knema furfuracea* (Hook.f. & Thomson) Warb.	Tree		
Myristicaceae	*Knema hookeriana* (Wall. ex Hook.f. & Thomson)	Tree		
Myristicaceae	*Knema malayana Warb*	Tree		
Myristicaceae	*Myristica cinnamomea* King	Tree		
Myristicaceae	*Myristica maxima* Warb.	Tree		
Myrsinaceae	*Ardisia oxyphylla* Wall. ex A. DC.	Shrub		
Myrsinaceae	*Ardisia pachysandra* (Wall. ex Roxb.) Mez	Shrub		
Myrsinaceae	*Ardisia lanceolata* Roxb.	Tree		
Myrtaceae	*Syzygium chloroleucum* (King) Masam.	Shrub		
Myrtaceae	*Eugenia* sp.9	Tree		
Myrtaceae	*Syzygium acuminatissimum* (Blume) DC	Tree		
Myrtaceae	*Syzygium claviflorum* (Roxb.) Wall. ex A.M. Cowan	Tree	Endemic	
Myrtaceae	*Syzygium linoceroides* (King) I.M.	Tree	Endemic	
Myrtaceae	*Rhodamnia cinerea* Ridl.	Tree		Medicinal
Ochnaceae	*Euthemis leucocarpa* Jack	Shrub		Medicinal
Ochnaceae	*Ochna integerrima* (Lour.) Merr.	Small Tree		
Ochnaceae	*Brackenridgea hookeri* (Planch.) A. Gray	Tree		
Ochnaceae	*Campylospermum serratum* (Gaertn.) Bittrich	Tree		
Ochnaceae	*Gomphia microphylla* Ridl.	Tree		Medicinal
Olacaceae	*Olax imbricata* Roxb.	Climber		
Olacaceae	*Ximenia americana* L.	Small Tree		Medicinal
Olacaceae	*Scorodocarpus borneensis* (Baill.) Becc.	Tree		Medicinal
Olacaceae	*Strombosia ceylanica* Gardn.	Tree		
Olacaceae	*Strombosia javanica* Blume	Tree		
Olacaceae	*Strombosia maingayi* Whitmore	Tree		

ISSN 1916-9752 E-ISSN 1916-9760

Orchidaceae	*Vanilla griffithii* Rchb.f.	Climber		Medicinal
Orchidaceae	*Appendicula anceps* Blume	Epiphyte		
Orchidaceae	*Epigeneium zebrinum* (J.J.Sm.) Summerh.	Epiphyte		Medicinal
Orchidaceae	*Grammatophyllum speciosum* Blume	Epiphyte	Endemic	Medicinal
Orchidaceae	*Cryptostylis arachnites* (Blume) Hassk.	Herb		
Oxalidaceae	*Averrhoa bilimbi* L.	Tree		Medicinal
Oxalidaceae	*Sarcotheca griffithii* (Planch. ex Hook.f.) Hallier f.	Tree	Endemic	
Palmae	*Arenga westerhoutii* Griff.	Palm		
Palmae	*Calamus castaneus* Griff.	Palm		
Palmae	*Calamus insignis* Griff.	Palm	Endemic	
Palmae	*Calamus javensis* Blume	Palm		
Palmae	*Daemonorops calicarpa* (Griff.) Mart.	Palm		
Palmae	*Eugeissona brachystachys* Ridl.	Palm	Endemic	
Palmae	*Eugeissona tristis* Griff.	Palm	Endemic	
Palmae	*Korthalsia rigida* Blume	Palm	Endemic	
Palmae	*Korthalsia scortechinii* Becc.	Palm		
Palmae	*Licuala kingiana* Becc.	Palm		
Palmae	*Licuala spinosa* Wurmb. Verh.	Palm		
Palmae	*Oncosperma horridum* (Griff.) Scheff.Bayas	Palm		Medicinal
Palmae	*Pinanga perakensis* Becc.	Palm	Endemic	
Palmae	*Pinanga subruminata* Becc.	Palm	Endemic	
Pandaceae	*Microdesmis caseariifolia* Planch.	Shrub		
Pandaceae	*Pandanus humilis* Lour.	Shrub	Endemic	Medicinal
Pandaceae	*Pandanus prainii* Martelli	Shrub		Medicinal
Pandaceae	*Galearia fulva* (Tul.) Miq.	Tree		
Passifloraceae	*Adenia penangiana* (Wall. ex G. Don) W.J. de Wilde	Cimber		Medicinal
Pentaphragmaceae	*Pentaphragma horsfieldii* (Miq.) Airy Shaw	Herb		
Piperaceae	*Piper magnibaccum* C. DC.	Climber		Medicinal
Poaceae	*Schizostachyum latifolium* Gamble	Herb		
Polygalaceae	*Polygala polifolia* Presl	Herb	Endemic	
Polygalaceae	*Xanthophyllum affine* Korthalsia	Tree		Medicinal
Polygalaceae	*Xanthophyllum amoenum* Chodat	Tree		
Polygalaceae	*Xanthophyllum ellipticum* Korth. ex Miq.	Tree		
Polygalaceae	*Xanthophyllum eurhynchum* Miq.	Tree		
Polygalaceae	*Xanthophyllum flavescens* Roxb.	Tree		
Polygalaceae	*Xanthophyllum griffithii* Hook.f. ex A.W. Benn	Tree		
Polypodiaceae	*Taenitis blechnoides* (Willd.) Sw	Fern		
Polypodiaceae	*Taenitis interrupta* Hook. & Grev	Fern		
Polypodiaceae	*Pyrrosia piloselloides* (L.) M.G. Price	Fern		
Rhamnaceae	*Ventilago malaccensis* Ridl.	Climber		
Rhizophoraceae	*Gynotroches axillaris* Blume	Small Tree	Endemic	Medicinal
Rhizophoraceae	*Pellacalyx saccardianus* Scort.	Tree		
Rubiaceae	*Paederia foetida* L.	Climber		Medicinal
Rubiaceae	*Argostemma oblongum* King	Herb	Endemic	
Rubiaceae	*Argostemma elatostemma* Hook.f.	Herb		Medicinal
Rubiaceae	*Coptosapelta griffithii* Hook.f.	Liana		Medicinal
Rubiaceae	*Oxyceros curtisii* (King & Gamble) K.M. Wong	Liana		
Rubiaceae	*Uncaria cordata cordata* (Lour.) Merr.	Liana		Medicinal
Rubiaceae	*Ixora grandifolia* Zoll. & Moritzi	Shrub		Medicinal
Rubiaceae	*Ixora umbellata* Koord. & Valeton	Shrub		
Rubiaceae	*Lasianthus cyanocarpus* Jack	Shrub		Medicinal
Rubiaceae	*Lasianthus densifolius* Miq.	Shrub	Endemic	Medicinal
Rubiaceae	*Prismatomeris glabra* (Korth.) Valeton	Shrub		
Rubiaceae	*Psychotria angulata* Korth.	Shrub	Endemic	Medicinal
Rubiaceae	*Saprosma scortechinii* King & Gamble	Shrub		Medicinal
Rubiaceae	*Ixora congesta* Roxb.	Shrub		
Rubiaceae	*Mycetia malayana* (Wall. ex Ridl.) Craib	Shrub		
Rubiaceae	*Psychotria griffithii* Hook.f.	Shrub		Medicinal
Rubiaceae	*Urophyllum blumeanum* (Wight) Hook.f.	Small Tree		

Rubiaceae	*Aidia densiflora* (Wall.) Masam	Tree		
Rubiaceae	*Canthium confertum* Korth.	Tree		
Rubiaceae	*Diplospora malaccensis* Hook.f.	Tree		
Rubiaceae	*Gardenia tubifera* Wall.	Tree		
Rubiaceae	*Nauclea officinalis* (Pierre ex Pit.) Merr. & Chun	Tree		Medicinal
Rubiaceae	*Nauclea subdita* (Korth.) Steud.	Tree		
Rubiaceae	*Psydrax maingayi* (Hook.f.) Bridson	Tree		
Rubiaceae	*Timonius corneri* K.M. Wong	Tree		
Rubiaceae	*Urophyllum leucophloem* Ridl.	Tree	Endemic	Medicinal
Rutaceae	*Maclurodendron porteri* (Hook.f.) T.G. Hartley	Tree	Endemic	
Rutaceae	*Zanthoxylum myriacanthum* Wall.	Tree		Medicinal
Sapindaceae	*Lepisanthes tetraphylla* (Vahl) Radlk.	Small tree	Endemic	Medicinal
Sapindaceae	*Lepisanthes senegalensis* (Poir.) Leenh.	Tree		Medicinal
Sapindaceae	*Xerospermum noronhianum* (Blume) Blume	Tree		
Sapindaceae	*Allophylus cobbe* (L.) Raeusch.	Tree		Medicinal
Sapotaceae	*Palaquium gutta* (Hook.f.) Baill.	Tree		
Sapotaceae	*Palaquium rostratum* (Miq.) Burck	Tree		
Sapotaceae	*Payena dasyphylla* (Miq.) Pierre	Tree		
Sapotaceae	*Payena lucida* A. DC.	Tree		
Sapotaceae	*Pouteria maingayi* (C.B. Clarke) Baehni	Tree		
Sapotaceae	*Pouteria malaccensis* (C.B. Clarke) Baehni	Tree		
Schizaeaceae	*Lygodium auriculatum* (Willd.) Alston.	Fern		
Scrophulariaceae	*Cyrtandromoea repens* Ridl.	Herb		Medicinal
Selaginellaceae	*Selaginella minutifolia* Spring	Fern		Medicinal
Selaginellaceae	*Selaginella intermedia* (Blume) Spring	Fern		Medicinal
Simarubaceae	*Brucea javanica* (L.) Merr.	Shrub		Medicinal
Simarubaceae	*Eurycoma longifolia* Jack	Treetlet		Medicinal
Smilacaceae	*Smilax calophylla* Wall. ex A. DC	Shrub	Endemic	Medicinal
Solanaceae	*Lycianthes laevis* (Dunal) Bitter	Shrub		Medicinal
Sterculiaceae	*Sterculia cuspidata* R.Br.	Small Tree		
Sterculiaceae	*Pterospermum javanicum* Jungh.	Tree		Medicinal
Thelypteridaceae	*Pronephrium repandum* (Fée) Holttum	Fern		
Thymelaeaceae	*Aquilaria* sp.	Tree		Medicinal
Thymelaeaceae	*Gonystylus affinis* Radlk.	Tree		Medicinal
Tiliaceae	*Pentace macrophylla* King	Tree	Endemic	
Tiliaceae	*Pentace strychnoidea* King	Tree		
Tiliaceae	*Schoutenia accrescens* (Mast.) Curtis	Tree		
Ulmaceae	*Gironniera parvifolia* Planch	Tree		
Ulmaceae	*Girroniera subaequalis* Planch.	Tree	Endemic	
Verbenaceae	*Clerodendrum deflexum* Wall.	Shrub		Medicinal
Verbenaceae	*Clerodendrum laevifolium* Blume	Shrub		
Verbenaceae	*Teijsmanniodendron hollrungii* (Warb.) Kosterm.	Small Tree		
Verbenaceae	*Teijsmanniodendron coriaceum* (C.B. Clarke)	Tree		
Verbenaceae	*Vitex pinnata* L.	Tree		Medicinal
Violaceae	*Rinorea anguifera* (Lour.) Kuntze	Tree		Medicinal
Violaceae	*Rinorea sclerocarpa* (Burgersd.) M. Jacobs	Tree		
Vitaceae	*Tetrastigma lawsoni* (King) Burkill ex A.W. Hill	Liana	Endemic	
Vittariaceae	*Anthrophyum callifolium* Blume	Epiphyte		
Woodsiaceae	*Diplazium bantamense* Blume	Fern		Medicinal
Zigiberaceae	Zingiber curtisii Holttum	Herb	Endemic	Medicinal
Zingiberaceae	*Etlingera metriocheilos* (Griff.) R.M. Sm.	Herb		Medicinal
Zingiberaceae	*Globba pendula* Roxb.	Herb	Endemic	Medicinal
Zingiberaceae	*Globba variabilis* Ridl.	Herb		Medicinal
Zingiberaceae	*Alpinia scabra* (Blume) Baker	Herb		

ISSN 1916-9752 E-ISSN 1916-9760