Tree Species Composition and Structureofa Coastal Hill Forest in Pulau Pangkor, Malaysia

S. Ghollasimood (Corresponding author)
I. FaridahHanum, M. Nazre, Abd Kudus Kamziah
Faculty of Forestry, Universiti Putra Malaysia
43400, Serdang, Selangor, Malaysia
Tel: 98-915-756-2704 E-mail: sghollassi@yahoo.com

Received: February 12, 2011 Accepted: February 28, 2011 Published: December 1, 2011
doi:10.5539/jas.v3n4p172 URL: http://dx.doi.org/10.5539/jas.v3n4p172

Abstract

Tree species composition and structure of a coastal hill forest in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor at Perak was studied based on the data from five 1-hectare plots. All stems with a diameter at breast height (dbh) ≥ 5cm enumerated, identified and their height weremeasured. The mean stem density was 659 (stems ha^{-1}), and a total of 45 families, 102 genera, 181 species, 3319 individuals were presented in the five 1-ha plot; this comprises 6.3% species, 19.2% genera and 42% families of the total tree taxa found in Peninsular Malaysia. Based on IVI, *Vatica maingayi,Xanthophyllum affine*,*Vatica pauciflora*were the most dominant tree species. The families of Dipterocarpaceae, Polygalaceae,Guttiferae and Myrtaceae were among the most important families with high FIV. Based on dbh class, nearly 50% of the trees were distributed in the lower diameter class(5-15cm). According to heightlife-form categories, 53% of stems were belonged to small trees (7-15m). Species accumulation curve showedan asymptote at the third hectare.

Keywords: Coastal hill forest, Importance value index, Basal area, Malaysia

1. Introduction

Tropical rainforest in five major regions (Corlett and Primack 2006), have the most diverse terrestrial ecosystems (Turner 2001) and extremely important for conserving biodiversity for the local and regional development and also for sustainable use of forests (Neshim *et al.*2009).

Malaysian forests harbour a very large portion of diversity and forests have an important role in the country socio-economic development and environmental conservation (Nizam Khan and Zakaria 2005).This diversity is under great threat with total forested area in Peninsular Malaysia with 44.7% of its land area (Abdul Rashid 2005). There are 16 forest types based on altitude and soil types and distributed from the coastal lines to the mountain (Whitmore and Sayar 1992).

The flora of Peninsular Malaysia contains the floristic elements of the Sunda Shelf and also of the mainland Asiatic species from seasonal climates (Saw and Chung 2004) and has been studied by several botanists. The first effort was done by Ridley (1922-1925) by *Flora of the Malay Peninsula*, while Whitmore and Ng (1972-1989) prepared the forest trees of Peninsular Malaysia in the *Tree Flora of Malaya* (Vol. 1 to IV).The current checklist catalogues reveals, Peninsular Malaysia has about 8893 taxa (species, subspecies and varieties) covering around 8200 native and 690 naturalised species (Saw*et al.* 2009) but the flora is not completely known and continuous botanical inventories is an on-going process.

Tree species constitute a large proportion of the flora of the Malay Peninsula. From 8096 species that comprise the native flora of the Malay Peninsula (Turner, 1997), 2830 species are trees (35%) in which are distributed in 106 families and 532 genera (Ng 1991).

Coastal hill forests are the climax vegetation. The main difference between the hill dipterocarp forests and lowland forests is the specific composition of the dominant of the upper strata of the vegetation. Relatively few studies have considered the plant diversity in a coastal hill forest. Symington (2004) recognized a floristic similarity between the costal hill and the hill dipterocarp forests. Abd. Rashid (2005) and Azhar Muda*et al.*

(2006) provided a list of plants found in coastal hill forest in Terengganu. But there is still insufficient information for Forestry Department of Malaysia to act upon especially for the consolidation of plant resources in coastal hill forest.This study focused on tree species richnessand evaluatesfloristic composition in a coastal hill forest.

2. Method and Material

2.1 Study area

This study was performed in Sungai Pinang Permanent Forest Reserve, Pulau Pangkor an island in Perak, north-west Peninsular Malaysia between 04°13.0'N latitude and 100° 33.0´E longitude (Figure 1). 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 (MOSTE 1997),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) (Meteorology Office, Sitiwan Station, Perak). The elevation of the study area ranges from 45to 350 m above the sea level. The texture of topsoil is mainly sandy loam.

2.2 Methods and data analysis

As 1 ha plots widely used and considered of appropriate size for studies in tropical forest, 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 plot was systematically surveyed by enumerating, identifying and measuring all trees with height and diameter at breast height (DBH) ≥ 5cm. DBH was measured at 1.3 m above the ground unless the stem was swollen; measurements were taken at the nearest lower point where the stem was cylindrical. Based on Kitamura *et al.* (2005) four life-form categories including: arboreal shrub (SH<7), small tree (ST 7-15m), mid-sized tree (MT 15-30m), and tall tree (TT>30m) were determined. The inventories were made in December 2008 till October 2009. Five soil samples from each plot were collected to determine the soil texture. The specimens were fixed and kept in herbarium of Forestry Faculty, in Universiti Putra Malaysia and identified on the basis of regional flora. In addition, local names 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 three variables (Curtis and McIntosh, 1951):

Relative dominance = (total basal area for a species/total basal area for all species)×100

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

The family importance values (FIV) (Mori *et al*. 1983) were used to compare the relative contribution of each taxonomic family to forest species composition and was calculated as the sum of the following three variables:

Relative diversity = (number of species in family/total number of species) × 100

Relative density = (number of individuals in family/total number of trees) × 100

Relative dominance = (basal area of family/total basal area) × 100

Also tree density for each plot (Tree density = Number of trees/area) calculated (Narayanan and Swarupanandan 1996).

3. Results

3.1 Floristic composition

A total of 3319 individualstrees with dbh≥ 5 representing 181 species belong to 102 genera in 45 families were identified within five 1-ha plots of a coastal hill forest that is comprises 6.4% species, 19% genera and 42% families of the total tree taxa found in peninsular Malaysia. *Vatica maingayi*(IVI 300.46),*Xanthophyllum affine* (IVI 177.33),followed by *Vatica pauciflora (*IVI165.73) were dominant tree species (Table 1,2).The most speciose were Dipterocarpaceae having 13 species or 7.18% of total number of species,followed by Guttiferae (8 species or 4.42%), Euphorbiaceae (7 species or 3.87%) andPolygalaceae (5 species or 2.76%), while more than 23 families were singletons (represented by only one species). Table 3 contrasts the FIV for all families in the study area in which it was characterised by a rich value of 506.4 for Dipterocarpaceae.

The number of families, species numbers and individual numbers within five plots were significantly difference ($P<0.001$, $P<0.0001$, $P<0.001$, respectively).

3.2 DBH and Basal area

Species richness in terms of the number of species decreased with increased diameter classes. Trees within class 5-14.9 cm dbh constitute an average of about 54% of individuals and the distribution for the others declined dramatically in which 21% of individuals belonged to the next higher range (15-24.9 cm) (Figure2). However several species (e.g. *Shorea lumutensis, Xanthophyllum affine* and *Syzygium filiforme*) attained dbh > 65 cm representing 2.5% of the total individuals.Figure 3 shows the distribution of basal area by dbh classes in five 1-ha plots. The total basal area for 3319 stemswas 28.17 $m^2ha^{-1}$and Dipterocarpaceae with 744 individuals had the largest basal area. Table 4 shows the 20 largest basal areas by species in this study area. Mean DBH between five plots were significantly difference ($P<0.0001$).

3.3 Species accumulativecurve

Species accumulative curve reached an asymptote and flatten out, since the curve began to level off at third plot, it suggests our sampling area captured maximum proportion of the species richness (Figure 4). As tropical ecologists believe tree species richness reaches an asymptote at 1-3 ha (Tuomisto *et al.* 1995, Condit *et al.* 1996).

3.4 Height and Density of trees

According to life-form categories, 53.5% of stems were small tree (1775 individuals), 24.4% mid-sized trees (810 individuals), 20.2% shrub (670 individuals) and 1.8% tall trees (60 individuals). Dipterocarpaceae was the most abundant family of tall tree (40%), mid-size tree (26.9%), shrub (20.62%) and small trees (19.7%). Mean tree density was 659 (stems/ha),Dipterocarpaceae obviously contributed to highest density (148 stems/ha) followed by Polygalaceae (46 stems/ha). The range of tropical lowland forest density is from 395 to 734 stems/ha (Swaine *et al.* 1987).

4. Discussion

Species richness is the most important characteristics of tropical rainforest ecosystem. Peninsular Malaysia has high diversity because it has been geologically stable from early Tertiary (Keng 1978) and the stable environment makes it easier for plants to survive (Ganesen 2008). The distribution of tree species in coastal hill has narrow ecological range. Many of lowland dipterocarp forest genera are represented but with different species and composition. *Shorea curtisii* for example is mainly limits to the ridges and upper slope areas (Ashton 1964, Saiful *et al.* 2008). In this area the ridges were often dominated by other non-dipterocarps such as *Swintonia* sp., *Xanthophyllum* sp. and *Sarcotheca* sp. It is notable that climax or late-successional species like *Sarcotheca griffithii* was the only non-dipterocarp species with high abundance in the last plot and *Xanthphyllum affine* was abundant and widespread across the gradient.

Microclimate is important because of its effects on species richness and ecosystem functions. In this area total vegetation cover was related on moisture and decreased with distance from the stream, which is likely to be caused by lower levels of soil moisture.Many of species are dependent on the higher amount of moisture, thesespecies are moisture obligates and mainly appeared in the first plot(Table 5).

Polygalaceae in the first plot was the dominant family with FIV 32.83 but Dipterocarpaceae was the dominant family with FIV 44, 77, 256 and 111 in plots 2 to 5, respectively. The importance of Dipterocarpaceae with 156 species (Turner 1997) and fourteenth most speciousin the flora as an emergent canopy tree in this area not only in terms of species richness but also in the proportional abundance of individuals is widely appreciated and remarkable. The extreme variability in stocking of economic species (large trees) was found on ridge-tops and slopes where the highest concentration of commercial timber tends to occur. According to Newbery *et al.* (1992), the regeneration of dipterocarps is unlikely to occur on slopes of 45 deg. or more. This observation is of immense importance to the Peninsular Malaysian hill forest especially by virtue of the fact that such terrain contributes 15-20% of the total land area in the hills whereas about 40% of the total land area of the Peninsular rises above 170 m and about 23%that of 300 m. Seedling recruitment is also poorer in the upper hill dipterocarp forests than in the steep lowlands or hill-ridge forests**.** Table 6 shows the comparison of coastal hill forest with lowland forest in other sites of Malaysia. In general, plant richness compared with lowland forest was low (Table 8 shows the distribution of some species along the hill).

In the third plot there was a sharp decline on the number of species and individuals. The main reasons were the abundance of stemless palm *Eugeissona tristis*(Bertam) on the ridges in which it made barrier for the successful establishment of natural regeneration, heavy felling of trees due to more exposed nature of the ridges resulting in gulley erosion and mass-flow of soil and third reason was high elevation (350 m a.s.l). The negative influence of elevation on diversity has been widely reported in studies (Gazol and Ibanez 2009). The ground flora of plots (except first plot) is extremely poor, due partly to the common occurrence of the palm *Eugeissona triste*.

The higher values of diversity found on slopes could be attributed to the bare soil surfaces created by leaf litter movement downward (Facelli and Pickett 1991a) and by a less crowded overstorey that enabled higher radiation on the soil. In the valley bottoms regeneration is unevenly distributed and most of families with one species appeared there, large woody species were also often comparatively poor and the forest was characterised by the richness in the ground flora and shrub layer (The details of all vascular plants publishedinSeptember 2011 in a different paper).

There are three types of plant distribution, random, clump, and uniform (Ludwig and Reynolds 1988). Majority of species were found to be distributed randomly in the plots. Some species like *Bouea oppositifolia*, *Agrostistachys longifolia, Mallotus penangensis* and *Xerospermum noronhianum*appeared clump distribution. Some tree species are very local in their distribution. For example, Pangkor Island is the only place where *Shorea lumutensis* occurs naturally in Peninsular Malaysia.

The frequency distribution in different size classes showed strong reverse-J, revealed a negative exponential relation in population size between the size classes (Figure2) (Seng *et al.* 2004).Pandy and Shukla (2003) stated reverse J distribution, indicative of uneven-aged stands among several dbh classes that correspond to the condition of natural forest and regeneration of trees and Rozas (2006) revealed this is in accordance with the idealized well-balanced population structure of the forests.

The maximum basal area in the first 1-ha plot belonged to Myrtaceae and in the other plots Dipterocapaceae was the dominant family. Dipterocarpaceae accounted for 45.6% of the total basal area that shows this family represented by large trees. There was a large gap between Dipterocarpaceae (BA 10.6 m^2) and the next most abundant family, Polygalaceae, (BA 2 m^2) (Table 6). According to Ramos and Amo (1992**),** a mature stand of primary dipterocarp forest can have an estimated basal area within the range of about 36-46 m^2/ha being common of tropical rainforest areas. An unmanaged primary lowland forest in Peninsular Malaysia usually has a basal area about 32 m^2/ha. Comparing these figures with those obtained from this study, it is clear that the basal area of the stand under study was lower than reported by others(Table 7). Differences in basal area may be attributed to altitudinal variations, species composition, age structure and successional stage of the forest (Swamy *et al.* 2000).

The investigation of endemism and the conservation status of the species are getting increasingly important with issues of plant conservation to be dealt under current forest management practices. The number of endemic trees totals 746 species which represents 26.4% of the total number of tree species (Ng *et al.* 1990). The endemic species accounted 24 (3.2%) (Appendix 1).According to IUCN red list of threatened species (2010) and(Ng *et al.*(2008), there were 13 critically endangered species, 18 lower risk, 6 endangered and 7 vulnerable species in this island.

5. Conclusion

Species richness is one measure of biodiversity and it is very important for ecosystem functioning, stability and integrity. Apart from the ecological reasons, maintaining high biodiversity in forest ecosystems has economic, spiritual, ethical, scientific and educational importance.This study helps to complete the description of biodiversity and forest structure and may be sued to interpret aspects of forests and population dynamics community.

The consensus has been that much more research is needed to provide directly relevant and applicable evidence for a better understanding of the hill coastal ecosystem, including the growth behaviour of the trees and the factors affecting it.

These kinds of studies are important, for conservation biodiversity, for local and regional development and also sustainable use of forest, e.g. by combining ecotourism and harvesting non-timber.

Acknowledgement

We thank the staff of Faculty of Forestry for their assistance in the field surveys and collection of tree samples and measurements.

References

Abdul Hayat, M.S., Kamziah A.K., FaridahHanum, 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.

Abdul Rashid, M.A. (2005). *Forest Management in Malaysia*. Paper presented during the Malaysian Timber Mission on Australia and New Zealand,7-11 April. Forestry Departmant Peninsular Malaysia, Kuala Lumpur.

Ashton, P.S. (1964). *Ecologicalstudies in the mixed dipteropcarpus forests of Brunei State*. Oxford Forest Memoire, No. 25. Oxford: Oxford University Press.

Azhar Muda, Na'aman J., Sabran, M.R., Som, J.M., Nizam, M.S., Latiff, A. (2006). Gunung Mandi Angin, Terengganu. In Z.Ismail, H. Moh Zaki, A. Moh Azani, A. Arifin, A.K. Moh Zaidey,I. Faridah-Hanum (Eds.). *Composition of trees in the central stand at Hutan Simpan Pasir Raja*. Jabatan Perhutanan Senenanjung Malaysia. Blackwell Publishing, Ltd.

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. http://dx.doi.org/10.2307/2261477

Corlett, R.T. and Primack, R.B. (2006). Tropical rainforest: why cross-continental comparisons are needed. *Trends in ecology and evolution,* 31, 104-110. http://dx.doi.org/10.1016/j.tree.2005.12.002

Curtis, J.T., McIntosh, R.P. (1951). An upland forest continuum in the prairie-forest border region of Wisconsin. *Ecology,* 32(3), 476-496. http://dx.doi.org/10.2307/1931725

Facelli, J.M, Pickett, T.A. (1991a). Indirect effects of liter on woody seedling subject to herb competition.*OIKO,* 62, 129-138. http://dx.doi.org/10.2307/3545257

Faridah-hanum, I, Awang Noor, A.G., Tuan Mariana, T.J. (2007). Stand structure and diversity of trees of tropical hill forest in Peninsular Malaysia. Paper presented at the *Seminar on Economic valuation of forest goods and services 2007* 16-17 December, Kuala Terengganu, Terenganu.

FaridahHanum, I, Philip, L. & Awang Noor, A.G. (2008). Sampling species diversity in a Malasian forest: The case of a logged-Over forest. *Pakistan Journal of Botany,* 40(4), 1729-1733.

Ganesan, S.K. (2008). *The biodiversity of the Malay Peninsula with special reference to Singapore.* Retrieved from http://wikitravel.org/en/West_Malaysia.http://wikitravel.org/en/West_Malaysia

Gazol, A. & Ibanez, R. (2009). Variation of plant diversity in a temperate unmanaged forest in northern Spain: behind the environmental and spatial explanation. *Plant ecology.* http://dx.doi.org/10.1007/s11258-9649-5.

IUCN red list of threatened species. (2010). [Online] Available: http://www.iucnredlist.org/apps/redlist/search.

Keng, H. (1978). *Orders and families of Malayan seed plants*. 2nd Edition.Singapore University Press.

Kitamura, S., Suzuki, S., Yumoto, T., Chuailua, T., Plongmai, K., Poonswad, P., Noma, N., Maruhashi, T., Suckasam, C. (2005). A botanical inventory of a tropical seasonal forest in Khao Yai National Park, Thailand: implications for fruit–frutivore interactions. *Biodiversity and Conservation,* 14, 1241–1262. http://dx.doi.org/10.1007/s10531-004-7848-x

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

Mori, S.A., Boom, B.M., de Carvalino, A.M. & Dos Santos, T.S. (1983). Ecological importance of Myrtaceae in an Eastern Brazilian wet forest. *Biotropica,*15, 68-70. http://dx.doi.org/10.2307/2388002

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

Narayanan, I.V. & Swarupanandan, K. (1996). Regeneration dynamic and sylvigenesis in the moist deciduous forests of southwest India. *New Forest,* 11, 185-205.

Neshim, I., Halvorsen, R., Nordal, I. (2009). Plant composition in the Maya Biosphere Reserve: natural and anthrogenic influences. *Plant Ecology.* http://dx.doi.org/10.1007/s 11258

Newbery, D., Campbel, E.J.F., Lee, Y.F., Ridsdale, C.E., Still M.J. (1992). Primary lowland dipterocarp forest at Danum Valley, Sabah, Malaysia: structure, relative abundance and family composition. Philosophical Transactions of the Royal Society of London Series B: *Biological Science,* 335, 341–356. http://dx.doi.org/10.1098/rstb.1992.0026

Ng, F.S.P. (1989). Tree Flora of Malaya.Volume 3&4.*Malaya Forest Records, 26*. Forest Department, West Malaysia.

Ng, F.S.P. (1991). Trees of Peninsular Malaysia.The state of nature conservation in Malaysia. *Malayan. Nat. Soc.,* 67-70.

Ng, P.K.L., Ho, H.C., Davison, G.W.H. (2008).*The Singapore red data book: Threatened plants and animals of Singapore*. NHBS Environment Bookstore.

Nizam Khan, N.K. & Zakaria, M.Y. (2005). Forest resources trend and sustainable forest management in Peninsular Malaysia, In M.A. Abdul Rashid (Eds.).*Forest management in Malaysia* (pp. 229-241). Forestry Department Peninsular Malaysia, Kuala Lumpur.

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. http://dx.doi.org/10.1016/S0378-1127(02)00137-8

Pandy, S.K., Shukla, R.P. (2003). Plant diversity in managed sal (*Shorea robusta*) forest of Gorakhpur, India: Species composition, regeneration and conservation. *Biodiversity and conservation,* 12, 2295-2319. http://dx.doi.org/10.1023/A:1024589230554

Procter, J., Anderson, J.M., Chai, P. & Vallack, H.W. (1983). Ecological studies in four contrasting lowland rain forests in Gunung Mulu National Park, Sarawak. I. Forest environment, structure and floristics. *Journal of Ecology,*71, 237–260. http://dx.doi.org/10.2307/2259975

Ramos, J., Amo, S. (1992). Enrichment planting in a tropical secondary forest in Veracruz, Mexico. *Forest Ecology and Management*, 54, 289-304. http://dx.doi.org/10.1016/0378-1127(92)90018-5

Ridley, H.N. (1922-1925). *The flora of the Malay Peninsula.* Volume 1-5. L. Reeve & Co., Ltd. London.

Rozas, V. (2006). Structural heterogeneity and tree spatial patterns in an old-growth deciduous lowland forest in Cantabria, northern Spain. *Plant Ecology*, 185, 57–72. http://dx.doi.org/10.1007/s11258-005-9084-1

Saiful, I., Faridah-Hanum, I., Kamaruzaman, J. (2008). Floristic diversity, composition and richness in relation to topography of a hill dipterocarp forest in Malaysia. Paper presented in: 3th IASME/WSBAS *Int. Conf. on Energy & Environment*, 23-25. Feb University of Cambridge, UK.

Saw, L.G., Chua, L.S.L. and Abdul Rahim, N. (2009). *Malaysian national strategy for plant conservation*. Ministry of Natural Resources and Environment and Forest Research Institute Malaysia.

Saw, L.G., Chung, C.K. (2005). Towards the flora of Malay. In M.A. Abdul Rashid (Eds.). *Forest Management in Malaysia* (pp. 211-224). Forestry Department Peninsular Malaysia, Kuala Lumpur.

Seng, H.W., Ratnamb, W., Noor, S.M., Clyde, M.M. (2004). The effects of the timing and method of logging on forest structure in Peninsular Malaysia. *Forest Ecology and Management,* 203, 209–228. http://dx.doi.org/10.1016/j.foreco.2004.07.050

Swaine, M.D., Lieberman, D. & Putz, F.E. (1987). The dynamic of tree population in tropical forest *Journal of Tropical Ecology,* 3, 359-366. http://dx.doi.org/10.1017/S0266467400002339

Swamy, P.S., Sundarapandian, S.M., Chandrasekar, P., Chandrasekaran, S. (2000). Plant species diversity and tree population structure of a humid tropical forest in Tamil Nadu, India. *Biodiversity and Conservation*, 9, 1643-1669. http://dx.doi.org/10.1023/A:1026511812878

Symington, C.F. (2004). *Malaysian forest record, No 16, Forester manual of diptrocarps*. Syonan-Hakubutukan.

Tuomisto, H., Ruokolainen, K., Kalliola, R., Linna, A., Danjoy, W., Rodriguez, Z. (1995). Dissecting Amazonian biodiversity. *Science,* 269, 63-66. 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. (2001). The *ecology of trees in the tropical rain forest*. Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511542206

Watson, J.G. (1928). *Malayan plant names*. Deputy Conservation of fores, Federated Malay States.

Whitmore, T.C. (1972). Tree flora of Malaya.Volume 1&2.*Malayan Forest records, 26*. Forest Department, West Malaysia.

Whitmore, T.C. & Sayer, J.A. (1992). *Tropical deforestation and species extinction*.Chapman & Hall.

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

Species	Family	RDE(%)	RDI(%)	RF(%)	IVI
Vatica perakensis King	Dipterocarpaceae	37.49	262.60	0.37	300.46
Xanthophyllum affine Korthalsia	Polygalaceae	22.69	152.80	1.84	177.33
Vatica maingayi Dyer	Dipterocarpaceae	20.96	144.05	0.72	165.73
Fordia unifoliata (Prain) Dasuki & Schot	Fabaceae	16.39	119.21	0.77	136.37
Diospyros buxifolia(Blume) Hiern	Ebenaceae	12.46	89.49	0.20	102.15
Shorea lumutensis Symington	Dipterocarpaceae	11.20	78.08	1.24	90.52
Girroniera parvifolia Planch.	Ulmaceae	9.65	69.97	0.12	79.74
Memecylon oligoneurum Blume	Melastomataceae	9.95	68.99	0.60	79.54
Swintonia floribunda Griff	Anacardiaceae	9.82	64.44	2.81	77.07
*Syzygium linoceroides*King	Myrtaceae	9.14	64.81	1.73	75.68
Vatica pauciflora (Korth.) Blume	Dipterocarpaceae	9.70	64.98	0.78	75.46
Palaquium rostratum (Miq.) Burck	Sapotaceae	8.52	61.65	3.16	73.33
Eurycoma longifolia Jack	Simarubaceae	9.28	63.61	0.09	72.98
Shorea curtisii Dyer ex King	Dipterocarpaceae	7.38	50.59	7.81	65.78
Xanthophyllum flavescens Roxb.	Polygalaceae	7.50	57.81	0.20	65.51
Mesua daphnifolia (Ridl.) Kosterm	Guttiferae	8.62	55.15	65.16	90.52
Calophyllum wallichianum Planch. & Triana	Guttiferae	7.60	53.15	2.33	63.08
Schoutenia accrescens (Mast.) Curtis	Tiliaceae	7.75	52.14	1.73	61.62
Syzygium filiforme (Wall. ex Duthie)	Myrtaceae	6.62	46.24	6.61	59.47
Xanthophyllum griffithii Hook.f.	Polygalaceae	6.32	51.38	0.38	58.08

RDE: Relative density, RDI: Relative diversity, RF: Relative frequency

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

Species	Family	RDE(%).	RDI(%).	RF(%)	IVI
Bhesa robusta(Roxb.) Ding Hou	Celastraceae	0.13	0.77	0.01	1.3
*Canarium patentinervium*Miq.	Burseraceae	0.13	0.77	0.01	0.91
Glochidion perakense(Müll.Arg.) Airy Shaw	Euphorbiaceae	0.13	0.77	0.01	0.91
Toona sureni (Blume) Merr.	Meliaceae	0.13	0.77	0.01	0.91
Endospermum diadenum (Miq.) Airy Shaw	Euphorbiaceae	0.13	0.77	0.02	0.92
Alseodaphne sp.	Lauraceae	0.13	0.77	0.02	0.92
*Hymenocardia punctata Wa*ll. ex Lindl.	Euphorbiaceae	0.13	0.77	0.03	0.93
*Fordia pauciflora*Dunn	Fabaceae	0.13	0.77	0.03	0.93
Elaeocarpus rugosus Roxb.	Elaeocarpaceae	0.13	0.77	0.05	0.95
*Macaranga hullettii*King ex Hook.f.	Euphorbiaceae	0.13	0.77	0.05	0.95
Callicarpa maingayi King & Gamble	Verbenaceae	0.13	0.77	0.14	1.04
Engelhardtia serrata Blume	Juglandaceae	0.12	1.00	0.01	1.13
Horsfieldia sp.	Myristicaceae	0.12	1.00	0.01	1.13
Adenanthera malayana Kosterm.	Fabaceae	0.12	1.00	0.02	1.14
Arthrophyllum diversifolium Blume	Araliaceae	0.12	1.00	0.06	1.18
Dillenia indica L.	Dilleniaceae	0.14	1.06	0.02	1.22
Hopea latifolia Symington	Dipterocarpaceae	0.14	1.06	0.03	1.23
Psychotria griffithii Hook.f.	Rubiaceae	0.14	1.06	0.03	1.23
*Santiria apiculata*Benn.	Burseraceae	0.12	1.00	0.12	1.23
Connarus semidecandrus Jack	Connaraceae	0.14	1.06	0.05	1.24
Croton erythrostachys Hook.f.	Euphorbiaceae	0.14	1.06	0.10	1.25

 ISSN 1916-9752 E-ISSN 1916-9760

Table 3. Important families according to decreasing order of FIV of five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Family	Relative diversity (%)	Relative density (%)	Relative dominance (%)	FIV
Dipterocarpaceae	255.59	42.47	208.34	506.4
Polygalaceae	28.17	24.8	48.28	101.25
Guttiferae	38.41	27.15	34.68	100.24
Myrtaceae	33.55	24.62	40.89	99.06
Euphorbiaceae	44.9	19.6	11.88	76.38
Ebenaceae	26.84	29.25	16.73	72.82
Sapotaceae	21	20.83	25.28	67.11
Myristicaceae	19.63	15.26	10.26	45.15
Flacourtiaceae	19.9	11.22	10.49	41.61
Rubiaceae	23.18	11.7	4.1	38.98
Tiliaceae	10.09	10.43	17.51	38.03
Lauraceae	22.25	8.3	6.6	37.15
Melastomataceae	14.24	15.82	5.48	35.54
Anacardiaceae	7.2	9.97	16.69	33.86
Meliaceae	18.03	5.7	6.13	29.86
Burseraceae	16.65	5.36	5.29	27.3
Fabaceae	8.96	8.76	9.44	27.16
Ulmaceae	11.6	9.7	3	24.3
Annonaceae	7.2	4.68	1.08	12.96
Simarubaceae	5.35	6.36	1.24	12.95
Sapindaceae	7.73	2.29	0.44	10.46
Elaeocarpaceae	6.12	1.42	1.98	9.52
Urticaceae	4.06	1.39	4.04	9.49
Moraceae	3.95	1.84	3.36	9.15
Violaceae	4.27	3.43	0.48	8.18
Anisophylleaceae	5.68	1.76	0.7	8.14
Oxalidaceae	1.85	3.54	1.52	6.91
Lecythidaceae	4.27	2.25	0.26	6.78
Verbenaceae	4.47	1.07	0.18	5.72
Fagaceae	2.32	0.36	0.66	3.34
Boraginaceae	1.76	0.9	0.24	2.9
Celastraceae	2.1	0.3	0.3	2.7
Rhizophoraceae	1.85	0.27	0.16	2.28
Sterculiaceae	1.85	0.27	0.07	2.19
Ochnaceae	1.76	0.25	0.06	2.07
Boraginaceae	0.77	0.78	0.4	1.95
Hydrocharitaceae	0.78	0.65	0.47	1.9
Passifloraceae	1.07	0.42	0.1	1.59
Myrsinaceae	0.78	0.65	0.15	1.58
Fagaceae	0.99	0.12	0.4	1.51
Annonaceae	1.18	0.23	0.09	1.5
Ixonanthaceae	0.99	0.11	0.34	1.44
Connaraceae	1.08	0.14	0.05	1.27
Dilleniaceae	1.08	0.14	0.02	1.24
Olacaceae	0.78	0.39	0.05	1.21
Araliaceae	0.99	0.12	0.06	1.17
Juglandaceae	0.99	0.12	0.01	1.12

Table 4. Tree basal area for 20 species according increasing order of Basal area in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Family	Species	Basal area (m^2ha^{-1})
Polygalaceae	*Xanthophyllum flavescens*	0.31
Myrtaceae	*Syzygium linoceroides*	0.33
Sapotaceae	*Pouteria malaccensis*	0.34
Myrtaceae	*Syzygium acuminatissimum*	0.35
Fabaceae	*Fordia unifoliata*	0.35
Sapotaceae	*Palaquium rostratum*	0.35
Tiliaceae	*Pentace macrophylla*	0.363
Guttiferaee	*Mesua grandis* .	0.39
Guttiferae	*Calophyllum wallichianum*	0.48
Dipterocarpaceae	*Shorea collina*	0.54
Anacardiaceae	*Swintonia floribunda Var. floribunda*	0.64
Myrtaceae	*Syzygium filiforme*	0.65
Dipterocarpaceae	*Dipterocarpus grandiflorus Blanc.*	0.66
Dipterocarpaceae	*Vatica lowii*	0.73
Dipterocarpaceae	*Vatica micrantha*	0.88
Dipterocarpaceae	*Vatica perakensis*	0.95
Dipterocarpaceae	*Vatica maingayi*	1.06
Polygalaceae	*Xanthophyllum affine*	1.26
Dipterocarpaceae	*Shorea curtisii*	2.00
Dipterocarpaceae	*Shorea lumutensis*	2.33

Table 5. Summary of the floristic composition of five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Plots	Family No.	Species No.	Individual No.	Mean DBH
1	37	130	766	118.6
2	31	101	841	135.03
3	27	75	411	115.12
4	26	85	595	127.19
5	31	93	706	154.81

 ISSN 1916-9752 E-ISSN 1916-9760

Table 6. Tree basal area for 20 families according to increasing order Sungai Pinang Permanent ForestReserve in Pulau Pangkor

Family	Basal area (m^2/h)
Urticaceae	0.17
Moraceae	0.19
Meliaceae	0.2
Rubiaceae	0.23
Melastomataceae	0.22
Burseraceae	0.23
Lauraceae	0.3
Myristicaceae	0.31
Fagaceae	0.41
Flacourtiaceae	0.42
Euphorbiaceae	0.49
Ebenaceae	0.66
Tiliaceae	0.66
Anacardiaceae	0.69
Sapotaceae	1.31
Myrtaceae	1.59
Guttiferae	1.61
Polygalaceae	2
Dipterocarpaceae	10.6

Table 7. Comparison of species richness and basal area in five 1-ha inventory plots, Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Site	Area(ha)	Species	Mean DBH(cm)	basal area (m^2/ha^{-1})	Density	References
Danum Valley	4.0	247	9.6	26.4	NA	Newbery *et al.* (1992)
Mulu	1.0	214	10	57.0	NA	Procter *et al.* (1983)
Pasoh	50.0	814	10	34	6418	Okuda *et al.* (2003)
Tranum	5.0	446	9.67	NA	NA	Faridah-Hanum *et al*. (2007)
Ayer Hitam	5.0	319	NA	NA	6621	Faridah-Hanum *et al*. (2008)
Langkawi	1.0	120	NA	30.39	3414	Abdul Hayat *et al*. (2010)
Ulu Sedili	4.5	NA	NA	39.23	3578	Seng *et al.* (2004)
Pulau Pangkor	5.0	211	11.89	28.17	3319	(This study)

Table 8. The distribution of some species on different parts of the hill in study area

Ridge	Slope	Valley	All over
Calophyllum Sp.	*Vatica mingayii*	*Streblus elongates*	*Eurycoma longifolia*
Dipterocarpus Sp.	*Barringtonia pendula*	*Barringtonia pendula*	*Sizygium Sp.*
Hopea Sp.	*Vatica hulletti*	*Sandoricum koetjape*	*Pouteria malaccensis*
Sarcotheca griffithii	*Payena dasyphylla*	*Aporusa nervosa*	*Fordia unifoliata*
Sarcotheca griffithii	*Hopea Sp.*	*Rhodamnia cinerea*	*Fordia unifoliata*
Shorea collina	*Vatica perakensis*	*Dialium Sp.*	*Diospyros Sp.*
Shorea curtisii	*Agrostistachys longifolia*	*Cordia dichotoma*	*Taijsmanniodendron criaceum*
Shorea foxworthyi	*Polyalthia gluca*	*Artocarpus lanceifolius*	
Swintonia floribunda	*Shorea lumutensis*	*Vatica pauciflora*	
Swintonia spicifera	*Shorea collina*	*Brackenridgea hookeri*	
Vatica hulletti	*Cleistanthus Sp.*		
Vatica mingayii	*Sandoricum koetjape*		
Vatica perakensis	*Xanthophyllum sp.*		
Xanthophyllum sp.	*Dipterocarpus Sp.*		
	Sarcotheca griffithii		
	Aporusa Sp.		
	Calophyllum wallichianum		
	Girroniera Sp.		

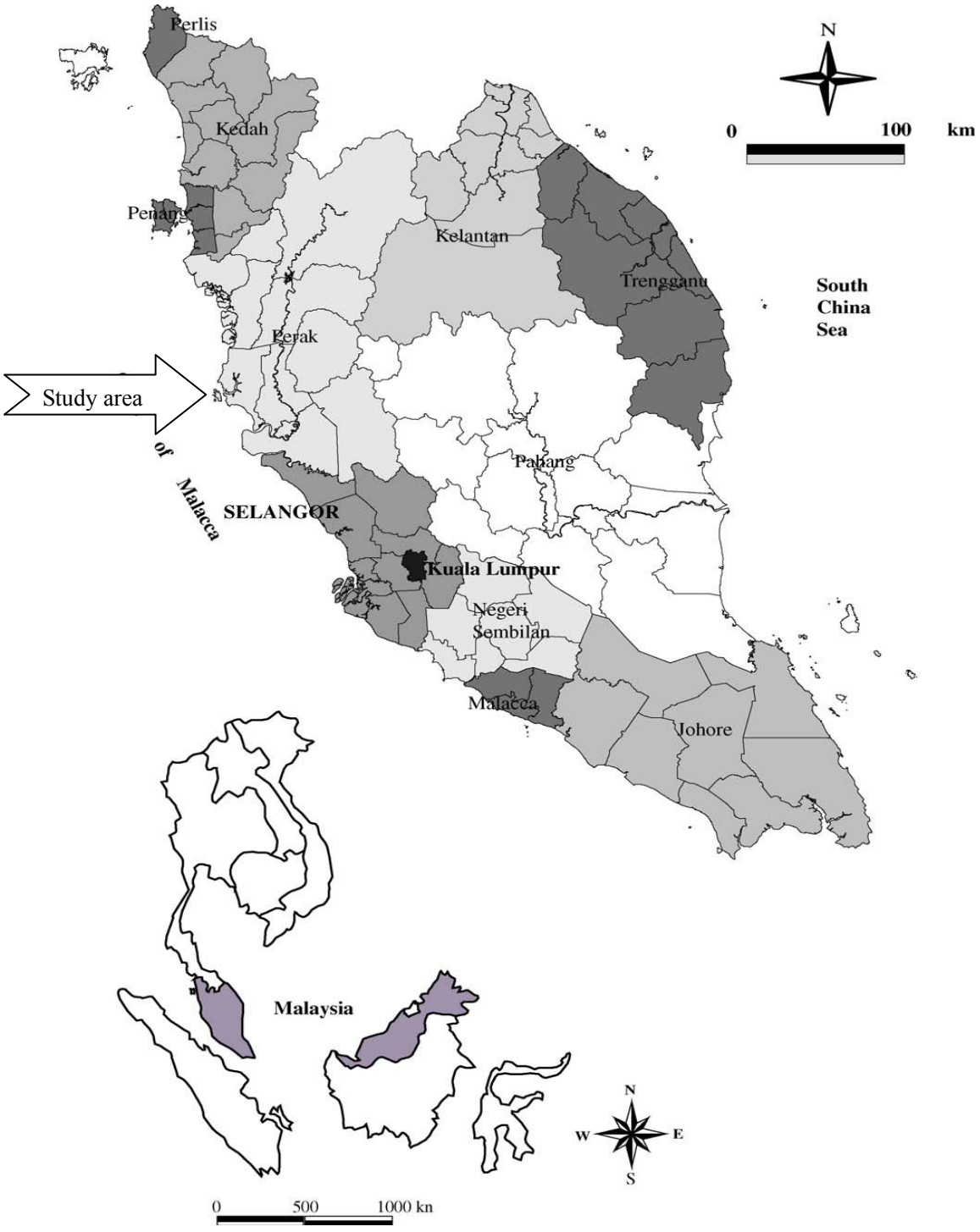

Figure 1. Map of Study area in Peninsular Malaysia

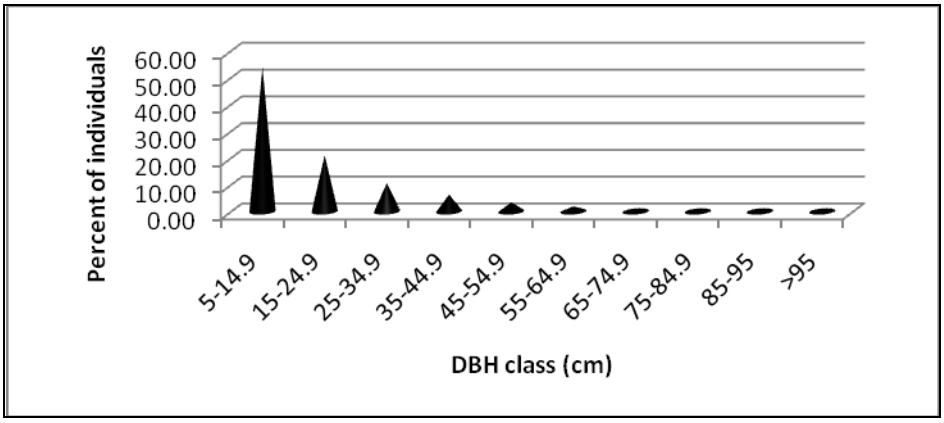

Figure 2. Diameter class distribution for trees dbh≥5 cm in five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

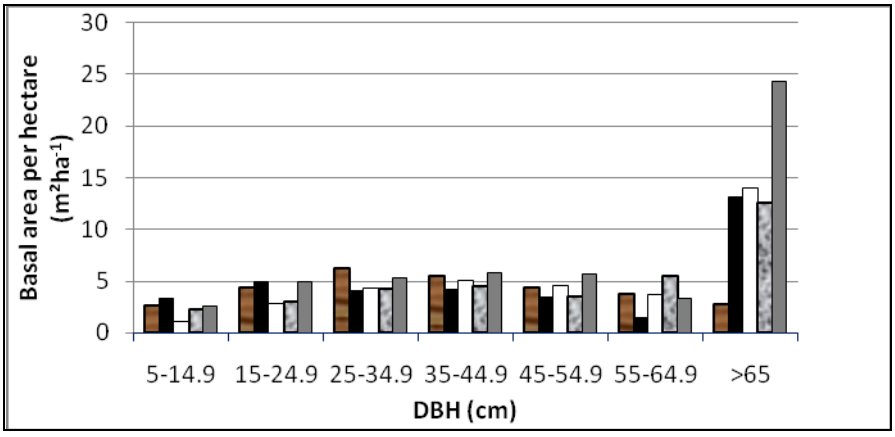

Figure 3. Distribution of basal area (m^2ha^{-1}) by dbh classes for trees≥5cm in five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

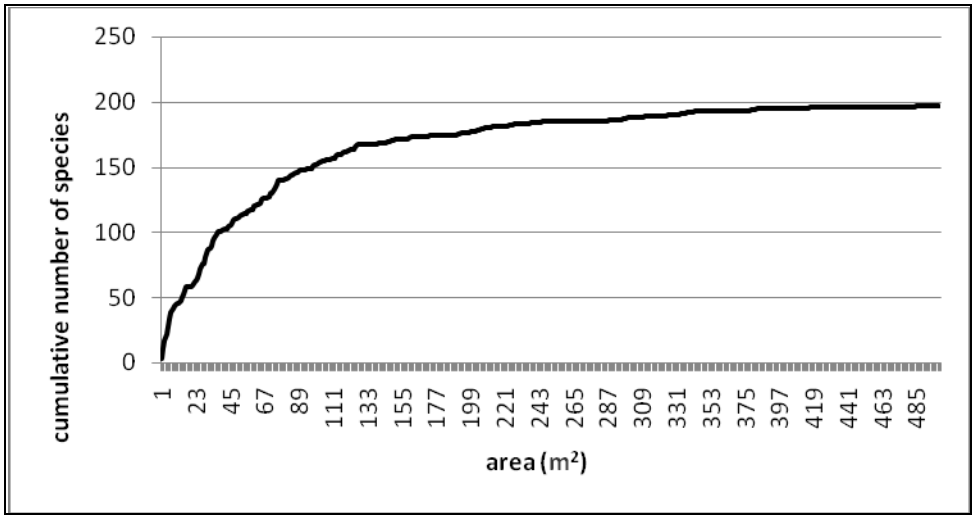

Figure 4. Species accumulative curve based on a cumulative species count in 10×10 m quadrats of a five 1-ha plots in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Appendix 1. Total list of tree species ≥5 cm dbh in five 1-ha plots, Sungai Pinang Permanent Forest Reserve in Pulau Pangkor

Species	**Family**	**Conservation**	**Endemic Sp.**	**Status**
Adenanthera malayana Kosterm.	Fabaceae		V	
Adenia penangiana (Wall. ex G. Don) W.J. de Wilde	Passifloraceae			
Aglaia argentea Blume	Meliaceae		LR	
Aglaia leptantha Miq.	Meliaceae		LR	
Aglaia leucophylla King	Meliaceae			
Agrostistachys longifolia (Wight) Benth. var. *longifolia*	Euphorbiaceae			
Aidia densiflora (Wall.) Masam	Rubiaceae			
Allophylus cobbe (L.)Raeusch.	Sapindaceae			
Alseodaphne sp.	Lauraceae			Endemic
Anisophyllea grandis (Benth.) Burkilltisii King	Anisophylleaceae		V	Endemic
Anisophyllea scortechinii King	Anisophylleaceae			
Anisoptera costata Korth.	Dipterocarpaceae		EN	
Aporusa benthamiana Hook.f.	Euphorbiaceae			
Aporusa nervosa Hook.f.	Euphorbiaceae			Endemic
Ardisia lanceolata Roxb.	Myrsinaceae			
Arthrophyllum diversifolium Blume	Araliaceae			
Artocarpus lanceifolius Roxb.	Urticaceae			
Barringtonia pendula (Griff.)Kurz	Lecythidaceae			
Bhesa robusta (Roxb.) Ding Hou	Celastraceae		LR	
Botryophora geniculata (Miq.) Beumée ex Airy Shaw	Euphorbiaceae			
Bouea oppositifolia (Roxb.) Meisn	Anacardiaceae			
Brackenridgea hookeri (Planch.) A. Gray	Ochnaceae		LR	
Callicarpa maingayi King & Gamble	Verbenaceae		LR	Endemic
Calophyllum ferrugineum Ridl.	Guttiferae			Endemic
Calophyllum wallichianum Planch. & Triana	Guttiferae			Endemic
Canarium littorale Blume	Burseraceae		CE	
Canarium patentinervium Miq.	Burseraceae		LR	
Canarium pilosum Benn.	Burseraceae			
Casearia clarkei King	Flacourtiaceae			Endemic
Casearia latifolia Ridl.	Flacourtiaceae			
Casearia velutinosa Ridl.	Flacourtiaceae			
Chisocheton pauciflorus King	Meliaceae		V	Endemic
Cinnamomum iners Reinw	Lauraceae			
Cleistanthus glaucus Jabl.	Euphorbiaceae		V	
Cleistanthus hirsutulus Hook.f.	Euphorbiaceae			
Cleistanthus macrophyllus Hook.f.	Euphorbiaceae			
Cleistanthus podocarpus Hook.f.	Euphorbiaceae			Endemic
Connarus semidecandrus Jack	Connaraceae			
Cordia dichotoma G. Forst.	Boraginaceae			
Croton erythrostachys Hook.f.	Euphorbiaceae			Endemic
Dacryodes laxa (Benn.) H.J. Lam	Burseraceae		LR	
Dacryodes longifolia (King) H.J. Lam	Burseraceae			Endemic
Dalbergia parviflora Roxb.	Fabaceae			

 ISSN 1916-9752 E-ISSN 1916-9760

Dehaasia cuneata (Blume) Blume	Lauraceae		
Dehaasia polyneura (Miq.) Kosterm	Lauraceae		
Dialium platysepalum Baker	Fabaceae		
Dillenia indica L.	Dilleniaceae		
*Diospyros buxifolia (*Blume) Hiern	Ebenaceae	CE	
Diospyros diepenhorstii Miq	Ebenaceae		
Diospyros kurzii Hiern	Ebenaceae		
Diospyros pendula Hasselt ex Hassk.	Ebenaceae		
Diospyros pilosanthera Blanco(Wall. ex G. Don)	Ebenaceae		
Diospyros rufa King & Gamble	Ebenaceae	LR	Endemic
Diplospora malaccensis Hook.f.	Rubiaceae	CE	
Dipterocarpus baudii Korth.	Dipterocarpaceae	CE	
Dipterocarpus costalatus	Dipterocarpaceae	CE	
Dipterocarpus grandiflorus Blanc.	Dipterocarpaceae	CE	
Drypetes pendula Ridl.	Euphorbiaceae		
Dysoxylum arborescens (Blume) Miq.	Meliaceae		
Dysoxylum rigidum (Ridl.) Mabb.	Meliaceae		
Elaeocarpus rugosus Roxb.	Elaeocarpaceae	V	
Elaeocarpus stipularis Blume	Elaeocarpaceae		
Elateriospermum tapos Blume	Euphorbiaceae		
Endospermum diadenum (Miq.) Airy Shaw	Euphorbiaceae		
Engelhardtia serrata Blume	Juglandaceae		
Enhalus acoroides (L.f.) Royle	Hydrocharitaceae		
Eugenia sp.9	Myrtaceae		
Eurycoma longifolia Jack	Simarubaceae	CE	
Ficus vasculosa Wall. ex Miq.	Moraceae		
Flacourtia rukam Zoll. & Moritzi	Flacourtiaceae		
Fordia pauciflora Dunn	Fabaceae	V	
Fordia unifoliata (Prain) Dasuki & Schot	Fabaceae		
Garcinia atroviridis Griff. ex T. Anderson	Guttiferae	CE	
Garcinia griffithii T. Anderson	Guttiferae		
Garcinia nigrolineata Planch. ex T. Anderson	Guttiferae		
Garcinia parvifolia (Miq.) Miq.	Guttiferae		
Garcinia scortechinii King	Guttiferae	LR	
Gardenia tubifera Wall.	Rubiaceae		
Girroniera parvifolia Planch.	Ulmaceae		
Girroniera subaequalis Planch.	Ulmaceae		
Glochidion perakense (Müll.Arg.) Airy Shaw	Euphorbiaceae		
Hopea anomala (King) Foxw.	Dipterocarpaceae		
Hopea beccariana Burck	Dipterocarpaceae	CE	
Hopea dryobalanoides Miq.	Dipterocarpaceae		
Hopea dyeri F. Heim	Dipterocarpaceae		
Hopea latifolia Symington	Dipterocarpaceae	CE	
Horsfieldia sp.	Myristicaceae		
Hydnocarpus curtisii King	Flacourtiaceae		
Hymenocardia punctata Wall. ex Lindl.	Euphorbiaceae		

Ixonanthes reticulata Jack	Ixonanthaceae		
Ixora grandifolia Zoll. & Moritzi	Rubiaceae		
Ixora umbellata Koord. & Valeton	Rubiaceae		
Knema furfuracea (Hook.f. & Thomson) Warb.	Myristicaceae	LR	
Knema hookeriana (Wall. ex Hook.f. & Thomson)	Myristicaceae	V	
Lasianthus cyanocarpus Jack	Rubiaceae		
Lasianthus densifolius Miq.	Rubiaceae		
Lepisanthes senegalensis (Poir.) Leenh.	Sapindaceae		
Lepisanthes tetraphylla (Vahl) Radlk.	Sapindaceae		
Lithocarpus cantleyanus (King ex Hook.f.) Rehder	Fagaceae		
Lijndenia laurina Zoll. & Moritzi	Melastomataceae		
Litsea myristicifolia (Wall. ex Nees) Hook.f.	Lauraceae		
Litsea nidularis Gamble	Lauraceae		
Litsea umbellata (Lour.) Merr	Lauraceae		
Lophopetalum floribundum Wight	Celastraceae		
Macaranga hullettii King ex Hook.f.	Euphorbiaceae		
Mallotus penangensis Müll.Arg.	Euphorbiaceae		Endemic
Mallotus subpeltatus (Blume) Müll.Arg.	Euphorbiaceae		
Memecylon dichotomum (C.B. Clarke) King	Melastomataceae		
Memecylon minutiflorum Miq.	Melastomataceae		
Mesua daphnifolia (Ridl.) Kosterm.	Guttiferae	LR	Endemic
Mesua ferrea L.	Guttiferae		Endemic
Mesua grandis (King) Kosterm.	Guttiferae		
Myristica cinnamomea King	Myristicaceae	LR	
Myristica maxima Warb.	Myristicaceae	LR	
Nauclea officinalis (Pierre ex Pit.) Merr. & Chun	Rubiaceae		
Palaquium gutta (Hook.f.) Baill	Sapotaceae		
Palaquium rostratum (Miq.) Burck	Sapotaceae		
Payena dasyphylla (Miq.) Pierre	Sapotaceae		
Pellacalyx ssaccardianus Scort.	Rhizophoraceae	LR	Endemic
Pentace macrophylla King	Tiliaceae		
Pentace strychnoidea King	Tiliaceae	LR	Endemic
Persea declinata (Blume) Kosterm.	Lauraceae		
Polyalthia glauca (Hassk.) F. Muell	Annonaceae		
Polyalthia hypoleuca Hook.f. & Thomson	Annonaceae		
Pouteria maingayi (C.B. Clarke) Baehni	Sapotaceae		
Pouteria malaccensis (C.B. Clarke) Baehni	Sapotaceae		
Pseudoclausena chrysogyne (Miq.) T.P. Clark	Meliaceae		
Psychotria griffithii Hook.f.	Rubiaceae		Endemic
Psydrax maingayi (Hook.f.) Bridson	Rubiaceae		Endemic
Pternandra coerulescens Jack	Melastomataceae		
Ptychopyxis caput-medusae (Hook.f.) Ridl.	Euphorbiaceae		Endemic
Pyramidanthe prismatica (Hook.f. & Thomson)	Annonaceae		
Rhodamnia cinerea Ridl.	Myrtaceae		
Rinorea anguifera (Lour.) Kuntze	Violaceae		
Ryparosa kunstleri King	Flacourtiaceae		

 ISSN 1916-9752 E-ISSN 1916-9760

Sandoricum koetjape (Burm.f.) Merr	Meliaceae		
Santiria apiculata Benn.	Burseraceae	LR	
Sarcotheca griffithii (Planch. ex Hook.f.) Hallier f.	Oxalidaceae		
Schoutenia accrescens (Mast.) Curtis	Tiliaceae		
Shorea collina Ridl.	Dipterocarpaceae		
Shorea curtisii Dyer ex King	Dipterocarpaceae	LR	
Shorea glauca King	Dipterocarpaceae	EN	
Shorea lumutensis Symington	Dipterocarpaceae	CE	Endemic
Shorea maxwelliana King	Dipterocarpaceae	EN	
Sterculia cuspidata R.Br.	Sterculiaceae		
Streblus elongatus (Miq.) Corner.	Moraceae		
Streblus ilicifolius (Vidal) Corner	Moraceae		
Strombosia ceylanica Gardn.	Olacaceae		
Swintonia floribunda Var. *floribunda* Griff.	Anacardiaceae		
Swintonia spicifera Hook.f.	Anacardiaceae	LR	Endemic
Syzygium acuminatissimum (Blume) DC.	Myrtaceae		
Syzygium linoceroides (King) I.M. Turner	Myrtaceae		
Syzygium linoceroides (King) I.M. Turner.	Myrtaceae		Endemic
Syzygium claviflorum (Roxb.) Wall. *ex* A.M. Cowan	Myrtaceae		
Teijsmanniodendron coriaceum (C.B. Clarke) Kosterm.	Verbenaceae		
Toona sureni (Blume) Merr.	Meliaceae		
Tristaniopsis merguensis (Griff.) Peter G. Wilson & J.T.	Myrtaceae		
Urophyllum blumeanum (Wight) Hook.f.	Rubiaceae		
Urophyllum leucophloem Ridl.	Rubiaceae		Endemic
Urophyllum villosum Wall.	Rubiaceae		
Vatica havilandii Brandis	Dipterocarpaceae	CE	
Vatica lowii King	Dipterocarpaceae	EN	
Vatica maingayi Dyer	Dipterocarpaceae	CE	
Vatica pauciflora (Korth.) Blume	Dipterocarpaceae	EN	
Vatica perakensis King	Dipterocarpaceae	EN	
Walsura pinnata Hassk	Meliaceae		
Xanthophyllum affine Korthalsia	Polygalaceae		
Xanthophyllum amoenum Chodat	Polygalaceae		
Xanthophyllum eurhynchum Miq.	Polygalaceae		
Xanthophyllum flavescens Roxb.	Polygalaceae		
Xanthophyllum griffithii Hook.f. ex A.W. Benn	Polygalaceae		
Xanthophyllum wrayi King	Polygalaceae		
Xerospermum noronhianum (Blume) Blume	Sapindaceae		

CE: Critical endangered, LR: Lower risk, EN: Endangered, V: Vulnerable