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Floristic Composition and Stand Structure of Wild Fruit Trees in a Lowland Dipterocarp Forest at Bangi Forest Reserve, Selangor, Peninsular Malaysia

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ABSTRACT

Bangi Forest Reserve, a thrice-logged lowland dipterocarp forest is one of the remaining fragmented forests in Langat Basin, Selangor. A descriptive study on floristic composition and stand structure of wild fruit trees had been conducted in this forest reserve. A total of 241 stands represented by 38 species from 21 genera and 15 families was characterized as having edible fruits are recorded in 0.5 ha plot. Both, Euphorbiaceae and Sapindaceae were recorded as the most speciose family number with six species each. *Baccaurea* was recorded to have the highest species number (6 species) and the highest total number of individuals (38 stands). *Castanopsis schefferiana* was recorded as a species with the highest number of individuals (36 stands). Only 20 % (48 stems from 19 species) comprised the adult wild fruit trees in this forest reserve. The species composition of wild fruit trees of this forest can be considered as moderate but has low stand density, the same condition as other primary lowland dipterocarp forest in Peninsular Malaysia.

1. Introduction

Lowland dipterocarp forests are one of the most diverse ecosystems in the world, characterized by their high species richness and complex stand structures [1]. Among the various components of these forests, wild fruit trees are particularly significant due to their contribution to forest

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biodiversity, forest regeneration, food source to frugivores and food security [2]. The wild fruit trees are diverse in Malaysia rain forest with more than 100 species of native fruit trees are still growing wild [3] and not fully exploited. On the other hand, [4], estimated about 3.2 % or 90 species of trees have fruit or edible seeds from the entire 2,830 tree species in Peninsular Malaysia. From a global perspective, fruit trees have multipurpose uses which not only provide edible fruits but also for medicinal products and livestock fodder, as well as fuel wood and less commercial timber [5]. Besides, fruit trees especially the wild species are important in the forest as the forests are also important habitats and temporary refuge for wild animals such as mammals, reptiles, amphibians and birds [6]. In Malaysia, wild fruit species are important as a food resources for humans too as well as a genetic resources and small income for native and local people [7].

Additionally, the fruits of these trees play a key role in seed dispersal mechanisms, facilitating the regeneration of forest areas and maintaining the ecological integrity of these habitats [8]. Unfortunately, knowledge of wild fruit trees, especially aspects of their reproduction, phenology and species composition are still not quite known because studies of these resources are still lacking. This study was conducted to determine the composition of wild fruit trees species in the tropical rainforest was inadequate in Peninsular Malaysia because there are only a few studies on the composition of wild fruit trees have been carried out in primary lowland dipterocarp forest [9,10] and in the primary upper hill dipterocarp forest [11].

Until now there has been no research on the composition of wild fruit trees in logged-over forest because all the previous studies that just focused on primary rainforest. The floristic composition in logged-over forest is different from that of primary rainforest where the total number of species decreased [12]. Logging may have an impact on wild fruit trees either the population declined or the trees died because of logging activities directly or due to sudden environmental changes such as a huge gap formation, changes in nutrient content in the soil, among possible factors. The previous plot studies in Bangi Forest Reserve which only involved the census data for trees which are at ≥ 5 cm in diameter [12-16] have excluded those trees with smaller size (i.e < 5 cm DBH). Studies involving those trees at ≥ 1cm in diameter tree DBH as conducted by [17] and [10] gave a more comprehensive views related to the composition and structure of the population of wild fruit trees in a forest. In fact, several species of wild fruit trees in Peninsular Malaysia have attained the mature size in diameter of ≥ 1 cm DBH and there are also species that reach mature size at approximately diameter of 5 cm, 10 cm or 20 cm. Mature size of the tree species and wild fruits is classified as a size where the trees have been able to produce flowers and fruits. This information is important to know how many wild fruit trees that have reached mature size in a locality to guarantee the survival of a species and thus help to give a broad picture of the areas to be preserved for the retention of individual trees that have matured. Among the species that can reach mature size in diameter of ≥ 1 cm DBH are *Baccaurea parviflora* and *Gnetum gnemon* [10].

For the purpose of the descriptive study in the determination of composition and diversity of wild fruits tree species in Bangi Forest Reserve, a thrice-logged lowland dipterocarp forest, the census data of trees with DBH of ≥ 1cm were used. This data involved the study plots covering 0.5 ha whereby all the wild fruit trees in the plot were marked, measured and identified. The knowledge gained from this study is expected to add further information concerning the composition of wild fruit trees, especially in the logged-over forests. This information is also important in terms of conservation of species of wild fruit trees, thus helping in the management of these forests in the future. Through a detailed inventory of species and an analysis of their distribution patterns, this research contributes to a better understanding of the ecological significance of wild fruit trees and informed conservation strategies to preserve these critical forest components [18,19].

2. Methodology

2.1 Study Site

Bangi Forest Reserve, a fragmented forest in Langat Basin, Selangor is located at latitude 2° 54'-2° 56' N and longitude of 101° 45.5'-101° 48.2' and classified as a lowland dipterocarp forest at the elevation between 50-110 m above sea level [20]. This forest was disturbed thrice by logging activities, the first time during colonial era of British, the second during the World War Two by Japanese for massive planting of *Palaquium gutta* (Getah perca trees) and the third time logging was carried out in the late 1960s for the development of UKM campus [15,21]. The structure of the forest still has five strata [22] similar to primary forest and the regeneration process in still on-going to achieve the climax communities.

2.2 Trees Census, Identification and Status of Wild Fruit Trees

Data for this study were obtained from 10 study plots measuring 25 m x 20 m each in Bangi Forest Reserve (Figure 1). The census involved all wild fruit trees with DBH ≥ 1 cm and above. Voucher specimens were collected and curated for further verification in the herbarium of Universiti Kebangsaan Malaysia (UKM). Status of wild fruit trees have been determined based on reference of certain literatures [9,10,23], local flora [24-28] and detailed consultation with the experience botanists from other institution. Estimation of the mature trees size was determined based on [10,11] and further confirmation from experts. Stand structure information is divided into the juvenile and mature trees.

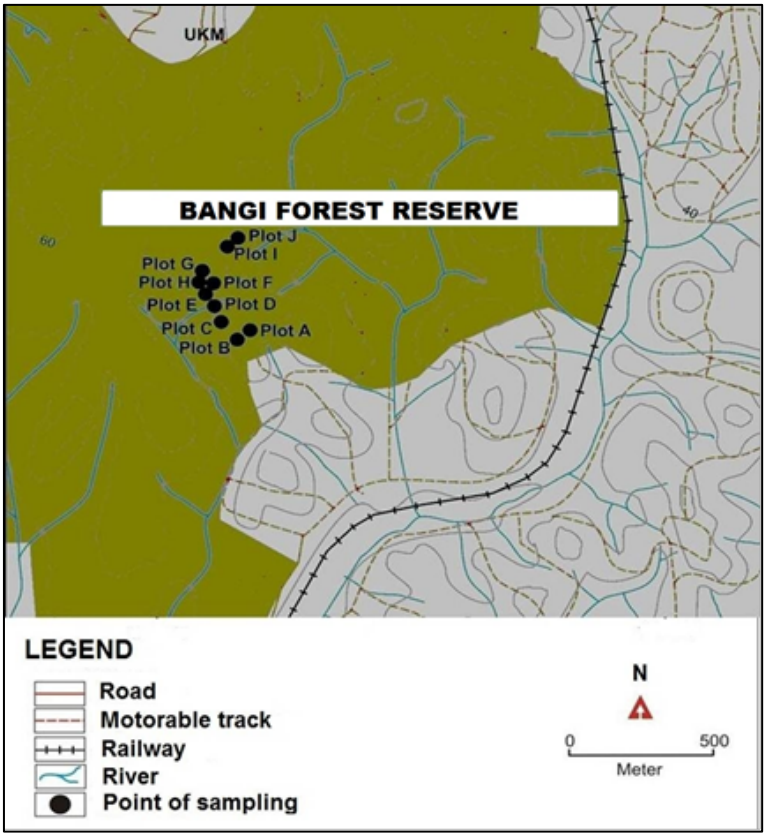

Fig. 1. Location of study plots in Bangi Forest Reserve, Selangor

3. Results and Discussion

3.1 Floristic Composition and Density

A total of 241 stands represented by 38 species of wild fruit trees in 21 genera and 15 families was recorded in the study area of 0.5 ha plot at Bangi Forest Reserve. At the family level, Euphorbiaceae and Sapindaceae had recorded the highest number of species, each with six species, followed by Moraceae with five species. In terms of density, Sapindaceae was recorded the highest individual total of 48 stands, followed by Euphorbiaceae (38 stands) and Fagaceae (36 stands). Detailed information for each family is shown in Table 1. The total number of species in this study is considered moderate compared to other studies in the primary forest of Peninsular Malaysia. For instance, a study by [11] in Temengor Forest Reserve, Perak, an upper hill dipterocarp forest has listed a total of 44 species of wild fruit trees from 25 genera and 13 families.

Table 1
Total number of genera, species and individuals for 15 families of wild fruit trees in 0.5 ha plot at Bangi Forest Reserve, Selangor

Family	Total number of genus	Total number of species	Total number of individuals
Anacardiaceae	2	2	6
Burseraceae	2	2	19
Euphorbiaceae	1	6	38
Fagaceae	1	1	36
Flacourtiaceae	1	1	1
Gnetaceae	1	1	2
Guttiferae	1	3	32
Leguminosae	2	3	8
Meliaceae	2	2	13
Moraceae	1	5	17
Oxalidaceae	1	2	6
Polygalaceae	1	1	3
Sapindaceae	3	6	48
Sterculiaceae	1	1	2
Tiliaceae	1	2	10
Total	21	38	241

At the genus level, *Baccaurea* recorded the highest total number of species (6 species) followed by *Artocarpus* (5 species) and both *Garcinia* and *Nephelium* each with 2 species (Table 2). Thirteen genera are represented by a single species each. On the other hand, in terms of density, *Baccaurea* also recorded the highest number of individuals (38 stands) followed by *Castanopsis* (36 stands), *Garcinia* (32 stands) and *Xerospermum* (30 stands). Thirteen genera were represented by less than 10 individual stands including two genera that are comprised by a single stand only. Nevertheless, in a 50 ha plot at Pasoh Forest Reserve, Negeri Sembilan, [10] found that *Garcinia* recorded the highest number of species (13 species), followed by *Mangifera* (12 species) and *Artocarpus* (10 species). Meanwhile, *Elateriospermum* showed the highest number of individuals in the study by [9] in a lowland forest at Ulu Kelantan, Kelantan which consists of 130 individuals in the 40 ha plot. In the 50 ha plot at Pasoh Forest Reserve, *Sterculia* recorded the highest individual total of 8,968 stands [10].

Table 2
Total number of species and individuals for 21 genera of wild fruit trees which recorded in 0.5 ha plot at Bangi Forest Reserve, Selangor

Genus	Family	Total number of species	Total number of individuals
Baccaurea	Euphorbiaceae	6	38
Artocarpus	Moraceae	5	17
Garcinia	Guttiferae	3	32
Nephelium	Sapindaceae	3	11
Dialium	Leguminosae	2	6
Microcos	Tiliaceae	2	10
Sarcotheca	Oxalidaceae	2	6
Xerospermum	Sapindaceae	2	30
Archidendron	Leguminosae	1	2
Bouea	Anacardiaceae	1	5
Canarium	Burseraceae	1	12
Castanopsis	Fagaceae	1	36
Flacourtia	Flacourtiaceae	1	1
Gnetum	Gnetaceae	1	2
Lansium	Meliaceae	1	6
Mangifera	Anacardiaceae	1	1
Pometia	Sapindaceae	1	7
Sandoricum	Meliaceae	1	7
Santiria	Burseraceae	1	7
Scaphium	Sterculiaceae	1	2
Xanthophyllum	Polygalaceae	1	3
Total		38	241

3.2 Stand Structure

A total of 38 species of wild fruit trees have been recorded in the 0.5 ha plot and represents about 79 % of the total of 48 species of wild fruit trees that occur in Bangi Forest Reserve (Ahmad Fitri (unpublished). Species-wise, *Castanopsis schefferiana* showed the highest total number of individuals with 36 stands. Based on the survey throughout this forest, *C. schefferiana* is among the common wild fruit trees species (personal observation). According to [29], this species is common in the lowland and hill forests of Peninsular Malaysia. The top leading density of wild fruit trees in Bangi Forest Reserve includes *Garcinia parvifolia* (27 individuals) and *Xerospermum noronhianum* (25 individuals) (Table 3). The most common speciesin Peninsular Malaysia, *Baccaurea parviflora* was on the fifth rank with 12 individuals. Previous study by [21] in Bangi Forest Reserve revealed that *Nephelium lappaceum* recorded the highest number of individuals with 10 stems in a 0.7 ha plot followed by *Baccaurea reticulata* (7 stems) and *Archidendron jiringa* (6 stems).

Previous studies in the primary forest of Peninsular Malaysia showed the different abundance of tree species. For example, *Xerospermum noronhianum* was the species that showed the highest abundance in the 50 ha plot at Pasoh Forest Reserve [17] with the total number of individuals of 8,968 stands [10]. Meanwhile, *Baccaurea parviflora* is on the third rank with 3,474 stands whilst *Sandoricum koetjape* is only represented by 125 individuals. A study conducted by Ahmad Fitri et al. (2017) at Temengor Forest Reserve, Perak found that the monotypic species, *Elateriospermum tapos* was recorded as the largest with a total of 121 individual stands. Furthermore, [11] also found *Baccaurea brevipes* on the second rank with 38 stands meanwhile *X. noronhianum* is in the fifth rank with 21 individuals. Another study b [9] also reported that *E. tapos* was the most abundant species with 130 of stands in the 40 ha study plot.

Table 3
Eleven leading wild fruit trees species with the highest total number of individuals in 0.5 ha plot at Bangi Forest Reserve, Selangor

Species	Family	Total number of individuals
Castanopsis schefferiana	Fagaceae	36
Garcinia parvifolia	Guttiferae	27
Xerospermum noronhianum	Sapindaceae	25
Baccaurea minor	Euphorbiaceae	15
Baccaurea parviflora	Euphorbiaceae	12
Canarium littorale	Burseraceae	12
Artocarpus scortechinii	Moraceae	7
Microcos latifolia	Tiliaceae	7
Pometia pinnata	Sapindaceae	7
Sandoricum koetjape	Meliaceae	7
Santiria laevigata	Burseraceae	7

In this study, wild fruit trees stands are classified into three classes, viz. 1.0-9.9 cm DBH, 10.0-19.9 cm and > 20.0 cm DBH. A total of 194 individuals was represented by 35 species for the first DBH class, while for the second DBH class, recorded a total of 23 individuals representing 12 species and the third DBH class consists of 24 individuals represented by 13 species. Further information for each DBH class is shown in Table 4. Besides, the total number of individual juvenile trees and mature trees are also shown in Table 4. These data indicate that most species of wild fruit trees are represented by juvenile trees (80%) and low mature trees (20%). Nineteen species are represented only by juvenile trees, five species represented by mature trees while 14 species represented by both juvenile and mature trees. The low number of mature trees and high number of juvenile trees is related with the last logging activities about 40 years ago when the disturbance has changed the microhabitat of this forest following by slow regeneration process.

Garcinia parvifolia and *Baccaurea minor* are represented by all juvenile trees, with 27 and 15 stands, respectively. *Baccaurea parviflora* was represented by all mature trees (12 stands). [10] also reported that the number of mature trees that were lower than the overall stand of wild fruit trees in the 50 ha plot at Pasoh Forest Reserve. They found that *Baccaurea parviflora* recorded the highest number of stands of mature trees (3,474 stands) followed by *Gnetum gnemon* (580 stands). The highest number of mature tree stands of both species is probably due to both species reached mature size at 1 cm DBH.

Table 4
Total number of juvenile trees, mature trees and total number of individuals for all DBH classes of wild fruit trees in 0.5ha plot at Bangi Forest Reserve, Selangor

Family/Species	Estimation of adult-size trees (cm dbh)	Total juvenile individual	Total mature individual	DBH Classes			Total individual
				1.0 - 9.9 cm	10.0 - 19.9 cm	> 20.0 cm	
ANACARDIACEAE							
Bouea oppositifolia	10	4	1	4	0	1	5
Mangifera gracilipes	20	1	0	1	0	0	1
BURSERACEAE							
Canarium littorale	20	10	2	8	2	2	12
Santiria laevigata	20	5	2	3	2	2	7
EUPHORBIACEAE							
Baccaurea brevipes	5	6	0	6	0	0	6
Baccaurea kunstleri	10	1	0	1	0	0	1
Baccaurea maingayi	10	3	0	3	0	0	3

Baccaurea minor	10	15	0	15	0	0	15
Baccaurea parviflora	1	0	12	12	0	0	12
Baccaurea reticulata	20	1	0	1	0	0	1
FAGACEAE							
Castanopsis schefferiana	30	33	3	28	3	5	36
FLACOURTIACEAE							
Flacourtia rukam	1	0	1	1	0	0	1
GNETACEAE							
Gnetum gnemon	1	0	2	2	0	0	2
GUTTIFERAE							
Garcinia eugeniifolia	4	4	0	4	0	0	4
Garcinia griffithii	10	1	0	1	0	0	1
Garcinia parvifolia	10	27	0	27	0	0	27
LEGUMINOSAE							
Archidendron bubalinum	10	2	0	2	0	0	2
Dialium indum var. *indum*	20	1	0	1	0	0	1
Dialium platysepalum	20	4	1	2	2	1	5
MELIACEAE							
Lansium domesticum	10	6	0	6	0	0	6
Sandoricum koetjape	20	6	1	6	0	1	7
MORACEAE							
Artocarpus kemando	20	2	0	2	0	0	2
Artocarpus lowii	20	1	0	0	1	0	1
Artocarpus nitidus ssp. *griffithii*	10	0	1	0	1	0	1
Artocarpus rigidus	20	5	1	3	2	1	6
Artocarpus scortechinii	20	1	6	1	0	6	7
OXALIDACEAE							
Sarcotheca griffithii	20	0	1	0	0	1	1
Sarcotheca monophylla	10	2	3	2	2	1	5
POLYGALACEAE							
Xanthophyllum amoenum	10	3	0	3	0	0	3
SAPINDACEAE							
Nephelium cuspidatum var. *eriopetalum*	10	3	0	3	0	0	3
Nephelium hamulatum	10	4	2	4	1	1	6
Nephelium lappaceum var. *lappaceum*	10	1	1	1	1	0	2
Pometia pinnata	10	6	1	6	1	0	7
Xerospermum laevigatum	10	5	0	5	0	0	5
Xerospermum noronhianum	10	19	6	19	5	1	25
STERCULIACEAE							
Scaphium macropodum	20	2	0	2	0	0	2
TILIACEAE							
Microcos fibrocarpa	10	3	0	3	0	0	3
Microcos latifolia	10	6	1	6	0	1	7
TOTAL		193	48	194	23	24	241

4. Conclusion

Bangi Forest Reserve had recorded a moderate number of wild fruit trees species as it had been thrice-logged in the past. But in terms of density, wild fruit trees in this forest had a low number of individuals, similar as in the other primary lowland dipterocarp forest especially with respect to mature trees. Mature tree comprised one fifth of the total individuals in the study plots. The lack of mature trees could be related with the last history logging about 40 years ago.

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References

[1] Whitmore, Timothy Charles. *An introduction to tropical rain forests*. 1990. https://doi.org/10.1093/oso/9780198501480.001.0001

[2] Corlett, R. T. The role of fruit-eating birds and mammals in the regeneration of tropical forests. *Journal of Tropical Ecology* 21, no. 1 (2005): 1-15.

[3] Soepadmo, E. The role of tropical botanic gardens in the conservation of threatened valuable plant genetic resources in South East Asia. In: Soepadmo, E. & Singh, K. G. (eds.). *Proceedings of the Symposium on Biological Resources and National Development*. Kuala Lumpur: Malayan Nature Society. (1973).

[4] Hashim, M. N. Wild fruit tree species; A lesser-known and under untilised forest resource; *Prosiding Simposium Buah-buahan Kebangsaan, Serdang*. (1986).

[5] Clarke, C., Schreckenberg, K. and Haq, N.N. *Fruit Products for Profit*. Diversification Booklet Number 16. (2011). Rome: Rural Infrastructure and Agro-Industries Division Food and Agriculture Organization of the United Nations.

[6] Yan, G., Zhang, Y., Zhang, L. and Ooishi, A. Conservation of wild fruit forest ecosystem in the Tianshan Mountains of Xinjiang, China. *Bull*. *Fac*. *Agric*. *Shizuoka Uni*. No. 49 (1999):9-13.

[7] Rukayah, A. (2002). *Buah-buahan Malaysia*. Kuala Lumpur: Dewan Bahasa dan Pustaka. 283 pp.

[8] Leighton, M., and Wirawan, N. Catastrophic drought and fire in Borneo tropical rain forest associated with the 1982-1983 El Niño Southern Oscillation event. In G.T. Prance (ed.), *Tropical Rain Forests and the World Atmosphere*, Basel: Birkhäuser. pp. 75-102. 1986.

[9] Whitmore, T. C. Wild fruits trees and some horticulture and farmaceutical plants in Ulu Kelantan. *Malayan Nature Journal* 24 (1971): 222-224.

[10] Saw, L. G., La Frankie, J. V., Kochummen, K. M. and Yap, S. K. Fruit trees in a Malaysian rain forest. *Economic Botany* 45, no.1 (1991):120-136. https://doi.org/10.1007/BF02860057

[11] Ahmad Fitri, Z., Latiff, A., Nizam, M. S., Abd Rahman, K., Serafina Christine, F. and Shamsudin, I. Wild fruit trees in an upper hill dipterocarp forest at Temengor Forest Reserve, Perak, Malaysia. *The Malaysian Forester* 80, no. 2 (2017): 129-135.

[12] Elbushari, B. E. and Latiff, A. Tree diversity and floristic community similarities of logged and unlogged lowland dipterocarp forests in Langat Basin. In, Shukor, M. N., Sahibin, A. R., Shaharuddin, M. I., Nik Mohd Shah, N. M., Jalil, M. S., Razani, U. & Latiff, A. (eds.). *Gunung Nuang, Selangor. Physical Enviornment and Biological Diversity*, Kuala Lumpur: Forestry Department of Peninsular Malaysia. pp. 124-144. 2005.

[13] Norashidah, J.. Biojisim dan Komposisi Flora Hutan Simpan Bangi. B.Sc. Thesis, Botany Department, Universiti Kebangsaan Malaysia (unpublished). 1993.

[14] Gim, L.S. Komposisi, Kepelbagaian dan Biojisim Atas Tanah Spesies Pokok di Plot Kekal Satu Hektar, Hutan Simpan Kekal UKM, Bangi. B. Sc. Dissertation. Universiti Kebangsaan Malaysia. (unpublished). 2006.

[15] Lajuni, J. and Latiff, A. Biomass and floristic composition of Bangi Permanent Forest Reserve, a twice-; logged lowland dipterocarp forest in Peninsular Malaysia. *Sains Malaysiana* 42, no. 10 (2013):1517-1521.

[16] Lajuni, J., Ahmad Zainudin, I. and Latiff, A. Above ground biomass and floristic composition of Bangi Permanent Forest Reserve, a twice logged lowland dipterocarp forest. In: Shukor, M. N., Sahibin, A. R., Shaharuddin, M. I., Nik Mohd Shah, N. M., Jalil, M. S., Razani, U. and Latiff, A. (eds.). *Gunung Nuang*, *Selangor*. *Physical Environment and Biological Diversity*. *Siri Kepelbagaian Biologi Hutan* 2 (2005): 145-162. Kuala Lumpur: Forestry Department of Peninsular Malaysia.

[17] Kochummen, K. M., La Frankie, J. V. and Manokaran, N. Floristic composition of Pasoh Forest Reserve, a lowland rain forest in Peninsular Malaysia. *Journal of Tropical Forest Science* 3, no. 1 (1990): 1-13.
[18] Ng, F.S.P. and Corlett, R.T. Tree species richness and density of lowland tropical rain forest in Peninsular Malaysia. *Biodiversity & Conservation* 11, no. 1 (2002): 11-21.
[19] Davies, S. J., Palmiotto, P. A., Ashton, P. S., Lee, H. S. and LaFrankie, J. V. Comparative ecology of 11 sympatric species of *Macaranga* in Borneo: Tree distribution in relation to canopy gaps and topography. *Journal of Ecology* 91, no. 4 (2003): 797-812.
[20] Mat Salleh, K.. The role and function of Universiti Kebangsaan Malaysia Permanent Reserve Forest in research and education. *Pertanika Journal of Tropical and Agricultural Science* 22, no. 2 (1999): 185 -198.
[21] Latiff, A. Floristic composition and conservation value of Bangi Forest Reserve, Selangor, with special reference to species of ethnobotanical importance. In: Nordin, M., Latiff, A., Mahani, M. C. & Tan, S. C. (eds.). Conservation Inputs from Life Sciences. *Proceedings of the International Symposium on Conservation Inputs from Life Sciences*, 27-30 Oct 1980, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia. Faculty of Science, Universiti Kebangsaan Malaysia (1981): 55-64.
[22] Noraini, M. T. Profil Hutan Simpan Bangi. In: Latiff, A. (ed.) Ekologi dan Biologi Hutan Simpan Bangi. *Kumpulan Kertas Kerja* 14 (1990): 125-138.
[23] Chung, R. C. K. and Soepadmo, E. Taxonomic revision of the genus *Microcos* (Malvaceae-Grewioideae) in Peninsular Malaysia and Singapore. *Blumea* 56 (2011): 273–299. https://doi.org/10.3767/000651911X619704
[24] Corner, E. J. H. (1988). *Wayside Trees of Malaya*. Volume 1 & 2. Malayan Nature Society.
[25] Ng, F. S. P. (ed.). (1978). *Tree Flora of Malaya*. Volume 3. Kuala Lumpur. Longman.
[26] Ng, F. S. P. (ed.). (1989). *Tree Flora of Malaya*. Volume 4. Kuala Lumpur. Longman.
[27] Whitmore, T. C. (ed.) (1972). *Tree Flora of Malaya*. Volume 1. Kuala Lumpur. Longman.
[28] Whitmore, T. C. (ed.) (1973a). *Tree Flora of Malaya*. Volume 2. Kuala Lumpur. Longman.
[29] Whitmore, T. C. "Tree Flora of Malaya, Volume 3." (1980): 85-86.