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# Pertanika Journal of Tropical Agricultural Science

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## Contents

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# Weedy Plants of Ayer Hitam Forest Reserve, Selangor

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**Keywords: Aquatic, terrestrial, weeds, Ayer Hitam Forest Reserve**

## ABSTRAK

*Hutan Simpan Ayer Hitam berkemungkinan menghadapi masalah ancaman spesies rumpai dari kawasan yang membangun di sekitarnya. Jumlah takson rumpai yang dikenal pasti dari hutan ini adalah 33 spesies, 29 genus dan 13 famili. Daripada jumlah ini hanya dua merupakan spesies rumpai akuatik iaitu Ceratopteris thalictroides (Parkeriaceae) dan Hydrilla verticillata (Hydrocharitaceae). Spesies rumpai terestrial yang paling dominan di hutan ini pula adalah Clidemia hirta (Melastomataceae) dan Chromolaena odorata (Compositae). Semua spesies rumput dan sedge direkodkan di kawasan kajian terganggu sahaja. Mimosa pigra hanya terdapat di kawasan yang sangat terganggu sahaja di sempadan hutan.*

## ABSTRACT

*The Ayer Hitam Forest Reserve has possibly been under constant threat from invasive species especially the weeds from surrounding development sites. The total number of weed taxa identified from this forest were 33 species, 29 genera and 13 families. Of these taxa, only two species aquatic weeds vizs., Ceratopteris thalictroides (Parkeriaceae) and Hydrilla verticillata (Hydrocharitaceae). The most dominant terrestrial weedy species in this forest were Clidemia hirta (Melastomataceae) and Chromalaena odorata (Compositae). All grasses and sedges spesies were recorded at the disturbed sampling sites only. Mimosa pigra was only found at the most disturbed site bordering the forest.*

## INTRODUCTION

Many aquatic plant species which have medicinal and ornamental values are on the brink of extinction due to development and disturbances of their natural habitats. For example, the everlasting threat of anthropogenic disturbances have gradually decreased the *Cryptocoryne* populations (Kiew 1990). In addition, the invasion of aquatic weed population such as *Hydrilla verticillata* has displaced the original populations of these endemic species.

The concept of weeds has emerged since the beginning of human civilization when man learn to grow their very own food (Mercado 1979). There are amny definitions of weeds but the definition used herein is a plant out of place, unwanted and posses no importance for human (Bailey 1941, Anon 1956). An example is *Eichhornia crassipes,* the water hyacinth which has been the centre of attention of many aquatic weed scientists due to its ability to colonize lakes and ponds in many areas of the world. The intrusion of this species into any pristine or disturbed areas has proved to create problems. Another aquatic weed which is considered a nuisance is *Hydrilla verticillata.* This submerged weed species has been found to be very problematic not only in Malaysia but also in many tropical countries (Cheam 1974, Anwar 1978, Gopal 1990, Jacobsen 1990, Masshor and Masnadi 1994).

## METHODOLOGY

A field survey was conducted from 4$^{th}$ to 5$^{th}$ May 2000 at the Ayer Hitam Forest, which covers 1248 ha of logged-over mixed dipretocarp forest in Puchong, Selangor. This relatively small and green area has been the centre of forestry research and development for Universiti Putra Malaysia since 1996 (Faridah Hanum 1999). A total of six sampling sites which were divided into undisturbed and disturbed areas were identified. The undisturbed areas were Sungai Rasau, Sungai Bohol and a pool in Sungai Rasau. The disturbed areas were the 3km logging trail, basecamp and part of Sungai Rasau that flows through a nearby construction site (Figure 1).

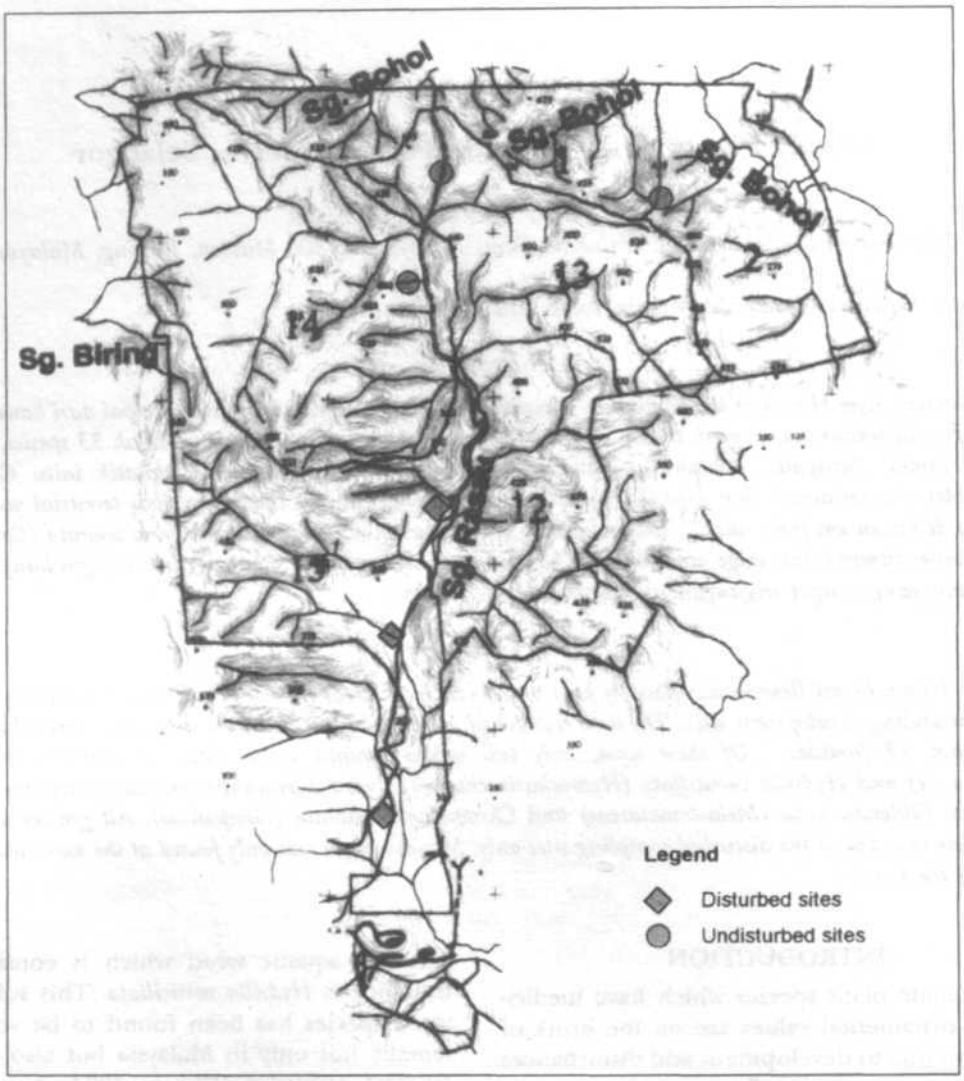


*Fig. 1. Sampling sites at Ayer Hitam Forest Reserve, Selangor*

All aquatic and terrestrial weeds located within the sampling sites were recorded and collected as herbarium specimens. All specimens were deposited at the Herbarium, School of Biological Sciences, Universiti Sains Malaysia, Penang. The abundance of weeds were determined by the Braun-Blanquet method (1932).

## RESULTS AND DISCUSSION

A total of 13 families, 29 genera and 33 species of plants were recorded in the survey (Table 1). From the survey conducted only two aquatic weeds, *Ceratopteris thalictroides* and *Hydrilla verticillata* were found to be abundantly distributed along the disturbed area of Sg. Rasau. The dominant terrestrial weedy species recorded were *Clidemia hirta* and *Chromolaena odorata*. These two species were found to be relatively abundant at all disturbed sampling sites. Several populations of the noxious weedy species *Mimosa pigra* flourish at the construction site only (Table 1) while grasses and sedges species were recorded from all the disturbed sites surveyed (Table 1).

The low number of aquatic weedy species recorded in the area was probably due to the physical conditions of the forest. Sg. Rasau and Sg. Bohol are fast flowing rivers, thus the habitats are not suitable for the colonization of many aquatic plants especially a floating one which needs a stagnant condition. Strong current can

TABLE 1
Abundance of weeds taxa in Ayer Hitam Forest Reserve, Selangor
Vegetation surveyed using Braun-Blanquet (1932) cover scale: (1) vegetation cover < 5%, (2) 5% ≤ vegetation cover < 25%, (3) 25% ≤ vegetation cover < 50%, (4) 50% ≤ vegetation cover < 75%, (5) 75% ≤ vegetation cover ≤ 100%.

| | | Sampling sites | | | | | |
|---|---|---|---|---|---|---|---|
| | | Undisturbed area | | | Disturbed area | | |
| Family | Species | Sg. Rasau | Sg. Bohol | Pool | Logging trail (3 km) | Base Camp | Sg. Rasau (construction site) |
| **Aquatic** | | | | | | | |
| Parkeriaceae | *Ceratopteris thalictroides* (L.) Brongn. | | | 1 | | 5 | 4 |
| Hydrocharitaceae | *Hydrilla verticillata* (L.f.) Royle | | | | | | 5 |
| **Broadleaf** | | | | | | | |
| Acanthaceae | *Asystasia nemorum* Nees | | | 1 | 3 | 4 | 3 |
| Acanthaceae | *Asystasia gangetica* (L.) T. Anderson | 1 | 1 | | | | |
| Compositae | *Chromolaena odorata* (L.) R.M. King & H. Rob | | | 2 | 4 | 5 | 5 |
| Compositae | *Mikania micrantha* Kunth. | | 1 | | 3 | 3 | 5 |
| Compositae | *Agerantum conyzoides* L. | | | | | | 5 |
| Dilleniaceae | *Tetracera scandens* (L.) Merr. | | | 1 | 2 | 1 | 2 |
| Euphorbiaceae | *Phyllanthus amarus* Schumach. & Thonn. | | | | 1 | 3 | |
| Euphorbiaceae | *Croton hirtus* L' Her. | | | | 1 | 1 | |
| Leguminosae | *Desmodium heterophyllum* (Willd.) DC | 1 | | | | 1 | |
| Leguminosae | *Mimosa pudica* L. | | | 1 | 2 | 4 | 5 |
| Leguminosae | *Mimosa diplotricha* C.Wright ex Sauvalle | | | 1 | | 3 | 5 |
| Leguminosae | *Mimosa pigra* L. | | | | | | 5 |
| Melastomataceae | *Clidemia hirta* (L.) D. Don | | | | 5 | 3 | 5 |
| Melastomataceae | *Melastoma malabathricum* L. | | | | 4 | 2 | 5 |
| Oxalidaceae | *Oxalis corniculata* L. | | | | 1 | 1 | 2 |
| Rubiaceae | *Hedyotis corymbosa* (L.) Lam | | | | 2 | 2 | 3 |
| Rubiaceae | *Borreria laevicaulis* (Miq.) Ridl. | | | | 1 | 1 | 1 |
| Scrophulariaceae | *Lindernia crustacea* (L.) F.Muell. | | | 1 | | | 2 |
| **Grasses** | | | | | | | |
| Gramineae | *Cynodon dactylon* (L.) Pers. | | | | 2 | 2 | 3 |
| Gramineae | *Eragrostis amabilis* (L) Wight & Arn. *ex* Hook & Arn. | | | | | 1 | 1 |
| Gramineae | *Pennisetum polystachion* (L.) Schult. | | | | 3 | | 5 |
| Gramineae | *Axonopus compressus* (Sw.) P. Beauv | | | | 1 | | 1 |
| Gramineae | *Panicum repens* L. | | | | 2 | 2 | 4 |
| Gramineae | *Paspalum conjugatum* Berg. | | | | | 3 | 5 |
| Gramineae | *Chrysopogon aciculatus* (Retz.) Trin. | | | | 1 | 2 | 2 |
| Gramineae | *Imperata cylindrica* (L.) P. Beauv | | | | 3 | 3 | 5 |
| Gramineae | *Centotheca lappacea* (L.) Desv. | | | | 1 | 2 | 3 |
| **Sedges** | | | | | | | |
| Cyperaceae | *Kyllinga nemoralis* (J.R. Forst.& G. Forst) Dandy *ex* Hutch.& Dalziel | | | | 2 | 2 | 3 |
| Cyperaceae | *Kyllinga polyphylla* Willd. *ex* Kunth | | | | 2 | 3 | 4 |
| Cyperaceae | *Scleria sumatrensis* Retz. | | | | 3 | 2 | 4 |
| Cyperaceae | *Cyperus distans* L. *f.* | | | | 1 | 3 | 2 |

easily uproot aquatic plants. However, the high population of *Ceratopteris thalictroides* recorded in Sg. Rasau was found in the slow moving part of the river near the bathing spot of the camp site. The high amount of light received in this location and possible adaptation to the new environment may contribute to its flourishing population. Any aquatic landscapes made by human such as dam, channel, drains and pond are likely to have a greater tendency to be infested by aquatic plants (Abdullah 1999). However, the conditions of water bodies at the surveyed sites may be insufficient for other aquatic weed species to flourish.

There were also larger populations of *C. thalictroides* and *H. verticillata* recorded at the construction site, immediately adjacent to the forest. This was probably due to the higher nutrient input from the workers' quarters. The impact of human activities to the water quality, the kind and amount of wastes and pollutants dumped into the water will create pollution and eutrophication that in turn can change the life-form in an aquatic ecosystem. Nutrients such as nitrogen, phosphorus and micronutrients are the important elements in hydrosoil for the aquatic plants growth (Steward 1984, Soerjani 1986, Sutton and Portier 1995). Too high nutrient concentrations however, can trigger unnecessary floral bloom.

Weedy species coverage in disturbed areas was relatively higher when compared to less disturbed sites (Fig. 2). The vast open areas in the construction site were found to be dominated by grasses and sedges. This maybe due to the opening of the area. The abundance of *Clidemia hirta* and *Chromolaena odorata* was due to regular disturbances of the sites surveyed. These species are good indicators for a disturbed habitat especially in newly opened areas. In addition to *C. hirta, Melastoma malabathricum* is also found in abundance in disturbed areas. Other broad-leaved weeds (Table 1) are amongst the pioneer plant species which can subsequently colonize the whole area.

The surrounding areas adjacent to Ayer Hitam Forest are currently under extensive housing development projects. The noxious weed, *Mimosa* pigra was only found at the construction site bordering the forest. The seeds of this species are believed to be brought by heavy machines brought from areas which have already been infested by *M. pigra.*

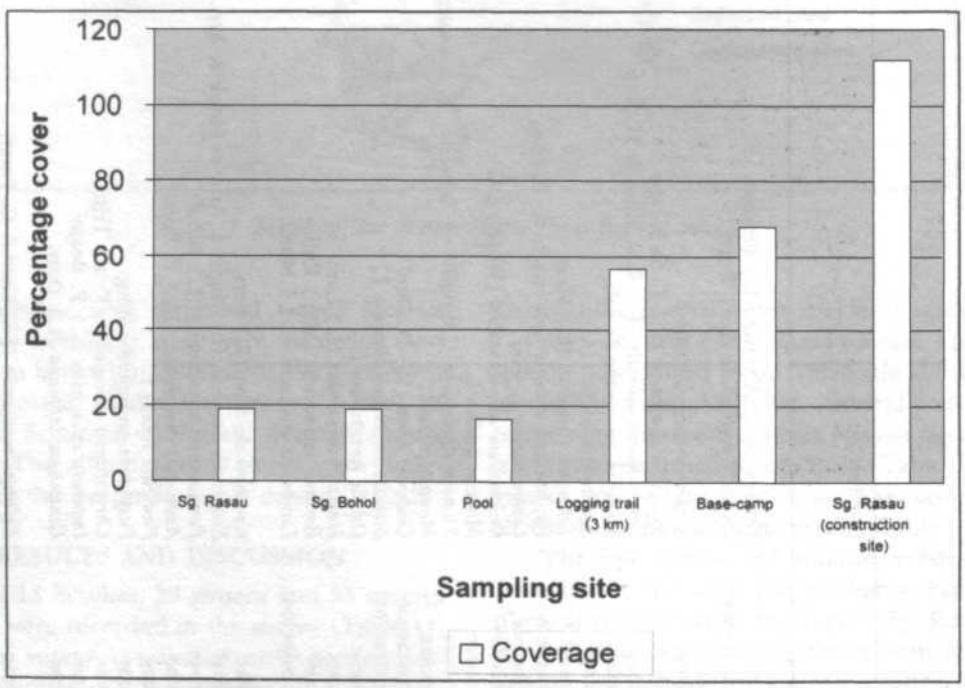


*Fig. 2. Percentage cover of sampling sites by weeds*

## CONCLUSION

The intrusion of weedy species especially the noxious ones should be considered as a serious threat to the Ayer Hitam Forest ecosystem. The invasion of noxious weeds such as *Mimosa pigra* from the adjacent area deserves close monitoring as it can displace original populations of other species in the undisturbed areas of the forest.

## ACKNOWLEDGEMENT

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# Preliminary Inventory of Non-Wood Resources in Ayer Hitam Forest Reserve, Selangor

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**Keywords : Non-wood, bamboo, palm, Ayer Hitam Forest Reserve**

## ABSTRAK

*Inventori takson bukan kayu di Komparmen 12 dari Hutan Simpan Ayer Hitam mendapati empat spesies buluh dan tujuh spesies palma. Species buluh tersebut adalah Bambusa vulgaris, Gigantochloa scortechinii, Schizostachyum zollingeri and Bambusa heterostachya. Spesies palma pula adalah Eugeissonia tristis, Oncosperma horridum, Oncosperma tigillarium, Arenga obtusifolia, Livistona rotundifolia, Licuala glabra dan Salacca zalacca. Hutan ini agak kaya dengan palma tetapi miskin dengan buluh.*

## ABSTRACT

*An inventory on non-wood taxa in Compartment 12 of the Ayer Hitam Forest Reserve recorded four species of bamboo and seven species of palms. The bamboo species are Bambusa vulgaris, Gigantochloa scortechinii, Schizostachyum zollingeri and Bambusa heterostachya. The palms species are Eugeissonia tristis, Oncosperma horridum, Oncosperma tigillarium, Arenga obtusifolia, Livistona rotundifolia, Licuala glabra and Salacca zalacca. This forest is considerably rich in palms but poor with bamboos.*

## INTRODUCTION

In recent years, many people have expressed concern at the rapid changes in Klang Valley's landscapes and natural systems fearing that the area will lose its distinctive natural character. Trends indicate that this situation is not improving and alienation of forest areas to other uses not only lead to environmental degradation, but also loss of valuable genetic resources of plants and animals. Recognising the vital ecological importance and the need to protect and conserve the natural resources especially for future generation, the State Government of Selangor has agreed to conserve the remaining portion of Ayer Hitam Forest Reserve (AHFR) as a green lung in the newly developed Malaysia Super Corridor.

Recognising the need to protect and conserve the natural resources, many research initiatives have been undertaken by the Faculty of Forestry, UPM to document the resources AHFR houses. This study for instance is an attempt to inventorize the existing non-wood resources in AHFR. The information gathered would complement existing information on plants for *in situ* conservation programmes for AHFR.

## MATERIALS AND METHODS

The inventory was carried out by using systematic strip line plot sampling. Inventory lines were systematically laid down at right angle to the base line at a distance of 100m apart. 22 inventory plots of size 100m × 100m each were then established at a distance of 50m apart along the inventory lines. Each plot was further divided into 20 sub-plots of 5m × 100m. The inventory was carried out in every alternate sub-plot (Fig.1). A total of 10 sub-plots was inventoried for every 1 ha plot. All bamboos and palms were identified and those plants that were found on the border of the sampling plots were recorded if more than half was located within the plot.

## RESULTS AND DISCUSSION

This study revealed the existence of four species of bamboo and seven species of palms in Compartment 12 of AHFR. The four species of bamboo found were *Bambusa vulgaris* Schrad.*ex*

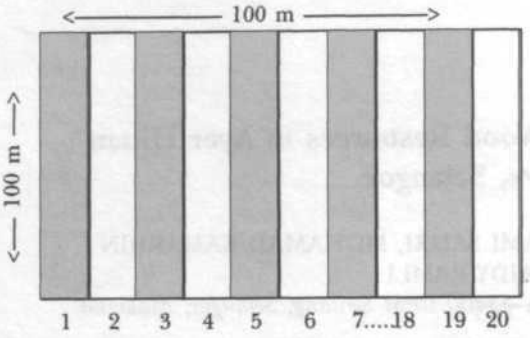


*Fig. 1. Outline of sub-plot for inventory*

Wendl, *Gigantochloa scortechinii* Gamble, *Schizostachyum zollingeri* Steud. and *Bambusa heterostachya* (Munro) Holttum. This compartment also has a poor density of bamboo with an average of 5 clumps per hectare (Table 1). The figure is in agreement with the data obtained from the Second National Forest Inventory (1981-1982) where 67% of the State of Selangor recorded the lowest density of bamboo with less than 10 clumps (poor), 13% with 11 - 20 clumps (moderate) while the remaining 20% has more than 20 clumps (rich) (Lokman *et al.* 1992)

TABLE 1
Composition of bamboo in Compartment 12, AHFR

| Plot no. | Species | No. of clumps |
|---|---|---|
| 1 | *G. scortechinii* | 3 |
| 2 | *B. vulgaris* | 13 |
| | *G. scortechinii* | 8 |
| | *S. zollingeri* | 4 |
| | *B. heterostachya* | 1 |
| 3 | *B. vulgaris* | 9 |
| | *G. scortechinii* | 3 |
| 5 | *G. scortechinii* | 3 |
| | *S. zollingeri* | 5 |
| 16 | *G. scortechinii* | 3 |
| | *S. zollingeri* | 6 |
| | Total | 58 |

*G. scortechinnii* and *B. vulgaris* showed a dominant presence in Compartment 12 (Table 1). The former species is the most common and widespread species in Peninsular Malaysia especially in disturbed or logged-over lowland forests (Wong 1995; Azmy and Khoo 1996). The results also showed that most of the bamboo were not only found growing gregariously but also in localised patches on riverbanks which is a dis-

TABLE 2
Composition of palms in Compartment 12, AHFR

| Plot | *Eugeissonia tristis* (Bertam) | *Oncosperma horridum* (Bayas) | *Oncosperma tigillarium* (Nibung) | *Salacca zalacca* (Salak) | *Arenga obtusifolia* (Langkap) | *Licuala glabra* (Palas) | *Livistona saribus* (Serdang) | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 8 | 5 | 4 | 0 | 0 | 0 | 42 |
| 2 | 8 | 7 | 6 | 0 | 13 | 4 | 0 | 38 |
| 3 | 9 | 8 | 6 | 0 | 4 | 0 | 0 | 27 |
| 4 | 6 | 11 | 9 | 0 | 4 | 0 | 0 | 30 |
| 5 | 5 | 6 | 5 | 0 | 3 | 2 | 5 | 26 |
| 6 | 18 | 10 | 9 | 0 | 6 | 0 | 0 | 43 |
| 7 | 29 | 15 | 9 | 0 | 3 | 0 | 0 | 56 |
| 8 | 21 | 9 | 5 | 0 | 4 | 0 | 0 | 39 |
| 9 | 23 | 9 | 3 | 0 | 0 | 0 | 0 | 35 |
| 10 | 24 | 8 | 3 | 0 | 0 | 0 | 0 | 35 |
| 11 | 29 | 17 | 15 | 0 | 0 | 0 | 0 | 61 |
| 12 | 30 | 5 | 3 | 0 | 0 | 0 | 0 | 38 |
| 13 | 21 | 3 | 5 | 0 | 0 | 0 | 0 | 29 |
| 14 | 25 | 2 | 0 | 0 | 0 | 4 | 0 | 31 |
| 15 | 9 | 3 | 4 | 0 | 0 | 2 | 0 | 18 |
| 16 | 7 | 4 | 0 | 0 | 0 | 0 | 7 | 18 |
| 17 | 15 | 6 | 5 | 0 | 4 | 0 | 0 | 30 |
| 18 | 26 | 4 | 6 | 0 | 0 | 0 | 0 | 36 |
| 19 | 13 | 3 | 4 | 0 | 0 | 0 | 3 | 23 |
| 20 | 11 | 12 | 0 | 0 | 2 | 0 | 0 | 25 |
| 21 | 5 | 3 | 0 | 0 | 4 | 0 | 0 | 12 |
| 22 | 25 | 0 | 0 | 0 | 3 | 0 | 0 | 28 |
| Total | 384 | 153 | 102 | 4 | 50 | 12 | 15 | 720 |
| No. of clumps or stems per ha | 35 | 14 | 9 | 0.4 | 5 | 1.0 | 1.0 | 65 |

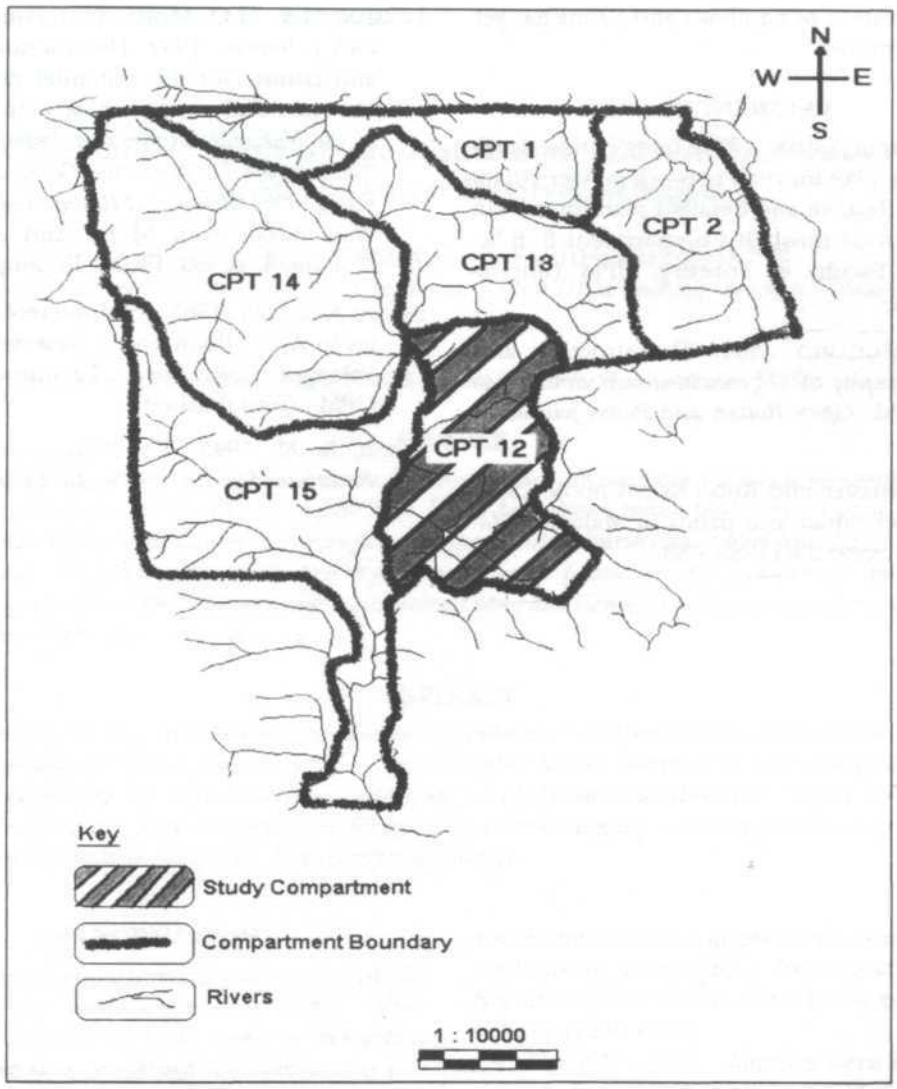


*Fig. 2. Location map of Compartment 12 Ayer Hitam Forest Reserve Puchong, Selangor*

tinctive pattern of most Malaysian bamboo (Ng and Nor 1980; Azmy 1991).

Seven palms species were also recorded viz., *Eugeissonia tristis* Griff., *Oncosperma horridum* (Griff).Scheffer, *Oncosperma tigillarium* Ridl., *Arenga obtusifolia* Mart., *Livistona saribus (Lour.) Merr., Licuala glabra* Griff. and *Salacca zalacca* (Gaert.) Voss. The study also showed that there is a high density of palms of various species with an average of 65 clumps per hectare in this Compartment (Table 2). *Eugeissonia tristis* is the most abundant species occuring and was present in all plots with a density of 35 clumps per hectare (Table 2). This is followed by *Oncosperma horridum* and *Oncosperma tigillarium* with a density of 14 and 9 clumps per hectare, respectively. These three species were mainly found in plots situated on undulating areas. *Salacca zalacca,* being the most uncommon species recorded here (0.4 clumps per hectare) was found in the swampy areas of the compartment (Table 2).

## CONCLUSION

Compartment 12 of AHFR is considerably rich in palms but poor with bamboos. An extension of this work to other areas of AHFR will be able to give a better picture of the diversity and density of these resources here. Until all taxa of palm and bamboo of AHFR are known from future inventories, the potential of AHFR for *in*

*situ* conservation of bamboos and palms has yet to be determined.

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# A Preliminary Study on the Distribution of Fruit Tree Taxa at Ayer Hitam Forest Reserve, Selangor

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**Keywords : Fruit trees, distribution, Ayer Hitam Forest Reserve, Burseraceae, Meliaceae, Sapindaceae**

## ABSTRAK

*Satu penilaian ke atas famili pokok buah-buahan Burseraceae, Sapindaceae dan Meliaceae mendapati 714 pokok daripada 10 genus dan 26 spesies dalam plot 5-ha. Enam belas pokok induk telah dikenal pasti, kesemuanya daripada famili Burseraceae dan ini menerangkan kenapa populasi Burseraceae tinggi berbanding Sapindaceae dan Meliaceae. Walaupun Hutan Simpan Ayer Hitam masih belum terpulih sepenuhnya daripada kesan pembalakan yang lepas, kepelbagaian pokok buah-buahan yang ada memadai dalam menyumbangkan makanan kepada hidupan liar yang berlainan.*

## ABSTRACT

*An assessment on the fruit trees families Burseraceae, Sapindaceae and Meliaceae showed that 714 trees from 10 genera representing 26 species were identified in the 5-ha plot. Sixteen mother trees were identified and all are Burseraceae explaining the high populations compared to Sapidaceae and Meliaceae. Despite the Ayer Hitam Forest Reserve being not fully recovered from the effects of previous logging activities, the diversity of fruit trees present is commendable in supplying food to different wildlife.*

## INTRODUCTION

Fruit trees form an important part in the species diversity of the forest (Saw *et al.* 1991). Very often the diversity of fruit trees in Malaysian lowland forests is moderate and present in low abundance (Hashim 1986, Jong *et al.* 1973, Soepadmo 1979, Whitmore 1971). Wild fruit tree species may play an important role in the selection of desirable traits for the improvement of some local fruits. An earlier study on the fruit tree taxa of Ayer Hitam Forest Reserve (AHFR) found 29 edible species and 14 species considered potentially edible because they were observed eaten by birds and animals (Faridah Hanum 1999, Daud Abu Hassan 1999, Edham 2001). This paper presents some preliminary results on the distribution of three fruit tree families over an area of 5-ha in AHFR.

## METHODOLOGY

This study was conducted on a 5-ha plot of Compartment 14, Ayer Hitam Forest Reserve, Selangor. Logging activities were carried out three times in this compartment from 1936 until 1966 using Commercial Regeneration Felling System (1936-1943 and 1965-1966) and Selective Felling (1946-1954).

Three fruit tree families were selected for the study viz., Burseraceae, Meliaceae and Sapindaceae. All trees with diameter at breast height (dbh) greater than 5 cm were measured and tagged according to the quadrat and systematically numbered. The coordinates (x,y) of the tree location in the subplots (20 m × 20 m) were recorded and the information then transferred to the coordinates (x,y) on the real plot size (250 m × 200 m). Flowering or fruiting specimens were collected in duplicates of three or one only for sterile specimens. The identification process of uncertain taxa was done at the herbaria of FRIM, Kepong and UKMB, Bangi.

## RESULTS AND DISCUSSION

A total of 714 trees from the families Burseraceae, Meliaceae and Sapindaceae were recorded and mapped over a 5-ha plot. Twenty

six species belonging to 10 genera of Burseraceae contributed the highest number of the fruit trees with 612 stems (86%) followed by Sapindaceae with 60 stems (8%) and Meliaceae with 42 trees (6%). Table 1 details out the composition of fruit tree taxa in the plot.

The distribution for every family investigated is shown in Figure 1 (Burseraceae), Figure 2 (Sapindaceae) and Figure 3 (Meliaceae). The populations of the two latter families are smaller compared to Burseraceae. When further investigated, it was found that no mother trees were present in the plot for Sapindaceae and Meliaceae. Mother trees are those trees having a dbh greater than 45 cm. From the data available, 16 trees or 2% of the total number of trees recorded are mother trees from the family Burseraceae, giving an average of 3 mother trees per ha. The distribution of mother trees for Burseraceae is shown in Figure 4. Nine of fifteen Burseraceae species have mother trees present within the 5-ha plot.

The most abundant species is *Santiria oblongifolia* with 18.1% of the total stems recorded followed by *Santiria apiculata* (13%) and *Santiria laevigata* (11.8%). Other species were less represented (< 10%), with *Pometia pinnata* being the most rare having only one stem recorded (Table 1). Thirteen species of the family Burseraceae (Kedondong) are represented in the plot and this comprises one-third the total number of species in this family in Peninsular Malaysia.

Although AHFR has been logged several times in the past, the existence of mother trees of several fruit tree species indicate that small genetic reserves of these taxa are still available in the forest. Small genetic reserves will serve as sources of seed, genetic banks and wildlife refuse from which the forest begins to recover from

TABLE 1
Composition of fruit tree taxa in 5-ha plot at Ayer Hitam Forest Reserve, Selangor

| Family | Genera | Species | No. Stems | % Composition |
|---|---|---|---|---|
| Burseraceae | *Canarium* | *Canarium apertum* H.J. Lam. | 12 | 1.7 |
| | | *C. littorale* Bl. | 16 | 2.2 |
| | | *C. littorale* Bl. forma *tomentosum* Leenh. | 23 | 3.2 |
| | | *C. patentinervium* Miq. | 16 | 2.2 |
| | | *C. pilosum* Benn. | 26 | 3.6 |
| | *Dacryodes* | *Dacryodes costata* (Benn.) H.J. Lam. | 48 | 6.7 |
| | | *D. longifolia* (King) H.J. Lam. | 31 | 4.3 |
| | | *D. rostata* (Bl.) H.J. Lam. | 19 | 2.7 |
| | | *D. rugosa* (Bl.) H.J. Lam. | 68 | 9.5 |
| | *Santiria* | *Santiria apiculata* Benn. | 93 | 13.0 |
| | | *S. laevigata* Bl. | 84 | 11.8 |
| | | *S. oblongifolia* Bl. | 129 | 18.1 |
| | | *S. rubiginosa* Bl. var. *nana* (H.J. Lam) Kalkman | 20 | 2.8 |
| | | *S. rubiginosa* var. *rubiginosa* | 12 | 1.7 |
| | | *S. tomentosa* Bl. | 15 | 2.1 |
| Meliaceae | *Aglaia* | *Aglaia edulis* (Roxb.) Wall. | 9 | 1.3 |
| | *Chisocheton* | *Chisocheton patens* Bl. | 24 | 3.4 |
| | | *C. rubiginosus* King | 6 | 0.8 |
| | *Sandoricum* | *Sandoricum koetjape* (Burm.*f*) Merr. | 3 | 0.4 |
| Sapindaceae | *Mischocarpus* | *Mischocarpus sundaicus* Bl. | 9 | 1.3 |
| | *Nephelium* | *Nephelium glabrum* var. *sufferugineum* (Radlk.) Ridl. | 3 | 0.4 |
| | | *N. maingayi* Hiern | 3 | 0.4 |
| | | *N. ramboutan-ake* (Labill.) Leenh. | 7 | 1.0 |
| | *Pometia* | *Pometia pinnata* Frost. | 1 | 0.1 |
| | *Xerospermum* | *Xerospermum laevigatum* Radlk. | 3 | 0.4 |
| | | *X. noronhianum* Bl. | 34 | 4.8 |
| | | | 714 | 100 |

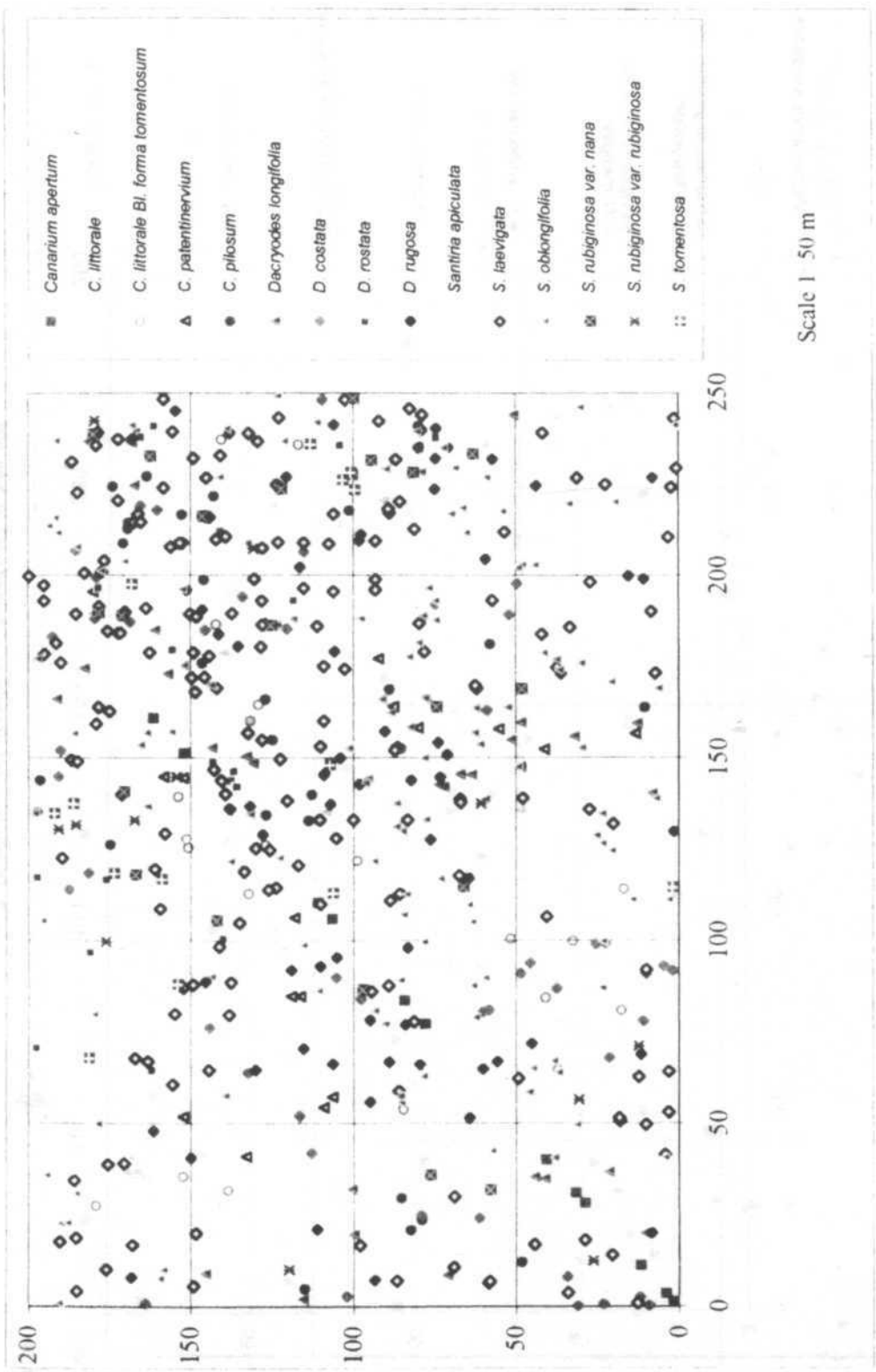


*Fig. 1. Distribution and abundance of Burseraceae in 5-ha plot*

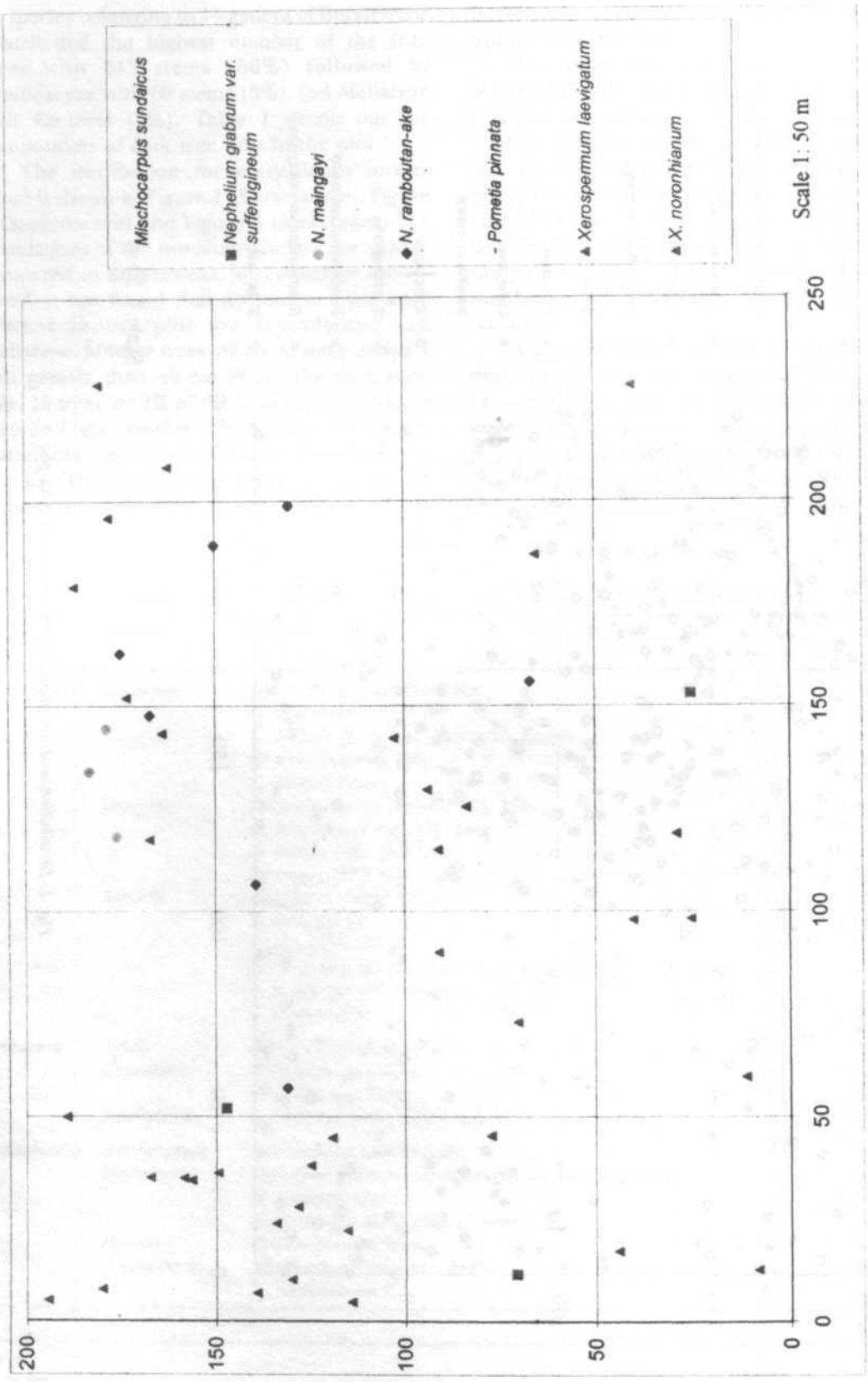


*Fig. 2. Distribution and abundance of Sapindaceae in 5-ha plot*

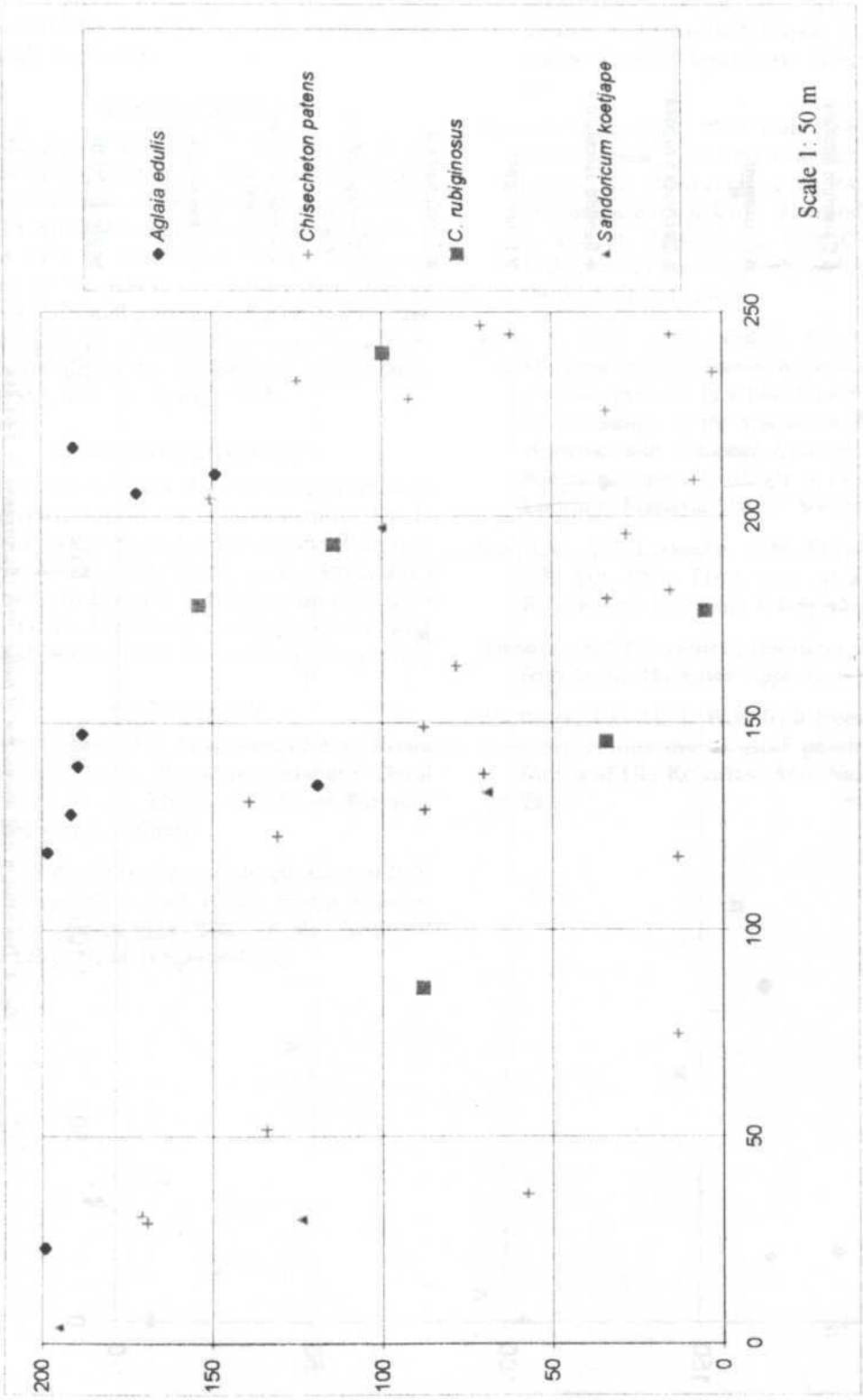


*Fig. 3. Distribution and abundance of Meliaceae in 5-ha plot*

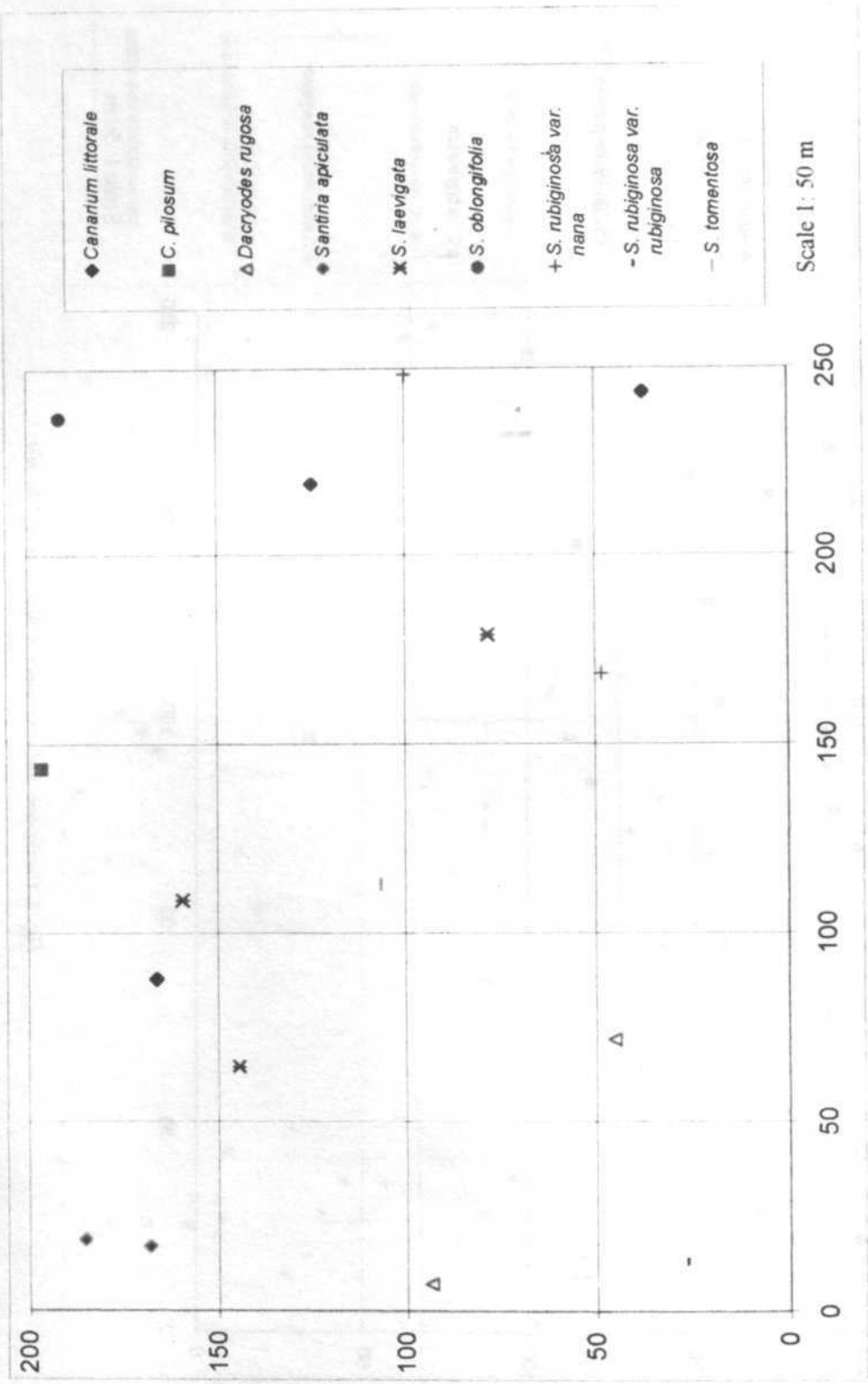


*Fig. 4. Distribution and abundance of mother trees (Burseraceae) in 5-ha plot*

logging damage. Fruit trees form an important part in the species diversity of the forest as they also provide food to the animals mainly birds and small mammals.

## CONCLUSION

Since the population of mother trees (≥ 45 cm dbh) of fruit species is low and unevenly distributed in this forest, it is suggested that whatever is left of AHFR be maintained and not further excised as it is detrimental to the long-term stability of the forest ecosystem. An effort to preserve the small genetic reserves of fruit tree species in AHFR would ensure it as a long- term wildlife refuge in the Multimedia Super Corridor (MSC) and the Klang Valley.

## ACKNOWLEDGEMENT

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# Species Composition of Small Mammals at the Ayer Hitam Forest Reserve, Puchong, Selangor

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**Keywords: Small mammals, species composition, species abundance, Rodentia, logged forest, hunting**

## ABSTRAK

*Satu kajian tentang komposisi dan kelimpahan mamalia kecil telah dijalankan di Hutan Simpan Ayer Hitam (HSAH), Puchong, Selangor. Sejumlah 1120 jam pemerangkapan merekodkan sebanyak 14 spesies mamalia kecil dari 11 genus dalam lima famili dan tiga order. Takson-takson tersebut terdiri dari enam tikus, empat tupai, tiga insektivor dan satu primat. Sejumlah 32 individu mamalia kecil telah ditangkap. Daripada jumlah ini, 17 individu atau 53% adalah tikus, 9 individu (28%) adalah tupai, 4 individu (13%) tupai muncong dan setiap satu individu (3%) bagi kedua-dua primat dan gimnur. Order Rodentia (tikus dan tupai) merupakan kumpulan utama mamalia kecil di kawasan ini dengan jumlah tangkapan sebanyak 82% atau 26 individu.*

## ABSTRACT

*A study on the species composition and abundance of small mammals was carried out in Ayer Hitam Forest Reserve (AHFR), Puchong, Selangor. A total of 1120 trapping-hours recorded 14 species of small mammals which belonged to 11 genera from five families and three orders. The taxa comprised of six murids, four sciurids, three insectivores and one primate. A total of 32 indiciduals of smalls mammals were captured. From this, 17 individuals or 53% were rats, 9 individuals (28%) were squirrels, 4 individuals tree shrews (13%) and 1 individual each (3%) for both primate and gymnures. The order Rodentia (rats and squirrels) was the main group of small mammals in the area, with a total capture of 82% or 26 individuals.*

## INTRODUCTION

Studies of small mammals are among the least favoured subject amongst the zoologists or wildlife ecologists (Louis *et al.* 1988). In Malaysia, studies on small mammals include those of Harrison (1968), Lim *et al.* (1977), Louis *et al.* (1988), Azmin *et al.* (1988) and Shabrina *et al.* (1988) in various secondary forest in the state of Selangor.

The alarming rate of exploitation of forested land in Ayer Hitam Forest Reserve(AHFR) has severely depleted the habitats of many wild animals (Zakaria and Mudim 1999, Zakaria and Topani 1999). Being rapidly developed, it is important to study and document the distribution of small mammals in the forest. It will also complement the existing database on animals for Ayer Hitam Forest Reserve. This study was undertaken to determine the species composition and abundance of small mammals (except bats) in the area.

## MATERIALS AND METHODS

This study was conducted during the expedition from 3-8 September 2000. Live trapping method was used to collect the data on small mammals. Small mammals considered in this study were those weighing less than 5kg. Trapping for small mammals especially rodents and other terrestrial mammals, with the exception of bats were carried out by using wire-cage (similar to rat-trap) with a baited hook release. Forty live traps measuring 30×15×15 cm were used and placed randomly in the forest. Various types of baits such as banana, papaya, coconut kernel, sweet potato, dried fish and anchovies or a combination of

these baits were used in the study. Banana was used most because it was found to be the most suitable bait for small mammal trapping (Azmin 1995). The types of baits used were very important because it could affect the types and number of animals captured. Lim (1973) noted that careful selection of baits could increase the number of animals caught in relation to the type of habitats sampled. The placement of traps was not strictly on the ground (Labang and Medway 1978) and a few traps were set on recumbent logs or dead trees, on a stump or on reachable higher branch of trees. All traps were left open throughout the day and night. A daily checking between 9.00 am and 10.00 am the following day was conducted. In each trapping session, traps were deployed for a period of 96 hours or approximately four days (Labang and Medway 1978). Every captured animal was identified to species level and euthanized by chloroform before the measurements on weight and length were carried out. All animals captured were marked on the left ear with red paint for identification and were released back in the area where they were caught.

## RESULTS AND DISCUSSION

A total of 14 species from 11 genera of small mammals (excluding bats) were identified from 1120 trapping hours (Table 1). All species belonged to five families from three main orders. Of these, six species were murids, four sciurids, three insectivores and one primate. The six murids caught comprised of five forest rats and two commensal rats. The four sciurids captured were tree and ground squirrels while the insectivores were treeshrews and gymnures. The slow loris was the only primate caught.

TABLE 1
Small mammals captured in Ayer Hitam Forest Reserve

| Species | Common Name | Number of Catch | Percentage |
|---|---|---|---|
| Order: **Rodentia** | | | |
| 1. **Family Muridae** | Rats | 17 | 53% |
| 1. *Leopoldamys sabanus* | Long-tailed giant rat | 2 | |
| 2. *Maxomys surifer* | Red spiny rat | 7 | |
| 3. *Mus castaneus* | House mouse | 2 | |
| 4. *Pithecheir parvus* | Monkey-footed rat | 1 | |
| 5. *Rattus rattus* | House rat | 1 | |
| 6. *Rattus tiomanicus* | Malaysian wood rat | 4 | |
| 2. **Family Sciuridae** | Squirrels | 9 | 28% |
| 1. *Callosciurus nigrovitatus* | Black-banded squirrel | 1 | |
| 2. *Callosciurus notatus* | Plantain squirrel | 6 | |
| 3. *Lariscus insignis* | Three-striped ground squirrel | 1 | |
| 4. *Sundasciurus tenuis* | Slender squirrel | 1 | |
| **Order Insectivore** | | | |
| 1. Family Tupaiidae | Tree Shrews | 4 | 13% |
| 1. *Tupaia glis* | Common tree shrew | 3 | |
| 2. *Tupaia minor* | Lesser tree shrew | 1 | |
| 2. Family Erinaceidae | Gymnures | 1 | 3% |
| 1. *Echinosorex gymnurus* | Moonrat | 1 | |
| **Order Primate** | | | |
| 2. Family Lorisidae | Primate | 1 | 3% |
| 1. *Nycticebus coucang* | Slow loris | 1 | |
| **Order:** | | | |
| Rodentia | Rats and Squirrels | 26 | 82% |
| Insectivore | Tree shrews and Gymnures | 5 | 15% |
| Primate | Loris | 1 | 3% |
| **Total No. of Individuals** | | **32** | **100%** |

Most of the captured mammals were common lowland forest species. By comparing the results with the study of Abdullah (1998) in same area, all the species recorded were similar to those found in the present study except for slow loris *(Nycticebus coucang)* and moonrat *(Echinosorex gymnurus)*. The absence of the two latter species in Abdullah (1998) could be due to the study being conducted only in the interior forest; both the species in this present study were caught near the forest edge. The capture of slow loris was a big surprise because the species is considered rare and seldom seen. Furthermore, this species is normally an arboreal species which spends most of its time on trees.

AHFR recorded more species of small mammals than Pasoh Forest Reserve, Negeri Sembilan (Kemper 1988). Based on a six-month study conducted in Pasoh Forest Reserve, only 11 species of small mammals (excluding bats) were obtained compared to 14 species caught in this expedition. AHFR is probably more diverse in terms of number of species of small mammals than Pasoh. Another study by Louis *et al.* (1988) recorded at least 21 species of small mammals (excluding bats) which included a few species of flying squirrels in AHFR. A study by Lim *et al.* (1977) in Bukit Lanjan Forest Reserve, Sg. Buloh, Selangor recorded a total of 51 species of small mammals (excluding bats) during a period of five years of intensive data collection. These species belonged to 16 families from 6 orders of terrestrial mammals listed by Medway (1983). A higher collection obtained by Lim *et al.* (1977) could be due to the different duration of study undertaken and that Bukit Lanjan Forest Reserve is less disturbed than AHFR.

A total of 32 individuals of small mammals were captured in the study area. The Rodentia (rats and squirrels) was the most abundant order of small mammals captured. Almost 82% of the number of individuals captured fall in this order. A similar result was obtained by Abdullah (1998), Louis *et al.* (1988) and Lim *et al.* (1977). The rats were the most abundant species comprising 53% or 17 individuals (Table 1 followed by squirrels 28% (9 individuals). The least number of individuals captured were insectivores and primate with 14% (5 individuals) and 3% (1 individual) respectively. *Maxomys surifer, Callosciurus notatus, Rattus tiomanicus* and *Tupaia glis* were among the most commonly captured species in the area.

The study shows that there was no dominant species found in the area. However, *M. surifer* (Red spiny rat) and *C. notatus* (Plantain squirrel) were more common than other species. The total number of individuals captured was seven and six respectively. A study by Hasnan (1999) also found that *C. notatus* were observed for 55% of the total number of observations made in AHFR. The high abundance of *M. surifer* and *C. notatus* in the area were probably related to their good adaptation in the disturbed forest habitats. Potential food sources for them in the area are easily available (Zakaria and Mudim 1999, Zakaria and Topani 1999).

According to Delany (1974) the rodents were able to consume many types of food such as plants, fruits and seeds without causing any negative effects to them. The existing Orang Asli settlement in the area may also be responsible for the high number of rodents (Zakaria and Topani 1999). Louis *et al.* (1988) had captured at least 13 species of rodents around the Orang Asli village during his study. Left over food and rubbish dumped by the villagers might have attracted these small mammals (Audy 1948).

## CONCLUSION

This study has shown that the forest is still rich in small mammal species, although not all small mammal groups were sampled. Many of the small mammal species have adapted to the forest since it was logged 30 years ago. The distribution and abundance of food resources and other factors such as the availability of suitable habitats (e.g. cover) could also be the factors that determine the species composition, distribution and abundance in the area (Zakaria and Nordin 1998). Therefore, it is recommended that any future development planned within the AHFR should take into consideration the habitat of wildlife populations. Any drastic change in the area will alter the wildlife habitats and eventually affect the existence of wildlife species.

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# Mosses of Ayer Hitam Forest Reserve, Selangor, Peninsular Malaysia

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**Keywords: Mosses, Ayer Hitam Forest Reserve**

## ABSTRAK

*Sejumlah 43 spesies dan 1 varieti lumut sejati dalam 22 genus dan 9 famili telah diperhatikan di Hutan Simpan Ayer Hitam, Selangor. Ini mewakili 9.1% daripada 481 takson lumut sejati yang telah dilaporkan bagi Semenanjung Malaysia dan Singapura. Tujuh spesies iaitu Fissidens papillosus, Syrrhopodon fimbriatulus, Pyrrhobryum latifolium, Acroporium lamprophyllum, Papillidiopsis malayana, Radulina hamata dan Trichosteleum mammosum dilaporkan buat pertama kali bagi negeri Selangor dan Fissidens guangdongensis merupakan catatan baru bagi Semenanjung Malaysia. Calymperaceae merupakan famili terbesar dengan 5 genus dan 18 spesies, diikuti oleh Sematophyllaceae (8 genus, 10 spesies), Hypnaceae (3 genus, 5 spesies) dan Fissidentaceae (1 genus, 5 spesies).*

## ABSTRACT

*A total of 43 species and 1 variety of mosses in 22 genera and 9 families were observed in the Ayer Hitam Forest Reserve, Selangor. This represents 9.1% of the 481 taxa of mosses reported for Peninsular Malaysia and Singapore. Seven species viz. Fissidens papillosus, Syrrhopodon fimbriatulus, Pyrrhobryum latifolium, Acroporium lamprophyllum, Papillidiopsis malayana, Radulina hamata and Trichosteleum mammosum are reported for the first time for the state of Selangor and Fissidens guangdongensis is a new record for Peninsular Malaysia. Calymperaceae is the largest family with 5 genera and 18 species, followed by Sematophyllaceae (8 genera, 10 species), Hypnaceae (3 genera, 5 species) and Fissidentaceae (1 genus, 5 species).*

## INTRODUCTION

The first account of mosses from the state of Selangor was that of Dixon (1926), in which he listed a total of 60 species in 37 genera and 14 families. These early collections of mosses were made mainly by H. N. Ridley and I. H. Burkill from the Singapore Botanic Gardens. The latest and most comprehensive listing of mosses of Selangor was given by Mohamed and Tan (1988) in their checklist of mosses of Peninsular Malaysia and Singapore. They reported the presence of 136 species of mosses in 58 genera and 22 families, an addition of 76 species over 42 years. Recently, a couple of studies on the floristic composition of mosses have been carried out in the Langat Basin in Selangor. Mohamad and Gidiman (1990) enumerated a total of 36 species and 1 variety of mosses in 18 genera and 9 families from Bangi Forest Reserve and a total of 74 species and 1 variety of mosses in 37 genera and 22 families occur in the lowland dipterocarp forests in the Langat Basin (Damanhuri and Ajamain 1999).

Bangi Forest Reserve, Ayer Hitam Forest Reserve and Bukit Tunggul Forest Reserve were once contiguous, but as new townships and highways were developed in the area, these forests became fragmented and isolated. Historically, these forests were logged several times in the last 60 years. Bangi FR and Ayer Hitam FR are twice-logged over forests. Although Ayer Hitam Forest Reserve is not situated in the Langat Basin, it is adjacent to it and situated about 25 km from Bangi Forest Reserve.

## MATERIALS AND METHODS

During the Ayer Hitam Forest Reserve Scientific Expedition organised by the Faculty of Forestry, Universiti Putra Malaysia from 2-5 May 2000, moss specimens were collected from various parts

of the area. Various microhabitats of mosses such as exposed tree roots, tree-buttresses, tree trunks, rotten logs, soil, surfaces and crevices of rocks and boulders etc. were carefully surveyed in order to obtain as many specimens and species as possible. Special attention was given to areas along the main river in the area, Sungai Rasau which flows through the middle of the Forest Reserve and the smaller streams because the moist and shady environment there are very conducive for the growth of bryophytes.

## RESULTS AND DISCUSSION

A total of 138 specimens of mosses were collected and these are deposited in the Bryophyte Herbarium, Universiti Kebangsaan Malaysia, Bangi (UKMB). The mosses enumerated in this paper were based on the above collections.

The moss flora of Ayer Hitam Forest Reserve comprises 43 species and 1 variety in 22 genera and 9 families (Appendix 1). This represents 9.1% of the 481 species, 17.7% of the 124 genera and 26.5% of the 34 families of mosses reported for Peninsular Malaysia and Singapore, and about 32.4% of the 136 species, 37.9% of the 58 genera and 40.9% of the 22 families recorded for the state of Selangor (Mohamed and Tan 1988). Out of the 44 taxa of mosses recorded, 7 species in 7 genera and 3 families are reported for the first time for Selangor viz. *Fissidens papillosus, Syrrhopodon fimbriatulus, Pyrrhobryum latifolium, Acroporium lamprophyllum, Papillidiopsis malayana, Radulina hamata* and *Trichosteleum mammosum.* Another species, *Fissidens guangdongensis* is a new record for Peninsular Malaysia. The occurrence of *F. guangdongensis* in Peninsular Malaysia was pointed out to us by Prof. Benito Tan of the National University of Singapore based on a specimen collected from Gunung Kajang, Pulau Tioman (A. Damanhuri 1065, UKMB). This species which prefers to grow on termite or ant nests in shady places seem to be quite common in Peninsular Malaysia. To date, we have seen and collected specimens from Hulu Langat (Selangor), Sungkai (Perak) and Taman Negara (Pahang). *Fissidens guangdongensis* is known to be distributed from southern China to Japan and the Philippines.

In terms of moss family, Calymperaceae is the largest with 5 genera and 18 species, followed by Sematophyllaceae (8 genera, 5 species), Hypnaceae (3 genera, 5 species) and Fissidentaceae (1 genus, 5 species). The family Calymperaceae is also very well represented in other lowland rain forests in Peninsular Malaysia (Damanhuri 1999, 2000; Damanhuri and Ajamain 1999; Mohamed and Mohamad 1987).

The number of moss species found in the Ayer Hitam Forest Reserve (1248 ha) is found to be higher than that reported for Bangi Forest Reserve (138 ha), a small isolated forest in the Langit Basin, Selangor (Table 1). This could be due to the larger land area of Ayer Hitam Forest Reserve and also the presence of several small rivers and streams in the area compared to Bangi Forest Reserve, which is devoid of streams. The number of mosses in Ayer Hitam Forest Reserve is about 58.7% of the 75 taxa found in the lowland rain forests (Hulu Langat Forest Reserve, Sungai Lalang Forest Reserve and Sungai Jeloh Forest Reserve) in the Langat Basin (30923 ha) (Table 1).

## CONCLUSION

For a small patch of isolated lowland forest in the midst of the Klang Valley which is less than 1300 ha in size, this Forest Reserve supports quite an interesting moss flora worthy of further scientific study and conservation. The high level of species occurrence is important for the long-term monitoring study of an isolated forest such as this. Seven of the species found here are new additions to the bryoflora of the state of Selangor and the presence of *Fissidens guangdongensis*, a new record for Peninsular Malaysia, shows that our knowledge about these tiny plants in this pocket of logged-over lowland forest is still far from satisfactory and complete. This is more reason why we should strive to propose for the conservation of some small green lungs in the midst of bustling developing areas.

## ACKNOWLEDGEMENT

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TABLE 1
Summary of moss taxa and numbers reported from Ayer Hitam Forest Reserve, Bangi Forest Reserve (Mohamad & Gidiman 1990) and Langat Basin, Selangor (Damanhuri & Ajamain 1999).

| | Locality | Ayer Hitam FR | | Bangi FR | | Langat Basin | |
|---|---|---|---|---|---|---|---|
| | Family | Genus | Species | Genus | Species | Genus | Species |
| 1. | Bartramiaceae | - | - | 1 | 1 | - | - |
| 2. | Bryaceae | 1 | 1 | 2 | 3 | 1 | 1 |
| 3. | Calymperaceae | 5 | 18 | 3 | 13 | 6 | 33 |
| 4. | Dicranaceae | - | - | 1 | 1 | 1 | 1 |
| 5. | Diphysciaceae | - | - | - | - | 1 | 1 |
| 6. | Ephemeropsaceae | - | - | - | - | 1 | 1 |
| 7. | Fissidentaceae | 1 | 4 + 1 var. | 1 | 3 + 1 var. | 1 | 6 + 1 var. |
| 8. | Hookeriaceae | 1 | 1 | - | - | 2 | 2 |
| 9. | Hypnaceae | 3 | 5 | 2 | 6 | 1 | 2 |
| 10. | Hypnodendraceae | - | - | - | - | 1 | 1 |
| 11. | Leucobryaceae | 1 | 1 | 3 | 4 | 1 | 2 |
| 12. | Meteoriaceae | - | - | - | - | 1 | 1 |
| 13. | Myuriaceae | 1 | 1 | - | - | 1 | 1 |
| 14. | Neckeraceae | - | - | - | - | 4 | 5 |
| 15. | Octoblepharaceae | - | - | - | - | 1 | 1 |
| 16. | Orthotrichaceae | - | - | - | - | 2 | 2 |
| 17. | Phyllodrepaniaceae | - | - | - | - | 1 | 1 |
| 18. | Plagiotheciaceae | - | - | - | - | 1 | 1 |
| 19. | Polytrichaceae | - | - | - | - | 1 | 1 |
| 20. | Pottiaceae | - | - | 2 | 2 | 1 | 1 |
| 21. | Pterobryaceae | - | - | - | - | 1 | 1 |
| 22. | Rhizogoniaceae | 1 | 2 | - | - | 1 | 1 |
| 23. | Sematophyllaceae | 8 | 10 | 3 | 3 | 4 | 5 |
| 24. | Thuidiaceae | - | - | - | - | 2 | 3 |
| Total | No. | 22 | 43 + 1 var. | 18 | 36 + 1 var. | 37 | 74 + 1 var. |

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## Appendix 1

Checklist of mosses in Ayer Hitam Forest Reserve, Selangor.

The arrangement of families follows that of Crosby and Magill (1978) with slight modifications. The habitat and distribution within Peninsular Malaysia are given. Species reported for the first time for Selangor are marked with '*' and '**' indicates new records for Peninsular Malaysia.

### 1. FISSIDENTACEAE

1.1 ***Fissidens ceylonensis*** Dozy & Molk.
A. Damanhuri 2000-173. On thin soil over surface of rock, in partial shade. All states.

1.2 ***F. crassinervis*** Sande Lac. var. *crassinervis*
A. Damanhuri 2000-262, 2000-238 and 2000-239. On soil in partial shade to open sites. All states.

1.3 ***F. crassinervis*** var. ***laxus*** (Sull. & Lesq.) A. Eddy
A. Damanhuri 2000-218, 2000-240, 2000-241, 2000-260 and 2000-263. On soil in partial shade to open sites. All states.

1.4 ****F. guangdongensis*** Z. Iwats. & Z. H. Li
A. Damanhuri 2000-287. On ant nest in full shade.

1.5 ****F. papillosus*** Sande Lac.
A. Damanhuri 2000-237. On termite nest in full shade. Pahang

### 2. LEUCOBRYACEAE

2.1 ***Leucobryum sanctum*** (Brid.) Hampe
A. Damanhuri 2000-252 and 2000-267. On rotten log and on surface of boulder in partial shade. All states.

### 3. CALYMPERACEAE

3.1 ***Arthrocormus schimperi*** (Dozy & Molk.) Dozy & Molk.
A. Damanhuri 2000-162, 2000-170, 2000-184 and 2000-219. On buttresses and at base of trees and palms, in partial to full shade. All states.

3.2 ***Calymperes erosum*** Müll. Hal.
A. Damanhuri 2000-242 and 2000-244. On thin soil at base of trees, in partial to full shade. Johor, Pahang, Perak, Pulau Langkawi, Pulau Pinang and Selangor.

3.3 ***C. lonchophyllum*** Schwägr.
A. Damanhuri 2000-168 and 2000-176. On tree trunks in full shade. Johor, Pahang, Perak, Pulau Langkawi, Pulau Pinang and Selangor.

3.4 ***C. moluccense*** Schwägr.
A. Damanhuri 2000-245. On tree trunk in full shade. Pahang, Perak and Selangor.

3.5 ***Leucophanes octoblepharoides*** Brid.
A. Damanhuri 2000-167, 2000-172, 2000-179, 2000-188, 2000-182, 2000-190, 2000-266, 2000-272, 2000-273, 2000-276, 2000-279, 2000-280, 2000-281, 2000-285 and 2000-291. On lianas, tree trunks and occasionally on rotten logs in partial to full shade. All states.

3.6 ***Mitthyridium constrictum*** (Sull.) H. Rob.
A. Damanhuri 2000-164. On fallen branch. Pahang and Selangor.

3.7 ***M. fasciculatum*** (Hook. & Grev.) H. Rob.
A. Damanhuri 2000-185, 2000-209 and 2000-222. On tree trunks in partial to full shade. Johor, Kedah, Pahang, Perak, Selangor and Terengganu.

3.8 ***M. flavum*** (Müll. Hal.) H. Rob.
A. Damanhuri 2000-202, 2000-261, 2000-271, 2000-274 and 2000-282. On tree trunks in partial to full shade. Pahang, Perak, Pulau Langkawi and Selangor.

3.9 ***M. jungquilianum*** (Mitt.) H. Rob.
A. Damanhuri 2000-203, 2000-204, 2000-221, 2000-246, 2000-269, 2000-278 and 2000-292. On tree trunks in full shade. Johor, Pahang, Perak and Selangor.

3.10 ***M. repens*** (Harv.) H. Rob.
A. Damanhuri 2000-161, 2000-183, 2000-243, 2000-268, 2000-270 and 2000-290. On tree trunks in partial shade. Johor, Melaka, Pahang, Perak, Pulau Pinang and Selangor.

***3.11 M. undulatum*** (Dozy & Molk.) H. Rob.
A. Damanhuri 2000-207, 2000-208, 2000-277, 2000-288 and 2000-289. On tree trunks in full shade. Johor, Kedah, Perak and Selangor.

3.12 ***Syrrhopodon albovaginatus*** Schwägr.
A. Damanhuri 2000-160 and 2000-178. On rotten logs in full shade. Pahang, Perak, Pulau Langkawi, Pulau Pinang and Selangor.

**3.13** ***S. aristifolius*** Mitt.
A. Damanhuri 2000-177 and 2000-286. On tree trunks in partial to full shade. Johor, Melaka, Pahang, Perak and Selangor.

**3.14** ***S. croceus*** Mitt.
A. Damanhuri 2000-165. On tree trunk in full shade. Johor, Kedah, Kelantan, Pulau Pinang and Selangor.

**3.15** ****S. fimbriatulus*** Müll. Hal.
A. Damanhuri 2000-250. On tree trunk in full shade. Johor and Perak.

**3.16** ***S. involutus*** Schwägr.
A. Damanhuri 2000-284. On tree trunk in partial shade. Johor, Kedah, Melaka, Pahang, Perak, Pulau Pinang and Selangor.

***3.17*** ***S. muelleri*** (Dozy & Molk.) Sande Lac.
A. Damanhuri 2000-159, 2000-171, 2000-174, 2000-180, 2000-181, 2000-187 and 2000-191. On tree trunks in full shade. Johor, Kedah, Kelantan, Pahang, Perak, Pulau Langkawi, Pulau Pinang and Selangor.

**3.18** ***S. spiculosus*** Hook. & Grev.
A. Damanhuri 2000-163, 2000-166, 2000-169, 2000-175, 2000-186, 2000-189, 2000-206, 2000-214 and 2000-283. On soil, tree trunks, rotten logs and on vertical walls of boulders, in full shade. Johor, Kedah, Melaka, Pahang, Perak, Pulau Langkawi, Pulau Pinang and Selangor.

## 4. BRYACEAE

**4.1** ***Orthodontium infractum*** Dozy & Molk.
A. Damanhuri 2000-195 and 2000-295. On moist soil in partial shade. Pahang and Selangor.

## 5. RHIZOGONIACEAE

**5.1** ****Pyrrhobryum latifolium*** (Bosch & Sande Lac.) Mitt.
A. Damanhuri 2000-192 and 2000-254. On tree trunks in full shade. Johor, Negeri Sembilan, Pahang, Perak and Pulau Pinang.

**5.2** ***P. spiniforme*** (Hedw.) Mitt.
A. Damanhuri 2000-253. On vertical wall of boulder in full shade. All states.

## 6. HOOKERIACEAE

**6.1** ***Callicostella papillata*** (Mont.) Mitt.
A. Damanhuri 2000-210. On thin soil over rotting cloth in full shade. Johor, Pahang, Perak, Pulau Pinang and Selangor.

## 7. MYURIACEAE

**7.1** ***Oedicladium pseudorufescens*** (Hampe) B. C. Tan & Mohamed
A. Damanhuri 2000-213. On tree trunk in partial shade. Johor, Kelantan, Melaka, Perak, Pulau Pinang and Selangor.

## 8. SEMATOPHYLLACEAE

**8.1** **Acanthorrhynchium papillatum** (Harv.) M. Fleisch.
A. Damanhuri 2000-212, 2000-216, 2000-217, 2000-255, 2000-293 and 2000-294. On rotten logs and tree trunks in partial to full shade. All states.

**8.2** ***Acroporium joannis-winkleri*** Broth.
A. Damanhuri 2000-224. On rotten log in full shade. Pahang and Selangor.

**8.3** ****A. lamprophyllum*** Mitt.
A. Damanhuri 2000-198. On tree trunk in full shade. Kedah, Kelantan, Melaka and Pahang.

**8.4** ***Clastobryophilum bogoricum*** (Bosch & Sande Lac.) M. Fleisch.
A. Damanhuri 2000-220 and 2000-251. On tree trunks in full shade. Pahang, Perak and Selangor.

**8.5** ****Papillidiopsis malayana*** (Dixon) B. C. Tan
A. Damanhuri 2000-24 and 2000-249. On tree trunks in full shade. Kedah, Melaka, Pahang, Pulau Langkawi and Pulau Pinang.

**8.6** ****Radulina hamata*** (Dozy & Molk.) A. Jaeger
A. Damanhuri 2000-233. On rotten log in full shade. Pahang, Perak and Pulau Pinang.

**8.7** ***Taxithelium isocladum*** (Bosch & Sande Lac.) Renauld & Cardot
A. Damanhuri 2000-205 and 2000-259. On liana and trunk of a small tree, in full shade. All states.

**8.8** ***Trichosteleum boschii*** (Dozy & Molk.) A. Jaeger
A. Damanhuri 2000-196, 2000-197, 2000-201, 2000-228, 2000-230, 2000-231 and 2000-256. On liana, tree trunks, exposed roots and rotten logs, in partial shade. All states.

**8.9** ****T. mammosum*** (M.ll. Hal.) A. Jaeger
A. Damanhuri 2000-226. On burnt wood in partial shade. Johor and Pulau Pinang.

**8.10** ***Trismegistia calderensis*** (Sull.) Broth.
A. Damanhuri 2000-232 and 2000-234. On surfaces of boulders in partial shade. Pahang and Selangor.

## 9. HYPNACEAE

**9.1** ***Ectropothecium buitenzorgii*** (Bél.) Mitt.
A. Damanhuri 2000-235. On thin soil over surface of boulder in full shade. All states.

**9.2** ***Isopterygium albescens*** (Hook. in Schwägr.) A. Jaeger
A. Damanhuri 2000-257. On small tree in full shade. Johor, Pahang, Perak and Selangor.

**9.3** ***I. minutirameum*** (Müll. Hal.) A. Jaeger
A. Damanhuri 2000-296. On rotten log. Johor, Kelantan, Pahang, Perak, Selangor and Terengganu.

**9.4** ***Vesicularia miquelii*** (Sande Lac.) M. Fleisch.
A. Damanhuri 2000-215, 2000-225, 2000-229 and 2000-248. On rotten logs in full shade. All states.

**9.5** ***V. reticulata*** (Dozy & Molk.) Broth.
A. Damanhuri 2000-247. On thin soil over rotting cloth in full shade. Johor, Perak, Perlis, Pulau Pinang and Selangor.

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# Tree Taxa Inventory at Ayer Hitam Forest Base-Camp

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**Keywords: Base-camp, tree species, endemic, education, Ayer Hitam**

## ABSTRAK

*Inventori yang dijalankan di sekitar kawasan perkhemahan melalui 6 denai baru mendapati 86 spesies pokok tumbuhan berbiji yang terkandung di dalam 68 genera dan 32 famili. Daripada jumlah tersebut 22 merupakan spesies balak, 9 spesies buah-buahan, 3 spesies ubat-ubatan dan 8 spesies pokok yang mengeluarkan bahan pencelup dan tanin. Daripada kesemua takson ini sebanyak 6 spesies yang endemik kepada Semenanjung Malaysia juga terdapat di kawasan ini; dua daripadanya adalah rekod baru bagi Negeri Selangor. Kawasan tapak perkhemahan ini sesuai dijadikan kawasan pembelajaran dan latihan amali bagi kursus-kursus berkaitan perhutanan dan alam sekitar.*

## ABSTRACT

*An inventory at the base camp along 6 new trails recorded a total of 86 species of seed plant taxa in 68 genera and 32 families. Of this number 22 timber species, 9 fruit tree species, 3 species with medicinal values and 8 species producing dye and tannins were identified. 6 Peninsular Malaysian endemics are also found here, two being new records for Selangor. This area is useful for teaching and practical training for forestry related and environmental courses.*

## INTRODUCTION

Ayer Hitam Forest Reserve, which is located within the Multimedia Super Corridor that connects Kuala Lumpur with the new administrative city of Putrajaya and business city of Cyberjaya plays a major role in teaching, research and extension works for Universiti Putra Malaysia. It is a support facility of the university for studies in forest management, recreation, botany, wildlife and other related fields. Besides being used for various educational purposes, this forest also offers research opportunities for scientists interested in working on tropical lowland forest ecosystems (Awang Noor *et al.* 1999).

At least 60 different studies have been carried out since 1996 when the Selangor State Government leased this forest to UPM for 80 years and the Faculty of Forestry is entrusted to manage. A few related aspects of plant diversity studies in this forest have been discussed in Faridah Hanum and Nurulhuda Hamzah (1999), Faridah Hanum (1999) and Faridah Hanum and Zamri Rosli (2000).

In this paper, an assessment on the suitability of the Ayer Hitam Forest base camp area for teaching forest related courses and environment in the university and its vicinity will be discussed. The base camp was established in 1996 in Compartment 15 at the entrance of the forest fringing a new housing estate. This compartment covers an area of 200 ha with slopes up to 10%.

## METHODOLOGY

6 trails namely A, B, C, D, E and F were identified based on easy accessibility from the base camp area (Figure 1). All trees greater than 5 cm at diameter breast height were aluminum tagged systematically and identified along these trails. Fertile specimens were collected and deposited at the Herbarium, Faculty of Forestry, Universiti Putra Malaysia.

## RESULTS AND DISCUSSION

Eighty-six species of tree taxa in 68 genera and 32 families were recorded from the base camp area. The most diverse families in terms of spe-

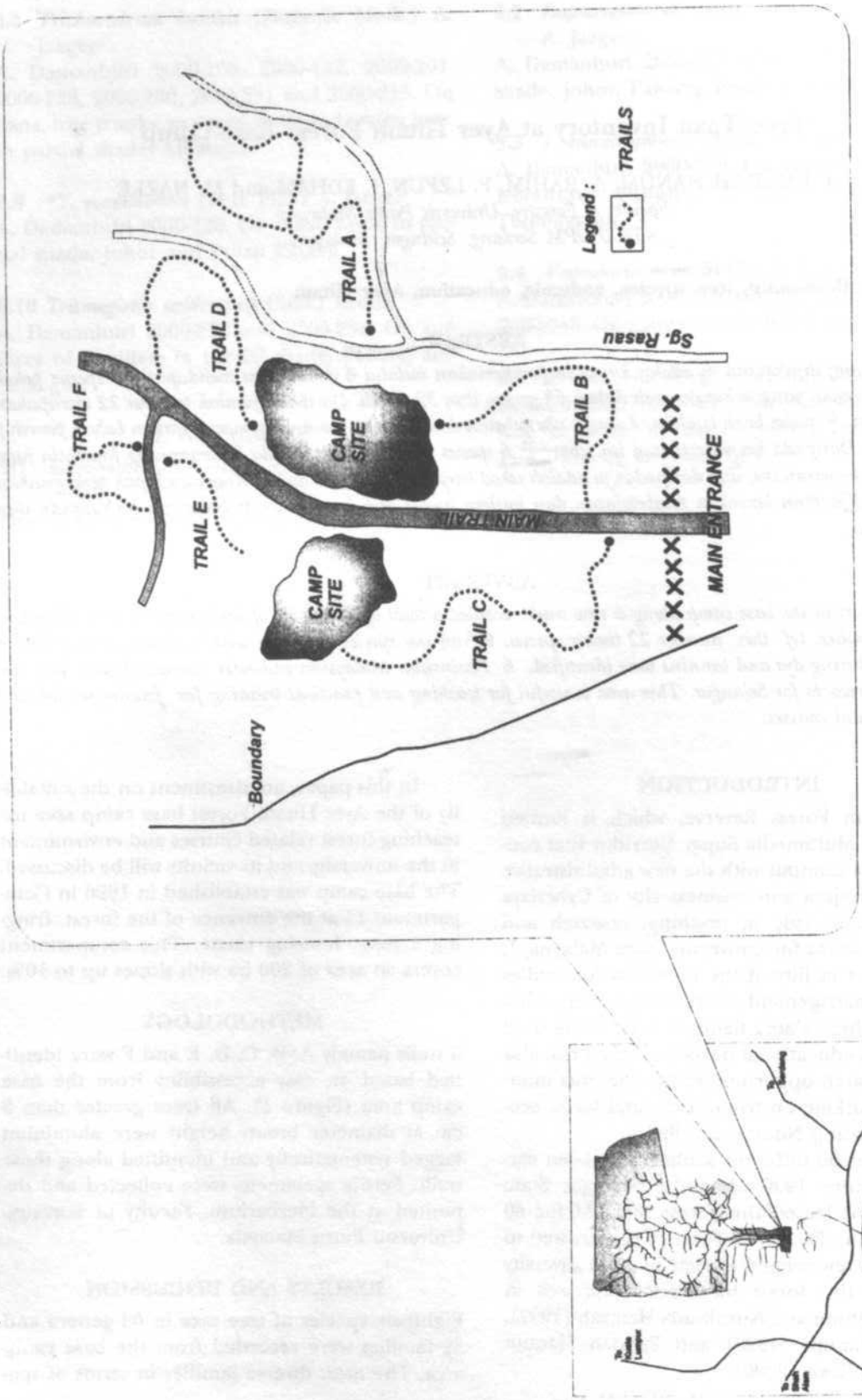


*Fig. 1: Location of trails at Ayer Hitam Forest Reserve base camp*

cies are Anacardiaceae (7 spp.), Euphorbiaceae (7 spp.) and Myristicaceae (7 spp.). (Table 1). Twenty two species from the total number of species identified in this area are classified as major commercial timbers included in 18 genera and 12 families as categorized by Soerianegara and Lemmens (1994) (Table 1). This constitutes about one-sixth of the total number of known timber species existing in this forest (Faridah Hanum 1999). Nine tree species recorded are edible fruit trees (Verheij and Coronel 1992), viz., Anacardiaceae (1 species), Burseraceae (2 species), Euphorbiaceae (2 species), Meliaceae (1 species) and Sapindaceae (2 species). These wild species were seen eaten by birds and small mammals during the inventory (Table 1).

Tree species with medicinal properties are *Calophyllum rubiginosum, Endospermum diadenum, Scaphium macropodum* and *Shorea leprosula* (Jansen *et al.* 1991). Details on the composition and uses of medicinal plants of this forest were discussed at length in Faridah Hanum and Nurulhuda Hamzah (1999). Besides timber, edible fruit and medicinal trees, this area houses a number of ethnobotanically useful species for tannins and dyes as a secondary product. 8 taxa were recorded to produce tannin and dye (Lemmens and Soetjipto 1992) (Table 1). Besides producing a dye, *Garcinia cowa* is also a vegetable (Lemmens and Soetjipto 1992).

TABLE 1
List of species at Ayer Hitam Forest Reserve base camp

| Family | Scientific name | Uses | | Remarks |
|---|---|---|---|---|
| Anacardiaceae | *Bouea macrophylla* Griff. | EF | | |
| | *Bouea oppositifolia* (Roxb.) Meisn. | T | | |
| | *Buchanania sessifolia* Blume | | | |
| | *Campnosperma squamatum* Ridl. | T | | |
| | *Gluta malayana* (Corner) Ding Hou | | | |
| | *Gluta torquata* (King) Tardieu | | | |
| | *Melanochyla fulvinervis* (Blume) Ding Hou | | | |
| Annonaceae | *Monocarpia marginalis* (Scheff.) J. Sinclair | | | |
| | *Polyalthia rumphii* (Blume) Merr. | | | |
| | *Xylopia fusca* Maingay *ex* Hook. *f* & Thomson var. *sessiliflora* Kochummen & Whitmore | | Endemic | New record for Selangor. Previously recorded from Kedah, Negeri Sembilan and Johor only. |
| Apocynaceae | *Dyera costulata* (Miq.) Hook. *f.* | | | |
| Burseraceae | *Canarium littorale* Blume | EF | | |
| | *Canarium pseudosumatranum* Leenh. | EF | Endemic | |
| | *Dacryodes rugosa* (Blume)H.J.Lam | | | |
| | *Scutinanthe brunnea* Thwaites | | | |
| Dilleniaceae | *Dillenia obovata* (Blume) Hoogl. | | | |
| Dipterocarpaceae | *Shorea leprosula* Miq. | T,M,t | | |
| | *Shorea macroptera* Dyer. | T | | |
| | *Shorea parvifolia* Dyer ssp. *velutina* P.S. Ashton | T | | |
| | *Shorea platycarpa* F. Heim | T | | |
| | *Vatica cuspidata* (Ridl.) Symington | T | Endemic | |
| Ebenaceae | *Diospyros buxifolia* (Blume) Hiern | | | |
| | *Diospyros sumatrana* Miq. | | | |

TABLE 1 (Continued)

| | | | |
|---|---|---|---|
| Elaeocarpaceae | *Elaeocarpus nitidus* | | Endemic : New record for Selangor. Previously recorded from Terengganu, Perak and Pahang only |
| Euphorbiaceae | *Antidesma cuspidatum* Mull. Arg. | | |
| | *Baccaurea javanica* (Blume) Mull. Arg. | d | |
| | *Elateriospermum tapos* Blume | EF | |
| | *Endospermum diadenum* (Miq.) Airy Shaw | T,M | |
| | *Macaranga gigantea* (Rchb.*f* & Zoll.) Mull. Arg. | d,t | |
| | *Macaranga triloba* (Blume) Mull. Arg. | | |
| | *Sapium baccatum* Roxb. | EF | |
| Fagaceae | *Lithocarpus rassa* (Miq.) Rehder | | |
| Guttiferae | *Calophyllum rubiginosum* M.R. Hend. & Wyatt-Sm. | T,M | |
| | *Cratoxylun arborescens* (Vahl) Blume | T | |
| | *Garcinia cowa* Roxb. | d,v | |
| | *Mesua ferrea* L. | T,d | |
| Irvingiaceae | *Irvingia malayana* Oliv. *ex* Benn. | | |
| Ixonanthaceae | *Ixonanthes icosandra* Jack | | |
| Lauraceae | *Cinnamomum iners* Reinw. | | |
| | *Litsea grandis* (Wall. *ex* Nees)Hook.*f.* | | |
| Lecythidaceae | *Barringtonia macrostachya* (Jack) Kurz | Rare | |
| Leguminosae | *Adenanthera malayana* Kosterm. | | |
| | *Adenanthera pavonina* L. | T | |
| | *Callerya atropurpurea* (Wall.) Schot | | |
| | *Koompassia malaccensis* Maing. *ex* Benth | T | |
| | *Parkia speciosa* Hassk. | EF | |
| Melastomataceae | *Pternandra echinata* Jack | | |
| Meliaceae | *Aglaia malaccensis* (Ridl.) Pannell | | |
| | *Sandoricum koetjape* (Barn.*f.*) Merr. | EF,d | |
| Moraceae | *Artocarpus dadah* Miq. | T | |
| | *Artocarpus elasticus* Reinw. *ex* Blume | | |
| | *Artocarpus lanceifolius* Roxb. | T | |
| | *Ficus benjamina* L. | | |
| | *Ficus oligodon* Miq. | | |
| | *Streblus elongatus* (Miq.) Corner | | |
| Myristicaceae | *Gymnacranthera farquhariana* (Hook.*f.* & Thomson) Warb. | | |
| | *Horsfieldia polysphelura* (Hook.*f*) J. Sinclair | | |
| | *Knema furfuraceae* (Hook.*f.* & Thomson) Warb. | | |
| | *Knema intermedia* (Blume) Warb | | |
| | *Knema patentinervia* (J. Sinclair) W.J. de Wilde | | |
| | *Knema scortechinii* (King) J. Sinclair | | |
| | *Myristica iners* Blume | | |

TABLE 1 (Continued)

| | | | |
|---|---|---|---|
| Myrtaceae | *Rhodamnia cinerea* Jack | T,d,t, | |
| | *Syzygium papillosum* (Duthie) Merr. & L. Perry | | |
| | *Tristaniopsis whiteana* (Griff.) Peter G. Wilson & J. T. Waterh. | | |
| Olacaceae | *Ochanostachys amentacea* Mast. | T | |
| | *Strombosia javanica* Blume | | |
| Rhizhophoraceae | *Carallia brachiata* (Lour.) Merr. | | |
| | *Pellacalyx axillaris* Korth. | | |
| Rubiaceae | *Nauclea officinalis* (Pierre *ex* Pit) Merr. & Chun | | |
| | *Pertusadina malaccensis* Ridsdale | | |
| | *Porterandia anisophyllea* (Jack *ex* Roxb.) Ridl. | | |
| | *Timonius wallichianus* (Korth.) Valeton | | |
| Rutaceae | *Melicope glabra* (Blume) T.G. Hartley | | |
| Sapindaceae | *Nephelium lappaceum* L. var. lappaceum | EF | |
| | *Nephelium maingayi* Hiern | | |
| | *Xerospermum noronhianum* (Blume) Blume | EF | |
| Sapotaceae | *Palaquium gutta* (Hook.*f.*) Baill. | T | |
| | *Palaquium maingayi* (C.B. Clarke) King & Gamble | T | Endemic : Kedah, Kelantan, Perak, Pahang, Selangor, Negeri Sembilan, Melaka, Johor |
| | *Pouteria malaccensis* (C.B. Clarke) Baehni | T | |
| Sterculiaceae | *Scaphium macropodum* (Miq.) Beumee *ex* Heyne | T,M | |
| Thymelaeaceae | *Aquilaria malaccensis* Lam | | |
| | *Gonystylus affinis* Radlk. | T | |
| Tiliaceae | *Microcos antidesmifolia* (King) Burret | | |
| Ulmaceae | *Gironniera nervosa* Planch | | |
| Verbenaceae | *Vitex pinnata* L. | T,d | |

Note : T = timber
M = medicine
EF = edible fruit
t = tannin
d = dye
v = vegetable

Noteworthy trees around the Ayer Hitam Forest base camp include the endemic taxa in Peninsular Malaysia such as *Canarium pseudosumatranum, Elaeocarpus nitidus, Xylopia fusca* var. *sessiliflora, Palaquium maingayi* and *Vatica cuspidata*, the latter two being recorded for the first time in Selangor (Turner 1995). This area contains nearly half the total number of tree families, nearly one-third the total number of genera and one-quarter the total number of known taxa enumerated from this forest previously (Table 2).

## CONCLUSION

Due to a good representation of taxa over a small area, the base-camp area is suitable for conducting forestry related courses and practicals in the university and its immediate vicinity. Caution though on areas having rare and endemic species as they are potentially at the highest risk

TABLE 2
Comparison of the total number of tree taxa in Ayer Hitam Forest

| Source | No. family | No. genus | No. species |
|---|---|---|---|
| Faridah Hanum (1999) | 56 | 160 | 400 |
| Present enumeration | 32 | 68 | 86 |

of endangerment when not adequately represented and unprotected as is the case with the Ayer Hitam Forest. Should this forest be opened to the public in the future, all trails except one which houses the rare and endemic species can be used as interpretation trails exhaustively. Since species have a critical minimum population size and range for optimal existence, very small residual populations of the rare and endemic taxa in this forest maybe unlikely to persist (Simberloff 1992). This is further aggravated by the edge effects which may include invasion and modification of the species composition by the more common species abundant just outside this forest.

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# Notes on the Herbaceous Plants of Ayer Hitam Forest Reserve, Puchong, Selangor

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**Keywords : Herbaceous plants, new records, Ayer Hitam Forest Reserve**

## ABSTRAK

*Berdasarkan kepada tinjauan yang dijalankan terhadap tumbuhan herba, didapati 27 spesies herba yang mewakili 19 famili telah direkodkan di Hutan Simpan Ayer Hitam. Daripada jumlah ini 8 telah direkod untuk pertama kalinya dari hutan ini. Lima spesies endemik di Semenanjung Malaysia juga terdapat di hutan ini. Penemuan ini telah menambahkan senarai semak tumbuhan herba di Hutan Simpan Ayer Hitam kepada 86 species.*

## ABSTRACT

*A survey conducted on the plants of Ayer Hitam Forest Reserve recorded 27 species of herbaceous plants which represented 19 families. From this total, 8 species are recorded for the first time from this forest. Five species endemic to Peninsular Malaysia are also found here. This finding has increased the current herb checklist of Ayer Hitam Forest Reserve to 86 species.*

## INTRODUCTION

The Ayer Hitam Forest Reserve is currently used by the staff and students of UPM to conduct biological research, biodiversity related courses and practical training. This forest is a mixed dipterocarp lowland forest which had been selectively logged between 1936 and 1965. After 35 years of regeneration there are now 430 species of seed plant taxa in 203 genera and 72 families; and 14 families of fern and fern-allies with 33 species recorded (Faridah Hanum 1999). Since then only a few studies had been carried on the herbaceous plants in this forest, notably by Faridah Hanum and Nurulhuda Hamzah (1999), Nasir (1999) and Shariffudeen (1999).

## METHODS

Herbaceous plant specimens were randomly collected during the 3-day expedition from 3rd to 5th May 2000 along the highest hill trail, stream near the base camp and trail to the highest waterfall. The herbaceous plants in this context include fern and fern-allies and herbaceous seed plants. Plant identification and data gathering were partly done in the field and at the herbarium of the Biology Department, UPM. All the specimens were deposited in this herbarium.

## RESULTS AND DISCUSSION

27 species of herbaceous plants representing 19 families were collected from Ayer Hitam Forest Reserve (Table 1). The largest family of herbaceous plant collected was represented by fern and fern-allies (7 families, 10 spp.). By comparing the collections from previous works (Faridah Hanum and Nurulhuda 1999, Nasir 1999 and Shariffudeen 1999), 8 additional spp. were collected for the first time from Ayer Hitam Forest Reserve and added to the database of herbaceous plants. Of the total number of herbaceous species enumerated here (27 spp.), 6 species are known Peninsular Malaysian endemics. With this

TABLE 1
Herbaceous plants of Ayer Hitam Forest Reserve, Selangor

| Family | Species | Collection No. |
|---|---|---|
| Araceae | *Scindapsus hederaceus* Miq. | AH076 |
| Commelinaceae | *Amischotolype griffithii* (C.B. Clarke) I.M. Turner* | AH070 |
| | *Amischotolype gracilis* (Ridl). I.M. Turner | AH068 |
| Cyatheaceae | *Cyathea moluccana* R. Br. | AH054 |
| Cyperaceae | *Mapania cuspidata* (Miq.) var. *petiolata* (C.B. Clarke) Uittien | AH060 |
| | *Cyperus distans* L.*f.* | AH046 |
| Dryopteridaceae | *Tectaria barberi* (Hook) Copel. | AH053 |
| | *Tectaria vasta* (Blume) Copel. | AH075 |
| | *Tectaria singaporeana* (Hook. & Grev.) Copel | AH072 |
| Gesneriaceae | *Didymocarpus platypus* C.B. Clarke* | AH047 |
| | *Didymocarpus serratifolius* Ridl.* # | AH036 |
| Hanguanaceae | *Hanguana malayana* (Jack) Merr. | AH055 |
| Hemionitidaceae | *Syngramma wallichii* (Hook. ) Bedd * | AH048 |
| Marantaceae | *Donax grandis* (Miq.) Ridl. | AH079 |
| Melastomataceae | *Sonerila albiflora* Stapf *# | AH050,062 |
| | *Phyllagathis hispida* King *# | AH044 |
| | *Phyllagathis grifithii* (Hook. *f. ex* Triana) King # | AH042 |
| Myrsinaceae | *Labisia pumila* Blume | AH064 |
| Piperaceae | *Piper stylosum* Miq. | AH077 |
| Rubiaceae | *Hedyotis philippinensis* (Wild. *ex* Spreng) Merr. *ex* C.B. Rob | AH002 |
| Selaginellaceae | *Selaginella wallichii* (Hook. & Grev. ) Spring | AH040 |
| | *Selaginella intermedia* (Blume) Spring var. *internedia* | AH004 |
| Taccaceae | *Tacca leontopetaloides* (L.) Kuntze | AH003 |
| Taenitidaceae | *Taenitis blechnoides* (Willd.) Sw. | AH001 |
| Thelypteridaceae | *Pronephrium triphyllum* (Sw.) Holtum * | AH067 |
| Woodsiaceae | *Diplazium crenatoserratum* (Sw.) T. Moore | AH043 |
| Zingiberaceae | *Globba variabilis* Ridl. ssp. *variabilis*# | AH039 |

* Recorded for the first time in Ayer Hitam Forest
\# Endemic to Peninsular Malaysia

addition, the total number of endemic plant species in Ayer Hitam is now 26. Previously recorded endemics are trees (20 spp.) (Faridah Hanum 1999).

## CONCLUSION

Eight more species are added to the current checklist of herbaceous plants in Ayer Hitam Forest, now totalling 86 species. The findings suggest that the present data on herbaceous plants of Ayer Hitam Forest Reserve is still in the infancy stage and require further studies. It is not impossible that this forest harbours many species of herbaceous plant which may be potential resources of new drugs and ornamentals for the house and garden.

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# Pteridophyte Flora of Ayer Hitam Forest Reserve, Selangor, Peninsular Malaysia

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**Keywords : Pteridophyte flora, Ayer Hitam Forest Reserve**

**ABSTRAK**

*Sebanyak 39 spesies tumbuhan pteridofit yang tergolong dalam 22 genus dan 15 famili telah direkodkan di Hutan Simpan Ayer Hitam, Puchong, Selangor. Senarai spesies yang disediakan ini berasaskan koleksi di kawasan kajian dan data yang tersedia sebelumnya. Kepelbagaian spesies yang rendah ini adalah bersesuaian dengan kedudukan hutan ini sebagai hutan sekunder.*

**ABSTRACT**

*A total of 39 species of pteridophyte in 22 genera and 15 families has been recorded in Ayer Hitam Forest Reserve, Puchong, Selangor. The list of species prepared was based on collections in study area and previous available data. The diversity of species is low and consistent with the nature of the forest as a secondary forest.*

## INTRODUCTION

Ayer Hitam Forest Reserve is a lowland dipterocarp forest situated at about 3° 0' N to 3° 02. 20' N and 101°37.90' E to 101°40.00' E, approximately 20 kilometers southwest of Kuala Lumpur. The forest is about 1248 hectares in size and is divided into six compartments (Compartment 1, 2, 12, 13, 14 and 15). Each compartment was logged at different times in the past. To date a small number of pteridophytes was collected and reported (Faridah Hanum 1999). This expedition aims to complement the previous data and provide a checklist of pteridophytes for Ayer Hitam Forest Reserve.

## METHODS

Specimens were collected along the vicinity of the base camp and both sides along the major streams. All voucher specimens were prepared as herbarium specimens and are deposited at UKMB and UPM.

## RESULTS

Checklist of ferns and fern-allies collected in Ayer Hitam Forest Reserve (AHFR).

**Ferns Allies**

**Lycopodiaceae**
*Lycopodium cernuum* (L.) Pic Sem
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 80 [UPM]; 1999, Faridah Hanum & Nurulhuda UDA 62 [UPM].

**Selaginellaceae**
*Selaginella ascendens* Alderw.
AHFR: 15/9/98, Nasir Abdul Rachman NAR 26 [UPM].

*S. ciliaris* (Retz.) Spring
AHFR: 3/5/00, Ahmed Zainudin *et al.* AZ 6696 [UKMB].

*S. intermedia* ( Blume) Spring
AHFR: 15/8/98, Nasir Abdul Rachman NAR 8 [UPM]; 3/5/00, Ahmed Zainudin *et al.* AZ 6722 [UKMB].

*S. stipulata* (Blume) Spring
AHFR: 30/9/98, Nasir Abdul Rachman NAR 39 [UPM].

*S. wallichii* (Hook & Grev.) Spring
AHFR: 15/8/98, Nasir Abdul Rachman NAR 5 [UPM]; 4/5/00, Ahmed Zainudin *et al.* AZ 6736 [UKMB].

*S. willdenowii* (Desv.) Baker
AHFR: 4/5/00, Ahmed Zainudin *et al.* AZ 6688 [UKMB].

**Ferns**

**Adiantaceae**
*Cheillanthes tenuifolia* (Burm.*f.*) Sw. subsp. *tenuifolia*
AHFR: 19/10/99, Nurulhuda UDA 82[UPM].

*Syngramma wallichii* (Hook.) Bedd.
AHFR: 4/5/00 Ahmed Zainudin *et al.* AZ 6738 [UKMB].

*Taenitis blechnoides* (Willd.) Sw,
AHFR: 14/9/98, Nurulhuda UDA 41[UPM]; 3/5/00, Ahmed Zainudin *et al.* AZ 6688[UKMB].

**Aspleniaceae**
*Asplenium nidus* L.
AHFR: 13/10/98, Nasir Abdul Rachman NAR 50 [UPM]; 15/8/99, Nurulhuda UDA 5[UPM].

**Blechnaceae**
*Blechnum orientale* L.
AHFR: 30/8/98, Nasir Abddul Rachman NAR 20 [UPM]; 14/9/98, Nurulhuda UDA 42[UPM]; 3/5/00, Ahmed Zainudin *et al.* AZ 6689[UKMB].

**Cyatheaceae**
*Cyathea latebrosa* (Wall. ex Hook.) Copel.
AHFR: 15/8/98, Nasir Abdul Rachman NAR 1, NAR 4, NAR 13; 30/8/98, NAR 23, NAR 38; 5/10/98, NAR 43; 13/10/98, NAR 49 [UPM].

*C. moluccana* R. Br.
AHFR: 30/8/98, Nasir Abdul Rachman NAR 21; 15/9/98, NAR 28; 13/10/98, NAR 59 [UPM]; 3/5/00, Ahmed Zainudin *et al.* AZ 6718 [UKMB].

**Dennstaedtiaceae**
*Lindsaea ensifolia* Sw.
AHFR: 3/5/00, Ahmed Zainudin *et al.* AZ 6707 [UKMB].

**Dryopteridaceae**
*Tectaria baberi* (Hook.) Copel
AHFR: 2001, Rusea *et al.*

*T. crenata* Cav.
AHFR: 3/5/00, Ahmed Zainudin *et al.* AZ 6715 [UKMB].

*T. singaporeana* (Wall. ex Hook & Grev.) Copel.
AHFR: 30/8/98, Nasir Abdul Rachman NAR 11 [UPM].

*T. vasta* (Blume) Copel.
AHFR: 2001, Rusea *et al.*

**Gleicheniaceae**
*Dicranopteris linearis* (Burm.*f.*) Underw.
AHFR: 30/8/98, Nasir Abdul Rachman NAR 19 [UPM].

**Nephrolepidaceae**
*Nephrolepsis auriculata* (L.) Trimen
AHFR: 30/8/98, Nasir Abdul Rachman NAR 10 [UPM]

**Ophioglossaceae**
*Helmintostachys zeylanica* (L.) Hook.
AHFR: 17/9/99, Nurulhuda UDA 61[UPM]

*Ophioglossum pendulum* L.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 75 [UPM]; 1999, Nurulhuda & Faridah Hanum UDA 39 [UPM].

**Polypodiaceae**
*Lecanopteris sinuosa* (Wall. *ex* Hook.) Copel.
AHFR: 4/5/00, Ahmed Zainudin *et al.* AZ 6745 [UKMB].

*Platycerium coronarium* (J.King) Desv.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 43 [UPM].

*Pyrrosia nummulariifolia* (Sw.) Ching
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 10 [UPM]; 1999, Nurulhuda & Faridah Hanum UDA 70 [UPM] ; 4/5/00, Ahmed Zainudin *et al.* AZ 6688 [UKMB].

*P. piloselloides* (L.) M.G. Price
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 53 [UPM]; 1999, Nurulhuda & Faridah Hanum UDA 60 [UPM] .

**Schizaeaceae**
*Lygodium circinnatum* (Burm.*f.*) Sw.
AHFR: 18/9/98, Nurulhuda UDA 73 [UPM].

*L. flexuosum* (L.) Sw.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 65[UPM]

*L. longifolium* (Willd.) Sw.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 35[UPM]

*L. microphyllum* (Cav.) R. Br.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 59[UPM]

*Schizaea dichotoma* (L.) Sw.
AHFR: 17/9/98, Nurulhuda UDA 69[UPM].

*S. digitata* (L.) Sw.
AHFR: 1999, Nurulhuda & Faridah Hanum UDA 76[UPM]

**Thelypteridaceae**
*Mesophlebion chlamydophorum* (C. Chr.) Holttum
AHFR: 5/10/98, Nasir Abdul Rachman NAR 42[UPM].

*Pronephrium triphyllum* (Sw.) Holttum
AHFR: 4/5/00, Ahmed Zainudin *et al.* AZ 6735 [UKMB].

**Woodsiaceae**
*Diplazium allantoideum* M.G. Price
AHFR: 15/9/98, Nasir Abdul Rachman NAR 25 [UPM].

*D. crenatoserratum* (Blume) T. Moore
AHFR: 15/9/98, Nasir Abdul Rachman NAR 22, NAR 27 [UPM].

*D. riparium* Holttum
AHFR: 30/9/98, Nasir Abdul Rachman NAR 40; 5/10/98, Nasir Abdul Rachman NAR 45 [UPM].

*D. tomentosum* Blume
AHFR: 15/8/98, Nasir Abdul Rachman NAR 6 [UPM].

## CONCLUSION

The pteridophyte flora of Ayer Hitam Forest Reserve comprises one species of lycopod, six species of sellaginellas and 32 species of ferns. This represents about 6.02% of the 647 species, 42.8% families and 15.5% of genera reported for Peninsular Malaysia (Parris and Latiff 1997). Of these 39 taxa, 6 species were identified as new additions to the previous list (Faridah Hanum 1999). Most of the taxa are lowland elements and easily found on the forest floor or as epiphytes on rocks and trees by the trails. Despite the larger land area of Ayer Hitam Forest (1248 ha) in comparison to the Bangi Forest Reserve (Bidin and Jaman 1990), the number of pteridophyte taxa is less. This is most probably due to past deforestation and disturbances in this area.

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# Preliminary Study on Diversity and Abundance of Ichneumonids and Braconids (Insecta: Hymenoptera) at the Ayer Hitam Forest Reserve

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**Keywords: Diversity, abundance, Hymenoptera, Ayer Hitam Forest Reserve**

## ABSTRAK

*Satu kajian awal tentang kepelbagaian dan kelimpahan ichneumonid dan braconid (Insecta: Hymenoptera) di Hutan Simpan Ayer Hitam (AHFR), Universiti Putra Malaysia telah dijalankan dari 4 – 11 April 2000. Hasil kajian ini menunjukkan bahawa AHFR didiami oleh pelbagai spesies ichneumonid dan braconid. Secara keseluruhannya, didapati bahawa spesies ichneumonid adalah hampir dua kali lebih melimpah dan pelbagai berbanding braconid. Walau bagaimanapun, kedua-dua kumpulan serangga ini mempunyai kepelbagaian spesies yang lebih tinggi dan signifikan di bahagian tengah hutan berbanding di kawasan pinggir hutan. Dua lagi tambahan subfamili ichneumonid (Adelognathinae dan Orthopelmatinae) untuk Malaysia telah ditemui dari hutan ini.*

## ABSTRACT

A *preliminary study on diversity and abundance of ichneumonids and braconids (Insecta: Hymenoptera) of Ayer Hitam Forest Reserve (AHFR) of Universiti Putra Malaysia was conducted from 4 – 11 April 2000. Results showed that AHFR houses a variety of ichneumonid and braconid species. Generally, the ichneumonids were nearly twice as abundant and diverse than braconids. However, both insect groups were significantly more diverse in the middle than in the forest fringes. Two more additions of ichneumonid subfamilies (Adelognathinae and Orthopelmatinae) for Malaysia were discovered from this forest.*

## INTRODUCTION

Insects are the most abundant animals on earth and two-thirds of insects inhabit the tropical rain forest. In Peninsular Malaysia, majority of these insects occupy the lowland forests. These forests provide habitats for thousands of insect species that are functionally important to the forest ecosystems. Insects can be pollinators, decomposers, herbivores, predators or parasitoids. Most parasitoids are in the order of Hymenoptera. They use or parasitize other insects for reproduction. As such, they are important regulators of other insect populations, mostly herbivores feeding on various parts of plants.

In recent years however, the rate of deforestation in the lowland forests is rather alarming. The destruction of natural habitats due to logging and development pose the greatest threat to insect communities in the forests. Since the parasitoid reproduction depends on other insects, their own population and role will be severely affected by the reduction of host population as a consequent of habitat destruction. In view of the changing ecosystem of Ayer Hitam Forest Reserve and its vicinity, a study on the diversity of Ichneumonids and Braconids, the two important group of parasitic Hymenoptera was conducted. Presently, scanty information is available on these in Malaysia except those of Idris (1996a and 1996b), Idris and Nur Azura (1998) and Nor Azura and Idris (1998).

## MATERIALS AND METHODS

The study was conducted at Ayer Hitam Forest Reserve (AHFR), Puchong, Selangor, about 20 km southwest of Kuala Lumpur and 6 km from Universiti Putra Malaysia (UPM), Serdang Campus, Selangor, Malaysia, at latitudes between 20° 57' N to 30° 04' N and longitudes 101° 38'E to 101° 41'E. The AHFR is an undulating lowland dipterocarp forest ranging from 15 m to 157 m above sea level, managed as a forest reserve by the Forest Office of Central Selangor and was selectively logged between 1936 and 1965 (Mohamad Zakaria and Rahmat Topani 1999). The study sites were located within compartments 1, 2, 12, 13, 14 and 15 of AHFR that has been leased to UPM for 80 years under an agreement between Universiti Putra Malaysia and the state government of Selangor.

Two transects were established within the compartments, both were parallel to each other and 200 m apart. There were three sampling points (= treatments) chosen along each transect across the compartments viz., two each at both ends and one in middle. The distance between the points was between 200 and 250 m, and 30 - 50 m from the outer sampling point to forest edge. A total of six malaise traps were used and one trap was placed at each sampling point beginning 4 until 11 September 2000. Traps were left in the forest for eight days before insects were collected and brought to the laboratory for sorting and identification. The specimen identification was made based on Wahl and Sharkey (1993) and Townes and Chiu (1970).

In reducing error and getting a more representative data, the insects collected from similar sampling point of two transects were pooled before analysis. Data were analyzed using GW Basic program to get differential species diversity between sampling points (Robinson, 1991) while $\chi^2$ was used to analyze differences in species and individual abundance among sampling points

## RESULTS AND DISCUSSION

*Abundance*

The ichneumonids and braconids collected are shown in Tables 1 and 2. There were eight ichneumonid subfamilies collected viz., Cryptinae, Anomaloninae, Cremastinae, Adelognathinae, Diplazontinae, Orthopelmatinae, Pimplinae, Collyriinae and the seven braconid subfamilies include Agathidinae, Rogadinae, Microgastrinae, Gnamptodontinae, Opiinae, Cheloninae and Doryctinae. A total of 38 morphospecies and 95 individual ichneumonids were collected. The braconids on the other hand had only 14 morphospecies and 27 individuals (Table 2), 3 – 4 times less abundant than ichneumonid. Braconids also seemed to be less abundant than ichneumonids in the Permanent Forest Reserve of Universiti Kebangsaan Malaysia (PFR-UKM) (Idris 1996b). As such, results of this study tend to disagree with universal claim that in tropical regions braconids are more abundant than ichneumonids (Noyes 1989, La Salle and Gauld 1993).

Of the eight ichneumonid subfamilies collected, the cryptine had the most numbers of morphospecies (22) and individuals (58) as compared with other subfamilies and morpho-species numbered 22, seemed to be the most abundant in AHFR (Table 1). This tends to agree with what was reported by Wahl and Sharkey (1993) as the majority of cryptine species are generalist and/or idiobiont parasitoid having wide host ranges irrespective of habitats. The morpho-species numbered 21 (Table 1) seemed to occur at all sampling points, indicating they are the least group that could be severely affected by habitat disturbances. As for braconids, however, no single subfamily seemed to have more number of morphpospecies over the others (Table 2). This indicates that AHFR does not have much resource to support braconid populations.

Although the collection was made for a period of one week, this study was successful in adding two more ichneumonid subfamilies for Malaysia, i.e., Adelognathinae and Orthopelmatinae, from 18 as listed by Idris (2000) to 20 subfamilies (55% of the total subfamilies recorded in the world). Interestingly, these two subfamilies were not collected from the PFR-UKM located only 15 km away from AHFR although studies at PFR-UKM was conducted for almost three consecutive years (Idris 2000, Hasnah 1999). This indicates that AHFR has plants and food sources that support the insect hosts of Adelognathinae and Orthopelmatinae as well as the parasitoids.

There was a significant difference in the number of species and total individuals of ichneumonids or braconids collected among

TABLE 1
List of Ichneumonidae collected from Ayer Hitam Forest Reserve, UPM

| Subfamily | Sampling Point[a] | Morphospecies | Number of Individuals |
|---|---|---|---|
| Cryprinae | I | 1 | 1 |
| | | 10 | 1 |
| | | 14 | 3 |
| | | 16 | 3 |
| | | 17 | 1 |
| | | 18 | 1 |
| | | 19 | 4 |
| | | 21 | 1 |
| | | 22 | 8 |
| | II | 2 | 1 |
| | | 3 | 1 |
| | | 4 | 1 |
| | | 5 | 1 |
| | | 6 | 1 |
| | | 7 | 1 |
| | | 8 | 1 |
| | | 9 | 1 |
| | | 11 | 1 |
| | | 12 | 1 |
| | | 13 | 1 |
| | | 15 | 5 |
| | | 19 | 1 |
| | | 20 | 1 |
| | | 21 | 4 |
| | | 22 | 13 |
| | III | 21 | 3 |
| Anomaloninae | I | 1 | 2 |
| | | 2 | 3 |
| | | 3 | 1 |
| | | 4 | 1 |
| Cremastinae | I | 1 | 1 |
| Adelognathinae | I | 1 | 6 |
| Diplazontinae | I | 1 | 2 |
| Diplazontinae | II | 1 | 1 |
| | | 2 | 1 |
| Orthopelmatinae | II | 1 | 1 |
| | | 2 | 1 |
| | | 3 | 1 |
| Pimplinae | II | 1 | 1 |
| | | 2 | 5 |
| | | 3 | 4 |
| Collyrinae | II | 1 | 2 |
| Pimplinae | III | 1 | 1 |
| Total | 8 | 39 | 95 |

a I, Inner, II (middle), III(near forest fringes)

TABLE 2
List of Braconidae collected at Ayer Hitam Forest Reserve, UPM

| Subfamily | Sampling Point[a] | Morphospecies | Number of Individuals |
|---|---|---|---|
| Agathidinae | I | 1 | 1 |
| Rogadinae | I | 1 | 1 |
| Microgastrinae | I | 1 | 1 |
| | | 2 | 5 |
| Agathidinae | II | 1 | 1 |
| | | 2 | 1 |
| Gnamptodontinae | II | 1 | 3 |
| | | 2 | 1 |
| Opiinae | II | 1 | 1 |
| | | 2 | 1 |
| | | 3 | 1 |
| Microgastrinae | II | 1 | 1 |
| | | 2 | 1 |
| | | 3 | 3 |
| Cheloninae | II | 1 | 1 |
| Doryctinae | II | 1 | 2 |
| | | 2 | 1 |
| Microgastrinae | III | 1 | 1 |
| Total 7 | | 14 | 27 |

a I, Inner, II (middle), III(near forest fringes)

sampling points ($\chi^2$ = 22.3 or 15.3, df = 2) (Tables 1 and 2). Both parasitoid populations tend to be lower at the forest fringes than in the middle (Tables 1 and 2). This is probably due to the abundance of insect hosts and food sources which increases from the forest fringe towards the interior forest. The ground-dwelling insects in AHFR were also found to be more abundant in the middle of the forest (Sajap *et. al.* 1999). In Sulawesi, Indonesia, parasitic hymenopterans are more abundant along the forest edge than in the inner forest (Noyes 1989). This was said to be due to plenty of nectar sources along the forest edge as compared to the inner forest.

*Diversity*

The diversity (Shannon index, H') for ichneumonid and braconid species is shown in Table 3. For ichneumonid species, H' was significantly higher ($P < 0.05$) at the sampling points 'I' (innermost) and 'II' (middle) than at the sampling point 'III' (forest fringes). In contrast, the braconid species was significantly more diverse at 'II' (H' = 2.45) than at 'I' (H' = 1.07) or 'II' (H' = 0). Generally, species diversity is influenced by the combination of two important factors i.e., the species evenness (E) and species richness (R) (Pielou 1975). However, our results suggest that 'E' plays a more important role in determining diversity than that of 'R'. As shown in Table 3, the ichneumonid species was less abundant at sampling point 'I' (R = 4.09) than at 'II' (R = 6.07) but its evenness was just slightly higher at 'I' (E = 0.89) than at II (0.86). Similarly for the braconids, the low H' value at 'I' may due to the low E rather than R value. There was no H' value for braconid species at 'III'. This was simply due to only one species or individual collected. Higher diversity in the middle of the

TABLE 3
Shannon index for species diversity (H'), evenness (E) and Margalef's index (richness, R) among plots for Ichneumonids and Braconids collected from Ayer Hitam Forest Reserve

| Family | Sampling Point[a] | H' | E | R |
|---|---|---|---|---|
| Ichneumonids | I | 2.49a | 0.89 | 4.09 |
| | II | 2.76a | 0.86 | 6.07 |
| | III | 0.56b | 0.81 | 0.72 |
| Braconidae | I | 1.07b | 0.77 | 2.44 |
| | II | 2.45c | 0.95 | 4.15 |
| | III | 0a | 0.00 | 0.00 |

[a] I, Inner, II (middle), III(near forest fringes).
In Column, the H' values with same letters are not significantly different (paired t-test, $P > 0.05$)

AHFR than in the forest fringes is expected as availability of life support resources (insect hosts and food/nectar sources) are more in the middle than in forest fringes. As discussed in the 'abundance' section above, the resource availability in the interior than at the edge of AHFR may play a big role in determining the H' value of the parasitoids. The abundance of insect hosts and food sources are important for the life and reproduction of most parasitic Hymenoptera such as ichneumonid and braconids (Jervis and Kidd 1996, Jervis *et al.* 1993). Sajap *et al.* (1999) also reported that the diversity of ground-dwelling insects increases from the forest fringes toward the centre of the forest.

It is interesting to note that H' of braconids at 'I' was significantly less diverse than at 'II' (Table 3). Unlike ichneumonids, the braconids are generalist parasitoids, and most probably they have high numbers of insect host species available around point 'II' than point 'I'. The specialist parasitoids such as ichneumonids are very mobile and actively find its hosts that are scattered in the landscape or forest (Hawkin and Sheehan 1994). Therefore, they have a higher probability of being trapped than the braconids.

## CONCLUSION

Results of our preliminary study indicated that AHFR has diverse ichneumonid and braconid species. AHFR currently acts as a refuge for many animals including insects nearby that are adversely affected by loss of habitats due to forest destruction and fragmentation. However, the current diversity of these parasitoids may decline if their life supports' resources continue to deplete as a result of forest disturbances. The longevity and fecundity of many parasitoids is highly correlated with the availability of nectar sources (Idris and Grafius 1995). The on-going and future projects such as housing estates and infrastructure construction occurring around the AHFR may also change the forest environment conditions that may be unfavorable to the ichneumonids and braconids, their insect hosts and associated food plants.

It is expected that more insects will be collected if the experiment is prolonged for at least a year. By so doing, information on the distribution pattern and presence of some new species could be recorded. This information may help us to understand which species may be a keystone species, endemic to AHFR or useful to be used as an indicator of habitat disturbance. Since Adelognathinae and Orthopelmatinae species have only been recorded in temperate areas, it is worthwhile to further investigate these taxa together with their hosts and plants that associate with them.

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# Potential of Ayer Hitam Forest Reserve, Selangor as a Wildlife Reserve

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**Keywords : Wildlife reserve, Ayer Hitam Forest, legislative provisions**

## ABSTRAK

*Dalam kepesatan pembangunan, Hutan Simpan Ayer Hitam kini menjadi sebagai satu tempat pertahanan terakhir bagi pemuliharaan fauna dan flora di Lembah Klang. Lokasi strategiknya menarik pelbagai ancaman, terutamanya daripada pemaju tanah dan industri. Keselamatan sebidang tanah ini mulai tergugat dan memerlukan suatu peruntukan perlindungan yang khusus. Kertas ini membincangkan keperluan pemuliharaan Hutam Simpan Ayer Hitam terutamanya perlindungan terhadap hidupan liar yang semakin berkurangan di dalamnya melalui beberapa cadangan pendekatan perundangan yang bermakna. Perlindungan alternatif untuk hutan ini termasuklah menjadikannya sebagai rizab hidupan liar di bawah Jabatan Perhutanan Negeri Selangor atau sebagai rizab/santuari hidupan liar di bawah Jabatan Perlindungan Hidupan Liar dan Taman Negara.*

## ABSTRACT

*In the rapidly developed Klang Valley , Ayer Hitam Forest Reserve has served as a last bastion for the conservation of the indigenous fauna and flora. Its strategic location has attracted many threats particularly from land developers and industries. Security of this piece of pristine land is at stake, which needs to be protected by specific legislation. This paper addresses the conservation needs of Ayer Hitam Forest Reserve, in particular the preservation of the decreasing wildlife populations within this reserve by meaningful legislative provisions. The protection alternatives for this forest include its designation as a forest reserve for wildlife under the State Selangor Forest Department or as wildlife reserve/sanctuary under the Wildlife and National Parks Department.*

## INTRODUCTION

The earliest reference to wildlife protection in Malaysia was Ordinance no. 111 of 1894, introduced in the Straits Settlement (Penang and Malacca). This ordinance gave protection only to certain species of birds. The protection was extended to include other wild animals and birds with the introduction of more comprehensive ordinance in 1904. By virtue of this latter ordinance, elephants, tapir, rhinoceros and green pigeon were protected (Khan 1988). Since legislation alone will not guarantee the survival of the biological heritage without protecting their habitat, steps were taken to provide permanent habitats for plants and wildlife through gazettement of wildlife reserves, nature reserves and national parks. The first public domain area set up by the federal agency for these purposes was dated 1903 with the designation of the Chior Wildlife Reserve in Perak (Stevens 1968). This wildlife reserve made up a total area of 689 ha (Perak State Notification No. 1107). The interest in protecting big game animals such as elephants and gaurs from over-hunting especially by hunters and planters have set the stage for more areas to be gazetted as wildlife reserve.

This trend for the conservation of wildlife and their habitats, however has lost steam due to the demand for more land for agricultural development particularly for oil palm plantations. The significant date for wildlife conservation turning point was after the year 1964 with the establishment of Sungai Dusun Wildlife Reserve in Selangor. After this period, there were no more significant areas that were set up for the protection of wildlife and their habitats.

Lately, people began to manipulate natural areas for their own interests and benefits. Nature and wildlife take lower priority in their pursuit of existence in Malaysia. The consequence is that if the forest is not effectively protected, fewer areas that are supposed to be

preserved would result in devastation. As these problems proceeded, the wildlife components of the ecosystem could be destroyed forever. This condition will later undermine the survival of such forest. A a result, the creditability of the nation's conservation strategy will be eroded.

The purpose of the paper is to highlight the importance of preserving Ayer Hitam Forest Reserve (AHFR), an island forest amidst a sea of urban development in the newly developed Malaysian Super-Corridor (MSC) as a habitat for wildlife. The forest is surrounded and neighboured by several nationally significant land development activities such as the Cyberjaya township, the new Federal Capital of Putrajaya, National Sports Complex and several major residential areas. Several alternative legislative approaches are presented for the sustainable management of wildlife and their habitats in AHFR.

## THE RATIONALE OF AHFR AS WILDLIFE RESERVE

Selangor state has a total of 10,428 ha (1.3% of state land; 0.1% of Peninsular Malaysia) of wildlife reserves under the administration of the Department of Wildlife and National Parks, and the state Forest Department. Thus, based on the total number of wildlife availability in the state especially in the forest reserves (30% of state land), it can be said that the area for the protection of wildlife is still small by comparison to the wildlife species to maintain its sustenance. Moreover, the characteristics of tropical diversity of species, however, is associated with relative scarcity of individuals of each kind of plants and animals of each component species. In other words, although there are many plants and animals in a given area, relatively fewer individuals of each kind will be found (Thang 1988). Thus, proportionately larger areas of suitable habitat will be necessary to ensure the survival of a given plant or animal population.

In the Klang Valley, Ayer Hitam Forest Reserve (AHFR) was designated as a forest reserve in 1930s. At present Ayer Hitam Forest Reserve is used by the Faculty of Forestry for education, research purposes and extension services. Thus, this forest serves as a honey pot to the students and staff of the Faculty for their "living classroom", forest camps and other forest related activities (Abdullah *et al.* 1999). In the very near future, AHFR will be the only forest for the entire population of newly developed residential and commercial areas nearby. AHFR can be considered relatively rich in biodiversity. There are 430 species of seed plants, 33 species of ferns and fern-allies, 127 timber species, 29 fruit trees species and 98 plant species with medicinal values (Faridah Hanum 1999). In order to attain the sustainable and productive ecosystem of such forest, conservation or better still a preservation approach must be applied to this area. This in turn will support effectively the wildlife and its habitat. Conservation in this case involves maintaining and improving semi-natural habitats and their associated species in as natural state as possible because there are no remaining areas that are unmodified by human activities. It also allows other use in the area for as long as the activities are compatible with the land and only involved minimal modification of the resources.

Although AHFR is a logged-over and isolated forest reserve, studies conducted here showed that this forest is still very rich with wildlife. AHFR contains 160 species of birds from 38 families, which is comparable to other primary areas in Peninsular Malaysia. The three largest families were Timaliidae (13 Babbler species), Cuculidae (12 Cuckoo species) and Pycnonotidae (12 Bulbul species) (Zakaria and Abdul Rahim 1999). Five species of primates, *Presbytis malalophos, Hylobates lar, Presbytis obscura, Macaca fascicularis* and *Macaca nemestrina* were found in this forest as compared to the total ten species present in Peninsular Malaysia. In addition *Nycticebus coucang* (slow loris) is known to occur in the area (Zakaria and Rahmat 1999). Jambari *et al.* (1999) reported that there were three species of bats, two species of reptiles, 11 species of frogs and toads and nine species of fishes have been recorded present in the forest. Studies by Ahmad Said *et al.* (1999) revealed that 11 orders of insects with hundreds of species are found in the forest. Hymenoptera was dominant, followed by Isoptera, Collembola, Coleoptera, Diptera, Othoptera, Thysanura, Homoptera,Hemiptera, Lepidoptera and Neuroptera. Big mammals such as tigers, wild boars, civets and mouse deers were also present (Isyrak per. comm.).

Being a forest amidst a sea of development, AHFR's role is dual: protecting the biodiversity and serving as a green lung especially to the MSC. As such it is also the only natural refuge for wildlife from other disturbed or destroyed habitats in the vicinity.

## LEGISLATIVE PROVISIONS IN THE PROTECTION OF AHFR

*AHFR as Forest Reserve for Wildlife*

As a forest reserve AHFR is managed under the jurisdiction of National Forestry Act, 1984 (Amendment 1993). Under the law, for the purpose of conservation of flora and fauna in a forest reserve, the Act under Section 10 specified that the State Director of Forestry with the approval of the State Authority has to classify permanent forest reserve into eleven functional classes of the forest. Functions with the exception of Subsection 10(1a) which is for timber production, all remaining 10 functional classes are for the purposes of protection and conservation that include forest sanctuary for wildlife (Zul Mukhshar 2000).

In addition, there are other sections in National Forestry Act (Amendment 1993) which give due consideration to wildlife protection. One of the relevant sections of such legislation include Section 81 which specified prohibition to use poisonous substance, or dynamite or other explosives in rivers or lakes for the purpose of fishing, or hunting, or set traps or snares; and trespass the permanent forest reserve in any manner. Futhermore, Section 111 enables the State Authority to make rules to implement and operationalize the provisions provided by the Act. Under the legislation of subsection 111(2) (s) of the Act, the State Authority may prescribe rules and regulations for multiple use of the forest. Among others, they may include wildlife, plant life, and objects of geological, archeological, historical, ethnological, scientific and scenic interest. As an example, this provision has been considered as one of the basis and viable options for the establishment and management of the Perlis State Park (Zul Mukshar 2000).

The National Forest Policy of 1978 revised in 1992 could provide an additional protection mechanism for AHFR in wildlife conservation. This policy can strengthen the protection of wildlife if enforced effectively by the Forestry Department particularly at the state level. Hence the policy specifically emphasized the need for the preservation of biological diversity and the conservation of areas with unique species of flora and fauna.

*AHFR as Wildlife Reserve*

Wildlife Reserve and Sanctuary could provide another alternative in the pursuant for the protection of wildlife in AHFR. The protection of Wild Life Act 1972 (Act 76, Laws of Malaysia) could be important. Under this law, Section 47 (a), it specified that the Ruler or the Yang di Pertua Negeri of a State may, after consultation with the Minister from time to time by notification in the *Gazette* to declare any State land to be a wildlife reserve or a wildlife sanctuary and designate the officer for the time being having the control of such reserve or sanctuary. Other important subsection of Section 47 that would lead to better protection of wildlife and its habitats is through (b) definition and alteration of the boundaries of the wildlife reserve or wildlife sanctuary, and (c) in the case of wildlife reserve, specify certain animals and birds (which are not protected wild animals or not protected wild birds within the meaning of this act) as protected or totally protected wild birds (as the case may require) which specification shall be in addition to the lists of wild animals and wild birds specified in the Schedules to this Act.

In strengthening for the protection of this reserve, the Act provided that under Section 48 (1), no person shall enter a wildlife reserve or a wildlife sanctuary unless he first obtains a written permit from the Director for Wild Life and National Parks authorizing him to do so. In addition under subsection (5) no person shall disturb or cut or remove any timber in a wildlife reserve. Section 49 (a), (b), (c) also specified that no person shall shoot, kill or take any animal or bird (wild or otherwise); take, disturb, damage or destroy the nest or egg of any animal or bird (wild or otherwise); disturb or remove any timber or vegetation in a wildlife sanctuary.

## CONCLUSION

The Ayer Hitam FR is presently facing pressures resulting from increasing human population in the surrounding areas and their need for more space. The protection status of the forest is still unclear as long as it is under the jurisdiction of the state government. The state government can convert the status of the forest into other land use especially for housing and industrial projects. This situation must be recognized and total commitment must be given to ensure the permanent protection status of this forest. Ultimately, AHFR should be administered and legislated as a forest reserve for wildlife or decisively as a wildlife reserve.

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# Phytochemical Screening of Ayer Hitam Forest Reserve : Isolation of Ariskanin-A from *Thottea corymbosa* (Griff.) Ding Hou (Aristolochiaceae)

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**Keywords:** ***Thottea corymbosa*, Aristolochiaceae, Ariskanin-A, aristolochic acid, herbal medicine.**

## ABSTRAK

*Semasa penyaringan fitokimia ke atas tumbuhan tinggi dari Hutan Simpan Ayer Hitam, Puchong, Selangor, suatu sampel akar Thottea corymbosa telah dikutip dengan banyaknya untuk kajian lanjutan ke atas juzuk bioaktifnya. Tumbuhan ini yang telah diguna sebagai ubat tradisi ialah suatu syrab yang senang dijumpai di rintis terbuka dalam hutan. Akar telah diekstrakkan secara berjujukan menggunakan petroleum eter, kloroform dan metanol dan diikuti oleh pemisahan pecahan kloroform dengan kromatografi turus dan kromatografi lapisan nipis. Dalam kajian ini kita ingin melaporkan pemencilan suatu aristolaktam, Ariskanin-A dengan nilai ketoksikan LC50 <200 ppm dalam Bioasai Kemautan Anak Udang Air Masin, berdasarkan data spektroskopik dan perbandingan kepustakaan.*

## ABSTRACT

*During a phytochemical screening of higher plants at Ayer Hitam Forest Reserve, Puchong, Selangor, we collected a large amount of sample of Thottea corymbosa roots for further investigation of its bioactive constituents. The plant is a shrub commonly used in herbal medicine and could easily be found along the open forest trails. The roots of the collected sample were consecutively extracted with petroleum-ether, chloroform and methanol followed by separation of the chloroform fraction by column chromatography and preparative thin-layer chromatography. In this study we reported the isolation of an aristolactam, Ariskanin-A with a toxicity value of LC50 <200 ppm in Brine-Shrimp Lethality Bioassay based on spectroscopic data and comparison with literature.*

## INTRODUCTION

As a continuation of our previous preliminary work (Mat So'ad and Nik Idris Yusoff 2001) on the phytochemistry of *Thottea tomentosa* (Blume) Ding Hou to isolate bioactive components of some pharmacological interests (or possibly toxic) especially Aristolochic acids and aristolactam, we chose to investigate the chemical constituents of its next-of-kin, *T. corymbosa*. The plant is called 'hempedu beruang' in Malay, a shrub found growing commonly along the open trails of lowland forests throughout Malaysia. In herbal medicine, the pounded leaves are applied to sore gums or tooth cavity for toothache. Also it is claimed that the shrub can be used even in drug form as an analgesic, antiasthmatic, antifertility and for treating impotence and snake-bite. Although the plant is widely used among the locals, to date no study on the phytochemistry and biological activity has ever been reported.

In Peninsular Malaysia the family Aristolochiaceae ia represented by two genera, namely *Aristolochia* and *Thottea*. The former consists of five species, namely *A. curitisii*, *A. foveolata*, *A. jackii*, *A. minutiflora* and *A. tagala* and the latter contains a total of seven species, namely, *T. corymbosa*, *T. dependens*, *T. grandiflora*, *T. parviflora*, *T. sumatrana*, *T. tomentosa* and *T. tricornis*. The species within *Aristolochia* have a very narrow range of distribution except *A. tagala* which is widespread. Turner (1995) stated that *A. curtisii* is only found in Penang, *A. foveolata* is found in Terengganu, *A. jackii* is found in Pahang

and *A. minutiflora* is known to occur only in Perak and Johore. However, all species of *Thottea* are widespread and *T. dependens* is endemic to Peninsular Malaysia. Several species of *Aristolochia* from India and China were reported to contain bioactive compounds in their respective pharmacological studies.The roots of *Aristolochia indica* revealed phenanthrene derivatives and a sesquiterpene which posseses antifertility activity (Pakrashi *et al.* 1977) besides being a source of aristolochic acid, a tumour-inhibitory principle, rarely found in nature as it contains a $NO_2$ group. In China, *Aristolochia debilis* decoction known as 'qing mu xiang' has a direct constrictive action on blood vessels and shows an inhibitory action on the heart (Wang 1983). Recently, it was found that Aristolochic acids I and II were reported to cause interstitial nephritis (Kazunori *et al.* 1999).

## MATERIALS AND METHODS

The clean air-dried roots of *T. corymbosa* (Voucher No. AZ 6681) were collected from Ayer Hitam Forest Reserve during the expedition and were cut into small pieces and milled. A specimen voucher was deposited in the Herbarium, Universiti Kebangsaan Malaysia, Bangi (UKMB).

UV spectrum was recorded on a Shimadzu UV Spectrophotometer in ethanol solution. Mass spectrum was obtained on Hewlett Packard 5989A Spectrometer operating at 70 ev and attached to a VG-Display Digispec data acquisition system computer. The $^1H$ and $^{13}C$ NMR spectra were measured in $CDCl_3$ solvent on a JEOL FX400 (400 Mhz) Spectrometer and the chemical shifts are expressed as δ values (ppm) downfield from tetramethylsilane (TMS) as an internal reference.

About 1.35 kg sample was then consecutively extracted with petroleum-ether, chloroform and methanol at room temperature, filtered and solvents dried off under reduced pressure on a rotary evaporator.

The slightly toxic chloroform extract (9.18 g) with a value of $LC_{50}$ <200 ppm on Brine Shrimp Lethality Bioassay was then subjected to dry-flash column chromatography, silica gel 60 (230-400 mesh) as adsorbent and hexane, ethylacetate and finally methanol as elueting solvents. The methanol fractions were combined and further fractionated by silica gel column chromatography, using gradient hexane-ethylacetate as solvent system. Then the hexane-ethylacetate (4:6) fraction was concentrated and checked on a thin-layer chromatography resulting in at least four spots. Finally, the crude was subjected to a further micro-column chromatography separation affording two major components labelled as AC3 (61.3 mg) and AC9 (30.7 mg) after a final preparative thin-layer chromatography purification. AC3 was then analysed by spectroscopic methods of ultra-violet spectrophotometry, mass spectroscopy and $^1H$ and $^{13}C$ nuclear magnetic resonance measurements to elucidate its chemical structure (Fig.1).

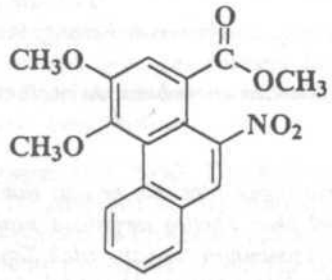


*Fig. 1. Compound AC3*

Yellow needles , 61.3 mg. TLC (silica gel ) with solvent system hexane-ethylacetate (8:2), $R_f$ 0.9. UV $\lambda_{max}$ ( MeOH, nm) : 256,272, 295,372.
IR $\nu_{max}$ ($cm^{-1}$): 1714 (C=O ester), 1584, 1513 ($NO_2$), 1448, 1342, 1235. MS m/z: 341[M+, $C_{18}H_{15}NO_6$], 295 [M-$NO_2$]$^+$, 280 [M - $NO_2$- Me]$^+$, 264 [M - $NO_2$- OMe]$^+$, 252, 237, 222, 194, 166. $^1H$-NMR, δ (ppm): 9.66 (1H,d,H-5), 8.33 (1H, s, H-9), 7.97 (1H, dd, H-8), 7.89 (1H,s,H-2), 7.80 (1H,td, H-6), 7.71 ($^1H$, td, H-7), 4.10(3H,s,3-OMe), 3.98 (3H,s, 4-OMe), 3.88 (3H, s, OCOMe). $^{13}C$-NMR δ (ppm): 167.6 (C=O), 151.6( C-5), 149.6(C9), 146.1(C8), 131.1(C4), 130.6, 130.5(C10),129.8, 128.4, 128.3, 127.4, 126.3, 124.9, 116.9, 116.4, 60.4(C3-OMe), 56.7 (C4-OMe) and 52.2 (OCOMe).

## RESULTS AND DISCUSSION

Compound AC3 was isolated from the hexane-ethylacetate (4:6) fraction by column chromatography from the slightly toxic chloroform extract with LC50 < 200 ppm on Brine-Shrimp Lethality Bioassay. The UV spectrum of AC3 showed bathochromic shifts at 256, 272, 295 and 372 nm. The IR spectrum clearly showed the absorption peaks at 1714 $cm^{-1}$ for carbonyl ester group and at 1513 $cm^{-1}$ for $NO_2$. Its mass spectrum gave a molecular weight of 341 which corresponds to a molecular formula of $C_{18}H_{15}NO_6$.The fragmentation peak at m/z 295

TABLE 1
The $^1$H NMR spectral data of compound AC3 as compared to Ariskanin-A

| δ 1H (ppm) | Compound AC3 | Ariskanin-A (Wu *et al.* 1994) |
|---|---|---|
| 1-COOMe | 3.88 (3H, s) | 3.86 (3H, s) |
| H-2 | 7.89 (1H, s) | 7.89 (1H, s) |
| 3-OMe | 4.10 (3H, s) | 4.10 (3H, s) |
| 4-OMe | 3.98 (3H, s) | 3.97 (3H, s) |
| H-5 | 9.66 (1H, d, 8.6 Hz) | 9.66 (1H, dd, 8.0, 1.8 Hz) |
| H-6 | 7.80 (1H, m, 1.0, 0.9 Hz) | 7.81 (1H, td, 8.0, 1.6 Hz) |
| H-7 | 7.71 (1H, dd, 1.4, 1.4 Hz) | 7.71 (1H, td, 8.0, 1.8 Hz) |
| H-8 | 7.97 (1H, dd, 1.4, 1.4 Hz) | 7.99 (1H, dd, 8.0, 1.6 Hz) |
| H-9 | 8.33 (1H, s) | 8.34 (1H, s) |

shows an elimination of $NO_2$ which supports the existence of $NO_2$ suggesting a typical aristolochic acid for the structure of AC3, fragment 280 a further loss of Me and 264 that shows a loss of OMe.

Integration of 1H-NMR spectrum showed the presence of 15 protons altogether consisting of six aromatic protons, and three each for 3-OMe, 4-OMe and OCOMe belonging to a methylester moeity. When comparing these proton signals with that of a known compound, Ariskanin-A from a published report (Wu *et al.* 1994), they are without any doubt very consistent and agreeable (Table 1).

In addition, the $^{13}$C-NMR spectral data clearly showed the presence of 18 carbon nuclei and this tally well with the molecular formula, $C_{18}H_{15}NO_6$ for Ariskanin-A. The signals at δ 52.2, 56.7 and 60.4 ppm are typical of a methylester aristolochic acid derivative.

## CONCLUSION

Therefore, it can be concluded that the compound isolated from the chloroform root extract of *T. corymbosa* collected from Ayer Hitam Forest Reserve can be identified beyond doubt as a methylester of aristolochic acid derivative i.e. Ariskanin-A based on the spectroscopic data which are comparable and agreeable with that of previous work done on a different species, *A. kankauensis* (Wu *et al.* 1994). Hence, this report constitutes the first report on the isolation of Ariskanin-A from *Thottea corymbosa* in Malaysia. It is worth mentioning that Ariskanin-A also showed some significant cytotoxity activity against certain cancer cell-lines. Finally, since species of Aristolochiaceae are the only source of aristolochic acids which cannot be synthesized, it is not far-fetched to say that future new drugs discovery begins here.

## ACKNOWLEDGEMENT

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# Importance of Ayer Hitam Forest Reserve in the Klang Valley and the Multimedia Super Corridor

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**Keywords: Forest, Klang Valley, Multimedia Super Corridor, Ecosystem healty, Conservation**

**ABSTRAK**

*Kedudukan Hutan Simpan Ayer Hitam dalam Lembah Klang dan Multimedia Super Corridor diketengahkan dan dibandingkan dengan keadaan dan keluasan kawasan hutan lain di kedua-dua kawasan ini. Anggaran semua kawasan hutan adalah berdasarkan peta sumber hutan (FS6 dari 1991). Anggaran populasi kawasan juga dibuat dari bancian 1990. Beberapa unjuran tertentu pada tahun 2000 dibuat dan dibincangkan.*

**ABSTRACT**

*The location of the Air Hitam Forest Reserve within the Klang Valley and the Multimedia Super Corridor is highlighted and compared to the state and extent of other forested areas in the Klang Valley and the Multimedia Super Corridor. As insufficient detailed information was available the estimates for the all forested area were based on the forest resources map (FS6 from 1991). Population of the areas were also estimated from the 1990 census. Some projections to the respective conditions in 2000 was also made and discussed.*

## INTRODUCTION

Traditional roles of forests include the production of timber and non-timber resources as well as for providing water. Since the last two decades, the other uses and roles of forests have become significant. These include the use of forests as resources for education and recreation, and also the role of forests in conservation of biological diversity as well as in maintaining global climate. In the last role, there has been much debate and even controvercy, although it is now accepted that forests are important as sinks and sources of CO2, which is important in global warming. In considering the role of the Air Hitam Forest Reserve (AHFR) within the Klang Valley (KV) and the Multimedia Super Corridor (MSC), we should look at some of the interesting statistics related to the extent of the forest within the areas and what roles they could possibly play in view of the size and condition of the AHFR and in relation to the other forests within the KV and MSC.

## METHODOLOGY

As it is difficult to get the latest maps and locations of the forest and the corresponding statistics, we have used the FS6 map (Anon, 1991) to genetrate the information. This map was produced in 1991 by the Forestry Department from the inventory conducted circa 1990. The information given is quite detailed as the forest are classified according the ecological type, when logged and quality of the forest. For example, an area can be classed or desribed as a logged forest, when logged (eg. 1981 - 1986) condition in 1990 - whether disturbed or regenerated. Although this is about 10 years old, it is still the most current forest resource map that is availabe. There are statistics from reports published since then but these do not show where the actual areas are.

The FS6 map and land-use map for central and south Selangor (including Kuala Lumpur) were digitized and combined. The KV and the MSC were marked out and the various forests in the areas were highlighted and estimated (Figures 1 and 2). From the Georaphical information system database, information on the total area, urbanised area, forested area, and the area of the AHFR (in 1991) can be extracted.

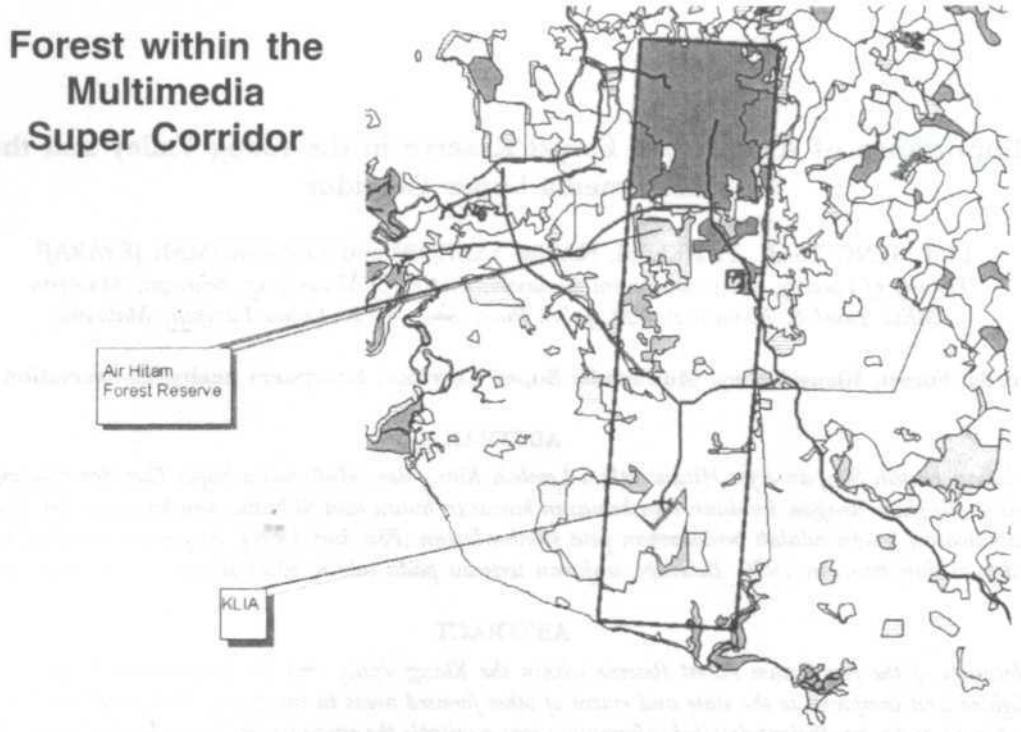


*Fig. 1. Forest within the Multimedia Super Corridor*

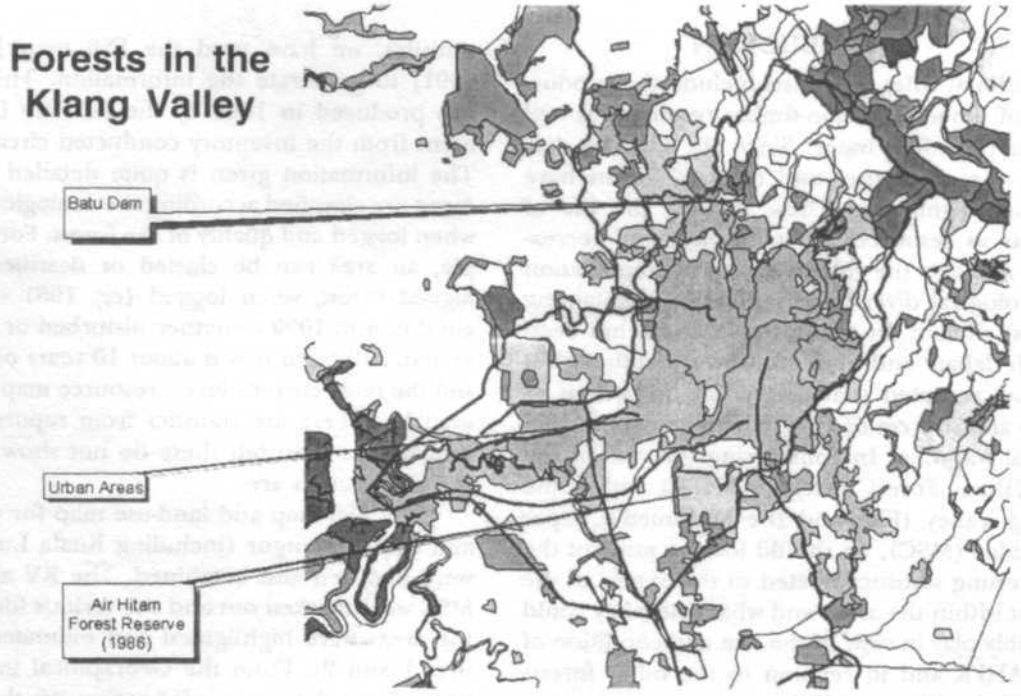


*Fig. 2. Forest in the Klang Valley*

## RESULTS AND DISCUSSION

*Status of Forest Resources in the Klang Valley (KV) and the Multimedia Super Corridor (MSC)*

The area of AHFR for 2000 was estimated at 1250 ha (rounded up from the official 1248 ha allocated) (Table 1 and 2). Much rapid development has taken place in the KV in the last 30 to 40 years. The rate of conversion of forested areas as well as tree covered areas to urban areas has increased tremendously in the last 20 years. The satellite image in 1990 still show some forested areas which are no longer so currently (Figure 3). The AHFR is a good example of what has happened in the last ten years in the whole KV area. Two large blocks have been excised and converted into housing estates (the Equine Park and Lestari Perdana) so that the whole area has been effectively halved from over 2500 ha to 1250 ha.

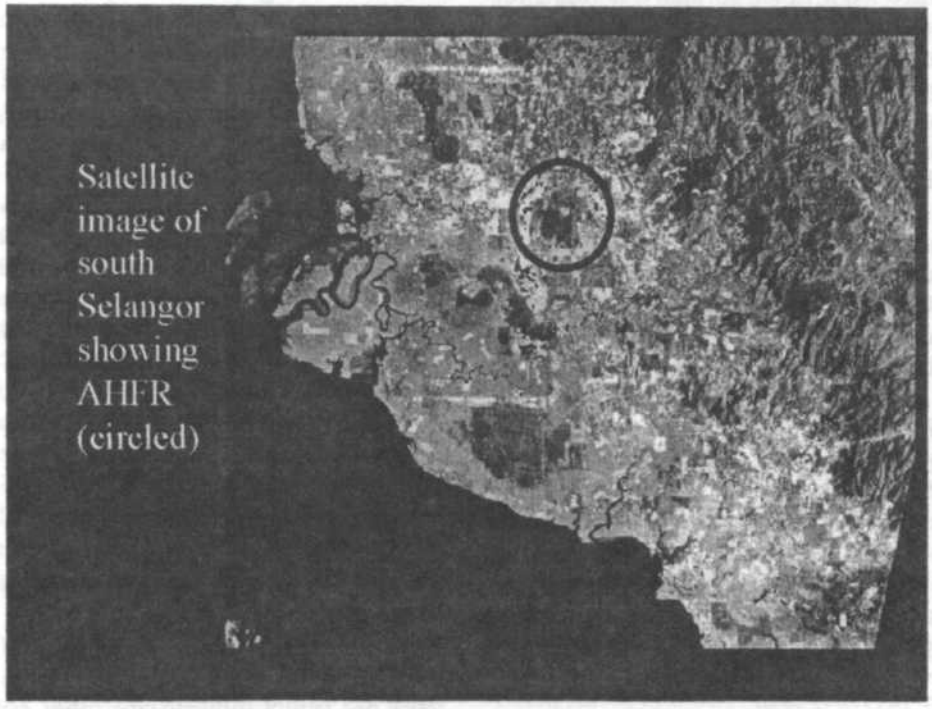


*Fig. 3. Satelite Image of South Selangor Showing AHFR (Circled)*

TABLE 1
Total land area and areas under different land-use in the Klang Valley

| | Total area (ha) | % of total area |
|---|---|---|
| Total KV area | 120,817.14 | 100.00% |
| Total urban area | 45,149.00 | 37.37% |
| Total rural area | 35,662.71 | 29.52% |
| Forested (non agric) | 8,045.67 | 6.66% |
| Forest (according to FS6) | 31,511.07 | 26.08% |
| AHFR (1991) | 2,550.00 | 2.11% |
| AhiFR (2000) | 1,250.00 | 1.03% |
| AHFR of total forest | 1,250.00 | 3.97% |
| Population in KV in 1991 | 2,193,963 | |
| Estimated KV Population in 2000 | 3,084,695 | |

TABLE 2
Land area and areas under different land-use in the Multimedia Super Corridor

| | Total area (ha) | % of total area |
|---|---|---|
| Total land area in the MSC | 92503.99 | 100.00 |
| Urban area | 25472.18 | 27.54 |
| Rural | 50121.23 | 54.18 |
| Forested (non agric) | 7254.61 | 7.84 |
| Forest (according to FS6) | 13854.10 | 14.98 |
| AHFR (1991) | 2559.46 | 2.77 |
| AHFR (2000) | 1250 | 1.35 |
| Estimated MSC Population in 2000 | 1058270 | |

*Importance of AHFR in the KV and MSC*

How can importance be assessed? It can be assessed in many ways; some of these may include:

1. Forest area per capita in the KV and MSC;
2. Distribution of forested areas - in the different sections of the KV - the eastern-most quarter, eastern-central quarter, western-central quarter and the western-most quarter. This can be similarly determined for the MSC (in a north to soouth direction);
3. Distance from other (primary/natural) forest patches and relative size of nearest forest patch/patches;
4. Suitability for protection of 'big' wildlife - is it too urbanised? except for those tolerant of urban environment such as some birds, small mammals such as civets, tree shrews and squirrels and reptiles such as monitor lizards;
5. Suitability for other forms of biodiversity - small animals such as insects and other invertebrates, and plants such as herbs and shrubs and microscopic plants and fungi as well asferns and perhaps secondary forest species:
6. Suitability as a water catchment/watershed,- the Rasau is only a small tributary of the Kelang and the amount of water from the forest area is probably not sufficient for sustained extraction although previously (over 30 years ago, there was an extraction point in the old forest area which is now under the Enquine Park area).

When reviewing the condition of the forest in AHFR with the other forests in the KV and the MSC, the AHFR still stands out as an important patch of forest that is recovering well - it is not quite olf growth (climax) forest which would resemble undisturbed stands, but it is an intermediate growth forest and thus in a much better condition than young growth or recently disturbed forests. AHFR is the only patch of lowland dipterocarp forest in the KV and MSC. The Kuala Langat Forest are peat swamp forests while the forests in the northern and eastern sections of the KV are mainly hill dipterocarp forests. The remnant patch of 1250 ha has a fairly high diversity of habitats and also comprises patches at different stages of recovery (Roland and Lim, 2000). However, because it is surrounded by development, it is and will be under much pressure and subject to encroachment. This could result in changes along the forest edges which will favour species that are more tolerant of such modified exposed conditions.

However, if the forest is viewed from a larger and perhaps a longer (time-wise) perpective, we can also see tha tAHFR is also relatively large compared to other patches of forests nearby, such as those in Bangi and Sg. Besi. We can then consider AHFR as an important source of biodiversity (plants and animals) for re-colonishing the other forests and other abandoned land/areas. Therein lies yet another role for the AHFR in the KV and MSC.

*Health of KV and MSC*

What is the basis of health of the KV and MSG? Does this refer to the health of the populace and/or of the natural ecosystems, or a combination of both? Does the index/ration of forest area per capita indicate anything? How do the figures in the KV and MSC compare with thise for the whole country and the world average? The ratio of the forest area per capita can be considered as what is available for the populace;

TABLE 3
Population densities and forest per capita

| Region | Total land area ha | Total forest 1000 ha | Population million | Density per 1000 ha | Forest/capita |
|---|---|---|---|---|---|
| World | 13,048,300,000 | 4,081,900 | 5,166 | 396 | 0.790 |
| Asia | 3,085,414,000 | 556,996 | 3,486 | 1,130 | 0.160 |
| Malaysia | 32,975,780 | 19,200 | 19 | 564 | 1.032 |
| KV | 120,817 | 31.51 | 2.19 | 18,151 | 0.014 |
| MSC* | 92,503 | 13,85 | 1.06 | 11,437 | 0.013 |

Data circa 1990/91

* Population figure is for 2000, MSC did not 'exist' in 1991

when compared to other areas, it could be an indication of what should be set aside for the maintenance of forest related function - supply of wood and non-wood products and fresh air and water and a place for recreation. The forest per capita ratios in the KV and the MSC are relatively low compared to the national and even world average have a lower quality of a life that is influenced by adjacent forests. The inverse value of persons per ha indicates the pressure of the population on the forest.

From the medical health point of view, would carbon dioxide, oxygen, dust, and pollutant levels indicate anything? Would the presence or absence of forests and water catchment indicate a healthy environment? Many of these relationships are not really known proven, but the availability of forests for recreation and exercise could certainly contribute to mental and physical health. How much of the forest and urban parks are actively used? What are the roles and importance of other forested areas in the KV and MSC? Are these primary or secondary forests? There is probably a need to classify forests according to 'their use' or level and type of disturbance, such as disturbed 'real' forest (such as AHFR) as against mature abandoned rubber and other 'secondary' forests such as Bt. Gasing, Bt. Nenas; Federal Hill and Kenny Hill and their usefulness for education, research and as sources of teaching materials.

The capacity of AHFR to store and absord Carbon has been estimated (Roland & Lim 2000) to range from about 40 t/ha to 115 t Carbon / ha and the absorption rate at 0.3 to 0.5 t/ha/ year. Much of the forest may be logged but as regrowing forests. they are useful in many ways - and can provide much diverse habitats for some of the smaller mammals. Air Hitam is relatively small and is an island in a sea of developed lanscape; even then, it is reputed to be home to a number large carnivores, which may soon die out because the area is rapidly becoming too small to sustain any viable population. In spite of this, there are still other wildlife species that may survive the shrinking AHFR.

## CONCLUSION

The KV and MSC are relatively small but economically important areas; but the extent of forests in these two strategic zones in Malaysia are relatively lower than the average for the country. Although the AHFR makes up less than 5% of the total forest area within the KV and the MSC, it is strategically located within these two zones and can play important ecological, economic and social roles in forestry, urban forestry, recreation, conservation and provide for many other functions such as in research and education. For these reasons and many others, the AHFR should therefore not only be conserved as a forest for its diverse uses and functions, but the area of forests within the KV and the MSC should be increased to bring the forest per capita of the two regions to at least the national average.

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# An Annotated Checklist of Higher Plants in Ayer Hitam Forest Reserve, Puchong, Selangor

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**Keywords : Annotated checklist, higher plants, Ayer Hitam Forest Reserve**

## ABSTRAK

*Hutan Simpan Ayer Hitam ialah suatu hutan subjenis Kelat-Kedondong bagi hutan tanah rendah dipterokarpa yang terletak di Lembah Klang yang kini sedang mengalami suatu pembangunan sosio-ekonomi dan fizikal amat pesat. Hutan ini telah beberapa kali dibalak dalam 60 tahun yang lalu dan kini beberapa ceruk vegetasinya sedang menuju ke arah klimaks semula. Ekspedisi ini yang telah dijalankan pada 2-5 Mei 2000. merangkumi beberapa ahli botani yang telah memerhati dan mengutip spesimen tumbuhan. Enumerasi yang diberikan di sini adalah berdasarkan kepada spesimen yang dikutip semasa ekspedisi, mencakupi 262 spesies tumbuhan vaskular yang tergolong dalam 142 genus dan 56 famili. Famili Myrtaceae, dengan 22 spesies adalah famili yang terbesar di dalam senarai, diikuti oleh Euphorbiaceae, Dipterocarpaceae dan Annonaceae, masing-masing dengan 21, 17 dan 14 spesies. Spesies genus Knema adalah yang terbesar dengan 13 spesies dan diikuti oleh Memecylon Syzygium dan Diospyros, masing-masing dengan 9, 7 dan 7 spesies.*

## ABSTRACT

*Ayer Hitam Forest Reserve is a Kelat-Kedondong subtype of the lowland dipterocarp forest situated in the Klang Valley which is currently undergoing a tremedous pace of socio-economic and physical development. The forest had been logged many times in the last 60 years or so and most vegetation niches are beginning to recover to their climax again. Our expedition, from 2-5 May 2000 involved a few botanists who observed and collected specimens of higher plants. The enumeration provided here is based only on the specimens collected during the expedition, includes 262 species of vascular plants belonging to 142 genera and 56 families. The Myrtaceae, with 22 species is the largest family in the checklist, followed by Euphorbiaceae, Dipterocarpaceae and Annonaceae with 21, 17 and 14 species, respectively . Species-wise the genus Knema, is the largest with 13 species, followed by Memecylon, Syzygium and Diospyros with 9, 7, and 7 species, respectively.*

## INTRODUCTION

The Ayer Hitam Forest Reserve, Puchong, Selangor covers an area of about, 3,500 ha prior to lease to Universiti Putra Malaysia in 1996. The Selangor State Goverment on 7th October 1996 leased this patch of the remaining lowland forest in the Klang Valley with 6 compartments, namely Compartments 1, 2, 12, 13, 14 and 15 to the University for 80 years for the purpose of education and research. In the past 10 years the University had used the forests for various educational purposes including industrial training of their forestry students and also research in biodiversity and environment by students and staffs from various faculties. The faculty members also were active in various

research projects in the forest. The size of this forest is now reduced by about 64% to 1,248 ha, after it was further excised for some socio-ecomonic development projects such as housing estates, oil palm plantation, new townships, factories, and highways, among others. In the present survey, this forest is classified as a disturbed Kelat-Kedondong-Mixed Dipterocarp type of lowland forest type (Faridah Hanum, 1999). Mat-Salleh (1999) has shown the role and function of a similar forest at Universiti Kebangsaan Malaysia that has been used by students and staff for similar purposes. The Ayer Hitam FR is located at 3° 00.00' N to 3° 02.20' N and 101° 37.90' E to 101° 40.00' E, approximately 20 km southwest of Kuala Lumpur.

Currently, this forest is thus completely surrounded by developed and developing areas, making it an "island forest" isolated in the middle of modern infrastructures and urban society. Being strategically located within the Multimedia Super Corridor, that connects the commercial city of Kuala Lumpur with the new administrative city of Putrajaya and business city of Cyberjaya, it is the only remaining lowland forest found in the Klang Valley, other than the smaller Bukit Nenas Forest Reserve in the heart of Kuala Lumpur. Historically, this forest was selectively logged several times from 1936 to 1966 and the impoverished diversity has begun to recover quite well (Mohamad Zakaria and Abdul Rahim 1999; Mohamad Zakaria and Rahmat Topani 1999). Formerly, the area was occupied by one of the remaining group of indigenous people, the Temuan tribe, but now moved to other more-disurbed areas of the forest (Faridah Hanum and Nurulhuda Hamzah 1999). This forest is also readily accesible by all kind of vehicles up to the base camp.

Logging activities were carried out in compartments 12 and 13 from 1936 until 1966. In those 30 years, these compartments were logged three times using Comercial Regeneration Felling system in 1936-1943 and 1965-1966, and Selective Felling in 1946-1954 (Faridah Hanum 1999). However, in 1990 silvicultural treatment has been carried out in these compartments.

## CHECKLIST OF HIGHER PLANTS IN AYER HITAM FOREST RESERVE

The checklist produced below is the result of botanical observation and collection done during the Scientific Expedition. It is arranged alphabetically by families, each family is followed by the species known, according to Turner (1995). Where possible local name(s) is included with brief notes on habit and distribution.

**Gymnosperms**

**1.0 Podocarpaceae**

1.1 *Podocarpus neriifolius* D. Don
Podo Bukit
Tree to 20 m tall; normally confined to hill and montane forests; its occurrence in this forest is botanically very interesting. Probably it is introduced from the hill forest or an escape from cultivation.

**2.0 Gnetaceae**

2.1 *Gnetum cuspidatum* Blume
Large liana; commonly found in the lowland and hill forests; widespread.

**Angiosperms - Dicotyledons**

**1.0 Acanthaceae**

1.1 *Acanthus volubilis* Wall.
Trailing shrub which is commonly found scattered in the surveyed area.

1.2 *Asystasia gangetica* (L.) T. Anderson
Rumput Israel
Creeping herbs; normally found in waste and idle areas, sometimes in cultivated areas too; could be considered a noxious weed which is believed to be introduced from India and now beginning to be naturalized in the country.

**2.0 Alangiaceae**

2.1 *Alangium ebenaceum* (C.B. Clarke) Harms var. *ebenaceum*
Mentulang Daun Bujur
Tree to 10 m tall; commonly found in lowland forest.

**3.0 Anacardiaceae**

3.1 *Bouea macrophylla* Griff.
Kundang
Tree reaching up to 20 m, produce edible fruits; quite common in lowland and hill forest.

3.2 *Bouea oppositifolia* (Roxb.) Meisn.
Kundang Tikus, Rumia
Tree reaching to 20 m tall, also bears edible fruits; lowland forest up to 700 m altitude; widespread.

3.3 *Buchanania sessifolia* Blume
Rengas Air
Small to medium tree; lowland forest to 700 m; throughout.

3.4 *Gluta malayana* (Corner) Ding Hou
Rengas Kerbau Jalang
Tree to 30 m tall; lowland forest, inlcluding swampy areas; quite widespread.

3.5 *Mangifera magnifica* Kochummen
Macang Hutan
Big tree reaching 30 m tall; lowland forest to 700 m altitude; widespread and apparently quite common in Pasoh Forest Reserve.

3.6 *Mangifera quadrifida* Jack
Macang hutan
Tree to 30 m tall; lowland rain forest to 900 m altitude; widespread.

3.7 *Melanochyla angustifolia* Hook.*f.*
Rengas
Tree to 20 m tall; lowland forest to 600 m altitude; widespread.

3.8 *Melanochyla fulvinervis* (Blume) Ding Hou
Rengas Padi Kulit Hitam
Tree to 20 m tall; lowland forest, occasionally in the hills up to 1350 m altitude; widespread.

3.9 *Parishia paucijuga* Engl.
Rengas
Tree to 30 m tall; lowland and hill forest to 400 m altitude; widespread.

**4.0 Annonaceae**

4.1 *Alphonsea curtisii* King
Mempisang
Medium tree reaching 20 m tall; lowland forest; an element of the northern part of Peninsular Malaysia but recorded for the first time in Selangor.

4.2 *Alphonsea cylindrica* King
Mempisang
Tree to 10 m tall; lowland forest; not widespread.

4.3 *Alphonsea lucida* King
Mempisang
Shrub to 3 m tall; lowland forest; endemic to Peninsular Malaysia.

4.4 *Fissistigma kingii* (Boerl.) Burkill
Mempisang
Large liana; lowland forest; quite widespread.

4.5 *Fissistigma lanuginosum* (Hook.*f.* & Thomson) Merr.
Mempisang
Liana; lowland forest; widespread.

4.6 *Monocarpia marginalis* (Scheff.) J. Sinclair
Mempisang
Large tree reaching to 30 m tall; produce good timber; rather common in lowland forest; widespread.

4.7 *Phaeathus ophthalmicus* (Roxb. *ex* G.Don) J. Sinclair
Mempisang
Small shrub; lowland forest; widespread.

4.8 *Polyalthia cauliflora* Hook.*f.* & Thomson var. *cauliflora*
Mempisang
Shrub or small tree; lowland forest; quite widespread.

4.9 *Polyalthia motleyana* (Hook.*f.*) Airy Shaw var. *oblonga* (King) J. Sinclair
Mempisang
Small tree to 4 m tall; lowland to lower montane forest.

4.10 *Polyalthia rumphii* (Blume) Merr.
Mempisang
Tree to 15 m tall; lowland and hill forest; widespread.

4.11 *Polyalthia sumatrana* (Miq.) Kurz
Mempisang
Tree to 20 m tall; lowland and hill forest; widespread.

4.12 *Popowia fusca* King
Mempisang
Tree to 10 m tall; lowland forest; endemic to Peninsular Malaysia with restricted distribution.

4.13 *Xylopia densifolia* Hook.*f.*
Mempisang

4.14 *Xylopia ferruginea* (Hook.*f.* & Thomson) Hook.*f.* & Thomson var. *ferruginea*
Jangkang Bukit
Tree to 20 m tall; lowland forest; widespread.

**5.0 Apocynaceae**

5.1 *Dyera costulata* (Miq.) Hook. *f.*
Jelutong
Huge lactiferous tree reaching 40 m; lowland forests; has been reported gregariously growing in Kuala Langat South peatswamp forest; widespread.

**6.0 Aristolochiaceae**

6.1 *Thottea corymbosa* (Griff.) Ding Hou
Hempedu beruang
Shrub to 2 m tall; lowland and hill forest; widespread.

6.2 *Thottea grandiflora* Rottb.
Hempedu beruang
Shrub to 2 m tall; lowland and hill forest to 600 m; widespread.

**7.0 Celastraceae**

7.1 *Bhesa paniculata* Arn.
Biku-Biku
Tree to 20 m tall; lowland and montane forest to 1300 m; widespread.

7.2 *Euonymus javanicus* Blume
Tree to 20 m tall; lowland and hill forest to 400m; widespread.

**8.0 Chrysobalanaceae**

8.1 *Atuna nannodes* (Kosterm.) Kosterm.
Geranam
Tree to 20 m tall; lowland and hill forest to 750 m altitude; widespread.

8.2 *Licania splendens* (Korth.) Prance
Membatu
Tree to 10 m tall; lowland forest; throughout.

8.3 *Parinari elmeri* Merr.
Merbatu, Mempari
Tree to 20 m tall; lowland and hill forest to 600 m altitude; an element of the south of Peninsular Malaysia.

**9.0 Combretaceae**

9.1 *Terminalia calamansanai* (Blanco) Rolfe
Jelawai Mentalun
Tree to 20 m tall; lowland forest; normally found in the north of Peninsular Malaysia and its occurrence in Ayer Hitam Forest Reserve is phytogeographically interesting.

9.2 *Terminalia foetidissima* Griff.
Jelawai Mempelam Babi
Tree to 20 m tall; lowland forest; an element of the southern part of Peninsular Malaysia.

9.3 *Terminalia phellocarpa* King
Tree to 20 m tall; more commonly found in swamp or alluvial forests; widespread.

9.4 *Terminalia subspathulata* King
Jelawai Jaha
Large tree to 30 m tall; lowland forest.

**10.0 Ctenolophonaceae**

10.1 *Ctenolophon parvifolius* Oliv.
Mertas
Buttressed tree reaching 30 m tall; hilly forest below 300 m, also in swamps; widespread.

**11.0 Dilleniaceae**

11.1 *Dillenia reticulata* King var. *reticulata*
Simpoh Gajah
Stilt-rooted tree to 20 m tall; lowland forest, widespread; an endemic variety.

11.2 *Dillenia sumatrana* Miq.
Simpoh Padang
Tree to 20 m tall; lowland forest; quite widespread.

**12.0 Dipterocarpaceae**

12.1 *Anisoptera costata* Korth.
Mersawa
Huge tree; lowland forest; widespread.

12.2 *Anisoptera curtisii* Dyer *ex* King
Mersawa Kuning
Large buttressed tree; lowland and hill forest to 700 m; widespread but more common in the north of Peninsular Malaysia.

12.3 *Anisoptera laevis* Ridley
Mersawa Durian
Big tree; lowland forest; widespread.

12.4 *Dipterocarpus crinitus* Dyer
Keruing Mempelas
Tree; lowland and hill forest to 850 m; widespread.

12.5 *Dipterocarpus verrucosus* Foxw. *ex* Slooten
Keruing Merah
Tree; lowland forest; more common in the south of Peninsular Malaysia.

12.6 *Hopea beccariana* Burck
Merawan Batu
Large buttressed tree; lowland and hill forest to 1200 m; widespread.

12.7 *Shorea acuminata* Dyer
Meranti Rambai Daun
Large buttressed tree to 40 m tall; lowland forest; known previously from Perak and Terengganu, hence constituting a new record for Selangor.

12.8 *Shorea hopeifolia* (F. Heim) Symington
Damar Siput Jantan
Very tall buttressed tree; lowland forest to 600 m; quite widespread.

12.9 *Shorea laevis* Ridley
Balau Kumus
Large buttressed tree; lowland and hill forest to 1000 m; widespread.

12.10 *Shorea macroptera* Dyer
Meranti Melantai
Large tree; lowland and hill forest to 900 m; widespread.

12.11 *Shorea multiflora* (Bruck) Symington
Damar Hitam
Small to medium sized tree; lowland and hill forest to 700 m; throughout.

12.12 *Shorea parvifolia* Dyer ssp. *parvifolia*
Meranti Sarang Punai
Large tree; common in lowland and hill forest to 800 m; widespread.

12.13 *Vatica cinerea* King
Resak Laut
Small to medium sized tree; lowland and hill forest to 600 m, including limestone hill forest; previously known from the northern states of Peninsular Malaysia including Pulau Langkawi.

12.14 *Vatica cuspidata* (Ridley) Symington
Resak Daun Runcing
Medium to large tree; lowland ridge forest often near the sea; widespread; endemic to Peninsular Malaysia.

12.15 *Vatica maingayi* Dyer
Resak
Tree; lowland forest to 500 m; widespread.

12.16 *Vatica odorata* (Griff.) Symington
Resak Bukit
Tree; lowland forest, mostly coastal; quite widespread.

12.17 *Vatica stapfiana* (King) Slooten
Resak
Medium sized tree; lowland forest; widespread.

**13.0 Ebenaceae**

13.1 *Diospyros adenophora* Bakh.
Kayu Arang
Tree to 10 m tall; lowland forest, also on limestone hill forest; endemic to Peninsular Malaysia but quite widespread.

13.2 *Diospyros areolata* King & Gamble
Kayu Arang, Merbatu
Tree to 30 m tall; lowland and hill forest to 700 m; widespread.

13.3 *Diospyros argentea* Griff.
Kayu Arang
Tree to 10 m tall; lowland and hill forest to 800 m; endemic to Peninsular Malaysia but widespread.

13.4 *Diospyros lanceifolia* Roxb.
Nyalin, Kayu Arang
Tree to 20 m tall; lowland and hill forest to 700 m; throughout.

13.5 *Diospyros maingayi* (Hiern.) Bakh.
Kayu Arang
Tree to 30 m tall; lowland and hill forest to 600 m; widespread.

13.6 *Diospyros sumatrana* Miq.
Kayu Arang
Tree to 30 m tall; lowland to montane forest at 1500 m; common throughout.

13.7 *Diospyros venosa* Wall. *ex* A. DC. var. *venosa*
Kayu Arang
Tree to 20 m tall; lowland to lower montane forest at 1300 m; throughout.

**14.0 Elaeocarpaceae**

14.1 *Elaeocarpus ferrugineus* (Jack) Steud ssp. *ferrugineus*
Mendung
Tree to 20 m tall; lowland to lower montane forest at 1200 m; common throughout.

14.2 *Elaeocarpus mastersii* King
Mendung
Tree to 20 m tall; lowland to montane forest at 2000 m; common throughout.

14.3 *Elaeocarpus nitidus* Jack var. *nitidus*
Mendung
Tree to 20 m tall; lowland to montane forest at 1500 m; common throughout.

14.4 *Elaeocarpus pedunculatus* Wall. *ex* Mast.
Mendung
Tree to 20 m tall; lowland and hill forest to 670 m; common throughout.

14.5 *Elaeocarpus pseudopaniculatus* Corner
Mendung
Tree to 10 m tall; a species which is known from the montane forest, especially At Fraser Hill and G. Tahan, its occurrence in the lowland forest of Selangor is both botanically and geographically interesting.

**15.0 Euphorbiaceae**

15.1 *Agrostistachys longifolia* (Wight) Benth. var. *leptosthachya* (Pax & K. Hoffm.) Whitmore
Jejulung
Small tree to 10 m tall; lowland to lower montane forest at 1050 m; throughout.

15.2 *Antidesma cuspidatum* Mull. Arg.
Berunai
Small tree; lowland forest; common throughout.

15.3 *Aporusa microstachya* (Tul.) Mull. Arg.
Nipis Kulit
Tree; hillsides in lowland forest to 400 m; quite widespread.

15.4 *Austrobuxus nitidus* Miq. var. *nitidus*
Tree to 20 m tall; lowland forest, including coastal forest, swamps, mountains; throughout.

15.5 *Baccaurea maingayi* Hook.*f.*
Tampoi
Tree to 20 m tall; hill forest; quite widespread but was not reported from Selangor before.

15.6 *Baccaurea parviflora* (Mull.Arg.) Mull.Arg.
Asam Tambun

Small tree to 5 m tall; lowland and hill forest to 600 m; widespread, more common in the north of Peninsular Malaysia.

15.7 *Blumeodendron griffithii* Hook.*f.*
Geraham Badak
Small tree, or sometimes reaching 20 m tall; hills to plains; throughout.

15.8 *Blumeodendron kurzii* (Hook.*f.*) J.J. Smith
Geraham Badak
Tree to 10 m tall; lowland forest; quite widespread.

15.9 *Blumeodendron tokbrai* (Blume) J.J. Smith
Geraham Badak
Tree to 20 m, sometimes stilt-rooted; lowland forest to 450 m, often in swamps; widespread.

15.10 *Bridelia stipularis* (L.) Blume
Kenidai
Shrub or small tree; normally in open country, often near streams; scattered throughout.

15.11 *Drypetes pendula* Ridley
Lidah-Lidah
Tree to 20 m tall; lowland forest; common throughout.

15.12 *Elateriospermum tapos* Blume
Perah Ikan
Tree to 30 m tall; lowland and hill forest to 600 m; throughout.

15.13 *Endospermum diadenum* (Miq.) Airy Shaw
Sesenduk
Tree to 30 m tall; lowland to lower montane forest at 1000 m; common throughout.

15.14 *Glochidion hypoleucum* (Miq.) Boerl.
Minyak Beruk
Shrub or small tree to 5 m tall; lowland to lower montane forest at 1200 m; throughout.

15.15 *Macaranga giganlea* (Rchb.*f.* & Zoll.) Mull.Arg.
Kubin
Tree to 15 m tall; common in disturbed lowland forest; throughout.

15.16 *Macaranga hosei* King *ex* Hook.*f.*
Mahang
Tree to 20 m tall; lowland forest; common throughout.

15.17 *Macaranga hypoleuca* (Rchb.*f.* & Zoll.) Mull.Arg.
Mahang Putih
Tree to 30 m tall; very common in secondary forest, especially along the forest edges; throughout.

15.18 *Macaranga triloba* (Blume) Mull.Arg.
Mahang Merah
Small tree; lowland forest including secondary growth; common throughout. Dr. T. C. Whitmore (pers. comm. 2000) said the correct name for this species is *M. bancana, M. triloba* as delimited is strictly a Javanese species.

15.19 *Mallotus penangensis* Mull.Arg.
Balik Angin
Tree to 15 m tall; lowland to lower montane forest at 1000 m; throughout; endemic to Peninsular Malaysia.

15.20 *Ptychopyxis costata* Miq. var. *costata*
Mendaruh
Tree to 4 m tall; lowland forest; supposedly very rare as it is previously known once from Sg. Kerian, Perak.

15.21 *Sapium baccatum* Roxb.
Ludai
Tree to 30 m tall; lowland and hill forest to 600 m; throughout.

**16.0 Fagaceae**

16.1 *Castanopsis schefferana* Hance
Berangan
Tree to 20 m tall; lowland forest; widespread.

16.2 *Lithocarpus conocarpus* (Oudem.) Render
Mempening
Tree to 30 m tall; lowland to montane forest at 1800 m; quite widespread.

16.3 *Lithocarpus cyclophorus* (Endl.) A. Camus
Mempening
Tree to 30 m tall; normally found in montane forest to 1800 m; widespread.

16.4 *Quercus argentata* Korth.
Mempening
Tree to 20 m tall; lowland to montane forest; quite widespread.

16.5 *Quercus gemelliflora* Blume
Mempening
Tree to 20 m tall; lowland to lower montane forest; widespread.

**17.0 Flacourtiaceae**

17.1 *Casearia capitellata* Blume
Shrub or small tree to 4 m tall; lowland forest; quite widespread.

17.2 *Flacourtia rukam* Zoll. & Moritzi
Rukam
Small thorny tree; lowland forest; widespread.

17.3 *Homalium dictyoneurum* (Hance) Warb.
Telur Buaya
Tree to 20 m tall; lowland forest; quite widespread.

17.4 *Homalium longifolium* Benth.
Bunga Gambi
Tree to 30 m tall; lowland forest; widespread.

**18.0 Guttiferae**

18.1 *Calophyllum alboramulum* P.F. Stevens
Bintangor
Tree to 20 m tall; lowland forest; it is a rare species as it is previously known from Johore only.

18.2 *Calophyllum dioscurii* P.F. Stevens
Bintangor
Tree to 20 m tall; lowland forest; widespread.

18.3 *Calophyllum rubiginosum* M.R. Hend. & Wyatt-Smith
Bintangor Karat
Tree to 20 m tall; lowland forest; quite widespread.

18.4 *Calophyllum tetrapterum* Miq. var. tetrapterum
Bintangor Kuning Daun Kecil
Tree to 20 m tall; widespread.

18.5 *Calophyllum wallichianum* Planch. & Triana var. *incrasstum* M.R. Hend. & Wyatt-Smith
Bintangor Daun Panjang
Tree to 20 m tall; lowland forest; widespread.

18.6 *Cratoxylum arbrescens* (Vahl) Blume
Geronggang
Tree to 30 m tall; common in lowland swamp forest, also in the hills; widespread.

18.7 *Cratoxylum sumatranum* (Jack) Blume
Derum
Tree to 10 m tall; lowland forest; it is a rare species as it is previously known once each from Terengganu and Selangor.

18.8 *Garcinia burkillii* Whitmore
Kandis
Tree to 15 m tall; lowland to lower montane forest, 420-600 m; endemic to central part of the peninsula.

18.9 *Garcinia cowa* Roxb.
Kandis
Tree occasionally to 20 m tall; lowland forest mostly; widespread.

18.10 *Garcinia malaccensis* Hook.*f.*
Manggis Hutan
Tree to 20 m tall; lowland forest to 540 m: quite widespread.

18.11 *Garcinia nigrolineata* Planch. *ex* T. Anderson
Kandis
Tree; lowland forest to 600 m; common throughout.

18.12 *Garcinia parvifolia* (Miq.) Miq.
Kandis
Tree to 20 m tall; lowland forest to 600 m; common throughout.

18.13 *Mesua ferrea* L.
Penaga Lilin
Tree to 20 m tall; lowland forest to 480 m; throughout but more common in the north of Peninsular Malaysia.

18.14 *Mesua lepidota* T. Anderson var. *lepidota*
Penaga Sabut
Tree to 20 m tall; lowland forest.

18.15 *Mesua racemosa* (Planch. *ex* Triana) Kostermans
Penaga Tikus
Tree to 20 m tall; more common in lowland forest; widespread.

**19.0 Hamamelidaceae**

19.1 *Exbucklandia populnea* (R. Br. *ex* Griff.) R. W. Br.
Geruk
A species normally found in lower montane forests and its occurrence in lowland forest of Ayer Hitam is interesting.

**20.0 Icacinaceae**

20.1 *Stenomerus malaccensis* (Mast.) Sleumer
Derhaka Mertua
Tree to 20 m tall; lowland and hill forest to 1300 m; throughout.

**21.0 Irvingiaceae**

21.1 *Irvingia malayana* Oliv. *ex* Benn.
Pauh Kijang
Tree to 40 m tall; lowland forest; widespread.

**22.0 Ixonanthaceae**

22.1 *Ixonanthes icosandra* Jack
Pagar Anak
Tree to 30 m tall; found in primary and secondary forest, mostly lowlands; throughout.

22.2 *Ixonanthes reticulata* Jack
Inggir Burung
Tree to 30 m tall; lowland and hill forest; throughout.

**23.0 Lauraceae**

23.1 *Actinodaphne sphaerocarpa* (Blume) Nees
Medang Payung
Tree to 20 m tall; lowlands and it is an

element of the northern part of Peninsular Malaysia.

23.2 *Alseodaphne foxiana* (Gamble) Kosterm.
Medang
Tree to 15 m tall; montane forest above 1000 m; endemic to Peninsular Malaysia and quite widespread.

23.3 *Alseodaphne nigrescens* (Gamble) Kosterm.
Medang
Small tree to 10 m tall; lowland to montane forest; widespread.

23.4 *Beilschmiedia dictyoneura* Kosterm.
Medang
Tree to 30 m tall; lowland to lower montane forest at 1000 m; widespread.

23.5 *Beilschmiedia glabra* Kosterm.
Medang
Tree to 20 m tall; lowland and hill forest to 900 m; previously known from Pahang and Johore.

23.6 *Cryptocarya rugulosa* Hook.*f.*
Medang
Tree to 30 m tall; lowland and hill forest; widespread.

23.7 *Litsea grandis* (Wall. *ex* Nees) Hook.*f.*
Medang Daun Besar
Tree to 20 m tall; lowland and montane forest to 1500 m; widespread.

**24.0 Lecythidaceae**

24.1 *Barringtonia macrostachya* (Jack) Kurz
Putat
Tree to 20 m tall; lowland forest, rarely in the mountains; throughout.

**25.0 Leguminosae**

25.1 *Adenanthera malayana* Kosterm.
Saga Daun Tajam
Tree sometimes to 30 m tall; lowland and hill forest to 900 m; often planted in villages; widespread but scattered.

25.2 *Adenanthera pavonina* L.
Saga Daun Tumpul
Tree 20 m tall; lowland forest, usually near the sea; often planted in villages; wild on East Coast and offshore islands of Peninsular Malaysia.

25.3 *Albizzia splendens* Miq.
Kungkur
Tree sometimes reaching 20 m tall; lowland and hill forest to 700 m; scattered throughout.

25.4 *Archidendron bulbalinum* (Jack) I.C. Neilsen
Kerdas
Tree to 20 m tall; lowland forest, often in secondary forest; the seeds are eaten with rice for flavour; widespread.

25.5 *Archidendron clypearia* (Jack) I.C. Nielsen
Jering
Shrub or tree to 20 m tall; more common in montane forest.

25.6 *Archidendron contortum* (Martelli) I.C. Neilsen
Petai Belalang
Shrub to small tree to 10 m tall; common in secondary forest, usually found in the beach forest; widespread.

25.7 *Callerya atropurpurea* (Wall.) Schot.
Tulang Daing
Tree to 20 m tall; open country, sometimes planted as ornamental plant; widespread.

25.8 *Dialium indum* L. var. *indum*
Keranji Paya
Tree to 20 m tall; scattered in lowland forest; widespread.

25.9 *Dialium platysepalum* Baker
Tree to 30 m tall; scattered in the lowland forest; throughout.

25.10 *Intsia palembanica* Miq.
Merbau
Large buttressed tree to 40 m tall; common in lowland forest and produce valuable timber; throughout.

25.11 *Koompassia malaccensis* Maing. *ex* Benth.
Kempas
Big tree to 50 m tall; common in lowland and hill forest; throughout.

25.12 *Parkia singularis* Miq.
Petai Meranti
Tree to 20 m tall or more; lowland and hill forest to 500 m; widespread.

25.13 *Sindora echinocalyx* (Benth.) Prain
Sepetir Daun Nipis
Tree to 30 m tall or more; hill forest to 700 m; widespread.

**26.0 Loganiaceae**

26.1 *Fagraea racemosa* Jack *ex* Wall.
Tembusu
Tree; common in secondary forest, especially near the seashore; widespread.

26.2 *Norrisia malaccensis* Gardner
Tree to 30 m tall; lowland forest; widespread.

**27.0 Melastomataceae**

27.1 *Memecylon amplexicaule* Roxb.
Nipis Kulit
Tree to 15 m tall; lowland and hill forest to 1200 m; widespread.

27.2 *Memecylon campanulatum* C.B. Clarke
Nipis Kulit
Tree to 20 m tall; lowland forest; widespread.

27.3 *Memecylon caeruleum* Jack
Nipis Kulit
Shrub or small tree to 10 m tall; lowland forest; widespread.

27.4 *Memecylon floridum* Ridley
Nipis Kulit
Tree to 15 m tall; hill forest to 1200 m; endemic to Peninsular Malaysia but widespread.

27.5 *Memecylon megacarpum* Furtado
Nipis Kulit
Tree to 15 m tall; lowland to montane forest at 1800 m; widespread.

27.6 *Memecylon minutiflorum* Miq.
Tema
Tree to 25 m tall; lowland to montane forest at 1800 m; widespread.

27.7 *Memecylon paniculatum* Jack
Nipis Kulit
Tree to 30 m tall; lowland and hill forest to 1200 m; widespread.

27.8 *Memecylon pubescens* (C.B. Clarke) King
Nipis Kulit
Tree to 30 m tall; lowland and hill forest to 1200 m; widespread.

27.9 *Memecylon wallichii* Ridley
Nipis Kulit
Small tree to 5 m tall; lowland and hill forest; endemic to Peninsular Malaysia and quite widespread.

27.10 *Pternandra coerulescens* Jack
Nipis Kulit
Tree to 15 m tall; lowland and hill forest; widespread.

27.11 *Pternandra echinata* Jack
Sial Menahun
Tree to 15 m tall; lowland and hill forest to 1200 m; widespread.

**28.0 Meliaceae**

28.1 *Aglaia edulis* (Roxb.) Wall.
Pasak
Tree to 20 m tall; lowland and hill forest; quite widespread.

28.2 *Chisocheton patens* Blume
Memberas
Tree to 20 m tall; lowland forest; widespread.

28.3 *Chisocheton tomentosus* (Roxb.) Mabb.
Pasak
Tree to 20 m tall; lowland and hill forest; widespread.

28.4 Sandoricum koetjape (Burm.*f.*) Merr.
Sentul
Tree to 30 m tall; lowland and hill forest, and more common near the shores; often cultivated in the villages for its edible fruits, widespread.

**29.0 Menispermaceae**

29.1 *Fibraurea tinctoria* Lour.
Large liana to 20 m long; lowland and hill forest margins; widespread and common.

**30.0 Moraceae**

30.1 *Artocarpus dadah* Miq.
Pudu
Tree to 20 m tall; lowland and hill forest; throughout.

30.2 *Artocarpus elasticus* Reinw. *ex* Blume
Terap Nasi
Tree to 20 m tall; lowland and hill forest; throughout.

30.3 *Artocarpus integer* (Thunb.) Merr. var. *silvestris* Corner
Cempedak
Tree to 20 m tall; lowland to montane forest; widespread.

30.4 *Artocarpus lanceifolius* Roxb.
Keledang
Tree to 30 m tall; lowland and hill forest; widespread.

30.5 *Streblus elongatus* (Miq.) Corner
Tempinis
Tree to 20 m tall; lowland forest; widespread.

**31.0 Myristicaceae**

31.1 *Gymnancranthera farquhariana* (Hook.*f.* & Thomson) Ward. var. *eugeniifolia* (A.DC.) R.T.A. Schouten
Penarahan
Tree to 20 m tall; lowland and hill forest to 1300 m; widespread.

31.2 *Horsfieldia fulva* (King) Warb.
Penarahan
Tree to 20 m tall; lowland forest; quite widespread.

31.3 *Horsfieldia irya* (Gaertn.) Warb.
Penarahan
Tree to 20 m tall; lowland forest; widespread.

31.4a *Horsfieldia polyspherula* (Hook.*f.*) J. Sinclair var. *polyspherula*
Penarahan
Tree to 30 m tall; lowland forest; widespread.

31.4b *Horsfieldia polyspherula* (Hook.*f.*) J. Sinclair var. *sumatrana* (Miq.) W.J. de Wilde
Penarahan
Tree to 30 m tall; lowland forest; widespread.

31.5 *Horsfieldia ridleyana* (King) Warb.
Penarahan
Tree to 20 m tall; lowland forest on poor soils; widespread.

31.6 *Horsfieldia sucosa* (King) Warb.
Penarahan
Tree to 20 m tall; lowland forest; widespread.

31.7 *Knema curtisii* (King) Warb. var. *curtisii*
Penarahan Daun Kecil
Tree to 10 m tall; lowland forest; widespread.

31.8 *Knema furfuracea* (Hook.*f.* & Thomson) Warb.
Penarahan Arang
Tree to 20 m tall; lowland forest; widespread.

31.9 *Knema glauca* (Blume) Warb.
Penarahan
Tree to 20 m tall; lowland forest; quite widespread.

31.10 *Knema hookeriana* (Wall. *ex* Hook.*f.* & Thomson) Warb.
Penarahan
Tree to 20 m tall; lowland and hill forest; widespread.

31.11 *Knema intermedia* (Blume) Warb.
Penarahan
Tree to 10 m tall; lowland forest; widespread.

31.12 *Knema kunstleri* (King) Warb.
Penarahan
Tree to 10 m tall; lowland and hill forest on poor soils; widespread.

31.13 *Knema latericia* Elmer ssp. *ridleyi* (Gand.) W.J. de Wilde
Penarahan
Tree to 10 m tall; lowland forest; quite widespread.

31.14 *Knema laurina* (Blume) Warb. var. laurina
Penarahan
Small tree; lowland forest; widespread.

31.15 *Knema malayana* Warb.
Penarahan
Tree to 15 m tall; lowland forest; widespread.

31.16 *Knema oblongifolia* (King) Warb.
Penarahan
Tree to 10 m tall; endemic to Peninsular Malaysia and quite widespread.

31.17 *Knema patentinervia* (J. Sinclair) W.J. de Wilde
Penarahan
Tree to 15 m tall; lowland forest; widespread.

31.18 *Knema pseudolaurina* W.J. de Wilde
Penarahan
Tree; lowland forest; widespread.

31.19 *Knema scortechinii* (King) J. Sinclair
Penarahan Arang
Tree to 20 m tall; lowland forest; widespread.

31.20 *Knema stenophylla* (Warb.) J. Sinclair
Penarahan
Tree to 10 m tall; lowland forest; widespread.

31.21 *Myristica iners* Blume
Penarahan
Tree to 20 m tall; lowland forest; common throughout.

31.22 *Myristica malaccensis* Hook.*f.*
Penarahan
Tree; lowlands; widespread.

**32.0 Myrsinaceae**

32.1 *Ardisia crassa* C.B. Clarke
Sem Babui
Small tree; lowland forest; a southern element of Peninsular Malaysia.

**33.0 Myrtaceae**

33.1 *Rhodamnia* cinerea Jack
Mempoyan
Tree to 15 m tall; quite common in the lowland forest, especially in the secondary forest near the sea; common throughout.

33.2 *Syzygium borneense* (Miq.) Miq.
Kelat
Tree to 15 m tall; lowland forest.

33.3 *Syzygium claviflorum* (Roxb.) *ex* Wall. var. *claviflorum* Cowan & Cowan
Kelat
Medium sized tree; lowland and hill forest; widespread.

33.4 *Syzygium politum* (King) I. M. Turner
Kelat Merah
Shrub or small tree sometimes to 20 m tall; lowland and hill forest; endemic to Peninsular Malaysia and widespread.

33.5 *Syzygium pseudocrenulatum* (M.R. Hend.) I.M. Turner
Kelat
Stilt-rooted tree to 20 m tall; lowland

forest; endemic to Peninsular Malaysia but widespread.

33.6 *Syzygium pyrifolium* (Blume) D.C.
Kelat
Tree to 15 m tall; lowlands; widespread.

33.7 *Syzygium rugosum* Korth. var. *rugosum*
Kelat
Tree to 20 m tall; lowland and hill forest; widespread.

33.8 *Syzygium syzygioides* (Miq.) Merr. & L.M. Perry
Kelat
Tree to 20 m tall; lowlands, often coastal; common throughout.

**34.0 Ochnaceae**

34.1 *Brackenridgea hookeri* (Planch.) A.Gray
Tree to 20 m tall; lowland and hill forest to 1000 m; throughout.

34.2 *Campylospermum serratum* (Gaertn.) Bittrich & M.C.E. Amaral
Mata Ketam
Tree to 20 m tall; lowland and hill forest to 1000 m; common near the sea; throughout.

**35.0 Olacaceae**

35.1 *Ochanostachys amentacea* Mast.
Petaling
Tree to 20 m tall; lowland and hill forest to 900 m; widespread.

35.2 *Scorodocarpus borneensis* (Baill.) Becc.
Bawang Hutan
Tree reaching to 30 m tall; its bark smells of garlic; lowland forest; widespread.

35.3 *Strombosia ceylanica* Gardner
Kamap
Tree to 20 m tall; lowland forest; widespread.

35.4 *Strombosia javanica* Blume
Dedali
Tree to 20 m tall; lowland forest; widespread.

**36.0 Oxalidaceae**

36.1 *Sarcotheca griffithii* (Planch. *ex* Hook.*f.*) Hallier *f.*
Belimbing Pipit
Tree to 20 m tall; lowland forest; widespread.

36.2 *Sarcotheca monophylla* (Planch. ex Hook.f.) Hallier f.
Pupoi
Tree to 20 m tall; lowland forest; endemic and widespread.

**37.0 Pandaceae**

37.1 *Galearia fulva* (Tul.) Miq.
Small tree; lowland and hill forest to 690; throughout.

**38.0 Polygalaceae**

38.1 *Xanthophyllum affine* Korth. *ex* Miq.
Minyak Beruk
Tree to 20 m tall; usually smaller; lowlands and mountains; widespread.

38.2 *Xanthophyllum amoenum* Chodat
Minyak Beruk
Tree to 30 m tall; lowland and hill forest; widespread.

38.3 *Xanthophyllum eurhynchum* Miq. ssp. *maingayi* (Hook.*f.* *ex* A.W. Benn.) Meijden
Minyak Beruk
Shrub or tree to 20 m tall; lowland to mountains, forest understory; widespread.

38.4 *Xanthophyllum griffithii* Hook.*f.* *ex* A.W. Benn ssp. *erectum* Meijden
Minyak Beruk

38.5 *Xanthophyllum stipitatum* A.W. Benn.
Minyak Beruk
Tree to 30 m tall; lowland and hill forest, usually on ridges; widespread.

38.6 *Xanthophyllum vitellinum* (Blume) Dietr.
Minyak Beruk
Tree to 30 m tall; lowland to lower montane forest; widespread.

**39.0 Rhizophoraceae**

39.1 *Carallia eugenioidea* King
Meransi Mata Keli
Shrub or small tree to 20 m tall; montane forests above 1200 m; previously not known from Selangor.

39.2 *Pellacalyx axillaris* Korth.
Membuloh
Tree to 20 m tall; damp or wet lowland or hill forest; widespread.

39.3 *Pellacalyx saccardianus* Scort.
Membuluh
Tree to 20 m tall; lowland and hill forest to 900 m; widespread; endemic to Peninsular Malaysia.

**40.0 Rosaceae**

40.1 *Prunus arborea* (Blume) Kalkman var. *arborea*
Pijat
Tree to 20 m tall; lowland to lower montane forest at 1300 m; widespread.

**41.0 Rubiaceae**

41.1 *Acranthera pulchella* (Ridley) K.M. Wong
Shrub; lower montane forest; endemic and previously known from Perak and Pahang.

41.2 *Aidia densiflora* (Wall.) Masam.
Mentiong
Small tree to 15 m tall; lowland to montane forest; throughout.

41.3 *Diplospora malaccensis* Hook.*f.*
Kopi Hutan
Tree to 15 m tall; lowland to montane forest at 1500 m; throughout.

41.4 *Ixora javanica* (Blume) DC. var. *retinervia* Corner
Shrub or small tree to 5 m tall; lowland and hill forest to 1000 m; widespread; an endemic variety.

41.5 *Nauclea officinalis* (Pierre *ex* Pit.) Merr. & Chun
Mengkal
Tree to 20 m tall; lowland and hill forest; throughout.

41.6 *Pertusadina eurhyncha* (Miq.) Ridsdale
Latticed tree to 20 m tall; lowland and hill forest to 400 m; scattered.

41.7 *Porterandia anisophyllea* (Jack *ex* Roxb.) Ridley
Tinjau Belukar
Tree to 10 m tall; lowland and hill forest; widespread.

41.8 *Psydrax maingayi* (Hook.*f.*) Bridson
Tree to 15 m tall; lowland to lower montane forest; endemic to Peninsular Malaysia and widespread.

41.9 *Psydrax nitidum* (Craib) K.M. Wong
Mentulang
Small tree to 5 m tall; lowland forest including that on limestone hill forest at Pulau Langkawi.

41.10 *Timonius compressicaulis* (Miq.) Boerl.
Shrub or small tree to 5 m tall; normally found on sandy and rocky shores; its occurrence in the Ayer Hitam FR is botanically noteworthy.

41.11 *Timonius wallichianus* (Korth.) Valeton
Timun
Tree to 5 m tall; lowland forests, common in secondary vegetation; widespread.

41.12 *Urophyllum glabrum* Wall.
Shrub or small tree to 5 m tall; lowland to lower montane forest at 1000 m; throughout.

**42.0 Rutaceae**

42.1 *Glycosmis chlorosperma* Spreng var. *chlorosperma*
Shrub; lowland to montane forest; widespread.

42.2 *Maclurodendron porteri* (Hook.*f.*) T.G. Hartley
Merlimau
Tree to 20 m tall; lowland to lower montane forest; throughout.

42.3 *Melicope glabra* (Blume) T.G Hartley
Pepauh
Tree to 20 m tall; lowland forest; widespread.

**43.0 Sapotaceae**

43.1 *Madhuca decipiens* J. Sinclair
Nyatoh
Tree to 20 m tall; lowland forest, previously known from Johore.

43.2 *Madhuca malaccensis* (C.B. Clarke) H.J. Lam.
Nyatoh
Tree to 20 m tall; lowland forest; widespread.

43.3 *Madhuca selangorica* (King & Gamble) J. Sinclair
Nyatoh
Tree to 15 m tall; lowland forest; endemic to the central part of Peninsular Malaysia, especially Selangor.

43.4 *Madhuca utilis* (Ridley) H.J. Lam
Bitis
Tree to 20 m tall; lowland forest; widespread.

43.5 *Palaquium gutta* (Hook.*f.*) Baill.
Nyatoh Taban Merah
Tree to 20 m tall; lowland and hill forest; widespread.

43.6 *Palaquium rostratum* (Miq.) Burck
Nyatoh Sidang
Tree to 30 m tall; lowland to montane forest; widespread.

43.7 *Payena maingayi* C.B. Clarke
Nyatoh Durian
Tree to 30 m tall; lowland forest; endemic to Peninsular Malaysia and widespread.

43.8 *Pouteria malaccensis* (C.B. Clarke) Baehni
Nyatoh Nangka Kuning
Tree to 30 m tall; lowland to lower montane forest; throughout.

**44.0 Simaroubaceae**

44.1 *Eurycoma longifolia* Jack
Tongkat Ali
Tree to 5 m tall; lowlands and hills; throughout.

44.2 *Eurycoma apiculata* Benn.
Tongkat Ali
Tree to 5 m tall; usually in the mountains; about 1200 m; widespread.

**45.0 Sterculiaceae**

45.1 *Pterygota alata* (Roxb.) R. Br.
Tree to 30 m tall; lowland forests near rivers; widespread.

45.2 *Scaphium longiflorum* Ridley
Kembang Semangkuk Jantung
Tree to 30 m tall; swampy lowland forest; endemic and widespread.

45.3 *Sterculia parvifolia* Wall. *ex* R.Br.
Kelumpang
Small tree to 10 m tall; hill forest; quite widespread.

**46.0 Theaceae**

46.1 *Gordonia maingayi* Dyer
Kadeng
Tree to 15 m tall; lowland to montane forest at 1600 m; endemic to Peninsular Malaysia and widespread.

46.2 *Gordonia scortechinii* King
Pagar anak
Tree; lowland forest; endemic and previously known from Perak and Pahang, hence it is a new record for Selangor.

46.3 *Ternstroemia bancana* Miq.
Tree to 20 m tall; lowland forest to 500 m; widespread.

**47.0 Thymelaeaceae**

47.1 *Aquilaria malaccensis* Lam.
Karas
Tree to 30 m tall; lowland and hill forest to 750 m; widespread.

47.2 *Gonystylus affinis* Radlk.
Ramin
Tree to 30 m tall; lowland forest to 330 m; widespread.

47.3 *Gonystylus bancanus* (Miq.) Kurz.
Ramin Dara Elok
Tree to 20 m tall; more common in the lowland peat swamp forest.

47.4 *Gonystylus maingayi* Hook.*f.*
Ramin
Tree to 30 m tall; lowland forest; widespread.

**48.0 Tiliaceae**

48.1 *Microcos antidesmifolia* (King) Burret
Chenderai
Tree to 10 m tall; lowland forest, often near rivers; widespread.

48.2 *Microcos lanceolata* (Miq.) Burret
Damak-Damak
Shrub or small tree; lowland forest; mostly found in the west coast states.

**49.0 Trigoniaceae**

49.1 *Trigoniastrum hypoleucum* Miq.
Marajali
Tree to 20 m tall; lowland forest; widespread.

**50.0 Ulmaceae**

50.1 *Gironniera nervosa* Planch.
Hampas Tebu
Tree to 35 m tall, usually smaller; lowland forest below 500 m; widespread.

50.2 *Gironniera parvifolia* Planch.
Hampas Tebu Licin
Tree to 20 m tall; lowland and hill forest to 900 m; widespread.

50.3 *Trema cannabina* Lour.
Shrub or small tree to 10 m tall; secondary forest to 1000 m; throughout.

50.4 *Trema orientalis* (L.) Blume
Mengkirai
Tree to 5 m tall; lowlands and hills.

**51.0 Verbenaceae**

51.1 *Vitex gamosepala* Griff.
Leban
Tree to 10 m tall; lowland and hill forest to 1200 m; throughout.

51.2 *Vitex pinnata* L.
Leban
Tree to 20 m tall; disturbed forest.

**Angiosperms – Monocotyledons**

In this scientific expedition for unknown reasons not much attention was given to collecting and observing the monocotyledons.

**52.0 Gramineae**

52.1 *Centotheca lappacea* (L.) Desv.
Rosette-forming herb to 1 m tall; shady places to 1500m; widespread.

52.2 *Lophatherum gracile* Brongn.
Herb to 1 m tall often forming loose rosette; openings in forest to 1650 m; widespread.

52.3 *Panicum trigonum* Retz.
Grass herb; common.

**53.0 Marantaceae**

53.1 *Stachyphyrnium griffithii* (Baker) K. Schum.
Herb; lowland forest; previously known from Perak, Pahang and southward; endemic.

**54.0 Palmae**

54.1 *Licuala* sp. (AZ 6743)

## DISCUSSION

The Ayer Hitam FR is a logged-over lowland dipterocarp forest which is fast recovering towards its climax. It is obvious from the above checklist that it is preliminary because it was based on observation and collection during a brief expedition and it must be taken together with other similar efforts taken by the researchers from the Faculty of Forestry, Universiti Putra Malaysia (Faridah Hanum 1999). In the above study a total of 430 species in 203 genera and 72 families were accounted whereas in this checklist only 262 species (ca. 60.9%) belonging to 142 genera (70%) and 56 families (77.8%) were enumerated. It is obvious that when the above list is compared with the present one the common taxa was very high, implying that collections were done on the same taxa, and most likely in the similar habitats. In the present checklist the following families are not represented at all: Burseraceae, Piperaceae, Zingiberaceae, Sapindaceae, Compositae, Dioscoreaceae, Proteaceae, Araliaceae, Crypteroniaceae, Opiliaceae, Sonneratiaceae, Vitaceae, Leeaceae, Solanaceae, Cyperaceae and Orchidaceae.

In the current checklist there are a total of 56 families, 54 are angiosperms and two are gymnosperms, some are represented by a species while others are quite largely represented by more than five species. The size of the 10 largest families is given, with Myrtaceae as being the largest containing a total of 22 species in four genera (Table 1). The Dipterocarpaceae, Guttiferae and Myristicaceae are represented by smaller number of genera but many species. The other large families such as Euphorbiaceae and Rubiaceae both are represented by larger number of genera and species. In many similar studies, the families such as Euphorbiaceae, Annonaceae and Rubiaceae which are always dominant in lowland dipterocarp forests present in large number in this logged over forest. The genera *Macaranga and Mallotus* (Euphorbiaceae) contain many pioneer species of the disturbed forests.

With respect to the size of genera, *Knema* (Myristicaceae) a lowland forest dweller is the largest genus containing a total of 13 species. This is followed by *Memecylon* (Melastomataceae) with 9 species and by *Syzygium* (Myrtaceae) and *Diospyros* (Ebenaceae) each containing 7 species (Table 2). All these genera are common components of lowland dipterocarp forest in Peninsular Malaysia, and their occurrence in the Ayer Hitam FR is highly expected. However, *Syzygium* is also common in beach forest (Tami 1996) and hill dipterocarp forest (Shamsul 2001). It is worth noting that *Shorea* and *Dipterocarpus* (Dipterocarpaceae) are still present in moderate frequencies within the forest, although logging had taken place in the last 60 years or so. It is fair to assume that the trees belonging to these timber genera are remnants of the past logging operations or they were purposely left then as they did not attain their cutting limits. The other comparatively large genera are *Elaeocarpus* (Elaeocarpaceae), *Calophyllum* and *Garcinia* (Guttiferae).

TABLE 1
The size of 10 largest families in Ayer Hitam FR

| Family | No. of genera | No. of species |
|---|---|---|
| Myrtaceae | 4 | 22 |
| Euphorbiaceae | 15 | 21 |
| Dipterocarpaceae | 5 | 17 |
| Annonaceae | 7 | 14 |
| Leguminosae | 9 | 13 |
| Guttiferae | 4 | 13 |
| Rubiaceae | 10 | 12 |
| Myristicaceae | 2 | 11 |
| Anacardiaceae | 6 | 8 |
| Ebenaceae | 1 | 7 |

TABLE 2
The size of 10 largest genera in Ayer Hitam FR

| Genus | No. of species |
|---|---|
| *Knema* | 13 |
| *Memecylon* | 9 |
| *Syzygium* | 7 |
| *Diospyros* | 7 |
| *Xanthophyllum* | 6 |
| *Shorea* | 6 |
| *Vatica* | 5 |
| *Elaeocarpus* | 5 |
| *Calophyllum* | 5 |
| *Garcinia* | 5 |

*Patterns of Plant Distribution in Ayer Hitam FR*

The species composition in Ayer Hitam FR is interesting from the botanical point of view. By far the most predominant are the elements of lowland dipterocarp forests but as the forest has been logged and silvicultural treatments had been carried out, some pioneer species and

introduced species are observed. Among the introduced species include *Podocarpus nerrifolius* and weed species such as *Asystasia gangetica, Eupatorium odoratum* and *Mikania micrantha.*

*Introduced Species*

It seems only *Podocarpus nerrifolius* is the only introduced species observed in the Ayer Hitam FR. Others are weedy species.

*Peninsular Malaysian Endemics*

In Peninsular Malaysia there are a total of 749 endemic tree species and the number of non-tree endemic species is not known. In Ayer Hitam FR there are 20 endemic species, viz. *Alphonsea lucida, Popowia fusca, Stachyphyrnium griffithii, Gordonia maingayi, G. scortechnii, Scaphium longiflorum, Diospyros adenophora, D. argentea, Garcinia burkillii, Vatica cuspidata, Alseodaphne foxiana, Memecylon floridum, M. wallichianum, Knema oblongifolia, Syzygium politum, Pellacalyx saccardianus, Acranthera pulchella, Psydrax maingayi, Madhuca selangorica* and *Payena maingayi.* Most of these have a wide distribution except *Acranthera pulchella* and *Madhuca selangorica* which seem to be found in Selangor.

*Rare Peninsular Malaysia Taxa*

There are species which are known from very few collection records in Peninsular Malaysia and they are known to occur in Ayer Hitam FR. These include *Ptychopyxis costata* var. *costata, Calophyllum alboramulum, Cratoxylon sumatranum, Madhuca decipiens, Beilschmeidia glabra* and *Acranthera pulchella.* This directly proves that Ayer Hitam FR is one of the refugia habitats for these taxa and hence conservation of this forest is deemed more important. Similar phenomenon has been shown by Mat-Salleh (1999) for Bangi FR at Universiti Kebangsaan Malaysia.

*Malaysian Montane Elements*

These are taxa which are known to occur on the mountains of Peninsular Malaysia and are observed and collected in the lowland forest of Ayer Hitam FR. These include *Elaeocarpus pseudopaniculatus* and *Exbucklandia populnea.* These taxa have proved that they could adapt to the microclimate of the lowlands.

*Southern Peninsular Malaysian Elements*

Those taxa which are known to occur south of Selangor, i.e. found in Negeri Sembilan, Malacca and Johore are termed the floristic elements of the south Peninsular Malaysia. Here, Selangor is taken as the mid-point between the south and north of peninsula. There are a few species which showed this pattern of distribution including *Parinari elmerii, Terminalia foetidissima* and *Ardisia crassa.*

*Northern Peninsular Malaysian Elements*

Conversely, all those taxa which are found north of Selangor, i.e. in Perak, Penang, Kedah and Perlis are termed as northern floristic elements. There are two species which showed this pattern of distribution including *Alphonsea curtisii* and *Terminalia calamansanai.*

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TURNER, I.M. 1995. A catalogue of the vascular plants of Malaya. *The Garden's Bulletin Singapore* **47(1 & 2)**: 1-757.

# Preparation of Manuscript

A full article should not exceed 10 printed pages (one printed page is roughly equivalent to 3 type-written pages) including figures and tables.

*A short communication*, not exceeding two printed pages, is intended for rapid publication.

*Typing and Paper*
Manuscripts should be typewritten on A4 paper, double spaced, and of letter quality with 4cm margins on all sides.

*Title page*
This page should bear the title of the paper with the full name of the author(s), followed immediately by the address. Author citation should also be provided. A short title not exceeding 60 characters should be provided for the running headline.

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Abstracts in Bahasa Melayu and English, each not exceeding 200 words, should follow immediately after the names and affiliation of author(s). Papers from outside of Malaysia may be submitted with an English abstract only.

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Illustrations including diagrams and graphs will be referred to as 'figures' and photographs as 'plates' in the text and numbered consecutively in Arabic numerals. All photographs (glossy black and white prints) should be supplied with appropriate scales.

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Metric units must be used for all measurements.

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Monographs
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Serials
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Chapter in Edited Book
Roberts, D.W. 1980. Toxins of entomopathogenic fungi. In *Microbial Control of Pests and Plant Diseases*, ed. H.D. Burgess, p. 441-463. New York: Academic Press.

Proceedings
Hussein, M.Y. 1986. Biological control of aphids on potatoes by inundative releases of predators. In *Biological Control in the Tropics*, ed. M.Y. Hussein and A.G. Ibrahim, p. 137-147. Serdang: Universiti Pertanian Malaysia Press.

Unpublished Materials (e.g. theses, reports & documents)
Normah, M.N. 1987. Effects of temperature on rubber (*Hevea brasiliensis* Muell - Arg.) Seed storage. Ph.D. Thesis, 206p. Universiti Pertanian Malaysia.

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