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The Role and Function of Universiti Kebangsaan Malaysia Permanent Forest Reserve in Research and Education

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ABSTRAK

Hutan Simpan Kekal UKM adalah kawasan berhutan yang masih ada di dalam kampus utama UKM di Bangi, yang merupakan kawasan yang dimajukan di atas hutan yang dahulunya dikenali sebagai Hutan Simpan Bangi. Kawasan seluas 138 ha (340 ekar) ini dikelaskan sebagai hutan yang telah dibalak yang sedang pulih, termasuk kawasan seluas 81 ha telah dikhaskan sebagai kawasan penyelidikan ekologi. HSKUKM telah diwartakan pada tahun 1993 untuk menghalang pembangunan kawasan hijau di bawah pengawasan UKM. Perkara ini telah ditekankan semula di dalam Polisi Kelestarian Hutan UKM yang telah dilancarkan pada tahun 1997. Hutan Simpan Bangi dahulunya adalah merupakan sebahagian dari kawasan berhutan Lembagan Langat yang telah terserpih. Kedudukan hutan ini yang hampir dengan kampus telah dioptimumkan oleh pelajar dan kakitangan UKM untuk penyelidikan mereka. Sejak dari peringkat awal pembangunannya, UKM telah menekankan pembinaan kampus yang menyerupai taman botani di mana para pelajar akan dapat menjadikannya sebagai makmal terbuka. Hasilnya UKM telah menjadi contoh dan sekarang mempunyai koleksi di antara terbaik bagi germplasma tumbuhan perhiasan dan teduhan terutama palma dan paku pakis. Hutan ini penting kerana ia merupakan sinki hijau karbon di Lembagan Langat serta ianya digunakan sebagai makmal biologi dan kelas terbuka bagi pelajar di UKM.

ABSTRACT

The UKM Permanent Forest Reserve is an area within the main campus of UKM in Bangi, developed in an area formerly known as Bangi Forest Reserve (BFR). This 138 ha (340 acres) of recovering logged-over forest, inclusive of some 81 ha of ecological research area was formally gazetted in 1993 as UKM Permanent Forest Reserve to safeguard and prevent further development of this green area. This was further reiterated in the UKM Sustainable Forest Policy which was introduced in 1997. The BFR was part of what was used to be known as Langat Basin Forest area which is now very much fragmented into various pieces of small left-overs. The close vicinity of the forest to the campus has been one of the main reasons for the extensive utilisation of the area for student research projects. Since the early days of its development, the planners of UKM have envisaged holistic concept of having the campus to resemble a botanic garden as a whole to serve as living laboratories for the use of UKM students in education and research. As a result, UKM has set an example and currently hold one of the best germplasm collections of ornamental plants, especially palms and ferns collections in Malaysia. The UKM Permanent Forest Reserve is an important carbon sink green area in the Langat Basin as well as a biological laboratory and open classroom for UKM students.

INTRODUCTION

The Bangi Forest Reserve (BFR) lies between 2° 54' N and 101° 4.5' E in the district of Hulu Langat, Selangor Darul Ehsan, some 35 km south of Kuala Lumpur. This quartzite soft rock-based forest is bordered by the Langat river in the North and Kuala Lumpur-Seremban highway in the South. Topographically the area is moderately flat with several small streams and patches of swamps, at altitude of 40 m to 110 m above sea level. BFR received its status as a forest reserve on 31 December 1906 and was placed under strict jurisdiction of the Selangor Forestry Department. Nevertheless unauthorized exploitation during the post World War II occurred and it was selectively logged during the

Japanese occupation in 1942-1945 (Latiff 1981). It was again logged off for the second time in the late 1960's. The Japanese planted *Palaquium gutta* after the logging was completed as a source for "gutta perca". In addition, native settlements were then allowed and *Hevea brasiliensis* trees were subsequently planted on the fringes of this reserve. Prior to handing of this Reserve to the Universiti Kebangsaan Malaysia (UKM) authorities in the 1970's, it had been the home of the Temuan community aborigines group.

The original 881 ha BFR was classified into 832 ha of regenerating lowland forest, 31 ha of fresh water swamps and 19 ha of rubber and oil palm plantations *(Fig. 1, 2)*. Most of these areas, especially plantation areas and those near the main road, were developed to accommodate infrastructures for the UKM campus facilities. Another 27 ha was later delineated for Malaysian Institute for Nuclear Technology (MINT) (then known as Pusat Penyelidikan Atom Tun Dr Ismail or PUSPATI) and some 200 ha was leased to Palm

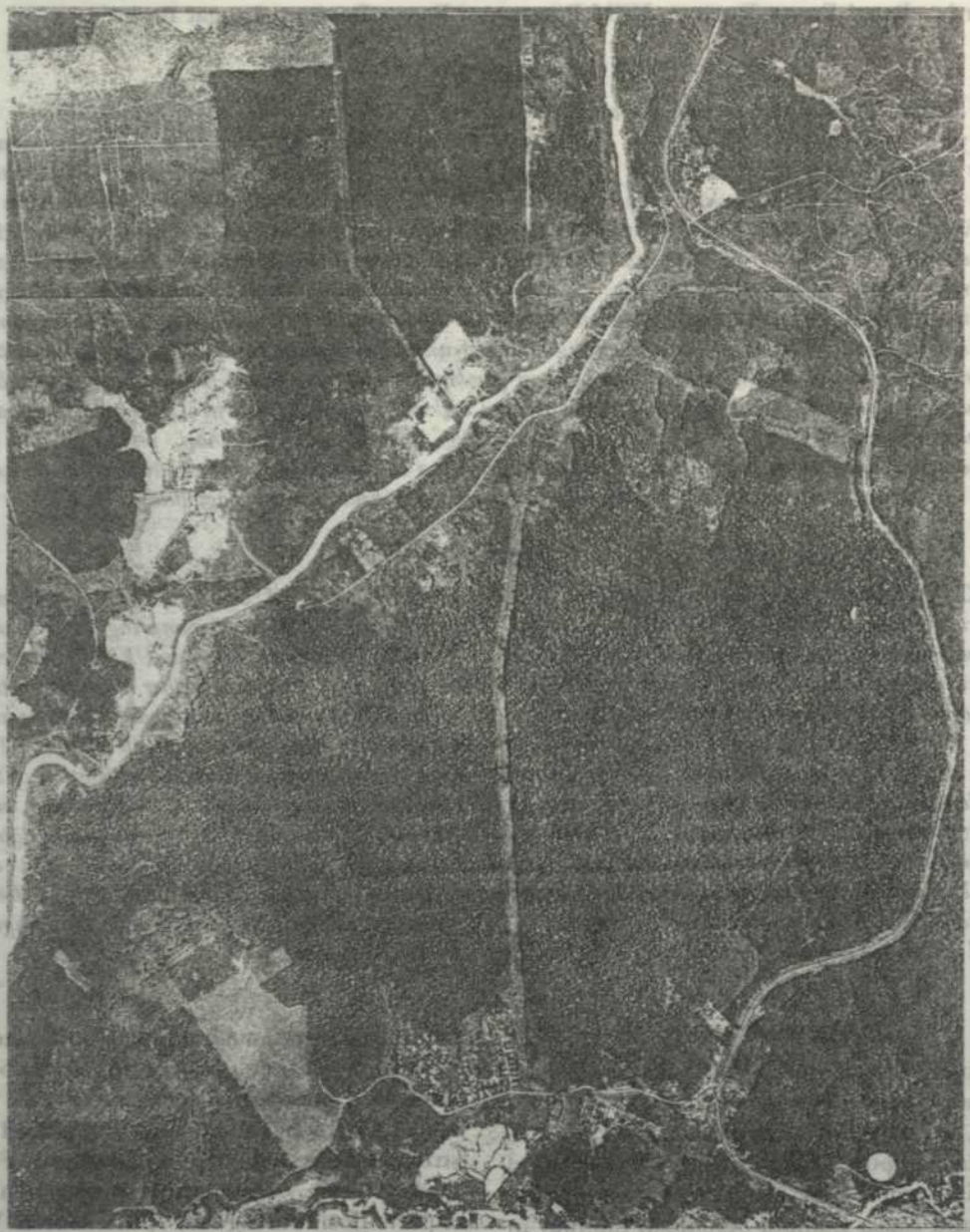

Fig. 1. Aerial photograph of the Bangi Forest Reserve in 1970's

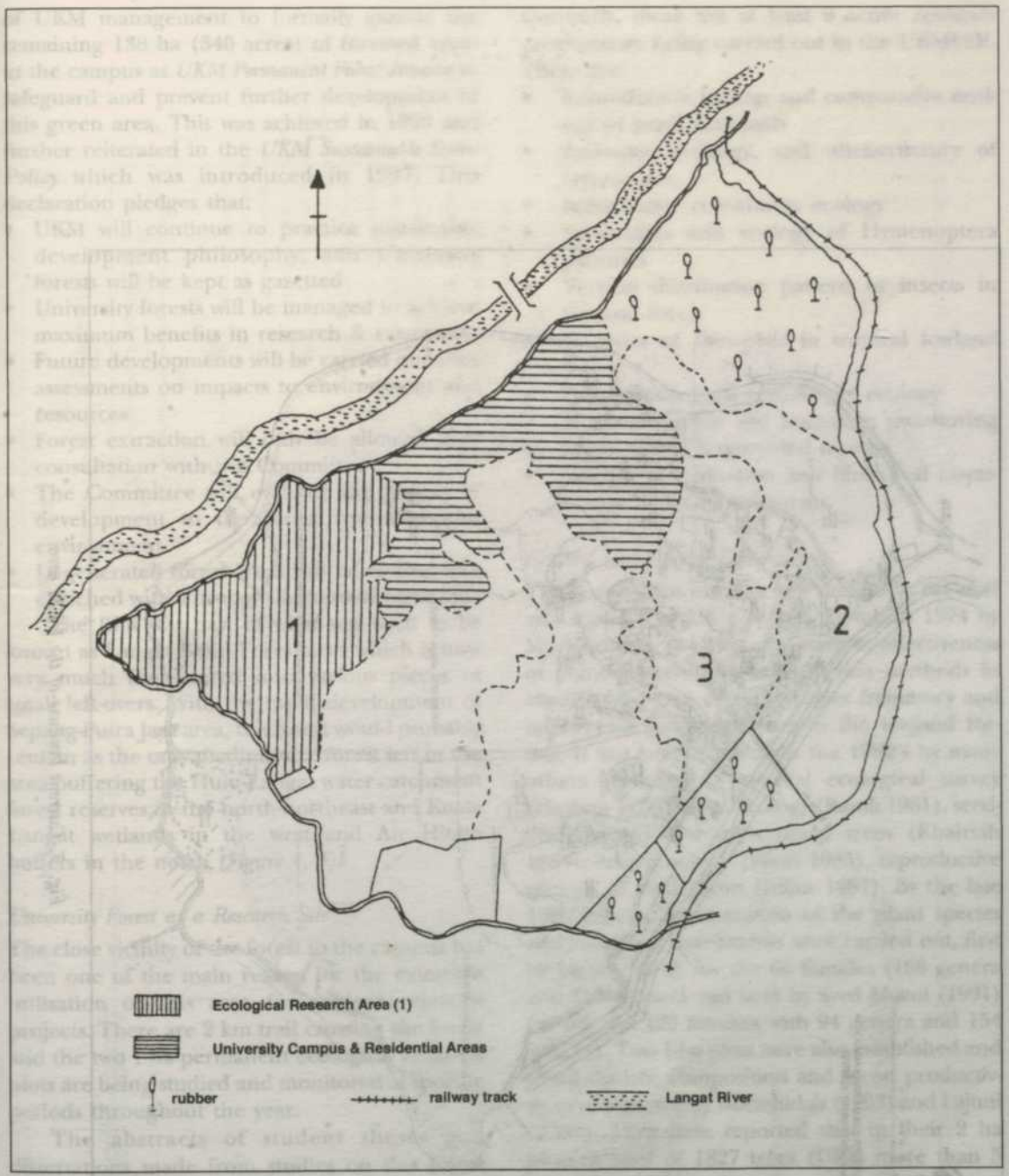

Fig. 2. Map of Bangi Forest Reserve in 1970's showing the ecological reseach area (1). The section 2 and 3 are under very disturbed forests

Oil Research Institute Malaysia (PORIM) for oil palm plantation. By late 1980's only a portion of the original forest (about 105 ha) remain designated by the University as the Ecological Research Area, where many on-going researches were carried out mostly by students of UKM *(Fig. 3)*.

The Establishment of UKM Permanent Forest Reserve

Following illegal encroachment of this area, which further reduced the ecological research area to a dangerously small fragment (said to be about 81 ha), biologists and senior academicians in the campus appealed to the top management

Fig. 3. Current landuse of the UKM area

of UKM management to formally gazette the remaining 138 ha (340 acres) of forested areas in the campus as *UKM Permanent Forest Reserve* to safeguard and prevent further development of this green area. This was achieved in 1993 and further reiterated in the *UKM Sustainable Forest Policy* which was introduced in 1997. This declaration pledges that:

- UKM will continue to practice sustainable development philosophy, and University forests will be kept as gazetted
- University forests will be managed to achieve maximum benefits in research & education
- Future developments will be carried out after assessments on impacts to environment and resources
- Forest extraction will only be allowed after consultation with the Committee
- The Committee will evaluate the impact of development to the forest resources and environment
- Degenerated forest areas will be revived and enriched with a proper silvicultural technique

The BFR was part of what was used to be known as Langat Basin Forest area which is now very much fragmented into various pieces of small left-overs. With the rapid development of Sepang-Putra Jaya area, this forest would probably remain as the only medium-size forest left in the area buffering the Hulu Langat water catchment forest reserves in the north-northeast and Kuala Langat wetlands in the west and Air Hitam buffers in the north *(Figure 4, 5)*.

University Forest as a Research Site

The close vicinity of the forest to the campus has been one of the main reason for the extensive utilisation of this area for student research projects. There are 2 km trail crossing the forest and the two 1-ha permanent ecological research plots are being studied and monitored at specific periods throughout the year.

The abstracts of student theses and dissertations made from studies on this forest and its components were recently compiled and published by Zubaid (1997). A total of 75 theses and dissertations were submitted from 1974 to 1997 for Ph.D (1 dissertation), M.Sc. (6) and B.Sc (68). These student academic reports cover:

- Vertebrate ecology & systematics (23)
- Floristics & plant ecology (22)
- Insect systematics & ecology (18)
- Invertebrate ecology & taxonomy (6)
- Genetic diversity (6)

Currently, there are at least 9 active research programmes being carried out in the UKMPFR. These are:

- Reproductive biology and comparative ecology of small mammals
- Anatomy, cytology, and ultrastructure of cryptogams
- Invertebrate community ecology
- Systematics and ecology of Hymenoptera parasites
- Vertical distribution pattern of insects in lowland forest
- Genetics of *Drosophila* in tropical lowland forest
- Comparative bird community ecology
- Floristic analysis and long-term monitoring of species in fragmented forests
- Ecosystem evaluation and biological assessments on forest fragments

Floristic and Faunal Composition

The flora of this forest is well studied by the staff and students of UKM. It was started in 1974 by Misri Kusnan, studying comparative effectiveness of point-quarters and random pair methods in assessing the tree density, species frequency and importance value attributes in the lowland forests. It was later followed in the 1980's by many others including a general ecological survey (Hashim 1980), palm ecology (Ramli 1981), seedling dynamics of dipterocarp trees (Khairiah 1984), ecophysiology (Voon 1985), reproductive ecology of seed plants (Julius 1987). By the late 1980's, detail enumeration of the plant species and ecosystem assessments were carried out, first by Jamili (1988) for the 66 families (166 genera and 360 species) and later by Syed Muzni (1991) for the rest (23 families with 94 genera and 154 species). Two 1-ha plots were also established and detail floristic composition and forest productivity were reported by Norashidah (1993) and Lajuni (1996). They have reported that in their 2 ha plots, a total of 1827 trees (DBH more than 5 cm) from 235 species representing 142 genera and 49 families were found. Most of them (nearly 70%) are small trees in the Class 1 (5 to 14.9 cm DBH) and only 1 % are in the large timber (Class 7 with DBH over 65 cm) category. Four out of the five largest trees were from the Dipterocarpaceae family. The total above ground biomass is estimated at 318 t per ha. The forest is being dominated by *Shorea acuminata, S. bracteolata, S. leprosula, Dipterocarpus baudii, D. crinitus*

Fig. 4. Lansat image of the Langat Basin as in 1998

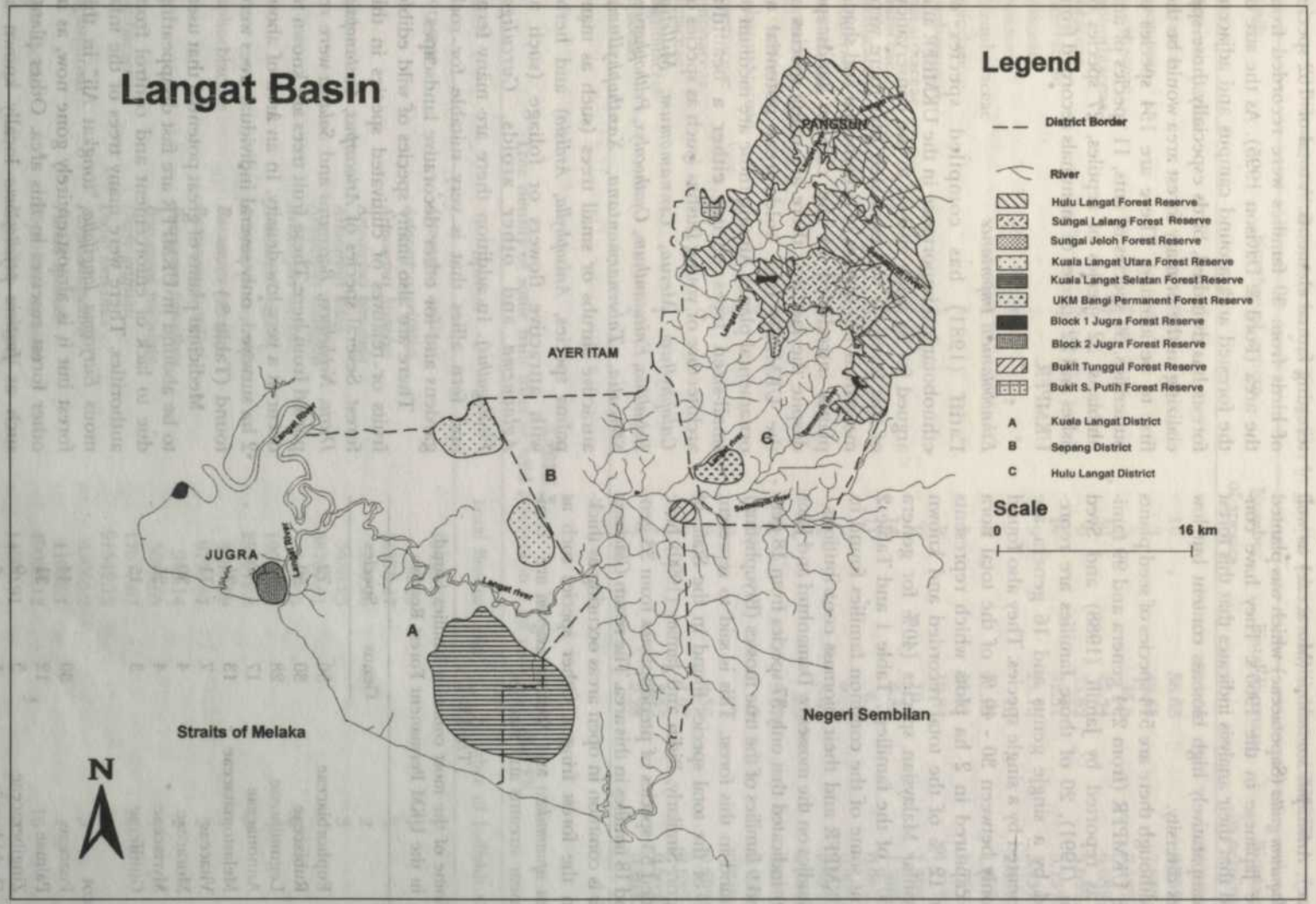

Fig. 5. Forest remnants in the Langat Basin

(Dipterocarpaceae), *Ptychopsis costata* (Euphorbiaceae), *Artocarpus scortechinii* (Moraceae) as well as *Palaquium gutta* (Sapotaceae) which was planted by the Japanese in the 1960's. They have concluded that their analysis indicates that this forest has comparatively high biomass content but low species diversity.

Although there are 514 species of seed plants in the UKMPFR (from 294 genera and 99 families) as reported by Jamili (1988) and Syed Muzni (1991), 20 of those families are represented by a single genus and 16 genera are represented by a single species. They also found that only between 30 - 40 % of the total flora were captured in 2 ha plots which represents about 12 % of the total recorded and known Peninsular Malaysian species (40% for genera and 60% of the families). Table 1 and Table 2 present some of the common families found in the UKMPFR and their biomass contributions.

Studies on the mosses by Damanhuri and Jikos (1990) indicated that only 37 species from 18 genera and 9 families of the true mosses (Bryophytina) are found in this forest. This is said to represent 30.8% of the total species found in the State of Selangor. Similarly, Bidin and Jaman (1990) have recorded 53 species of pteridophytes from 33 genera and 18 families in this area. The resam *Gleichenia linearis* is common in open areas occuring as thickets on the forest fringes. Other species such as *Cyathea squamulata* and *Schizaea wagneri* are common near streams and swamps.

TABLE 1
Some of the most common families found in the UKM Permanent Forest Reserve

		Genus	Species
Dicot			
	Euphorbiaceae	50	72
	Rubiaceae	30	50
	Leguminosae	28	42
	Annonaceae	17	37
	Melastomataceae	13	21
	Vitaceae	7	11
	Moraceae	4	30
	Myrtaceae	4	25
	Guttiferae	3	15
Monocot			
	Poaceae	30	44
	Palmae	12	31
	Zingiberaceae	5	9
	Orchidaceae	5	5
	Pandanaceae	2	5

The Bangi Forest Reserve has quite an interesting faunal elements. A total of 162 species of birds from 39 families were recorded from the area (Ford & Davison 1995). As the size of the forested area around campus and adjacent forests has dwindled, birds especially those specializing in the primary forest area would be the first to be affected. There are 134 species of butterflies, 39 species of ants, 11 species of amphibians, 32 species of reptiles, 27 species of fishes and 52 species of mammals recorded from UKMPFR.

Ethnobotanical Importance

Latiff (1981) has compiled species of ethnobotanical importance in the UKMBFR and argued for its value vis-á-vis to the conservation of this forest. It was estimated that there were more than 100 species of ornamental and shade plants introduced to the campus landscape despite the fact that there are many species in the UKMPFR that hold great potential as ornamental plants. Among those are medium or small-sized trees having either a beautiful architecture or young flushes (such as species of *Calophyllum, Mesua, Cinnamomum, Milletia, Polyalthia, Enicosanthum, Cyathocalyx, Pelthophorum, Sterculia, Tabernaemontana, Xanthophyllum*), attractive shrubs or small trees (such as many palms species, *Anisophylla, Ardisia*) and herbs with attractive flowers or foliage (such as *Aglaonema* and other aroids, *Curculigo, Phyllagathis*). In addition there are many ferns and fern allies that is very suitable for rock gardens and for other decorative landscapes.

There are also many species of wild edible fruits or relatives of cultivated species in this forest. Several species of *Artocarpus, Castanopsis, Durio, Nephelium, Baccaurea* and *Salacca* were reported from here.These fruit trees are known to occur at a very low density. In an area of about 2 ha surveyed, only several individual trees were found (Table 3.)

Medicinal plants of great potential that used to be abound in UKMPFR are fast disappearing due to lack of enforcement and control from authorities. There were many trees of the infamous *Eurycoma longifolia* "tongkat Ali" in this forest but it is almost entirely gone now, as in other forest reserves in this area. Other plants such as *Justicia ptychostoma* locally known as "sebongkok", claimed to be effective for treatment of cold among children is abundant in this

TABLE 2
Biomass contribution from top 25 families in the two 1-ha research plots in UKMPFR

Family	Number of genera	Number of species	Total Biomass	Biomass in percentage
Dipterocarpaceae	2	7	215.66	34.04%
Rubiaceae	10	10	58.63	9.25%
Sapotaceae	4	7	49.45	7.80%
Apocynaceae	2	2	45.5	7.18%
Euphorbiaceae	17	30	42.34	6.68%
Moraceae	3	9	35.82	5.65%
Burseraceae	5	17	32.51	5.13%
Fabaceae	7	9	21.73	3.43%
Clusiaceae	1	3	13	2.05%
Rhizophoraceae	4	4	11.93	1.88%
Sapindaceae	4	5	11.11	1.75%
Bombacaceae	1	2	10.84	1.71%
Anacardiaceae	7	9	10.1	1.59%
Lauraceae	12	14	8.83	1.39%
Myristicaceae	5	11	6.3	0.99%
Guttiferae	2	5	5.72	0.90%
Sterculiaceae	2	4	5.61	0.89%
Myrtaceae	3	15	5.3	0.84%
Flacourtiaceae	5	6	5.07	0.80%
Melastomataceae	2	3	5	0.79%
Celastraceae	3	3	4.7	0.74%
Annonaceae	7	9	4.36	0.69%
Ulmaceae	1	2	4.02	0.63%
Magnoliaceae	1	1	3.53	0.56%
Tiliaceae	2	3	2.28	0.36%

TABLE 3
Tree density of some fruit trees or wild relatives in 2 ha plots in UKMPFR

Family	Species	Total Biomass (Kg)	Number of Individuals
Moraceae	*Artocarpus axillaris*	13429.85	1
	Artocarpus griffithii	98.29	1
	Artocarpus hispidus	11373.47	5
	Artocarpus kemando	280.26	2
	Artocarpus lowii	3438.23	3
	Artocarpus maingayi	38767.01	9
	Artocarpus nitidus	6092.5	6
	Artocarpus rigidus	19627.32	5
	Artocarpus scortechinii	257072.8	43
Euphorbiaceae	*Baccaurea brevipes*	4645.59	14
	Baccaurea kunstleri	9778.87	2
	Baccaurea parviflora	949.14	2
	Baccaurea reticulata	3625.65	4
Bombacaceae	*Durio griffithii*	17077.67	20
	Durio lowianus	91342.12	19
Leguminosae	*Parkia singularis*	43065.2	3
	Parkia speciosa	11088.1	1
Sapindaceae	*Nephelium costatum*	49059.12	16
	Nephelium maingayi	14600.91	1
Sterculiaceae	*Scaphium macropodum*	50186.3	23

forest. So does *Willughbeia firma* (for treatment of headache and fever), *Thottea grandiflora* (dysentery), *Labisia pumila* (after childbirth), *Diospyros wallichii* (yaws), *Macaranga denticulata* (snake-bite) and various species of Annonaceae especially *Goniothalamus malayanus, Goniothalamus curtisii, Uvaria grandiflora, Artabotrys suaveolens, Xylopia malayana* and *Fissistigma fulgens* (after childbirth) which are so abundant in this forest. Other plants of ethnobotanical importance, such as species utilised by natives for general construction, are also recorded in this forest. The nibung (*Oncosperma tigillaria*) and bayas (*O. horrida*) for example are noted for their fine long lasting wood and hardness are growing in areas near swamps. The valuable kayu gaharu (*Aquilaria malaccensis*) noted for its valuable incense wood and resin were used to be there as well.

The residents of Bangi and surrounding area are known to collect many plants from this forest for their own use. Plants that were collected include medicinal plants, rattans, and palas leaves during festive seasons. The high biomass per hectare in Bangi forest can afford to stabilize its surrounding area and perhaps the only green lung remaining. Forest biomass has a direct bearing on its contribution to regulating the environment. A forest with higher biomass have lower albedo, hence it has the ability to regulate climate more effectively. This is especially important in stabilizing the daily temperature, and hydrological regimes (Sham *et al.* 1987; Soepadmo 1984). Studies by Sham (1986 & 1990) also showed that the presence of several trees in a medium size park can influence the temperature of that area. BFR also an important genetic stock for fruit growers around this area. The absence of pollinator fauna in this forest may have serious negative implication on fruit harvest, which can directly hurt the growers economic gain. BPFR is also a good place as a recreation area for nature and outdoor enthusiasts. As times goes by areas around this forest will become more urbanized. This forest can become an important recreation area for residents.

Economic Value of Botanical Resources

In an analysis to calculate the value of botanical resources based on tree standings in the two 1-ha plots in this forest, Mat Salleh *et al.* (1997) estimated that the stumpage value (SV) for UKMPFR is approximately RM 17,000 per ha. About 80% of those value are from the dipterocarps (Table 4, Table 5). The total value for the remaining forest in UKM is projected to worth close to RM 1.4 million based on market price of the timber in that year (1997). This value is comparable to other recovering logged-over forests in this area (Table 6).

Proper evaluation of tropical forests are necessary to make judicious use of the forest (Godoy 1992), and it is best represented if we can capture the total economic value. This total economic value is given by a sum of a number of components,

Total economic value = Direct-Use Value + Indirect-Use Value + Option Value + Existence Value

However, in this study we have only covered partial direct-use value, we did not yet take into consideration other non-timber forest products, for example medicinal plants. At the same time,

TABLE 4
Top 15 commercial families from UKMPFR

Families	Volume	CR	PM	SV	Stands
Dipterocarpaceae	123.09	37778	10848	26930	103
Apocynaceae	27.93	3373	1262	2111	18
Sapotaceae	27.46	2693	1096	1597	32
Anacardiaceae	20.03	1111	603	508	22
Clusiaceae	6.7	778	296	483	35
Rubiaceae	7.88	731	305	426	276
Fabaceae	9.54	765	342	423	50
Burseraceae	14.81	867	457	410	151
Moraceae	11.83	754	379	375	77
Euphorbiaceae	12.76	699	382	317	351
Bombaceae	4.04	311	142	169	39
Celastraceae	2.1	219	87	132	5
Magnoliaceae	1.56	183	69	114	1
Sapindaceae	4.12	234	125	108	57
Lauraceae	2.97	181	93	88	35

TABLE 5
Top 15 commercial species from UKMPFR

Species	Family	CR	PM	SV	Stands
Shorea acuminata	Dipterocarpaceae	12703	3568	9135	24
Shorea leprosula	Dipterocarpaceae	10965	3095	7870	20
Shorea bracteolata	Dipterocarpaceae	6480	1959	4521	15
Dipterocarpus baudii	Dipterocarpaceae	5892	1632	4260	10
Palaquium gutta	Sapotaceae	2489	987	1502	16
Dyera costulata	Apocynaceae	2237	873	1364	17
Shorea parvifolia	Dipterocarpaceae	1287	367	920	10
Alstonia scholaris	Apocynaceae	1135	389	747	1
Gluta sp.	Anacardiaceae	757	279	477	1
Mesua ferrea	Clusiaceae	615	238	376	11
Artocarpus scortechinii	Moraceae	685	356	329	43
Pertusadina eurhyncha	Rubiaceae	486	254	232	37
Dipterocarpus crinitus	Dipterocarpaceae	418	215	203	23
Durio lowianus	Bombaceae	300	133	167	19
Elateriospermum tapos	Euphorbiaceae	310	155	155	27

TABLE 6
Comparative analysis of stumpage value (SV) for several forest reserves in Malaysia

Forest Reserve	Ecosystem	Assessment	SV/ha
Johor: Lenggor	HDF	1994	17644
Kedah: Ulu Muda	HDF	1994	26022
Kelantan: Berangkat	HDF	1989/90	6525
Negeri Sembilan: Angsi	HDF	1995	8674
Negeri Sembilan: Johol	HDF	1995	9233
Negeri Sembilan: Pasoh	HDF	1995	5178
Negeri Sembilan: Serting	HDF	1995	11361
Pahang: Lesong	HDF	1989/90	19793
Sabah: Ulu Bengkoka	HDF	1995	13947
Terengganu: Jengai	HDF	1988/89	15779
Selangor: Raja Muda	Peatswamp	1990	2149
Selangor: Air Hitam (14)*	LDF	1996	17170
UKMPFR	LDF	1993-1996	17276

indirect-use value or functional value as related to ecological function performed by the forests, such as biogeochemical cycling and the regulation of watershed is also not being accounted for, not to mention option value and existence value. If all these values are being added up, UKMPFR would value more than we have given here. A mere RM 1.4 million is only a glimpse of its potential value. Therefore policies should be adjusted for responsible long-term resource management of UKMPFR, so that this vast store of wealth will be sustained if not conserved.

Germplasm Depository

Since the early days of its development, the planners of UKM have envisage the establishment of a campus as a "botanic garden" (Latiff & Ismail 1984). The idea of turning the existing and future infrastructures into a Botanic garden for the University was proposed in 1981 and agreed in principle by the University's Committee for Campus Beautification and Landscape in 1982. This holistic concept was designed to promote the green image of UKM and to serve a living laboratories for the use of UKM students in education and research. As a result, UKM campus has set an example and currently hold one of the best germplasm collections of ornamental plants, especially palms, and ferns collections in Malaysia. The campus hold 97 species of interesting ornamentals and shade trees introduced to the campus (Table 7).

TABLE 7
Ornamental and shade plants introduced to the UKM campus

Botanical name	Local Name	Botanical name	Local Name
Acacia auriculaeformis		*Hibiscus rosa-sinensis*	Bunga raya
Acalpha simensis	Akalifa siam	*Hibiscus tiliaceus*	Bebaru
Acytinophloeus macarthuri	Palma	*Ixora coccinea*	Siantan hutan
Adenanthera pavonina	Saga	*Ixora javanica*	Jarum-jarum
Aglaia odorata	Belangkas	*Jacaranda filicifolia*	Introduced
Aleurites moluccana	Buah keras	*Lagerstroemia flos-reginae*	Bungor besar
Allamanda cathartica		*Lagerstroemia indica*	Bungor Kedah/India
Andira inermis		*Lawsonia inermis*	Inai
Archontophoenix alexandre		*Licuala glabra*	
Areca catechu	Pinang	*Licuala grandis*	
Baccaurea motleyana	Rambai	*Litchi chinensis*	Laici
Bauhinia blakeana	Tapak kuda	*Livistonia chinensis*	
Borassus flabellifer		*Livistonia rotundifolia*	
Brunsfelsia examina		*Mangifera foetida*	Macang
Calliandra surinamensis		*Mangifera odorata*	Kuini
Calophyllum inophyllum	Bintangor laut	*Melaleuca cajupti*	Gelam
Caryota mitis		*Melia indica*	
Cassia biflora		*Mesua ferrea*	Penaga
Cassia fistula	Dulang/ Tengguli	*Milletia atropurpurea*	Tulang dacing
Cassia spectabilis	Introduced	*Mimosops elengi*	Bunga tanjung
Casuarina equisetifolia	Ru	*Mussaenda phillipica*	Introduced
Casuarina sumatrana	Cemara	*Nerium odorum*	Introduced
Cerbera odollam	Pong-pong	*Ochna kirkii*	
Chrysolidocarpus lutescens	Introduced	*Peltophorum pterocarpum*	Jemerlang laut
Cinnamomum iners	kayu manis	*Phoenix dactylifera*	
Cocos nucifera	Kelapa gading	*Phoenix roebelinii*	
Codieum variegatum	Podi	*Phoenix rupicola*	
Congea tomentosa		*Pithecellobium dulce*	Madras Thoru
Corypha utan		*Plumbago capensis*	Ceraka
Cupressus sp.		*Podocarpus polystachyus*	Setada, jati laut
Cyrtostachys renda		*Polyalthia longifolia*	Asoka
Delonix regia	Semarak api	*Pometia pinnata*	Kasai
Diospyros discolor	Buah mentega	*Pongamia pinnata*	Mempari
Durata repens		*Ptychococcus paradoxus*	
Dyera costulata	Jelutong	*Ptychosperma macarthurii*	
Ehretia microphylla	Pokok pagar	*Randia macrantha*	
Elaeis guineensis		*Rhaphis humilis*	
Eugeissona tristis		*Rhapis excelsa*	
Eugenia aromatica	Cengkih	*Roystonea oleracea*	
Eugenia malaccensis	Jambu bol	*Roystonia regia*	"Royal palm"
Euodia ridleyi	Telor belangkas	*Salix babylonica*	Jendalu
Euphoria longan	Longan	*Samanea saman*	Pokok hujan
Euphoria malaiensis	Mata kucing	*Sizygium grandis*	Jambu laut
Fagrea fragrans	Tembusu	*Sterculia foetida*	Kelumpang
Ficus benjamina	Walungin	*Swietenia macrophylla*	Mahogani
Ficus pumila		*Tamarindus indicus*	Asam jawa
Ficus roxburgiana	Kelebok	*Tecomaria capensis*	
Garcinia mangostana	Manggis	*Veitchia merrillii*	
Gardenia carinata	Bunga cina		

(*Source*: Latiff & Ismail 1984, with addition from recent inventory)

The campus also currently has three germplasm collection programs viz. The Fern Garden, the Ginger Germplasm Collection and The UKM Annonaceae Germplasm Depository (UAGD). The Fern Garden or Taman Paku Pakis (a.k.a. Fernarium) was later setup in 1988 in the 13 ha formerly allocated as an arboretum area (Bidin 1990). It was the first such garden to be established in Malaysia and currently being recognised by the Botanic Garden Council Secretariat of the International Union for the Conservation of Nature (IUCN) as one of the premier germplasm collection in the tropics. The Garden has 6 trails and devided into three sections viz. Ethnobotany, Conservation and Exotics. Currently the garden holds nearly 100 species from 46 genera and 25 families. Ginger Germplasm Collection was only started in 1997 and currently hold 80 species from 10 genera of Zingiberaceae and Costaceae. The UKM Annonaceae Germplasm Depository, the newest section, was started last year in 1998 with more than 50 collections of *Goniothalamus* from all over Malaysia, to supplement 30 other species of Annonaceae found in UKMPFR.

Nature Education Forest

In an effort to provide permanent infrastructure for co-curricular activities for students of UKM, the management has decided to designate 24 ha of UKMPFR as Nature Education Forest. It is currently developed and managed by Co-Curriculum Centre of UKM. Some basic infrasructures such as camp site, multi-purpose hall, dining & cooking area, cleaning and shower rooms, tracking nature trails, wall climbing facilities, obstacle course and mountain craft has been built. The facility can accommodate 300 students at a time and being used almost daily not only by UKM students, school children from Klang Valley area, NGOs as well as voluntary organizations.

CONCLUSION

The UKM Permanent Forest Reserve is an important green area in the Langat Basin, both as a biological laboratory and open classroom for university students as well as an environment buffer to the surrounding areas. The forest, although fragmented as it is, still harbours interesting and important biological resources with high biomass constituents. This forest is a big carbon sink with an estimated 44,000 tonnes for the entire area. The high biomass content in this forest enable it to perform an ecosystem regular function as a life system support, such as flood, climate and erosion. This forest remnant, together with other fragmented forests in the Klang Valley, have a considerable value for research, recreation, education and conservation for our future generations. Removal of these remnants would be catastrophic not only to our environment but also to wildlife and other important germplasm resources. Even the seemingly mobile avifauna was known to suffer and diminish as reported to be happening in Singapore and Bogor Botanic Gardens (Ford & Davison 1995).

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