

報 文



マレーシア国クチン, ビンツルの熱帯雨林および  
熱帯雨林回復実験結果\*

Tropical Rainforests in Kuching and Bintulu Area in Malaysia  
and Experimental Results of Their Restoration\*

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Synopsis

The tropical rainforests in southeast Asia are classified into several types by Peter Ashton (1991). Their species composition is not yet clarified because of the high species richness. In this report several types of tropical rain forest were recorded based on phytosociology: 1. dipterocarp forests on mesic sites; 2. swamp forests on wet sites; 3. heath forests (kerangas) on dry sites; 4. secondary *Macaranga* forests. Very tall, developed tropical forests are now very few around Kuching and Bintulu. They were surveyed only in Similajau National Park and the experimental forest in Universiti Pertanian Malaysia (UPM), Bintulu Campus. These well developed tropical rainforests are *Dryobalanops aromatica* (kapur) and *Cotylelobium burckii* forest. When the tropical rainforests have an emergent tree layer, the cover values are similar to those of the tree crowns of the tree-1 layer. Forests without an emergent tree layer have about the same tree crown cover as the tree-1 and tree-2 layer.

This is because of the selective cutting of big trees before. The various *Macaranga* secondary forests have similar species composition, number of layers and community height. The forest composition and site conditions are related to the growth of the seedlings to be planted in abandoned shifting-cultivated fields. The growth of these tropical forest species was compared with the growth of species in experimental plantation since 1990 at the abandoned shifting-cultivation area on the UPM campus. Seedlings of kerangas canopy species grow very well (1.5-2m/year) on the abandoned shifting-cultivation fields. The growth of kerangas species is better than that of mesic and swamp species. Tropical species grow two times faster than warm-temperate species in Japan which were planted as seedlings of native canopy species, in dense plantations (1-3 individuals/m<sup>2</sup>).

Keywords: tropical rainforests, kerangas, swamp forest, *Macaranga* forest, secondary forest, restoration, native species, dense plantation, Dipterecarps forest.

1. Introduction

Natural tropical forests in Sarawak are one of the remnants of tropical rainforest in Borneo.

The very natural mature forests, however, are now very few in Sarawak, especially in the Kuching and Bintulu areas. The area surveyed is shown in Figure 1. Even national parks have

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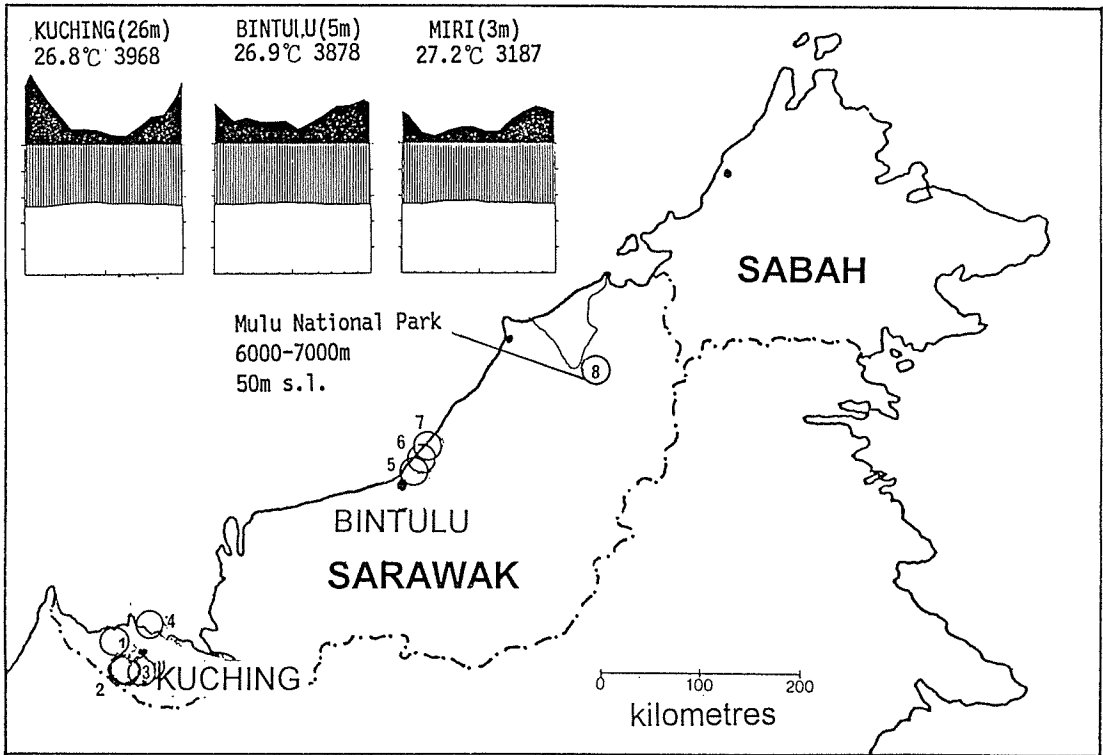
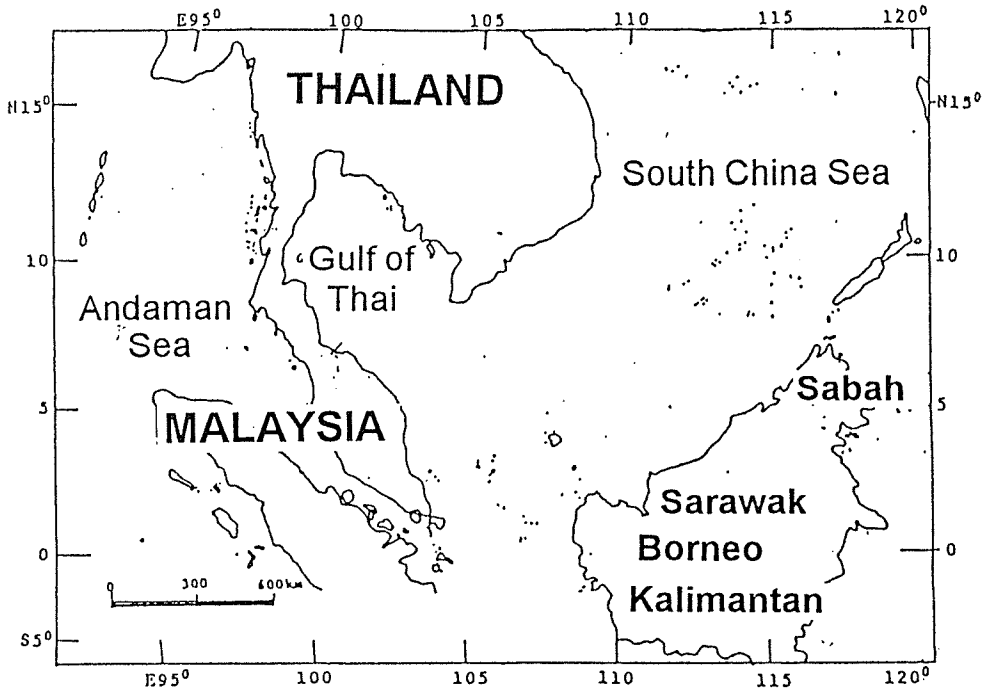


Figure. 1 Location of survey area.

1. Kubah National Park, 2. Setapok Forest Reserve, 3. Semenggok Wildlife Rehabilitation Center, 4. Bako National Park, 5. UPM campus, 6. Likau Forest Reserve, 7. Similajau National Park, 8. Gunung Mulu National Park.

young tropical forests which were left from selective cutting. The tropical forests in Southeast Asia have been studied by several ecologists and taxonomists (Whitmore 1984, Ashton 1991, etc.). Phytosociological reports were very rare (Miyawaki et al. 1978). This research is done based on the phytosociological (Braun-Blanquet) method. We selected and surveyed mature tropical forests and other forests on more natural sites. The areas surveyed were in the national parks, preserved swamps, remaining areas of coastal forest, the Arboretum and Experimental Forest at the University of Agriculture Malaysia, and *Macaranga* secondary forest. These were surveyed for comparison of species composition for the "rehabilitation of tropical forests by Miyawaki Method" (Miyawaki, Fujiwara & Ozawa 1993). *Dryobalanops aromatica* forest in Similajau National Park is mature, 60m high and with 138 species, including *Shorea* spp., *Hopea*, *Vatica*, and etc. *Shorea* and *Dryobalanops* forests occur on mesic sites. In swamps *Palaquium* dominates and makes simple-species stands.

Before this field survey we made experimental plantations for the restoration of tropical forests based on the "Miyawaki method" since 1990. University of Agriculture Malaysia members collected seeds and seedlings from kerangas forests, meranti forests, and/or swamp forests where they can get permission to collect seeds and/or seedlings, such as clear-cut areas, University campus, etc. From these forests the seedlings and seeds were picked from roadsides and/or planning areas of the tropical forests to be clear-up cut for oil-palm plantations. Then the seeds were cultivated in the nursery and planted in the grassland remaining after shifting-cultivation (Miyawaki 1990, 1991, 1992). With these results (which species and individuals could grow, how many cm, and whether they survived or not) we compare the natural site conditions of species from field survey and plantations results.

Field surveys based on phytosociology in

tropical forest are very difficult due to the high species diversity, tall trees, hot climates, high humidity, etc. Mr. Dami helped us with climbing the trees, collection of herbarium species and helping Mr. Haji Othman and Othman Bojo with species determination. Prof. Dr. Elgene O. Box edited this paper. We give the acknowledgement for them here.

## 2. Research method and location of field survey.

The tropical rain forests were surveyed by the phytosociological method (Braun-Blanquet 1951, 1964, Ellenberg 1957, Fujiwara 1987). In the field, homogeneous sites and mature forests were selected as far as possible. In the tropical rain forests the vegetation layers are sometimes not clear. Four to five layers were recognized, and species lists and total estimation of cover and abundance were made in each layer.

### 1) Kuching (26m s.l.)

The annual precipitation is 3968mm and the mean annual temperature is 26.8°C. Kuching has a rainy season from November to February, with a drier season from March to October (Figure 2). The Semanggok National Park is located south of Kuching. This forest is a tropical forest with middle age after selective cutting. The big trees were already cut down and used for timber. The remaining trees are preserved as a National Park. These are mostly *Shorea beccariana*, *Vatica oblongifolia*, *Scaphium macropodum*, *Eugenia palembanica*, *Tristania whitiana*, etc., in the canopy layer 33m high.

Kubah National Park is located east of Kuching. Kubah National Park has hilly topography. The forests in this national park are also remnant forests from selective cutting. The DBH of the biggest individual was only 34cm. The vegetation sample was taken on a narrow ridge. Species number of canopy layer is relatively large. 22 species, including *Alseodaphne oblanceolata*, *Endiandra clavigera*, *Gluta wallichii*, *Litsea* sp.,

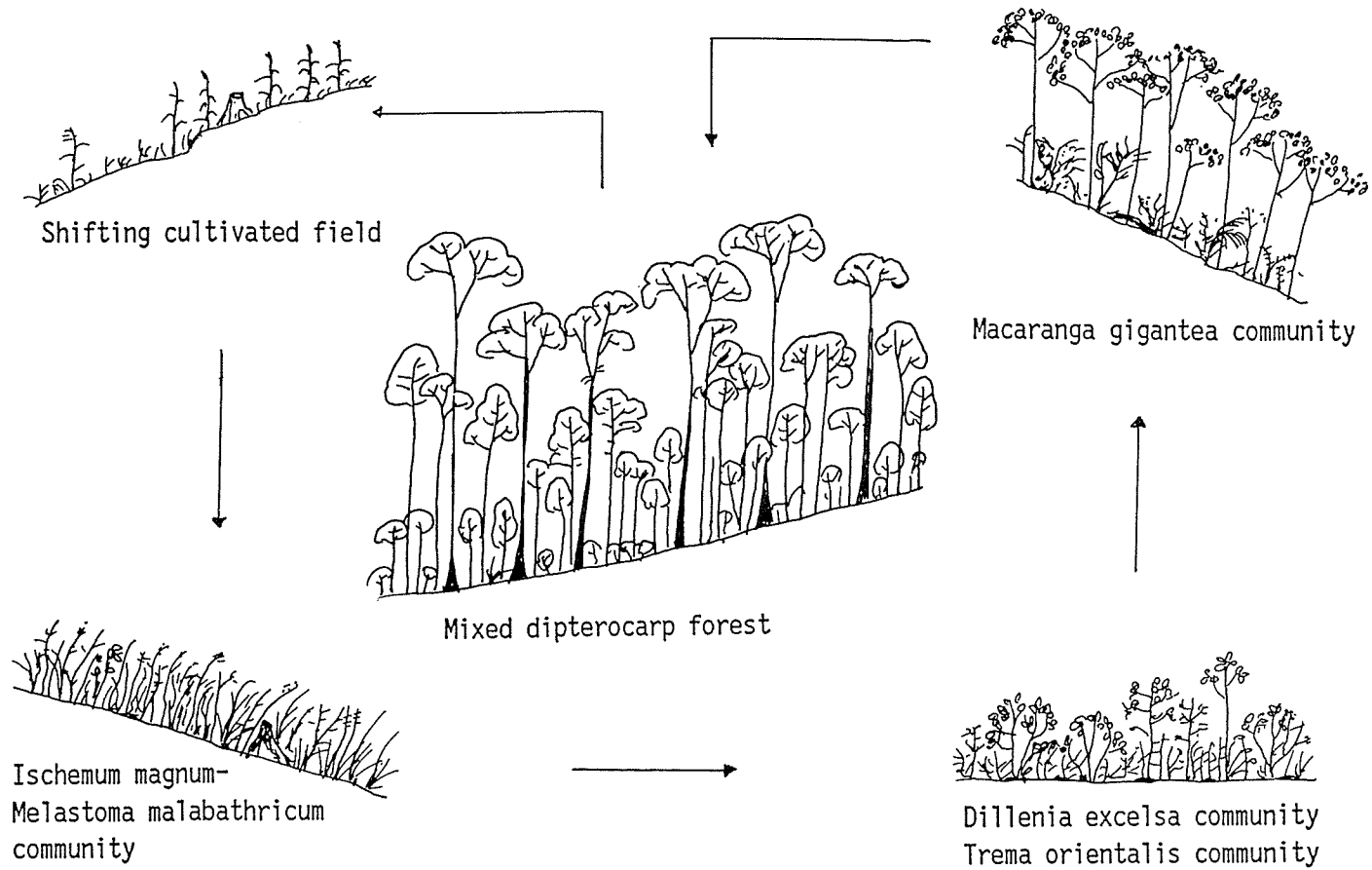


Figure 1. Vegetation succession at the plantation area for the restoration of tropical forests in UPM Bintulu campus, Sarawak.

*Eugenia kuchingensis*, *E. excelline*, *Pithecellobium* sp., *Anisophylea cornerrii*, is 32m. 151 species appear on this site.

Stapok Forest Reserve is a swamp forest. It is located just in a suburb area of Kuching. This swamp forest is mostly open in the canopy layer. The most closed forest was surveyed. The tree height is very high, 45m, and the DBH of the thickest one is 100cm. The main species are *Palaquium pseudocuneatum*, *P. walsuraefolium*, *P. gutta*, *Dryobalanops rappa*, *Copaifera palustris*, *Gluta* sp., *Elaeocarpus stipularis*, etc. The total number of tree-layer species is 11. The forest on severe sites has somewhat dominant species. The total number of species in the relevé was 121.

## 2) Bintulu (3m)

Bintulu is located in the middle of Sarawak, next to the seaside. The climate is wetter than Kuching. The annual precipitation is 3878mm and the mean annual temperature is 26.9°C. Bintulu has a rainy season from September to January. The experimental plantation area for "restoration of tropical forests" is in the Universiti Pertanian Malaysia (UPM) Campus Bintulu.

In the UPM campus the remnants of tropical rain forests remain as an Arboretum and Experimental Forest UPM in Nyabau Forest Reserve. They are located in a valley bottom and on a slope (55-65m elevation). They are 48-55m high. Some thick trees like *Koompassia malaccensis* still remain (DBH 70cm). The Arboretum has many species in the canopy layer, about 23 species in a relevé. The main species in the tree layer are *Allantospermum borneense*, *Shorea scaberrima*, *S. amplexicaulis*, *S. crassa*, *S. cordinervis*, *S. macroptera*, *Hopea kerangasensis*, *H. beccariana*, *Dipterocarpus pendula*, *D. rigidus*, *Vatica vatanensis*, *Calophyllum ardens*, *Artocarpus sarawakensis*, *A. odoratissimus*, *Eugenia kuchingensis*, etc. This forest is dipterocarp forest. The experimental forest UPM has some emergent trees such as *Koompassia malaccensis*, *Dryobalanops*

*beccarii*, and *Shorea feruginea*. Then *Shorea materialis*, *S. crassa*, *Whiteodendron moultonianum*, *Dipterocarpus gloosis*, *Eugenia kuchingensis*, *Allantospermum borneense*, *Palaquium stenophyllum*, *Parishia maingayii*, *Mesua macrantha*, and *Cironiera* sp. occur in the main tree layer. The Arboretum of UPM in Nyabau Forest Reserve is located on a steep slope. *Allantospermum borneense*, and 22 species occur in the tree layer. These include *Shorea amplexicaulis*, *S. scaberrima*, *S. crassa*, *Dipterocarpus rigidus*, *Calophyllum ardens*, *Eugenia kuchingensis*, etc. Kerangas forests occur along the coastline and on sand dunes. They are cut now, even a part of the Similajau National Park. The tree layer of kerangas on sand dunes is very simple. *Cotylelobium burckii*, *Parishia maingayi*, *Tetramerista glabra*, *Shorea ovata*, and *S. albida* from the tree layer at 10 m above sea level. The undercanopy tree layer is dominated by *Cotylelobium burckii*, *Whiteodendron moultonianum*, and 14 species. The kerangas of Likau Forest Reserve has *Casuarina* species such as *Casuarina novile*, *C. sp.* with *Dipterocarpus actangulus*, *Cotylelobium burckii*, *Palaquium ridleyi*, etc.

The Similajau National Park has *Dryobalanops* forest, which remains relatively natural and is 60 m high. The emergent trees are *Dryobalanops aromatica*, *Koompassia malaccensis*, *Dipterocarpus actangulus*, and *Litsea* sp. Especially *Dryobalanops aromatica* has 98cm DBH. The tree layer is 30m high. *Hopea*, *Vatica*, *Shorea*, *Koompassia*, *Gluta*, and *Aporosa* dominate in tree layer. The forest of the Similajau National Park were also selectively cut.

## 3. Communities

### 1) Tropical rainforests in Kuching and Bintulu

The tropical rainforests in Kuching and Bintulu are mostly not closed forest. These forests have four or five layers. The cover of the

emergent tree layer is 25-60%. The tree layer under the emergent tree or canopy tree layer (tree 1 layer) has a cover value of 30 % (when the forest has *Artocarpus dadah*, etc. The height of the forest no emergent tree layer, cover 80%-85%). The cover of the understorey tree layer (T2) is 30-80%, and that of the shrub layer is 40-70%. The herb layer does not have a large cover value, usually 15-30%. except in swamp 70 %. It is . The tropical rainforests in Kuching and Bintulu are classified into three communities.

In these communities several species are common, such as *Pandanus* sp., *Stemonorous secundiflorus*, *Gluta* sp., *Diospyros* sp., *Garcinia* sp., *Calamus* sp., *Kotalsia* sp., etc.,

- (1) *Cryostachys lakka-Whiteodendron moulitianum* community (kerangas community)

Kerangas forests occur on coastal sandy areas. These were differentiated by *Cryostachys lakka*, *Whitedendron moulitianum*, *Shorea albida*, *Eugenia attenuata*, *Buthemis minor*, *Gnetum* sp. The community height is 40-50m, and cover is 60-80%. Kerangas forests are not completely closed forests. They are composed by 70-95 species with 4-5 layers.

Kerangas forests in Bintulu are classified into a *Cryostachys lakka-Whiteodendron moulitianum* community. This community has two subunits. The subunit 1 is differentiated by *Cotylelobium burckii*, *Swintonia glauca*, *Tetramerista glabra*, *Horsefieldia kerangasicola*, *Myristica malaccensis*, *Xanthophyllum spicata*, *Dipterocarpus crinitus*, and *Oncosperma tigliaris*. This subunit community was surveyed in part of Similajau National Park. The topography is flat. The soil is whitesand and shallow. The biggest tree is *Shorea albida*, which has 125cm DBH and 50m.

Most species of the emergent tree layer, such as *Swintonia glauca* (100cm, 50m), *Tetramerista glabra* (88cm, 35m), *Cotylelobium burckii* (80cm, 45m), etc., have big DBH. The subunit 2 community is differentiated by *Casuarina novile*, *Trystania beccarii*, *Palaquium ridleyi*, *Casuarina* sp., *Dacryodes* sp., *Barringtonia*

*sarcostachys*, *Cotylelobium* sp., *Gironniera subaequalis*, *Ternstroemia aneura*, *Actinodaphne borneensis*, *Bulbophyllum* sp., etc.

This subunit community was surveyed in Likau Forest Reserve and on a slope on white sand.

This community has *Casuarina* and genera common with subtropical forest, such as *Actinodaphne*, *Ternstroemia*.

- (2) *Hopea kerangasensis-Allantospermum borneense* community (mesic dipterocarp comm.)

The mesic dipterocarp forests in Kuching and Bintulu are characterized by *Hopea kerangasensis*, *Allantospermum borneense*, *Scaphium marcopodum*, *Heritiera aurea*, *Strombosia lucida*, *Memecylon* sp., *Gironniera nervosa*, *Shorea maxwelliana*, *S. scaberrima*, *S. macroptera*, *S. amplexicaulis*, etc. This dipterocarp forest is named *Hopea kerangasensis-Allantospermum borneense* community. This community has several types of forest. The height varies from 32 to 60m. The total number of species is large, 126-148 species.

This community is differentiated into three subunits.

The 1st subunit is differentiated by *Sindora beccariana*, *Tristania whiteana*, *Beilschmiedia madang*, *Shorea ovalis*, *Xanthophyllum macrophyllum*, etc.. This was surveyed in Semangok National Park, Kuching.

The 2nd subunit is differentiated by *Dryobalanops aromatica*, *Mesua garcinoides*, *Santiria tomentosa*, *Dacryodes costata*, *Lithocarpus leptogyne*, etc. It has two subunits.

The 1st subunit is differentiated by *Alseodaphne oblanceolata*, *Endiandra clavigera*, *Alstonia excelsa*, *Gluta wallichii*, etc. It was surveyed on a ridge of the Kuhba National Park after selective cutting. The 2nd subunit is differentiated by *Hopea fluviallis*, *Kokoona reflexa*, *Litsea rufo-fusca*, *Grewia fibrocarpa*, *Calophyllum cunnum*, *Barringtonia* sp., etc. It was surveyed in the Similajau National Park and was still natural. The 2nd subunit has an emergent tree layer (60m high

and the biggest tree has 97 - 98cm DBH).

The 3rd subunit is differentiated by *Palaquium stenophyllum*, *Shorea pauciflora*, *Vatica nitens*, *Anisophyllea cornori*, etc. It was surveyed in the UPM Campus. It has 143 - 148 species and a height of 48 - 55m. It occurs on a NW 10° - 20° slope. It has two subunits. The 1st subunit is differentiated by *Shorea ferruginea*, *S. materialis*, *S. isoptera*, *Dryobalanops beccarrii*, *Dacryodes incurvata*, *Dipterocarpus globosus*, etc., and occurs in the bottom of a valley (the experimental forest of UPM). The 2nd subunit is differentiated by *Aglaiia cordata*, *Vatica vatancensis*, *Calophyllum ardens*, *Hopea garangbuaya*, *Shorea crassa*, *Knema latifolia*, *Dipterocarpus rigidus*, etc..

(3) *Palaquium walsuraefolium*-*Dryobalanops rappa* community (swamp comm.)

The swamp forest in Kuching is characterized by *Palaquium walsuraefolium*, *Dryobalanopsis rappa*, *P. pseudocuneatum*, *Polyalthia hypoleuca*, *Gonystylus bancanus*, *Copaifera palustris*, *Shorea platycarpa*, *Ganua motleyana*, *G. pierrei*, *Actinodaphne myriantha*, etc., and classified as a *Palaquium walsuraefolium*-*Dryobalanops rappa* community. This community is 45m high, and the cover of tree 1 layer is 70%, i. e. the canopy is not closed. The herb layer is 1.5m high and has 70% cover. The total number of species is 118.

## 2) *Macaranga* secondary forest

*Macaranga* secondary forests can be seen in the UPM campus. These sites were tropical rain forests until 1985. People clear cut the forests for orchards. Then they abandoned the orchards. The *Macaranga* forests thus have a short history of only 8 years.

*Macaranga* forests are differentiated by *Macaranga gigantea*, *Vitex pubescens*, *Blechnum* sp., and *Alpina* sp. These secondary forests are named *Macaranga gigantea* community. The sites of *Macaranga gigantea* community have yellowish brown sandy loam or silt loam and are sunny and dry to mesic. The community height is 10-13m. DBH of

*Macaranga gigantea* is 10-23cm. *Macaranga gigantea* community grew very fast, 10-13m within 8 years. Total number of species is not so many, 62-64.

*Macaranga gigantea* community has two subunits. The 1st subunit is differentiated by *Ficus* sp., *Semecarpus glauca*, *Sarcostigma paniculata*, *Tetracera glaberrima*, and *Macaranga hepuluca*. The other subunit is differentiated by *Macaranga triloba*, *Palaquium sericium*, *Ficus hemsleyana*, *Endospermum didinum*, etc.

In *Macaranga gigantea* community, several species are common, such as *Callicarpa pentandra*, *Melastoma malabathricum*, *Saurauia glabra*, *Lygodium* sp., etc. It is important that there are no tropical canopy species, such as *Shorea*, *Dipterocarpus*, *Dryobalanops*, *Hopea*, etc. How many does it take for the canopy species of tropical rain-forest to get in the secondary forests? It is the question of exsistens of seeds resouces and seeds distribution.

## 4. Species richness

The number of species in each layer is shown (Figure 4-6). The cover is shown on each layer in each relevé (Figure 7, 8). The tropical mature forests show a species richness pentagon. The secondary *Macaranga* forests show square shapes. The cover of each layer has the characteristic shape. When the forests have five layers with an emergent tree layer, the shape of the graph is slender. The thick shape shows four-layer forests.

## 5. Restoration of tropical forests in Bintulu

300,000 seeds and seedlings were nursed in the UPM campus and were planted in the abandoned shifting-cultivation area, at three individuals per square meter and with oil-palm leaves and weeds for mulching (Figure 8, Table 3). UPM members reported the growth data for several species of these seedlings (Abas 1992,

Table 1. Tropical rain forests in Kuching and Bintulu area.

	1 - 2	Coastal forest (including Kerangas)		Dipterocarpaceae forest		8		
	1	2	3	4	5	6	7	8
Releve reference number	1	2	3	4	5	6	7	8
Original releve number (in the field)	6	7	1	2	5	9	10	3
Releve date	93	93	93	93	93	93	93	93
	2	2	2'	2	2	3	3	2
	28	28	23	24	27	1	2	25
Releve size (m)	1200	750	750	400	2250	900	2000	750
Altitude (m)	10	30	50	287	50	55	65	90
Aspect	L	NW	W	L	W	NW	NW	L
Slope	-	20	25	-	10	10	20	-
Height of super tree layer ST (m)	50	-	-	-	60	55	-	-
Cover of super tree layer ST (%)	60	-	-	-	30	25	-	-
Height of tree layer 1 (m)	24	40	33	32	30	45	48	45
Cover of tree layer 1 (%)	60	80	70	80	30	65	85	70
Height of tree layer 2 (m)	12	20	28	12	18	20	18	18
Cover of tree layer 2 (%)	50	40	80	30	80	60	30	30
Height of shrub layer (m)	5	8	7	6	7	8	7	7
Cover of shrub layer (%)	50	70	60	70	40	70	70	40
Height of herb layer (m)	1.2	1.5	1	1	1	0.8	0.9	1.5
Cover of herb layer (%)	20	20	30	30	15	20	30	70
Number of species	81	85	121	152	139	154	111	154
Differential species								
Whiteodendron moulonium	T1	3.3	.	.	.	1.1	.	.
	T2	1.2	2.2	.	.	.	.	.
	S	1.1	1.2	.	+	2.1	.	.
	H	2.2	2.3	.	.	.	.	.
Shorea albida	ST	2.1	.	.	.	.	.	.
	T1	1.1	+	.	.	.	.	.
Eugenia attenuata	T2	3.3	.	.	.	.	.	.
	S	3.3	+	.	.	.	.	.
Cryptotachys lakka	T2	2.3	.	.	.	.	.	.
	S	2.2	2.2	.	.	.	.	.
	H	1.2	1.2	.	.	.	.	.
Euthemis minor	S	+	+	.	.	.	.	.
Gnetum sp.	S	1.1	+	.	.	.	.	.
Cotylelobium burckii	ST	3.3	.	.	.	.	.	.
	T1	3.3	.	.	.	.	.	.
	T2	+	.	.	.	.	.	.
Swintonia glauca	ST	2.1	.	.	.	.	.	.
	S	+	.	.	.	.	.	.
Tetramerista glabra	ST	2.2	.	.	.	.	.	.
Horsefieldia kerangasicola	T1	2.2	.	.	.	.	.	.
	S	1.1	.	.	.	.	.	.
Myristica malaccensis	S	2.2	.	.	.	.	.	.
Xanthophyllum spicata	T1	2.1	.	.	.	.	.	.
Dipterocarpus crinitus	T1	2.1	.	.	.	.	.	.
Oncosperma tigilaris	T1	1.1	.	.	.	.	.	.
	T2	1.1	.	.	.	.	.	.
Casuarina novile	T1	.	4.4	.	.	.	.	.
	H	.	1.1	.	.	.	.	.



Crystania beccariana	T1	.	2.2	.	.	.	.	.	.
Palaquium ridleyi	T1	.	2.2	.	.	.	.	.	.
	S	.	1.1	.	.	.	.	.	.
Casuarina sp.	T1	.	2.2	.	.	.	.	.	.
Dacryodes sp.	T1	.	2.2	.	.	.	.	.	.
Barringtonia sarcostachys	T2	.	1.1	.	.	.	.	.	.
Cotylelobium sp.	T2	.	2.2	.	.	.	.	.	.
	H	.	1.2	.	.	.	.	.	.
Gironniera subaequalis	S	.	1.1	.	.	.	.	.	.
Ternstroemia areura	S	.	2.2	.	.	.	.	.	.
Actinodaphne borneensis	S	.	1.2	.	.	.	.	.	.
Bulbophyllum sp.	S	.	1.1	.	.	.	.	.	.
	H	.	1.1	.	.	.	.	.	.
Shorea andulensis	S	.	+	.	.	.	.	.	.
Actinodaphne pruinosa	S	.	+	.	.	.	.	.	.
Aposinaceae	S	.	+	.	.	.	.	.	.
Edinandra sp.	S	.	+	.	.	.	.	.	.
Allantospermum borneense	T1	.	.	.	.	1.1	1.1	2.2	.
	T2	.	.	2.1	.	.	2.3	.	.
	S	.	.	.	.	+	2.2	1.1	.
Scaphium marcopodum	T1, T2	.	.	2.1	+	.	.	.	.
	S	.	.	.	.	1.1	.	.	.
	H	.	.	.	.	1.1	.	.	.
Heritiera aurea	S	.	.	+	+	.	+	.	.
Strombosia lucida	T2	.	.	+	.	+	1.1	.	.
	S	.	.	+	.	+	.	.	.
Memecylon sp.	T1, S	.	.	+	+	.	.	.	.
	H	.	.	.	+	.	.	.	.
Gironniera nervosa	S	.	.	+	+	.	.	+	.
Hopea kerangasensis	T2	.	.	.	.	.	2.2	3.2	.
	S	.	.	.	.	3.2	2.2	+	.
	H	.	.	.	.	2.2	.	2.2	.
Cephalomappa sp.	S	.	.	.	+	+	+	.	.
	H	.	.	.	.	+	.	.	.
Shorea maxwelliana	T1	.	.	.	.	.	2.3	.	.
	S	.	.	.	+	.	+	.	.
Shorea scaberrima	T1, S	.	.	.	.	1.1	+	1.2	.
	H	.	.	.	.	+	.	.	.
Gymnacranthera sp.	T1	.	.	.	.	.	+	.	.
	S	.	.	.	.	.	+	+	.
Shorea macroptera	T1	.	.	.	.	.	2.3	.	.
	T2	.	.	.	.	.	2.2	2.2	+
	S	.	.	.	.	.	1.1	2.2	.
Xanthophyllum flavescens	T1	.	.	.	.	.	+	.	.
	S	.	.	.	.	.	+	1.2	+
Eugenia sp. 2	T2	.	.	.	.	.	1.2	.	+
	S	.	.	.	.	.	+	+	.
Aglaia sp.	T2, S	.	.	.	.	.	+	1.1	.
Bouea macrophylla	T2, S	.	.	.	.	.	+	.	+
Shorea amplexicaulis	T1	.	.	.	.	.	.	.	1.2
	T2, S	.	.	.	.	.	+	3.2	2.2
Polyalthia sp.	S	.	.	.	.	.	+	+	.
Strechnos sp.	T2	.	.	.	.	.	.	+	.
	S	.	.	.	.	.	+	1.2	2.1
Euphobiaceae	S	.	.	.	.	.	+	+	+

Artocarpus anisophyllus	S	.	.	.	.	+	1.1	.	.
	H	.	.	.	.	+	.	.	.
Derris sp.	H	.	.	.	.	+	+	.	.
Sindora beccariana	T1	.	.	2.1	.	.	.	.	.
	H	.	.	.	.	+	.	.	.
Tristania whiteiana	T1	.	.	2.2	.	.	.	.	.
Shorea beccariana	T1	.	.	2.1	.	.	.	.	.
	S	.	.	1.1	.	.	.	.	.
Beilschmiedia madang	T2	.	.	1.1	.	.	.	.	.
Shorea ovalis	T2	.	.	2.2	.	.	.	.	.
	S	.	.	+	.	.	.	.	.
Xanthophyllum macrophyllum	T2	.	.	1.1	.	.	.	.	.
Annonaceae	T2	.	.	1.1	.	.	.	.	.
	H	.	.	+	.	.	.	.	.
Balbophyllum sp.	T2	.	.	1.1	.	.	.	.	.
Diospyros microphylla	T2	.	.	1.1	.	.	.	.	.
Calamus sp. 2	T2	.	.	1.1	.	.	.	.	.
	H	.	.	1.2	.	.	.	.	.
Xanthophyllum palaquium	T2	.	.	1.1	.	.	.	.	.
Shorea atrinervosa	T2	.	.	1.1	.	.	.	.	.
Mesua garcinoides	T1, S	.	.	.	1.1	1.1	.	.	.
Dryobalanops aromatica	ST, S	.	.	.	2.2	3.3	.	.	.
	T2, H	.	.	.	2.2	1.2	.	.	.
	T2, S	.	.	.	1.2	+	.	.	.
Santiria tomentosa	T2, S	.	.	.	1.2	+	.	.	.
Dacryodes costata	S	.	.	.	+	+	.	.	.
Lithocarpus leptogyne	S	.	.	.	+	+	.	.	.
Vatica borneensis	S	.	.	.	+	1.2	.	.	.
Baccaurea sumatrana	T2	.	.	.	.	+	.	.	.
	S	.	.	.	+	+	.	.	.
Crudia sp.	S	.	.	.	+	+	.	.	.
Alseodaphne oblanceolata	T1	.	.	.	2.2	.	.	.	.
Endiandra clavigera	T1	.	.	.	2.2	.	.	.	.
Ashtonia excellusa	T1	.	.	.	1.1	.	.	.	.
Eugenia excelline	T1	.	.	.	+	.	.	.	.
Hydnocarpus sp.	T1	.	.	.	1.1	.	.	.	.
Helicia sp.	T1	.	.	.	1.1	.	.	.	.
Artocarpus dadah	T1	.	.	.	1.1	.	.	.	.
	T2	.	.	.	+	.	.	.	.
Gluta wallichii	T1	.	.	.	2.2	.	.	.	.
Stecuria sp.	T1	.	.	.	1.1	.	.	.	.
Cliستانthus griffitii	T2	.	.	.	1.1	.	.	.	.
Hopea flubiallis	T2	.	.	.	.	3.2	.	.	.
	S	.	.	.	.	2.2	.	.	.
Kokoona reflexa	T2	.	.	.	.	2.2	.	.	.
Litsea rufo-fusca	T2	.	.	.	.	1.2	.	.	.
Astrolobus sp.	T2	.	.	.	.	1.1	.	.	.
Elateriospermum tapus	T2	.	.	.	.	1.1	.	.	.
Grewia fibrocarpa	T2	.	.	.	.	1.1	.	.	.
Callophyllum cunnum	T2	.	.	.	.	1.1	.	.	.
Barringtonia sp.	T2	.	.	.	.	1.1	.	.	.
Palaquium stenophyllum	T1, S	.	.	.	.	.	1.1	+	.
Urticaceae	T2, S	.	.	.	.	.	+	+	.
Polyalthia sp.	T2, S	.	.	.	.	.	1.1	+	.
Canarium sp.	T2	.	.	.	.	.	+	+	.
Shorea pauciflora	T2, S	.	.	.	.	.	1.1	+	.



	S	.	.	.	.	.	.	.	+
Ganua motleyana	T2	.	.	.	.	.	.	.	1.2
Ganua pierrei	T2	.	.	.	.	.	.	.	1.2
	S	.	.	.	.	.	.	.	+
Luvunga sp.	S	.	.	.	.	.	.	.	1.1
	H	.	.	.	.	.	.	.	+
Ctenolophon parvifolius	S	.	.	.	.	.	.	.	1.1
Pothos sp.	S	.	.	.	.	.	.	.	1.1
Actinodaphne myriantha	S	.	.	.	.	.	.	.	1.1
Cyathocalyx magnificus	S	.	.	.	.	.	.	.	1.1
Santiria laevigata	S	.	.	.	.	.	.	.	1.1
Sterculia rhoidifolia	S	.	.	.	.	.	.	.	1.1
Wallubergia sp.	S	.	.	.	.	.	.	.	1.1
Vatica mangachapoi	S	.	.	.	.	.	.	.	1.1
Other species									
Pandanus sp. 1	T2	.	.	1.1	1.1	.	.	.	.
	H	+	+2	2.2	+	1.1	.	2.3	.
Stemonorous secundiflorous	T2	.	.	.	.	+	+	.	.
	S	2.3	+	+	.	+	+	.	+
Gluta sp.	T1	.	.	.	.	2.1	.	.	2.1
	T2	.	.	.	.	1.1	1.1	+	.
	S	+	+	.	.	.	+	.	.
Diospyros sp.	T1	.	.	.	.	1.1	.	.	.
	T2	.	.	.	.	2.2	.	.	.
	S	+	.	.	+	.	+	+	+
	H	.	.	.	.	+	.	.	.
Garcinia sp.	T2	.	.	.	.	1.2	.	.	.
	S	+	+	.	+	1.1	+	+	.
Eugenia sp.	T1	.	.	.	.	1.1	.	.	.
	T2	.	+	.	.	2.2	.	+	.
	S	.	.	.	+	+	+	+	+
	H	.	.	.	.	.	.	+	.
Calamus sp. 1	T2	.	.	+	.	+	+	+	.
	S	.	3.3	+	.	2.2	1.1	1.1	.
	H	.	.	.	.	1.1	+	1.1	.
Rubiaceae sp. 1	T2	.	.	.	.	.	.	+	.
	S	.	.	+	1.1	.	+	+	+2
	H	.	.	.	+	.	+	.	+
Kotalsia sp.	S	.	+	+	.	1.2	+2	.	1.1
	H	.	+	.	.	+	+2	.	.
Rubiaceae sp. 2	S	.	.	+	.	+	.	+	+
	H	.	.	.	.	.	.	+	.
Leguminoceae sp	T2	+	.	.	.	+	+	.	.
	S	.	.	+	.	.	.	+	.
	H	+	.	.	.	+	.	.	.
Palaquium gutta	T1	3.3	.	.	.	.	.	.	3.3
	T2	+	2.3	.	.	.	.	.	+
	S	.	.	.	+	.	.	.	1.1
	H	.	.	.	+	.	.	.	.
Palaquium sp.	T1	2.1	.	3.1	.	.	.	.	.
	T2	+	.	.	.	.	.	.	.
	S	+	.	.	+	.	.	.	.
Eugenia palembanica	T1	.	.	2.1	.	.	.	.	.
	S	.	+	.	.	.	.	.	1.2

Shorea angostifolia	T2	.	.	+	.	.	.	.
	H	.	.	+	.	.	.	.
Myristica iowiana	T1	2.2	.	.	.	.	.	.
	T2	.	.	1.1	.	.	.	.
Mesua macarantha	T1	.	.	.	.	.	1.1	.
	T2	.	1.2	2.2	.	.	.	.
	S	.	+	.	.	+	.	.
Orchidaceae	T2	.	.	1.1	.	.	.	.
	S	.	.	.	.	.	.	+
	H	+	.	.	.	.	.	+
Walsura grandifolia	T2	.	.	+	.	.	.	.
	S	.	.	+	.	.	+	.
Ganua sp.	T1	.	.	.	+	.	.	.
	T2	1.2	.	.	+	.	.	.
Goniothalamus andersonii	S	.	.	+	+	.	1.1	+
	H	.	.	+	.	.	.	+
Xylopia caudata	T2	.	.	.	.	.	+	.
	S	.	.	+	.	.	.	.
Ganua kingiana	S	.	1.2	+	+	.	.	.
	H	.	.	.	+	.	.	.
Xanthophyllum sp. 1	S	.	1.2	+	+	.	.	.
Gnetum gnemon	S	.	.	+	.	.	.	+
Rubiaceae 3	S	.	.	+	+	.	+	.
Gymnacranthera ueginiifolia	S	.	.	+	.	.	.	+
Pimelodendron griffithium	S	+	.	+	+	.	.	.
	H	+	.	.	.	.	.	.
Ficus sp.	S	.	.	+	.	.	.	+2
Gluta beccarii	S	.	.	+	.	.	.	+
Dellinia excelsa	S	+	1.2	+	.	.	.	+
Bauhinia sp.	S	.	.	.	.	+	.	.
	H	.	.	+	.	.	.	.
Araceae	S	.	.	.	.	.	.	1.1
	H	.	.	+	.	.	.	+2
Liliaceae	H	.	.	1.2	+	.	.	.
Anisophyllea conerei	T1	.	.	.	.	.	1.1	.
	T2	.	.	.	1.1	1.2	.	.
	S	.	.	+	.	+	+	.
Melastoma sp.	S	.	.	.	+	+	.	.
	H	.	.	+	.	.	.	.
Dehaasia sp.	T1	.	.	.	+	.	.	+
	S	.	.	.	+	.	.	.
Litsea sp.	T1	.	.	.	2.1	2.1	.	.
	S	+	.	.	+	.	+	+
Mezzetia leptopoda	T1	.	.	.	+	.	.	.
	H	.	.	.	.	+	.	.
Eugenia kuchingensis	T1	1.1	2.2	.	2.1	.	1.2	.
	T2	.	1.1	.	.	.	.	.
	S	+	.	.	+	.	.	.
Shorea multiflora	T1	2.1	.	.	+	.	.	.
Connarus sp.	T2	.	.	.	+	.	.	.
	S	.	.	.	.	.	+	+
	H	+	.	.	.	.	.	.
Canarium caudatum	T2	.	.	.	+	+	.	.
Shorea parvifolia	T2	.	+	.	1.1	.	.	.
Eugenia lineata	T2	.	.	.	+	.	.	.

	S	.	.	.	1.2	.	+	.	.
Ixora sp. 1	T2	.	.	.	.	1.1	.	.	.
	S	+	.	.	+	.	+	.	.
	H	+	.	.	.	+2	.	.	.
Eliocarpus stiplolaris	T1	.	.	.	.	.	.	.	1.1
	T2	.	.	.	.	.	.	.	1.1
	S	.	.	.	+	.	.	.	1.1
Litsea grandis	S	+	.	.	+	.	.	.	.
Blumeodendron calophyllum	T1	2.2	.	.	.	.	.	.	.
	S	1.1	+	.	+	.	.	.	.
Artocarpus sarawakensis	T1	.	.	.	.	+	.	1.1	.
	S	.	.	.	+	.	.	.	.
Liquala spinosa	S	.	2.2	.	+	+	+	+	.
Tetracera sp.	T2	+	.	.	.	.	1.1	.	.
	S	+	.	.	+	.	+	+	.
	H	.	.	.	.	.	+2	+	.
Piper sp.	S	.	.	.	+	.	.	.	+
Mesua sp.	S	.	.	.	+	.	.	.	+
Symplocos sp.	S	.	+	.	+	.	.	.	.
Mannispermaceae	S	.	.	.	+	.	+	.	+
	H	.	.	.	+	.	+	.	.
Memecylon beccarianum	S	.	.	.	+	.	+	.	.
Litsea oppositifolia	S	.	.	.	+	.	+	.	.
Alpinia sp. 1	H	+	.	.	2.2	+	.	+	+
Ficus dotoide	T2	.	.	.	.	.	.	.	+2
	S	.	.	.	.	.	+	.	+
Cinnamomum sp.	S	.	.	.	1.1	.	.	.	1.2
Fagrea sp.	S	.	.	.	.	.	.	1.1	+
Ziziphus sp.	S	.	.	.	.	.	+	.	+
Stolobus sp.	T2	.	1.1	.	.	1.1	.	.	.
Randia sp.	T2	.	.	.	.	+	.	.	.
	S	.	+	.	.	.	+	.	.
Demophocalyx denticulatus	T2	.	.	.	.	1.2	.	.	.
	S	.	.	.	.	2.2	+	.	.
Callophyllum canum	S	.	.	.	.	+	.	.	.
	H	.	.	.	.	+	.	.	.
Mallotus penangensis	T2	1.1	.	.	.	.	.	.	.
	S	+	1.1	.	.	+	.	.	.
Barringtonia reticulata	S	+	1.2	.	.	.	.	.	.
Drypetes sp.	S	+	+	.	.	.	.	.	.
Lesianthus sp.	T1	+	.	.	.	.	.	.	.
	S	.	.	.	.	.	.	1.2	.
Apocynaceae	S	+	+	.	.	.	.	.	.
Knema intermedia	S	+	.	.	.	.	+	+	.
Diospyros mangii	T2	.	1.2	.	.	.	+	.	.
Callophyllum tesmanii	S	.	2.2	.	.	.	+	.	.
Callophyllum nordosum	S	.	+	.	.	.	+	.	.
	H	.	.	.	.	.	.	+2	.
Pandanus sp. 2	H	.	+	.	.	.	.	+2	.
Santiria griffithii	S	.	.	.	.	.	.	.	+
	H	.	.	.	.	.	.	+	.
Lithocarpus andersonii	S	.	.	.	.	.	+	.	+
Timoniul sp.	T2	.	.	.	.	+	.	.	.
	S	.	.	.	.	.	.	.	+
Diospyros sp. 2	T2	.	.	.	.	+	.	.	.

	S	1.1	.	.	.	+	+	.	+2
	H	.	.	.	.	1.1	.	.	.
Calamus sarawakensis	S	.	.	.	.	.	.	.	2.3
	H	.	.	.	.	.	1.1	.	.
Monocarpia marginalis	S	.	.	.	.	.	+	.	1.2
	H	.	.	.	.	.	.	.	+
Mangifera havilandii	T2	1.1	.	.	.	.	.	.	.
	S	1.1	.	.	.	1.2	.	.	.
	H	+	.	.	.	.	.	.	.
Timonius flavoscens	S	+	.	.	.	.	.	.	+
Glochidion sp.	S	.	.	.	.	.	+	.	+
Aldisia sp.	S	.	+	.	.	.	+	.	+
Arocasia sp.	S	.	.	.	.	.	+	.	+
Fragrea racemosa	S	.	.	.	.	+	+	.	+
Alpinia sp. 2	H	.	.	.	.	1.1	.	.	+
Cliostanthus sp.	T1	.	.	.	.	1.1	.	.	.
	T2	.	2.2	.	.	+	.	.	.
	S	.	1.2	.	.	.	.	.	.
Garcinia parvifolia	T1	.	.	.	.	1.1	.	.	.
	S	.	1.2	.	.	.	.	.	.

Additional species which occurring once in Releve' reference no: no. 1; *Cotylelobium malayanum* T2+, H+, *Barringtonia racemosa* S+, *Pithecellobium* sp. S+, *Erythroxylum cuneatum* S+, *Cinnamomum inners* S+, *Meliosma* sp. S+, *Sindora* sp. S+, *Vatica parvifolia* H+, *Agrostistachys longifolia* S+, *Linociera laxiflora* S+, *Mysictea guatteriiifolia* H+, no. 2: *Ixonanthes beccarii* T1+, *Dyaliūm lorinum* T1+, *Myristica vilosa* S-1.1, *Lasianthus rhinocerotis* S+, *Trigonopleura malayana* S+, *Artobotrys* sp. 2 S+, *Vatica brunigi* S+, *Parinari* sp. 1 S+, *Gluta macrocappa* S+, *Alstonia angustiloba* S+, *Parinari* sp. 2 S+, *Goniothalamus* sp. S+2, *Xylopa ferruginea* S+, *Santiria apiculata* S+, *Parthenosis* sp. S+, *Nerpenthes rafflesiane* H+, *Swintonia* sp. H+, *Pandanus* sp. 3 H+, *Phystocataria* sp. H+, *Pinangia* sp. H-1.2, *Tetrastigma trifoliata* H+, *Callophyllum scribilitifolium* H+, no. 3: *Schefflea borneensis* T2+, *Passictigma* sp. T2+, H+, *Polyalthia cauliflora* T2+, S+, *Pouteria malaccensis* T2+, *Discida* sp. T2+, *Gonystylus velutinus* S+, *Alangium ebenacium* S-1.2, *Luvunga* sp. S+, *Lepisanthes fruticosa* S+, *Memecylon drum* S+, *Garciana pinangiana* S+, *Gonystylus micranthus* S+, *Lithocarpus gracilis* S+, *Lygodium* sp. S+, *Hopea nervosa* S+, *Urophyllum* sp. S+2, *Fordia coriasia* S+, *Erycibe bullata* S+, *Memecylon costatum* S+, *Fragrea elliptica* S+, *Fissistigma rigidum* S+, *Actinodaphne glomerata* S+, *Goniostalamus sumatrana* S+, *Diospyros siamang* S+, *Ptychopytis grandis* S+, *Euphoria malayaensis* S+, *Linociera laxiflora* S+, *Durio kutejensis* S+, *Poliata gluca* S+, *Xanthophyllum obscurum* S+, *Tetracera fagifolia* S+, *Rinorea horneri* S+, *Xanthophyllum scoptinea* S+, *Knema galeata* S+, *Grewia* sp. S+, *Pandanus andersenia* S+, *Psychotria elemeri* S+, *Asplenium nidus* S+, *Heritiera* sp. S+, *Anisophyllea disticta* S-1.1, *Diospyros feruginescens* H+, *Pinanga crassipis* H+, *Alseodaphne coriacea* H+, *Colocasia* sp. H+, *Eugenia cerina* H+, *Callophyllum biflorum* T2+, H-1.2, *Gingiberaceae* H-1.1, *Fobaceae* H+, *Selleginella* sp. H+2, *Calamus* sp. 3 H+, *Calamus* sp. 4 H+, *Calamus* sp. 5 H+, *Araceae* H+, *Dischidia hirsuta* H+, *Croton argiratus* H+, *Adjianthum* sp. H-1.2, *Diplazium* sp. H-1.1, *Araceae* 3 H+, *Artocarpus heterofilus* H+, no. 4: *Callophyllum muvosa* T2+, *Hydnocarpus* sp. 2 T1+, *Eurya* sp. T2+, *Gardenia* sp. T2+, *Polyosma* sp. T2+, *Tetractomis beccarii* T2+, *Shorea brunnescens* T2+, S+, H+, *Adinandra acuminata* T2+, *Macaranga hyponica* T2+, *Elacocarpus* sp. T2+, *Lasianthus maingayi* S-1.1, *Palaqium rigidum* S-1.1, *Pouteria malaccensis* S-1.1, *Symplocos* sp. S+, *Anisophyllea javanicum* S-1.2, *Alseodaphne conari* S+, *Pinandra coeruleascens* S-1.1, *Memecylon garcinoides* S+, *Croton* sp. S+, *Parastemum spicatum* S+, *Cannosperma squamata* S+, *Dipterocarpus crinitus* S+, *Diospyros mangi* S+, *Teijsmanniodendron borneensis* S+, *Eliocarpus* sp. S+, *Cyatostemma* sp. S+, *Pravavinia* sp. S+, *Barringtonia lanceolata* S+, *Canarium pudatum* S+, *Licuala* sp. S+, *Portaceae* 1 S+, *Diplospora* sp. S+, *Lithocarpus beptongyne* S+, *Baccaurea brevipes* S+, *Knema* sp. S+, *Xanthophyllum spicatum* S+, *Callophyllum havilandii* S+, *Durio excelous* S+, *Celastraceae* S+, *Shorea elliptica* S+, *Lithocarpus* sp. S+, *Helicia acuminata* S+, *Sabtieria piculata* S+, *Brackenridea hookeri* S+, *Cantium didynum* S+, *Memecylon edule* S+, *Pheba* sp. S+, *Callaria* sp. S+,

*Toona* sp. S+, *Lindera* sp. S+, *Lasianthes griffithii* S+, *Parthenosis* sp. S+, *Palaquium rostratum* S+,  
*Aesynanthes* sp. S+, *Artocarpus komando* S+, *Dichranopteris liniaris* S+, *Callophyllum tesmania* H-1.2,  
*Spicata palastemum* H+, *Polyalthia sumatrana* H+, *Dycopi evena* H+, *Cleistanthus myrianthus* H+,  
*Friesodielsia affinis* H+, *Memecylon laevigatum* H+, *Diomonorops* sp. 1 H+, *Diomonorops* sp. 2 H-1.2,  
*Helicia axelcia* H+, *Engelhardia serrata* H+, *Strychnos ignatii* H+, *Aresthecum* sp. H+, *Gingerberaceae*  
H+, *Elaphoglossum peltatum* H+, no. 5: *Hopea* sp. T1-3.2, *Polyalthia gluca* T1-1.1, *Horsfieldia* sp. T1-1.1,  
S+, *Vatica* sp. T1-2.2, T2-1.2, *Mallotus* sp. T2+, *Knema galeata* H+, *Trigonostemon* sp. T2+, S+,  
*Gonocaryum minus* T2+, *Gluria borneensis* T2+, *Gymnacranthera contracta* T2+, *Parinstonia* sp. T2+,  
*Mezzetia* sp. T2+, *Pleiocarpidia borneensis* S-1.2, *Lasianthus constrictus* S+, *Mesua acuminatissima*  
S+, *Pavetta axillaris* S+, *Tarenna* sp. S+, *Callophyllum canum* S+, H+, *Casearia* sp. S+, *Lophopetalum*  
*glabrum* S+, *Cleistanthus coriaceus* S+, *Memecylon amplexicaula* S+, *Crudia reticulata* S+, *Mitrephora*  
*mangii* S+, *Terrina* sp. S+, *Mitreaphera* sp. S+, *Canarium hirsutum* S+, *Palaquium canum* S+, *Castanopsis*  
*motleyana* S+, *Kopcia* sp. S+, *Chisocheton beccarianus* S+, *Disepalum puchrum* H+, *Cleistanthus myrianthus*  
H+, *Perroteria* sp. H+, *Alphonsea johorensis* H+, *Maranthaceae* H+2, no. 6: *Litsea racemosa* S+,  
*Girroniera* sp. T1-1.1, S+, *Cannosperma* sp. T2+, *Walsura pinnata* T2+, S+, *Grewia* sp. T2+, *Mesua*  
*myrtifoliar* T2-1.1, *Aporusa prainiana* T2+, *Polyalthia macrana* T2+, *Santiria costata* T2+, H+, *Artocarpus*  
*nitidus* T2+, *Macaranga triloba* T2+, *Xanthophyllum aneonum* S+, *Palaquium rugosum* S+, *Antidesma* sp. S+,  
*Knema furufracea* S+, *Microtropis bivalvis* S+, *Chisocheton* sp. S+, *Aglia tridostemon* S+, *Drypetes kikir*  
S+, *Trichadenia philippinesis* S+, *Artocarpus elasticus* S+, *Xanthophyllum affine* S-1.1, *Pinandra* sp.  
S+, *Goniathalamus* sp. S+, *Fahrenheitia pendula* S+, *Meiogyne* sp. S+, *Litsea erectinervia* S+, *Grewia*  
*borneensis* S+, *Brownlowia* sp. S+, *Lophopetalum beccariana* S+, *Meliosma sumatrana* S+, *Chukrasia* sp. S+,  
*Strewnon* sp. S+, *Xylopia* sp. S+, *Xerospermum* sp. S+, *Lasianthus scabridus* S-1.1, *Lindera* sp. S+, *Aglia*  
*shawiana* S+, *Pterospermum javanicum* S+, *Urticaceae* S+, *Eugenia* sp. 4 S+, *Eugenia* sp. 5 S+, *Eugenia* sp.  
6 S+, *Diospyros* sp. 4 S+, *Acronychia* sp. S+, *Dipterocarpus pulcher* S+, *Friensytia* sp. S+, *Durio*  
*glavolens* S+, *Dacryodes megacarpa* S+, *Litsea* sp. 2 S+, *Dacryodes laxa* S+, *Araceae* S+, *Cryptocaria* sp.  
H+, *Unknown climber* H+, no. 7: *Durio kutegensis* S+, *Acronychie* sp. S+, *Grewia cinnamomifolia* S+,  
*Casearia* sp. S+, *Bulbophyllum* sp. S+, *Dacryodes uncbata* S+, *Marsypopetalum karai* S+, *Heliciopsis* sp.  
S+, *Gluta willitia* S+, *Gluta laxiflora* S+, *Vitex* sp. S+, *Scaphium borneensis* S+, *Christanthus*  
*perocarpus* S+, *Asperenium* sp. S+, *Wallubergia* sp. H+, *Stolobus* sp. H+, *Lanceanthus* sp. S+2,  
*Callophyllum biflorum* H+2, *Cyathocalyx* sp. H+, *Caranthea* sp. H+, *Pathenocis* sp. H+, *Amopipalus* sp.  
H+, *Goniothalamus insignis* H+, *Ficus* sp. H+, *Eugenia clorantha* H+, *Artocarpus odoratissimus* T1-1.1,  
*Kibersia hirfa* T2+, *Acio heteropetala* T2-1.1, *Meduca* sp. T2+, *Garcinia brevipes* T2-1.1, *Mesua longifolia*  
T2+, *Pentace* sp. T2-1.1, no. 8: *Aeschynanthus* sp. S+, *Shorea macrantha* S+, *Ancaria* sp. S+, *Ilex* sp.  
S+, *Shorea longiflora* S+, *Flagellaria* sp. S+, H+, *Medinella* sp. S+, *Neoscortechinia* sp. S+2,  
*Perycnetia* sp. S+2, *Asplenium nidus* S+, *Croton tigilium* S+, *Stenochlaena laputris* S+, *Passiflora*  
sp. S+, *Pomettia pinnata* S+, *Derris trifoliata* S+, *Ctenolophon* sp. S+, *Parvifolius* sp. S+, *Alangium*  
*javanicum* S+, *Urticaceae* S+, H+, *Santiria herrii* S+, *Gluta motleyana* S+, *Gluta pierrei* S+,  
*Psychotria* sp. S+, *Xerospermum* sp. S+, *Freymitia* sp. S+, *Cristinatia* sp. S+, *Diospyros havilandii* H+,  
*Elaeocarpus beccarii* H+, *Commelinaceae* H+, *Gesneriaceae* H+, *Daracina* sp. H+, *Macaranga* sp. H+,  
*Dioscorea* sp. H+, *Bauhinia* sp. H+, *Pitos* sp. H+, *Goodyerasp* H+, *Pitiobium* sp. H+, *Hopea* sp. H+,  
*Polyalthia gluca* T1-1.1, *Horsfieldia* sp. T1-1.1, S+, *Vatica* sp. T1-2.2, T2-1.2.

Location in Releve' ref. no. 1: Similajau National Park, Sarawak. no. 2: Likau Forest Reserve, Sarawak.  
no. 3: Semenggok National Park, Sarawak. no. 4: Kubah National Park, Sarawak. no. 5: Similajau National  
Park, Sarawak. no. 6: Experimental Forest in UPM, Bintulu. no. 7: Arboratum in UPM, Bintulu. no. 8: Stapok  
Forest Reserve, Sarawak.



Table 2 .: Tropical secondary forest with *Macaranga gigantea* community.

Releve reference number	1	2	3
Original releve number (in field)	4	8	11
Releve date	93	93	93
	2	3	3
	26	1	3
Releve size (m)	240	400	800
Altitude (m)	50	50	45
Aspect	NW	NW	E
Slope	20	20	25
Height of tree layer 1 (m)	12	10	13
Cover of tree layer 1(%)	85	80	80
Height of tree layer 2 (m)	7	7	8
Cover of tree layer 2 (%)	15	30	20
Height of shrub layer (m)	3	3	3
Cover of shrub layer (%)	30	20	20
Height of herb layer (m)	1.5	0.9	2
Cover of herb layer (%)	70	30	40
Number of species	65	62	63

## Differential species :

<i>Macaranga gigantea</i>	T1	4.4	5.4	5.4
	T2	1.1	2.2	.
	S	+	.	.
<i>Vitex pubescens</i>	T1	.	1.2	+
	T2	.	+	2.2
	S	+	.	.
<i>Blechnum sp.</i>	S	1.2	.	.
	H	.	2.2	2.3
<i>Alpina sp.</i>	S	2.2	.	.
	H	.	1.2	+
<i>Cyperus sp.</i>	H	4.4	3.4	3.2

## Differential species of under unit :

<i>Ficus sp.</i>	T1	2.3	.	.
	T2	1.2	.	.
	S	+	.	.
<i>Semecarpus glauca</i>	T1	1.1	.	.
<i>Sarcostigma paniculata</i>	T1	1.2	.	.
	T2	1.2	.	.
<i>Tetracera glaberrima</i>	T1	+	.	.
	T2	1.2	.	.
<i>Macaranga hepuluca</i>	T1	3.3	.	.
<i>Macaranga triloba</i>	T1	.	+	1.2
<i>Palaquium sericium</i>	T2	.	1.1	.
	S	.	+	+
<i>Ficus hemsleyana</i>	T2	.	2.3	.
	S	.	2.3	1.1
<i>Endospermum didinum</i>	T2	.	.	2.2
	S	.	+	.
<i>Ormosia sp.</i>	S	.	+	+
	H	.	+	.
<i>Anisophyllea sp.</i>	S	.	.	+
	H	.	+	.

Fordia coreacia	S	.	.	+
	H	.	+	.

## Others

Callicarpa pentandra	T2	+2	.	.
	S	1.2	+	.
Melastoma malabathricum	S	1.2	.	.
	H	.	1.1	.
Lygodium sp.	S	+	.	.
	H	.	+	.
Saurauia glabra	T2	.	.	1.1
	S	+	.	.
Ziziphus sp.	S	+	.	+

Additional number of species occurring once in releve reference no 1  
Mussaendopsis beccariana T2+, Timonius polycarpa T2+, Phytocrene  
racemosa T2+, Leea indica T2-1.1, Durio zibethinus T2+, Lithocarpus  
leptogyne T2+, Artocarpus longifolius T2+, Melastoma sp.1 T2+,  
Randia grandifolia T2+, Melletia vasta T2+, Goniiothalamus malayanus  
T2+, Calamus sp. T2+, Aglaia trichostemon T2+, Tetracera macrophylla  
T2+, Shorea isoptera T2+, Mallotus paniculatus T2+, Goniiothalamus  
tortilipelatus T2+, Dillenia subfrutecosa S-1.2, Alpina sp. 2 S-1.2,  
Conarus sp. S+, Tetrastigma trifoliata S+, Alstonia angustifolia S+,  
Mangifera panjang S+, Artobotrys costatus S+, Memecylon edule S+,  
Europhyllum borneensis S+, Dimophocalyx denticulatis S+, Manispermaceae  
S+, Pithecellobium borneense S+, Dioscorea sp. S+, Strychnos sp. S+,  
Costus sp. S+, Calamus sarawakensis S+2, Brackenridgea hookeri S+,  
Liliaceae 1 H+, Cypraceae 2 H+, Maranthes sp. H+; no. 2; Connersonia  
bartrania T1-2.2, Ficus condensa T1-2.2, Durio glaveolens T2+, Politia  
sp. T2+, Anisophyllea beccariana T2+, Gnetum sp. S+, Dillenia eximia  
S+, Anisophyllea cornori S+, Meliosma pinnata S+, Lephopetalum sp. S+,  
Diospyros sp. S+, Premna integrifolia S+, Rinorea sp. S+, Koopasia  
malacensis S+, Asplenium sp. S+, Fagrea racemosa S+, Diospyros pendula  
S+, Dacryodes rugosa S+, Dillenia excelsa S+, Gironniera parvifolia S+,  
Drypetes sp. S+, Glochidion lutescens S+, Barringtonia sarcostachys S+,  
Macaranga hosei S+, Vitaceae S+, Baphinia sp. 1 S+, Baphinia sp. 2 S+,  
Xanthophyllum flavescens S+, Arthocarpus elasticus S-1.1, Paranephelium sp.  
S+, Dillenia subpruiticosa S+, Ficus uncinata H+, Derris sp. H+, Cucurliigo  
sp. H+, Maranthes sp. H+, Vitis trifoliata H+, Stenoclena sp. H+,  
Dsytochotria sp. H+, Pteridium sp. H+; No. 3; Timonius sp. T1+, Strolobus  
sp. T1+, Macaranga prunosa T1+, Leguminosae T1-1.2, Gnetum latifolium T1-  
1.2, Sindora sp. T2+, Pentace sp. T2+, Isonandra lanceolata T2-1.1,  
Beilchmiedia madang T2-1.1, Arthocarpus anisophyllus T2-1.1, Knema grandis  
T2-1.2, Palaquium stenophyllum T2-1.2, Smilax sp. S+, Pinandra sp. S+,  
Polyalthia caulifolia S+, Paretta sp. S+, Glochidion sp. S+, Garcinia sp.  
S+, Fagrea blumei S+, Vatica oblongifolia S+, Nephelium nepecium S+,  
Tetracera sp. S+, Ganea sp. 1 S+, Milletia sp. S+, Wallubergia sp. S+,  
Ganea sp. 2 S+, Swintonia sp. S+, Semecarpus sp. S+, Ryparosa hullettii  
S+, Pternandra multiflora S+, Ixora sp. S-1.1, Grewia blattacfolia S+,  
Eugenia sp. S+, Reprorusa rudii S+, Hydnocarpus sp. S+, Strombosia lucida  
S+, Emmelia sp. S+, Antidesma sp. H+, Ardisia sp. H+, Gleichenia linearis  
H+, Putalsia sp. H+, Rubiaceae 1 H+2, Maranthaceae H+, Stenoclena dactris  
H+, Cortalsia sp. H+, Hostus sp. H+, Rubiaceae 2 H+, Ligualala spinosa H+.

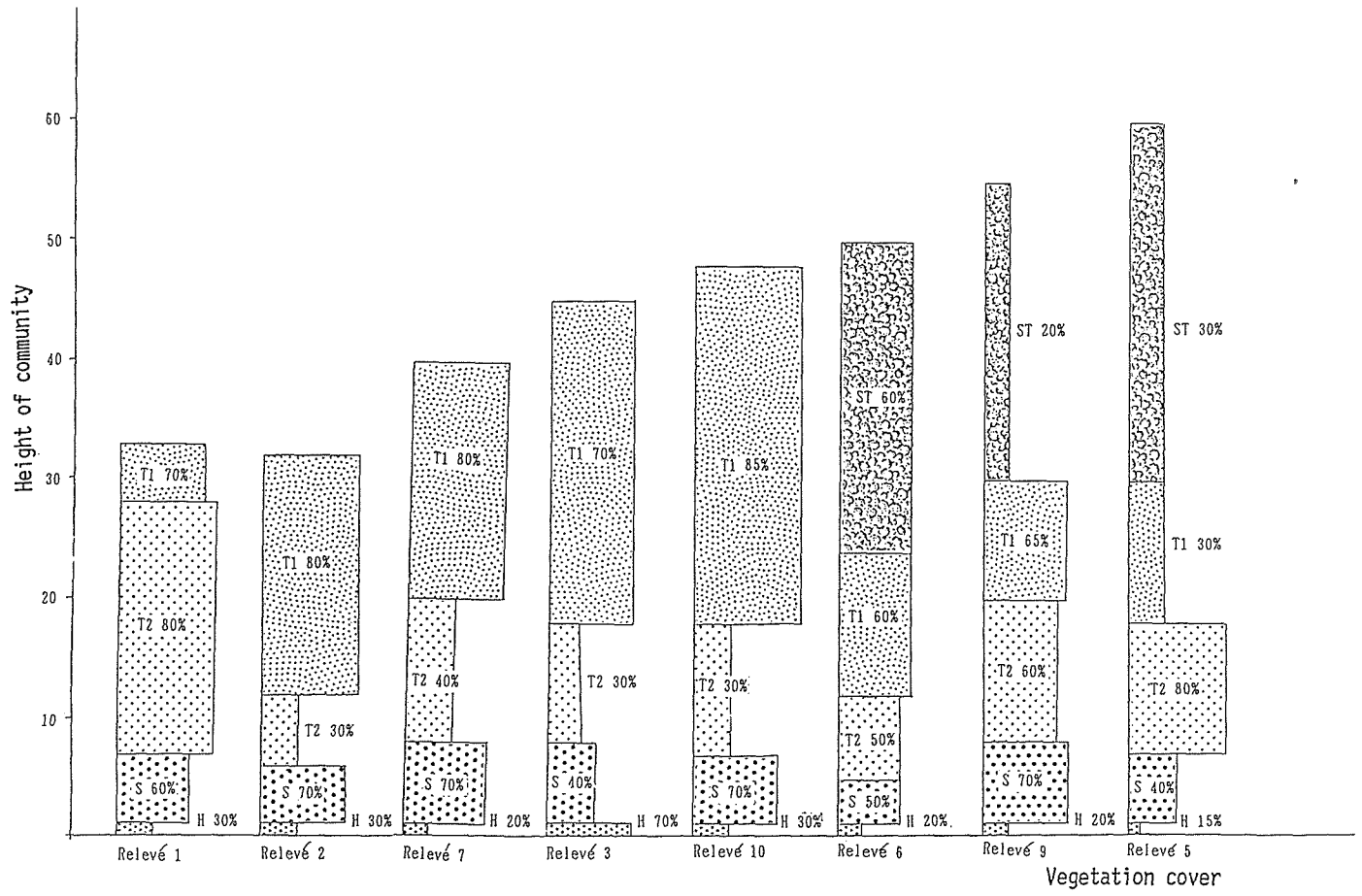


Fig. 4 The vegetation of each forest layer in the tropical forests.

Location in Relevé ref. no. 1: Plot B Third Phase area of Joint Project between UPM and YNU, Universiti Pertanian Malaysia Bintulu Campus, no. 2: Line Planting Second Phase area of Joint Project between UPM and YNU, Universiti Pertanian Malaysia Bintulu Campus, no. 3: Old Universiti Pertanian Malaysia's orchard.

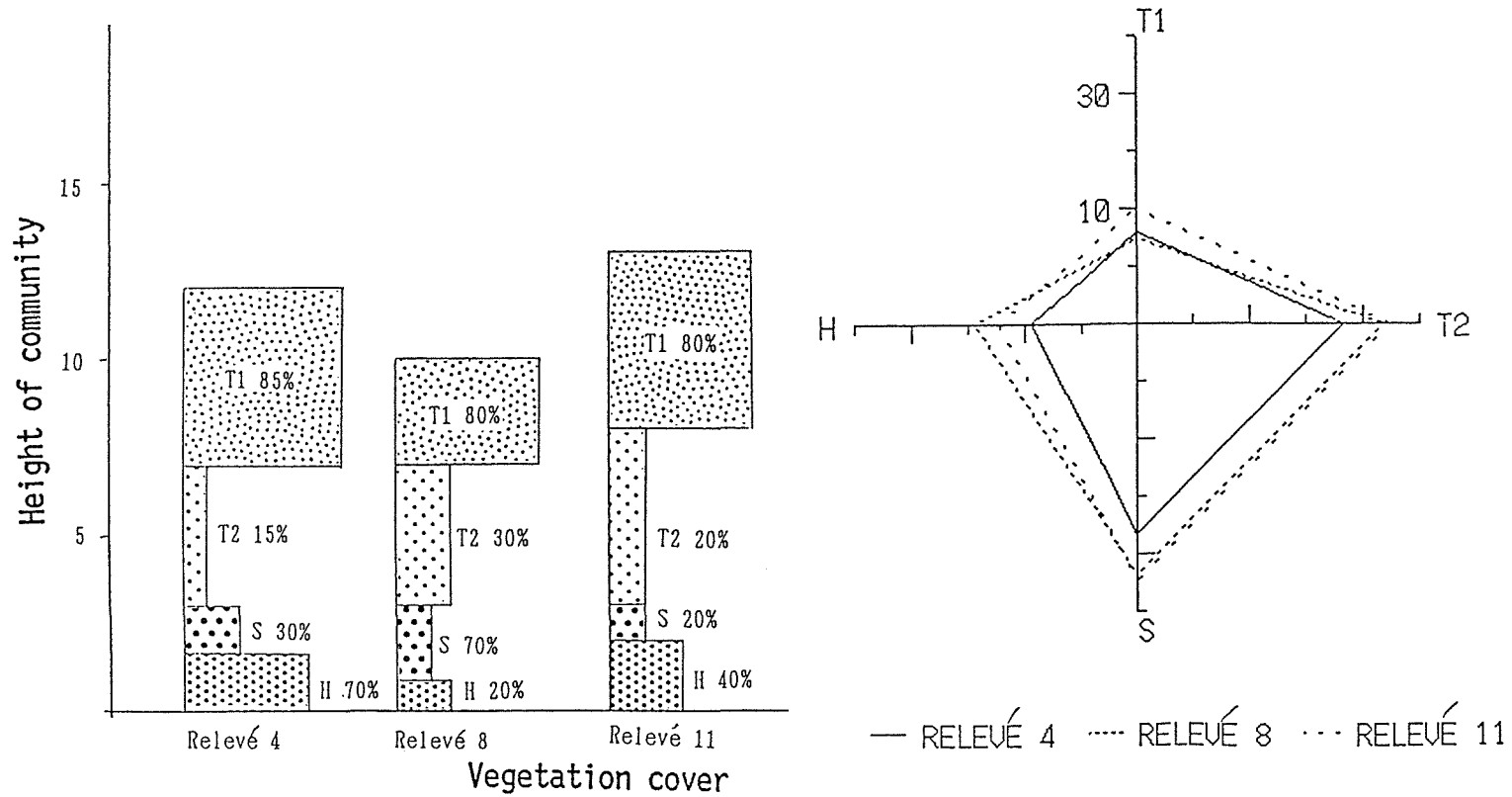


Fig. 5 The vegetation cover of each forest layer(left)and the species - richness polygon of tropical secondary forests (Each vertex represents one layer) (right).

Zaki et al. 1993). In comparing these data with phytosociological field results, one can see that the seedling species from moist sites and short (less than 50cm) had not grown so well. The kerangas species and species from mesic sites, such as *Shorea ovata*, *S. maxwelliana*, *Cotylelobium burckii*, *Dipterocarpus actangulus*, *Dryobalanops aromatica*, etc., and also pioneer species as *Durio graeolense* and *Anisophyllea beccariaña* have good growth. At the mesic site and with intensive care of weeding and watering, the species from mesic sites grow very well (Zaki et al. 1993).

## 6. Conclusion

Restoration of tropical forests is a difficult problem in developing countries because of the cost for plantation and maintenance. Also, general people use forests for firewood, charcoal, hunting, shifting cultivation, etc. Even governments in developing countries cut tropical forests for timber export and used areas for rubber plantations (before, in tropical Asia) and now for oil-palm plantation, pastures etc.

For these problems, local land-use planning is most important where tropical forests are preserved. How many percent should be restored for local and people in the other world is a question.

Forest Research Institute of Malaysia (FRIM) succeeded at restoration of several tropical dipterocarp forests in the Malay peninsula since 1932, which took a long time. From 1972, we got ca 200 experimental sites in Japan based on phytosociology (the idea of potential natural vegetation) and in tropical Asia from 1990. This successful result involved dense planting of mixed pot seedlings of canopy species which have well developed root systems. The results showed that this is the best way to recover natural forests in a very short time with short, concentrated maintenance after plantation. These plantations were recorded to grow one meter in a year, even in the warm-temperate zone, and 50 cm to one meter in a half year in

tropical Asia (Fujiwara 1993).

The above is summarized as follows:

1. Three types of tropical forests were recognized in the tropical forests in Kuching and Bintulu area. They are *Cyrtostachys lakka-Whiteodendron moultianum* community (kerangas forest), *Hopea kerangasensis-Allantospermum borneense* community (dipterocarp forest), and *Palaquium walsuraefolium-Dryobalanopsis rappa* community (swamp) (Table 1).
2. Seeds and seedlings were picked up from natural forests in the UPM campus and from the planning area for clear cutting. Then UPM members germinated these seeds and made potted seedlings. Seedlings to be used under different shade conditions were nursed in the nursery. Then they were planted in the abandoned shifting-cultivation areas in the UPM campus (Miyawaki 1993).
3. The kerangas species have grown especially well on the abandoned shifting-cultivation areas, which were dry, sunny, low in nutrients, and windy.
4. The restoration of natural forests to use seedlings of natural canopy trees, with well developed rootsystems, succeeded even in the tropical forest region, with the above plantation method (Miyawaki method). It is based on the phytosociological method (to understand the community composition and site condition). Then seeds and seedlings are collected and nursed to make seedlings with well developed root systems. The dense plantation of these seedlings should succeed.

Restoration of native forests especially tropical forest are the main key to local green planning and recovering the diversity of ecosystems from today, based on phytosociology and several experimental results.

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