

# *Gonystylus bancanus*

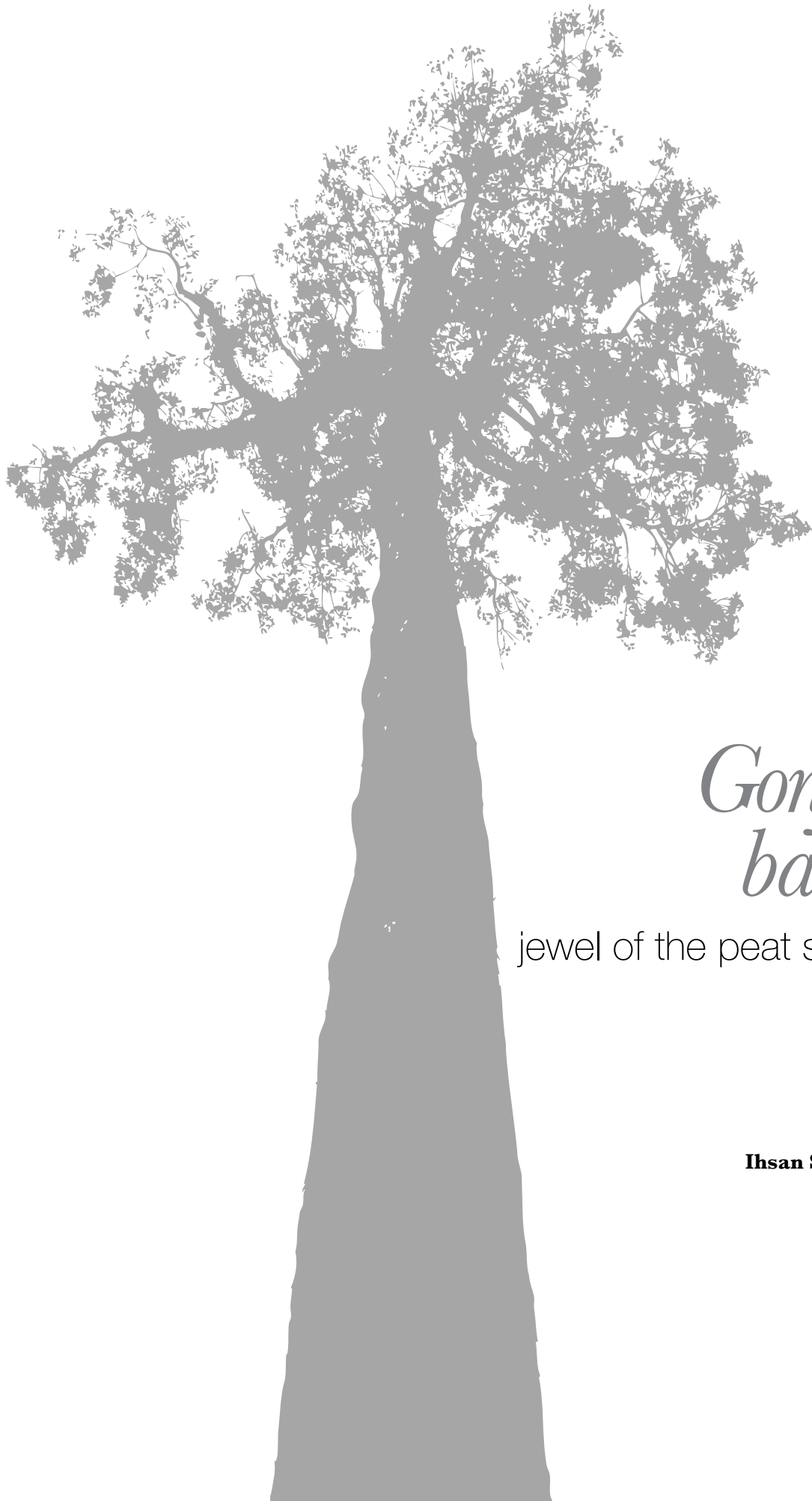
jewel of the peat swamp forest



Khali Aziz Hamzah  
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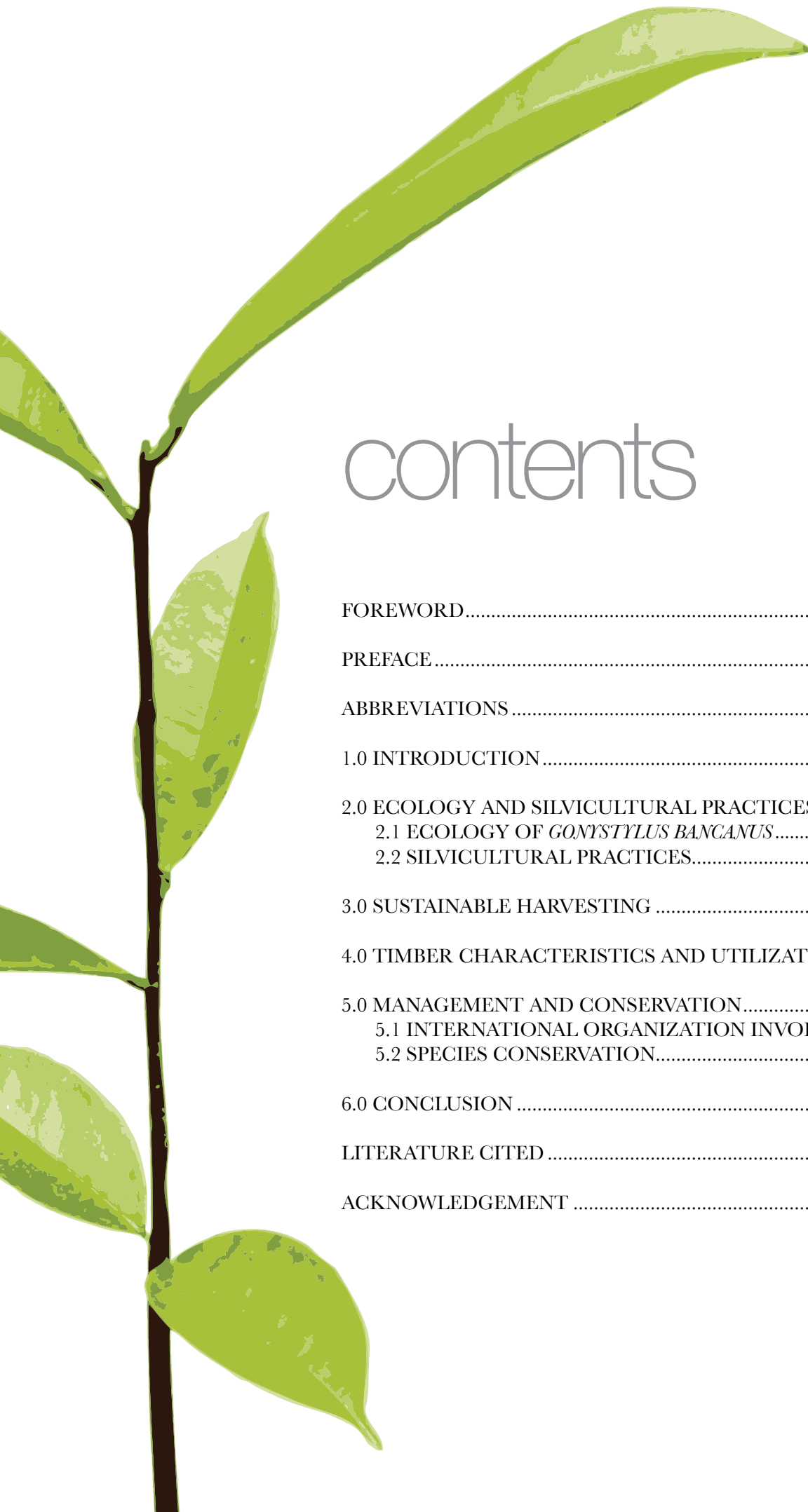
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# foreword

This book is published as an outcome of FRIM activity funded by ITTO-CITES. *Gonystylus bancanus* or locally known as ramin melawis is the main timber species of peat swamp forests (PSF). Apart from being the only species of *Gonystylus* found here, this species is amongst the most valuable commercial timbers produced from the forests of Malaysia and Indonesia. Since 2001, the *Gonystylus* species are listed in Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), prohibiting international trade of this material without proper permits via trade regulation. Despite receiving more attention in terms of research compared to the other *Gonystylus* species, the study conducted on *G. bancanus* is still insufficient. Thus, its comprehensive information is direly needed to be used in managing and conserving the species. This pictorial book depicts briefly in words some important information on the distribution of *G. bancanus*, its ecological characteristics, silvicultural practices, sustainable harvesting, timber characteristic, utilization, management and conservation of the species, coupled with relevant images. Thus, I would like to congratulate the authors of this book on their effort to document the *G. bancanus*. I sincerely hope that this book could be used as a guide in identifying and understanding the species for its better management and conservation. Likewise, I greatly appreciate the financial contribution made by ITTO-CITES in publishing this book. It is hoped that the adoption of this initiative by other international agencies will enhance and improve the management and conservation of forest in this country.

**Dato' Dr Abd. Latif Mohmod**

Director-General FRIM





# preface

**A picture is worth a thousand words** – relying on the strength of the quote, we the authors of this pictorial book believe that this simple publication will provide readers with an overview of *Gonystylus bancanus* (ramin melawis), an important tree species. Written in simple layman term and full of photographs with a brief description of each, the main intention of publishing this book is to create a higher degree of public awareness on the various aspects of *G. bancanus* – a peat swamp forest species currently listed in the CITES Appendix II. Being listed in the Appendix II means all commonly traded parts and derivatives of *G. bancanus* are regulated by the Convention and require CITES permits. The main aim of listing the species in CITES is to ensure that as a timber resource, *G. bancanus* is extracted on a sustainable basis from the natural forest. As awareness is one of the main factors in conservation, we hope that this book provides information that will help to improve the management and conservation of this peat swamp forest species for the betterment of mankind.

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# abbreviations

CITES.....	Convention on International Trade in Endangered Species of Wild Fauna and Flora
dbh .....	diameter at breast height
FR .....	forest reserve
FRIM .....	Forest Research Institute Malaysia
GEF.....	Global Environment Facility
IMP .....	integrated management plan
ITTO .....	International Tropical Timber Organization
m .....	meter
MC&I.....	Malaysia Criteria & Indicator for Forest Management Certification
MUS.....	Malayan Uniform System
PSF.....	peat swamp forest
RIL.....	reduced impact logging
SEPPSF .....	South East Pahang Peat Swamp Forest
SMS .....	Selective Management System
UNDP .....	United Nations Development Program









**chapter 1**

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# Introduction

## CHAPTER 1.0 INTRODUCTION

*Gonystylus bancanus* or locally known as ramin melawis is a tree normally associated with peat swamp forest (PSF). In Malaysia, this important species is sought for its high quality timber for furniture and is only found in the PSF. Due to its high value, the *G. bancanus* can be considered as the *jewel of the peat swamp forest*. The total area of PSF in Malaysia is about 1.54 million ha as shown in Table 1.1. Since *G. bancanus* is only found naturally in the PSF, geographically the *G. bancanus* distribution in Malaysia is associated with the location of PSF which largely can be found in the state of Sarawak and some parts of Sabah (Figure 1.1). In Peninsular Malaysia, the southeast Pahang PSF (SEPPSF) is considered a rich *G. bancanus* area, in addition to some PSF areas in other states including Selangor and Johor.

Table 1.1 Distribution, area and types of forest in Malaysia (million ha, 2008)

Region	Land area	Natural forest			Plantation forest	Total forested land	% of total land area
		Dry inland	Swamp forest	Mangrove forest			
Peninsular Malaysia	13.16	5.40	0.30	0.10	0.08	5.88	44.7
Sabah	7.37	3.83	0.12	0.34	0.11	4.40	59.7
Sarawak	12.30	7.92	1.12	0.14	0.06	9.24	75.1
Total (Malaysia)	32.83	17.15	1.54	0.58	0.25	19.52	59.5

Source: FRA (2010)



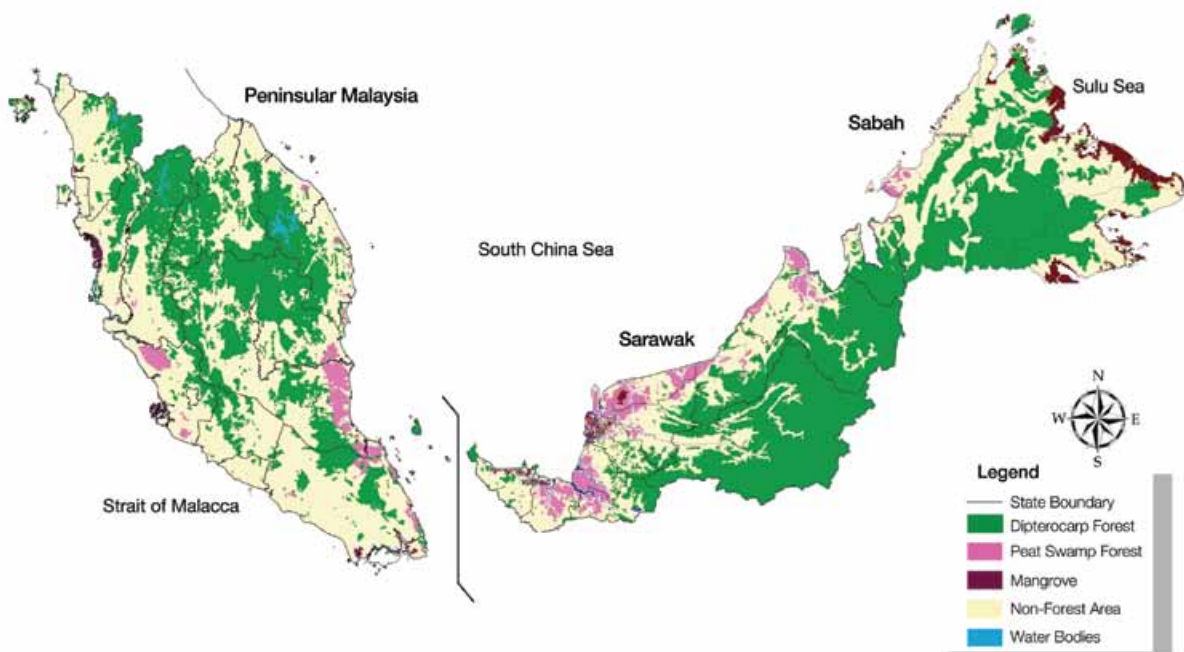


Figure 1.1 The distribution of peat swamp forest in Malaysia which is the natural habitat for *G. bancanus*.

In general, there are three different layers of tree in the PSF namely the upper layer, the middle layer and the understorey (Wyatt-Smith 1963). *Gonystylus bancanus* tree is considered as a main canopy layer species in which it can grow as high as 40 m tall. Figure 1.2 shows the profile diagram of a virgin PSF showing the different layers of tree canopy that include *G. bancanus* species.

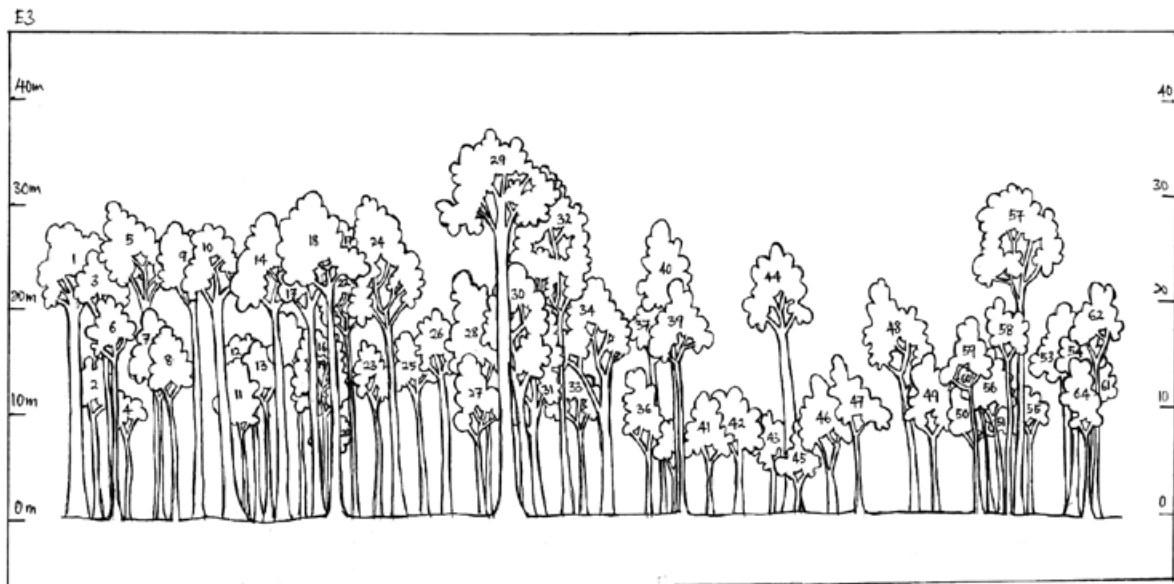


Figure 1.2 Forest profile of virgin PSF: 39, *Baccaurea bracteata*; 54, *Blumeodendron tokbrai*; 14, 61, *Calophyllum ferrugineum*; 27, *Calophyllum sclerophyllum*; 47, *Camnosperma coriaceum*; 2, 33, 49, 50, *Diospyros lanceifolia*; 53, *Diospyros maingayi*; 18, 32, *Durio carinatus*; 3, 9, 17, 24, *Gonystylus bancanus*; 21, 29, 40, *Koompassia malaccensis*; 15, 30, *Licania splendens*; 43, 58, *Litsea elliptica*; 36, 38, 44, 56, 60, *Litsea gracilipes*; 51, *Litsea grandis*; 12, 16, 41, *Lophopetalum floribundum*; 45, *Lophopetalum multinervium*; 6, 7, 8, 11, 20, 55, 64, *Neoscortechinia forbesii*; 10, *Palaquium ridleyi*; 22, 37, 52, *Parastemon urophyllum*; 23, 48, *Polyalthia glauca*; 5, *Polyalthia hypoleuca*; 1, 57, *Shorea platycarpa*; 13, *Syzygium cerinum*; 19, 26, 31, 46, *Syzygium inophyllum*; 34, 62, *Syzygium kiahii*; 25, 35, *Syzygium lineatum*; 4, *Tetractomia majus*; 59, *Xantophyllum ellipticum*; 28, 42, *Xylopia magna*.







**chapter 2**

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# Ecology & Silvicultural Practices

## CHAPTER 2.0 ECOLOGY AND SILVICULTURAL PRACTICES

### 2.1 Ecology of *Gonystylus bancanus*

Kurz described *G. bancanus* in 1864 (Soerianegara & Lemmens 1994). Other synonyms for *G. bancanus* include *G. miquelianus* Teijsm. and Binn., *G. bancanus* Gilg. and *G. hackenbergii* Diels. *Gonystylus bancanus* had been earlier described as *Aquilaria bancana* by Miquel in 1861. However, Kurz transferred the species to the genus *Gonystylus* as *G. bancanus* (Miq.) Kurz.

*Gonystylus bancanus* is a medium to fairly large tree, which can grow up to 40 m in height with approximately up to 120 cm dbh (Kartiko 2002) as shown in Figures 2.1.1 – 2.1.3. The trunk is branchless up to about 20 m high, the base sometimes fluted with numerous roots as breathing organ (Ng & Shamsudin 2001). Nonetheless, quite a number of *G. bancanus* trees in Pekan Forest Reserve (FR) have straight boles more than 30 m (Ismail 2009). The surface is often cracked and shallowly fissured. The bark is greyish to red-brown, and the inner bark is reddish brown and fibrous. The sapwood is white to pale yellowish cream colour.

The leaves are thick, leathery, elliptical, oblong-oblongate or obovate and are frequently folded lengthwise. The veins are numerous, almost parallel but not reaching the margin. The inflorescences are up to 9 cm long, densely tomentose. The flowers are arranged in 2 to 5 clusters, 1 to 1.8 cm long (Figure 2.1.4). The fruits are in capsules, woody, rounded and open naturally at maturity. There are 1 to 3 seeds per fruit. The seed is ovoid, dark in colour and about 28 x 22 x 6 mm in size (Figures 2.1.5 – 2.1.6) and there are about 250 - 300 seeds per kg (Kartiko 2002).

According to Shamsudin (1997), *G. bancanus* is abundant in primary PSF in Pahang and a dominant species in size class of 70 cm dbh and above. This is supported by studies of Blackett and Wollesen (2005) and Ismail *et al.* (2005). They reported that *G. bancanus* is the second most abundant species after *Calophyllum ferrugineum* var. *ferrugineum* in Pekan FR of trees in size class of 30 cm dbh and above.

Naturally, young individuals of this species tend to clump together within a small area underneath the mother trees (Shamsudin & Ng 1995). It is believed that limited distance of seed dispersal due to fairly large and heavy fruits might be one of the reasons that give *G. bancanus* the tendency to grow in clump. Regeneration is mostly within 10 m radius from the mother trees. The number of seedlings decreases with the increase in distance and no single seedling has been recorded at a distance of 20 m away from the mother tree (Nurul Huda 2003, Shamsudin 1999). In a ground survey of a *G. bancanus* dominant area, it was commonly observed that several big-sized trees ( $\geq 30$  cm dbh) were naturally distributed within 10 m<sup>2</sup> (Ismail *et al.* 2005).

*Gonystylus bancanus* flowers supra-annually (Ismail 2009) and a total of 71–86 days was recorded for a full development from bud to matured fruit (Figures 2.1.7 – 2.1.8). Flowers of *G. bancanus* are pollinated by thrips (*Heterothrips* sp.) and stingless bees (*Trigona canifrons* and *T. laeviceps*) as shown in Figure 2.1.9. Identified predators of the *G. bancanus* flowers and fruits are aphids (*Aphis* sp.), Prevost's squirrel (*Callosciurus prevostii*) and plantain squirrel (*C. notatus*) (Figures 2.1.10 – 2.1.11). *Gonystylus bancanus* seed is dispersed naturally by normal gravity. In addition, Malayan flying fox (*Pteropus vampyrus*) was identified as the animal species that disperses the fruits. Some fruit bats, namely *Cynopterus sphinx*, *Megaerops ecaudatus* and *Penthetor lucasi* were also identified as potential seed dispersal agents of *G. bancanus* in Pekan FR.



Figures 2.1.1 (a-e) *Gonystylus bancanus* are dominant trees and tend to grow close to each other in their natural habitats.



a









a

Figures 2.1.2 (a-b) *Gonystylus bancanus* showing cracked and shallowly fissured bole. It is common to see fungi growing on *G. bancanus* trunk.





b





Figure 2.1.3 The bark and sapwood of *G. bancanus*.





Figures 2.1.4 (a-e) Flowers and brownish-coloured fruits of *G. bancanus* with one to three seeds per fruit.





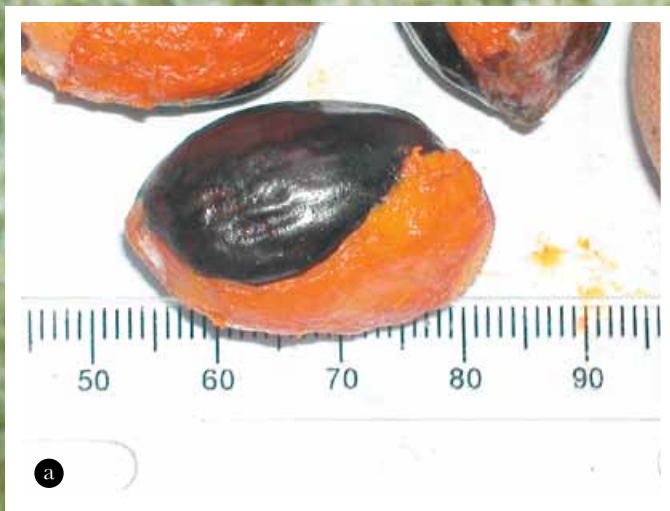
c



e







Figures 2.1.5 (a-f) The seeds of *G. bancanus* are ovoid, dark in colour and about 28 x 22 x 6 mm in size. There are about 250 - 300 seeds per kg.



**c**









Figure 2.1.6 A 20-m tower for phenological study attached to a *G. bancanus* tree in Pekan FR.





Figures 2.1.7 (a-c) Gregarious fruiting of *G. bancanus* in Pekan FR in 2004. It was estimated that more than 60% of *G. bancanus* trees flowered in that year.









Figure 2.1.8 Matured fruits on the forest floor will germinate once favorable environmental conditions are met (top). Wild seedling two weeks after germination (right).



Figure 2.1.9 Pollinators of *G. bancanus* are thrips (right) and stingless bees (left). They were found pollinating the *G. bancanus* inflorescences during the day and night.





Figure 2.1.10 Aphids suck fluids from *G. bancanus* inflorescences (top). Plaintain squirrel (left) and Prevost's squirrel (right) consume the fruits and seeds of *G. bancanus*.





Figure 2.1.11 Infested *G. bancanus* fruit (left) and decaying log (right). Felled logs should be transported to mill immediately after extraction or submerged in water to avoid blue stain. The natural durability of felled logs in the field is about two weeks.

## 2.2 Silvicultural Practices

Enrichment planting or forest rehabilitation is the main silvicultural treatment practiced in logged-over PSFs. The enrichment planting activity will be conducted about two or three years after logging completed if the areas were found to be poorly-stocked. Studies on appropriate planting techniques, species suitability and cost-effective planting programs are being conducted by FRIM. Ismail *et al.* (2006) have recommended *G. bancanus* for forest rehabilitation programme in PSFs (Figures 2.2.1 – 2.2.7). This was based on rehabilitation studies conducted in a highly degraded PSF in Raja Musa FR, Selangor, where *G. bancanus* showed more than 70% survival. The species was also used in planting trials in secondary PSF at Sungai Karang FR, Selangor and logged-over PSF in Pekan FR, Pahang which yielded promising results of more than 70% survival, especially trees planted using line planting technique (Ismail *et al.* 2006).

Studies were also conducted to investigate the germination rate and vegetative propagation of *G. bancanus*. Shamsudin (1999), and Ismail and Shamsudin (2003) reported on a germination rate of *G. bancanus* at about 63 and 95%, respectively. The *G. bancanus* can be propagated via vegetative propagation with rooting ability of more than 50% (Mohamad Lokmal *et al.* 1993, Ismail & Shamsudin 2003) (Figure 2.2.8). A related study by Guanah (2005) using misting system recorded 75 – 93% survival and rooting percentages ranging from 65 – 80%. The species also has the potential to produce plantlets through tissue culture (Shamsudin & Aziah 1992). These findings are adequate to justify the availability of quality planting materials of *G. bancanus* for planting programme naturally or even as forest plantation. In addition, Ismail *et al.* (2007) reported that the species showed a promising growth performance in planting trials at non-peat swamp areas. Eleven-year-old planted *G. bancanus* showed survival of about 52% with dbh and total height increments of 0.9 cm year<sup>-1</sup> and 69 cm year<sup>-1</sup>, respectively (Figure 2.2.9).





Figures 2.2.1 (a-b) *Gonystylus bancanus* after three years of planting under canopy in PSF at Sungai Karang FR, Selangor. The dbh increment is about 0.9 cm year<sup>-1</sup>.



Figure 2.2.2. *Gonystylus bancanus* prefers line planting method and is not suitable for open planting as it requires partially shaded condition during the initial growth period.





Figures 2.2.3 (a-b) *Gonystylus bancanus* under canopy planting in *Macaranga*-dominated area in Pekan FR.





Figure 2.2.4 A temporary nursery near planting site to maintain vigourosity of the seedlings before planting.





a



b

Figures 2.2.5 (a-d) Raising *G. bancanus* seedlings in nursery is not difficult as it only requires normal nursery management practices in terms of preparing planting media, watering schedule, and treating pests and diseases. These seedlings were raised from seeds collected from the Pekan FR.







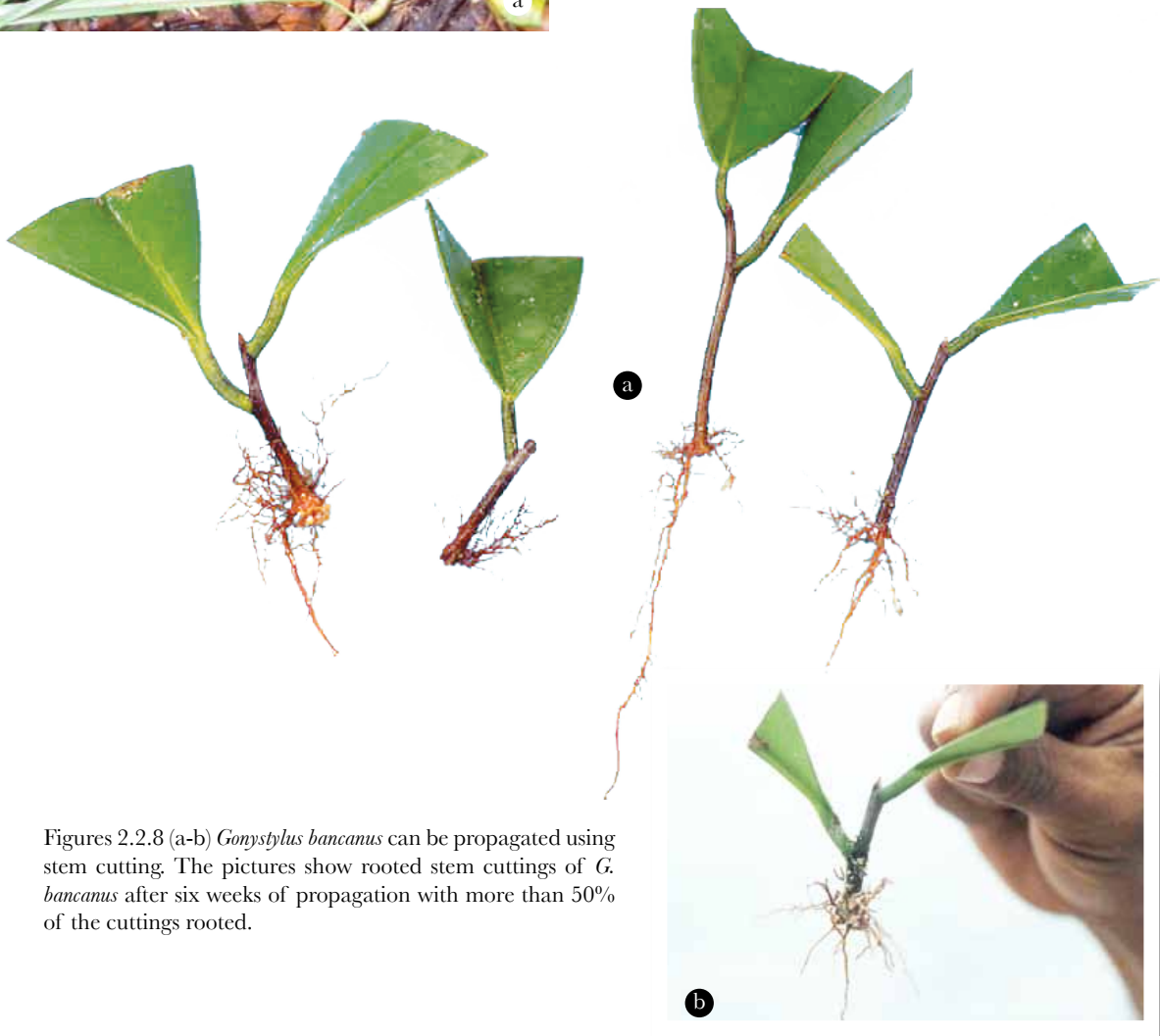


Figures 2.2.6 (a-c) *Gonystylus bancanus* seedlings naturally prefer partly shaded environment with a certain degree of soil wetness to grow.





Figures 2.2.7 (a-b) Determining seedling dynamics of *G. bancanus* at Pekan FR to investigate its population.



Figures 2.2.8 (a-b) *Gonystylus bancanus* can be propagated using stem cutting. The pictures show rooted stem cuttings of *G. bancanus* after six weeks of propagation with more than 50% of the cuttings rooted.





Figures 2.2.9 (a-b) *Gonystylus bancanus* planted in 1993 on non-PSF soil at FRIM campus.









**chapter 3**

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# Sustainable Harvesting

### 3.0 SUSTAINABLE HARVESTING

In general, harvesting in PSF is a very difficult task due to its swampy and unstable forest floor. Since the stand structure and the forest environment of the PSF is different from the dry inland forests, the harvesting system needs a modification. Zulkifli (2005), Mohd Hizamri (2006) and Ismail *et al.* (2010) had demonstrated that reduced impact logging (RIL) method could be implemented successfully in the PSF environment (Figure 3.1). It is recommended that the RIL method should be promoted and enforced in PSF harvesting. The Forestry Department of Pahang (2006) instructed that only RIL method is allowed to be used for harvesting in all forest reserves in the SEPPSF including the Pekan FR. Since 1999, more than 4,000 ha out of 50,000 ha of Pekan FR were harvested using the RIL method (UNDP/GEF 2008). Canals are not allowed in Pekan FR and logs were transported using permanent forest roads. Small logs and waste wood were used as foundation for the forest road. Sand were brought from outside of the forest reserves and placed on top of the foundation, subsequently the roads were compacted. The cost of forest roads construction was estimated at about RM100,000 km<sup>-1</sup> (Salleh *et al.* 2008). The RIL method rely on the use of Rimbaka – a mobile high lift timber harvester with an extended boom and powerful winching system for harvesting activities (Figures 3.2 - 3.6). The Rimbaka timber harvester can extend its cable up to 150 m hence minimizing the machine movement in the forests. The safe operation winching distance is 125 m. Nevertheless, for easier harvesting planning, a 100-m cable extraction is recommended in Pekan FR (Ismail *et al.* 2010).

Other than Pahang, important PSF areas in Peninsular Malaysia are located in the state of Selangor. Prior to 1999, conventional harvesting method using traxcavator with canal or railway was used in the PSF at Selangor (Figure 3.7). However, since then harvesting activities in Selangor PSF has adopted a RIL method known as ‘pre-determined skid trail’ (Jonas & Shamsudin 1999). Canal construction is prohibited and only railway is allowed. The railway is used to transport logs from the harvesting areas to a temporary log yard, after which the logs are then transported to permanent log yards by either using existing forest roads or river. The implementation of a RIL method in the PSF in Selangor is based on the outcomes of several studies conducted in the state such as those by Bernd (1997), Jonas and Shamsudin (1999) and Saharudin *et al.* (2004).



Figures 3.1 (a-c) *Gonystylus bancanus* with suitable size for harvesting in Pekan FR.





a



b



c







Figure 3.2 Rimbaka timber harvester in action. The use of Rimbaka timber harvester to extract logs in Pekan FR contributes to RIL.





Figure 3.3 The Rimbaka timber harvester minimizes its movement by pulling logs using long cable to reduce damage to the forest floor.





Figures 3.4 (a-b)  
Logs extracted using  
Rimbaka timber  
harvester at the  
logging corridor and  
temporary log yard.





Figure 3.5 Forest conditions before (left) and after (bottom) log harvesting in the PSF of Pekan FR.



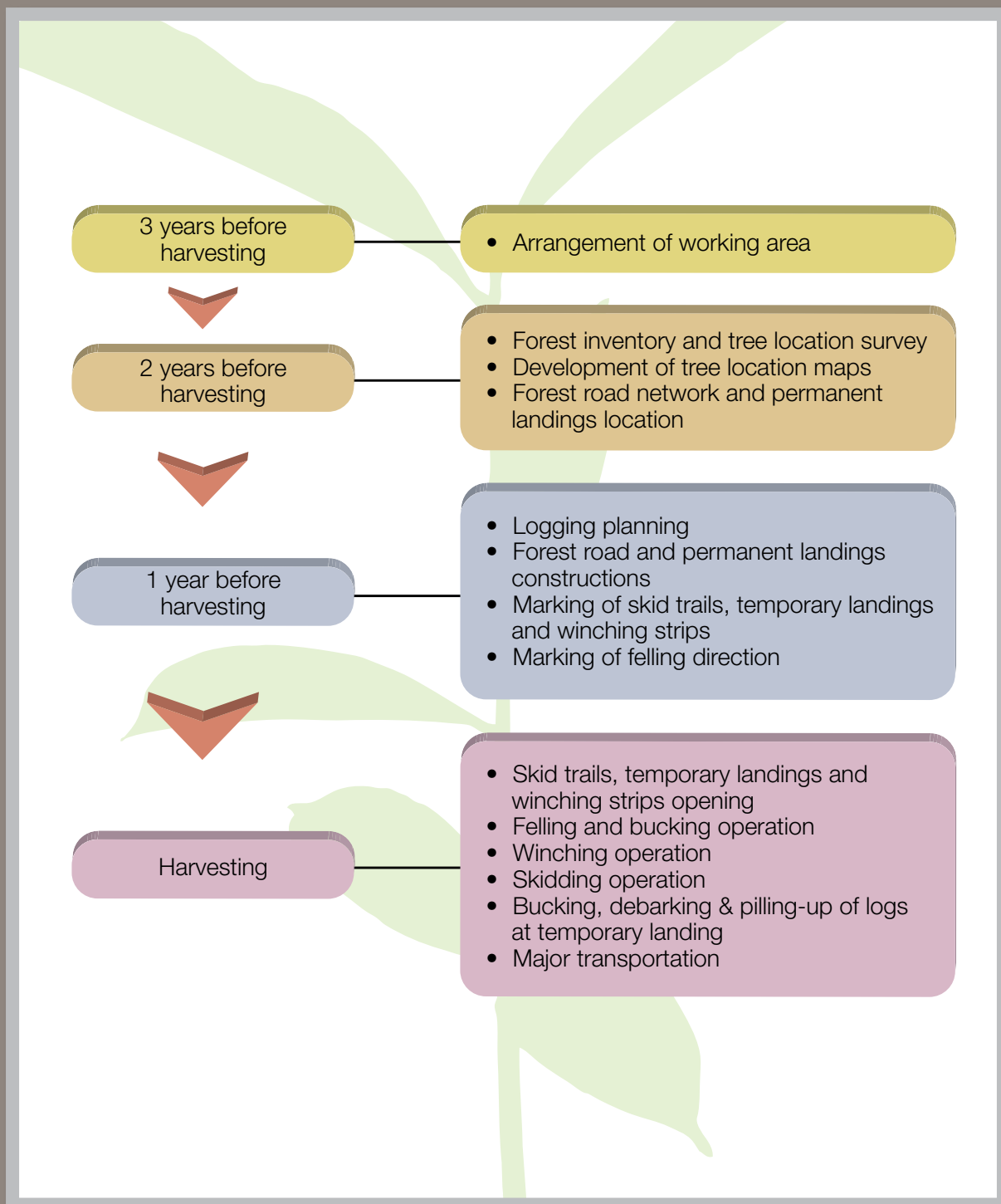


Figure 3.6 Recommended RIL guidelines for harvesting in the tropical PSFs (source: Elias & Khali 2008). Rimbaka timber harvester is used at the harvesting stage.





Figures 3.7 (a-c) Harvesting in the PSF of Selangor using modified traxcavator to extract the logs. Railway was used to transport the logs to the temporary log yard.





**chapter 4**

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# Timber Characteristics & Utilization



## CHAPTER 4.0 TIMBER CHARACTERISTICS AND UTILIZATION

*Gonystylus bancanus* is a light hardwood timber with air dry density ranging from 530–785 kg m<sup>-3</sup> at 15% moisture content. The heartwood is white to yellowish-white or creamy yellow, weathering to pale-straw-colour and not distinctly differentiated from the sapwood which is lighter in colour (Figure 4.1). The grain is straight or shallowly interlocked while the texture is moderately fine and even (Figure 4.2). The timber is moderately strong and classified under Strength Group 5. The timber is easy to work with hand tools and machines. It is easy to saw, cross-cut and plane in green and dry conditions into smooth surfaces. The timber can be easily bored but the resulting finish is rough. Mortising and shaping give good results. When nailing it tends to split and pre-boring is necessary. The wood can be stained and polished well. The timber air dries fairly slowly, without serious defects with only moderate cupping, bowing and surface checking. Staining and discoloration could be reduced by dipping in preservative solution after sawing. Without chemical treatment the timber is prone to blue stain and powder-post beetle attack (Figure 4.3). Shrinkage is moderately high, especially in the tangential direction averaging 3.4%. Schedule C or B is recommended for kiln drying but for timbers of more than 4 cm thick, schedule B is advisable. Although the timber is non-durable, it is easily treated with preservatives.



Figure 4.1 Sapwood and heartwood of a *G. bancanus* log is not distinctly differentiated.





Figure 4.2 *Gonystylus bancanus* wood is pale straw in colour.





Figure 4.3 Powder-post beetle attack on *G. bancanus* log.

Other than the colour and physical features, the timber can be identified on site from its wood anatomical structure mainly from the distribution and arrangement of vessels, rays and parenchyma. These anatomical features may be visible with the unaided eye on a clean cut surface with a very sharp pocket knife or observe through x10 magnification lens (Figure 4.4). The structure on transverse section gives the best indication of its wood identity where vessels are small, solitary, in radial pairs or 3, parenchyma aliform to confluent, winged-aliform usually thin and long, rays are fine. These features are visible with x10 lens as well as under a microscope (Figure 4.5). Other fine features are only visible under the microscope that require thin wood slices be cut with a microtome (Figure 4.6) of 20-25  $\mu\text{m}$  thickness, stained with safranin and prepared on a glass slides with the transverse, tangential and radial sections arranged next to each other on a single glass slide (Figures 4.7 to 4.10). Observed under light microscope, rays are uniseriate, sometimes with biseriate rays present (Figure 4.9), homocellular with mostly procumbent cells (Figure 4.10).



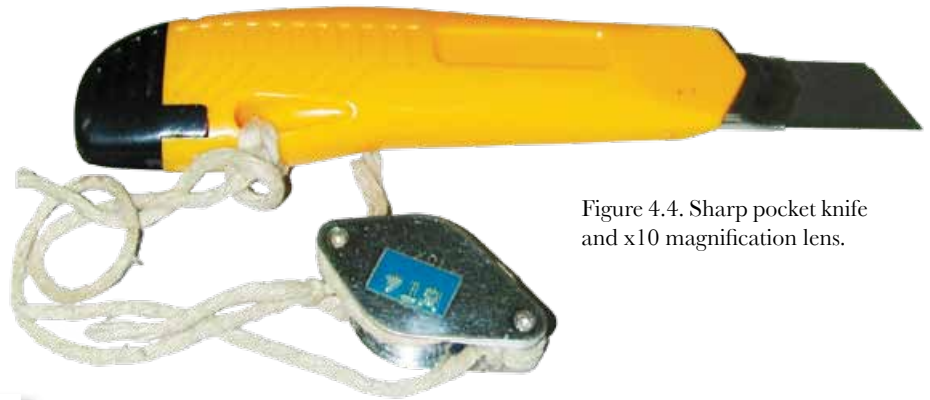


Figure 4.4. Sharp pocket knife and x10 magnification lens.



Figure 4.5. Wood slices observed under light microscope.

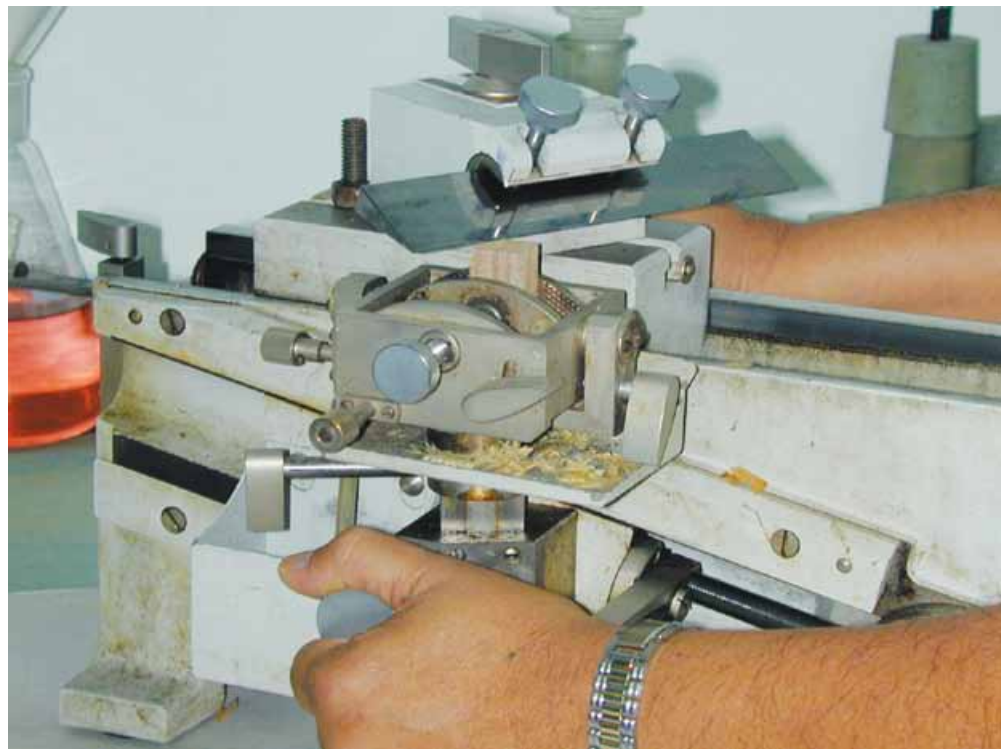


Figure 4.6. Microtome for slicing wood sample.



Figure 4.7 Glass slides with stained wood slices.



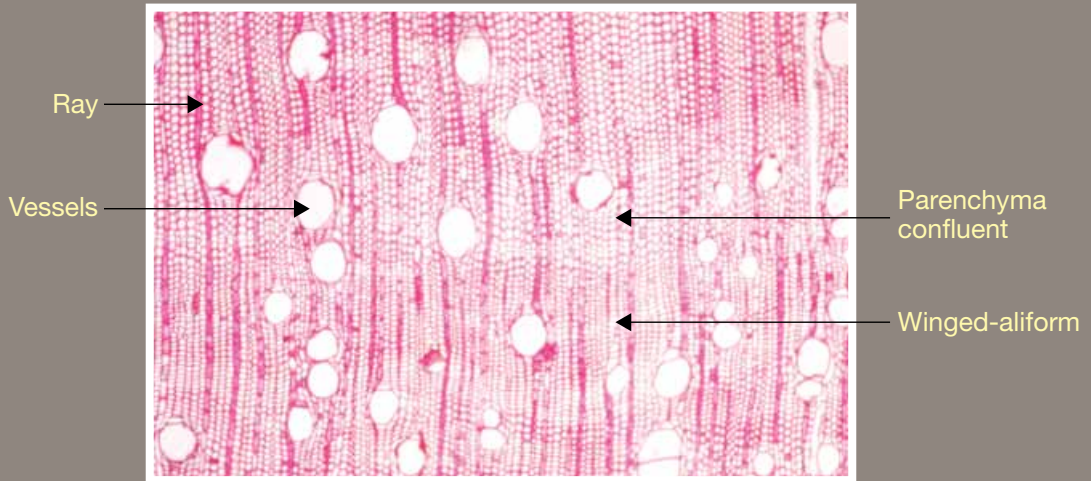


Figure 4.8 *Gonystylus bancanus* on transverse section

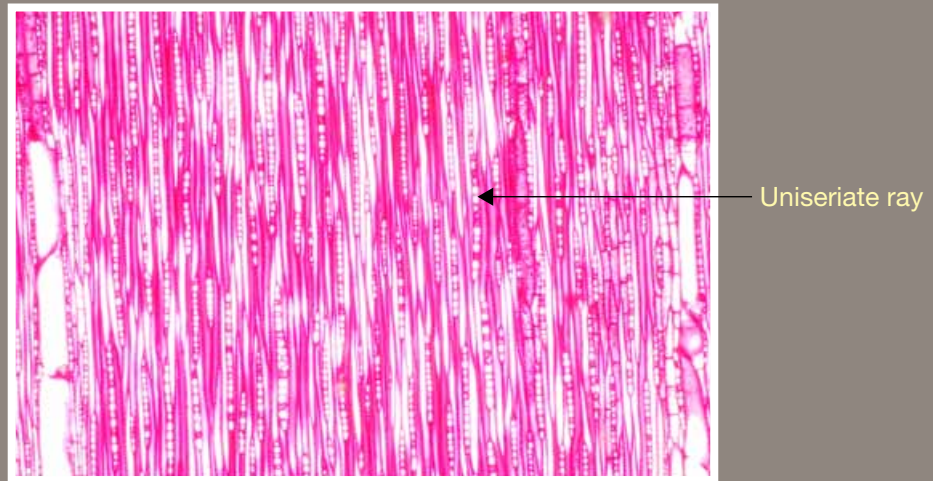


Figure 4.9 *Gonystylus bancanus* on tangential section

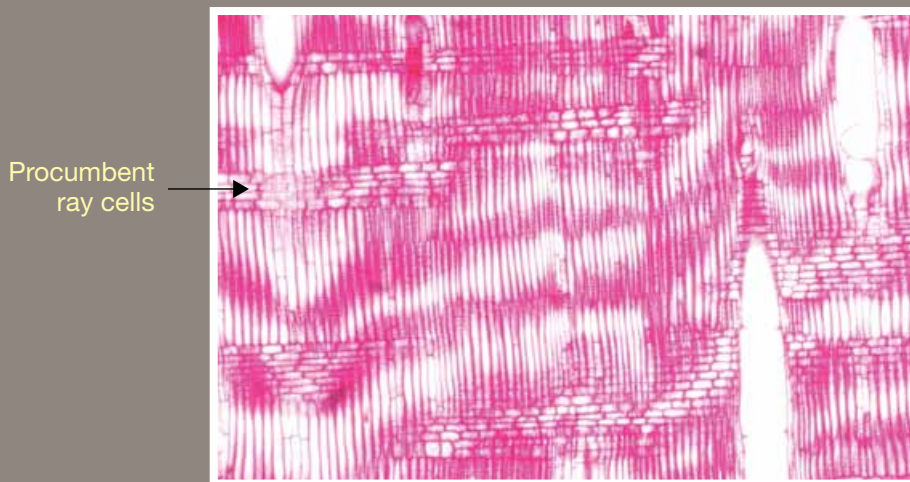


Figure 4. 10 *Gonystylus bancanus* on radial section



The timber is suitable for a wide range of applications (Figure 4.11). It is a first class joinery timber and suitable for furniture, interior decorations such as wall paneling, light flooring, rulers, drawing boards, picture frames, toys, turnery, rotary peeled plywood, veneer sheets and for light construction such as door and window frames, mouldings, skirtings, ceilings, partitions, stair treads, and counter-tops. The timber is also used for garden tool handles, clothes hangers, louver doors, snooker cues, dowels, table and kitchen ware, venetian blinds, paint brushes and doll's house furniture.

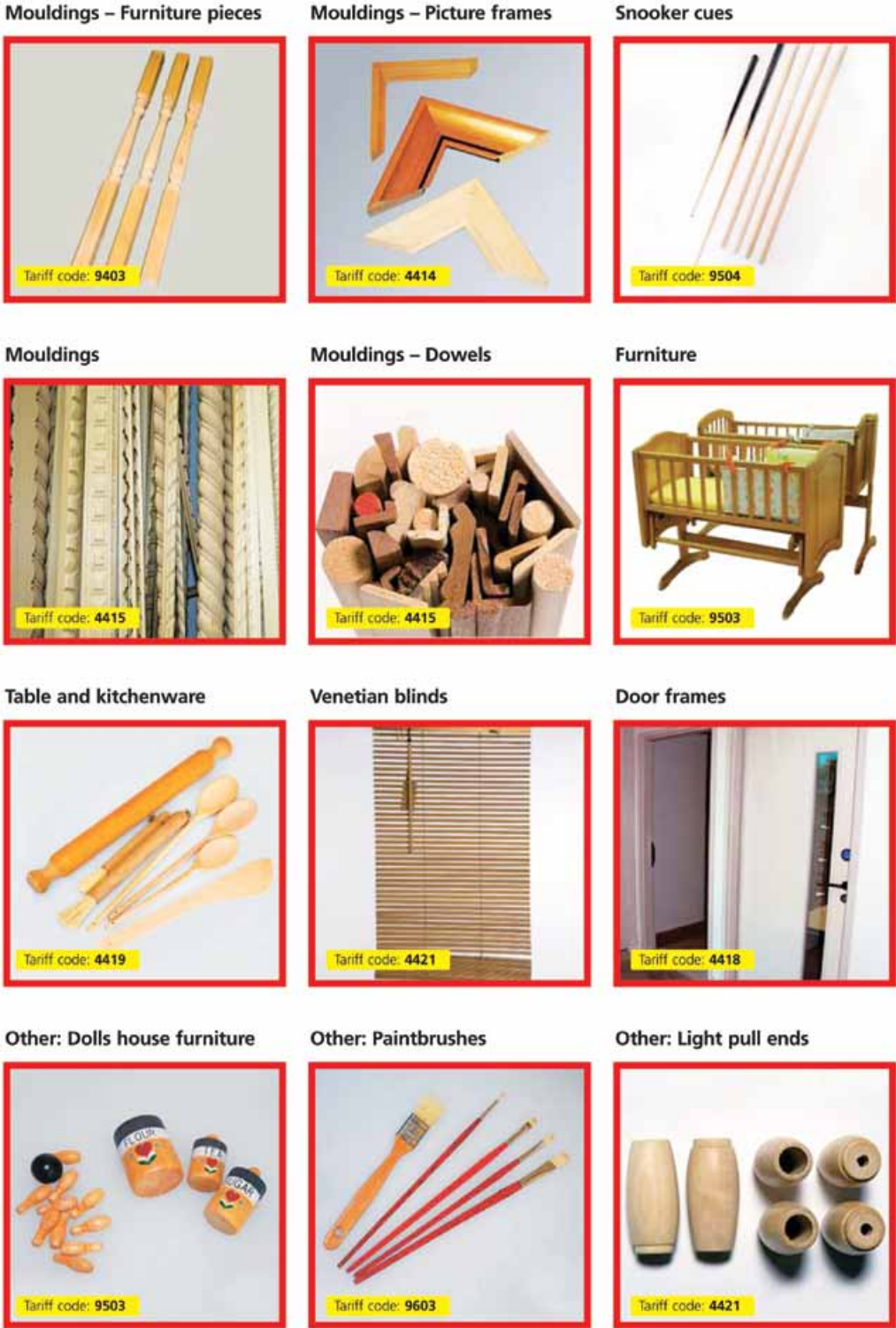


Figure 4.11 Products made from *G. bancanus* timber (source: Garrett *et al.* 2010)





**chapter 5**

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# Management & Conservation



## CHAPTER 5.0 MANAGEMENT AND CONSERVATION

The management of PSF forest reserve in Malaysia is in line with the National Forest Policy, endorsed in 1978 and revised in November 1992. The management of the forest reserve is undertaken by the state Forestry Department (FD) and complies with the *Malaysian Criteria and Indicators for Forest Management Certification* [MC&I(2002)] requirements, which was based on the Principles and Criteria of the Forest Stewardship Council (FSC). In brief, the MC&I(2002) requirements gives due recognition to the importance of environment and ecology, as well as the protection of the local community's rights.

Sound management of the *G. bancanus* habitat that is the PSF will ensure the future sustainability of the species. Since the PSF is a very fragile ecosystem, the management of this habitat requires an integrated approach which takes into consideration various ecological, environmental and socio-economic factors.

### 5.1 International Organization Involvement

Malaysian government always welcome assistance from the international organizations in providing fund to undertake studies and research in order to improve the effectiveness of managing her natural resources including the PSF. The involvement of United Nations Development Program, Global Environment Facility and FRIM (UNDP/GEF-FRIM) in ensuring the sustainable management and conservation of PSF in Malaysia is a good example. The five-year project initiated by the Government of Malaysia started in 2002 and was successfully completed in 2007. It covered three project areas namely the Klias PSF in Sabah, the Loagan Bunut PSF in Sarawak and the SEPPSF in Pahang, and proved that the PSF can be managed for both sustainable use and conservation purposes. The concept of managing this fragile ecosystem of PSF based on integrated approach was well demonstrated in this project. The UNDP/GEF-FRIM Project had successfully developed an Integrated Management Plan (IMP) for the SEPPSF taking into account the broader national development context, through the active involvement of relevant state agencies and broader consultations with stakeholders such as the local communities, private sectors and non-governmental organizations. Apart from promoting inter-agency coordination in the planning process, the project also introduced the ecosystem approach and landscape multi-disciplinary assessments to bring about better comprehension of the conservation targets and threats to the PSF sustainability (UNDP-GEF 2008). The IMP is currently being implemented by the Pahang state authority at the SEPPSF area to ensure the PSF is being managed for both conservation and timber production on a sustainable basis. The IMP among others focuses on managing the PSF area based on six management zones as shown in Figure 5.1 which include:

- **Zone 1:** Forest Reserves for timber production and ecosystem protection;
- **Zone 2:** Forest Reserve Extensions for the protection of ecosystem integrity through achieving connectivity;
- **Zone 3:** 1000 m Buffer zone for the reduction of impact of activities outside the forest reserves;
- **Zone 4:** 400 m Riverine buffer for the protection of associated wetlands;
- **Zone 5:** Degraded and logged peat lands with the potential for development; and
- **Zone 6:** Alienated and developed peat lands adjacent to PSF.



Each zone has a set of short and long term Prescriptive Actions leading towards the achievement of the agreed objectives including biodiversity conservation, maintenance of ecological integrity, and ensuring sustainable management of the forest reserves in the SEPPSF.

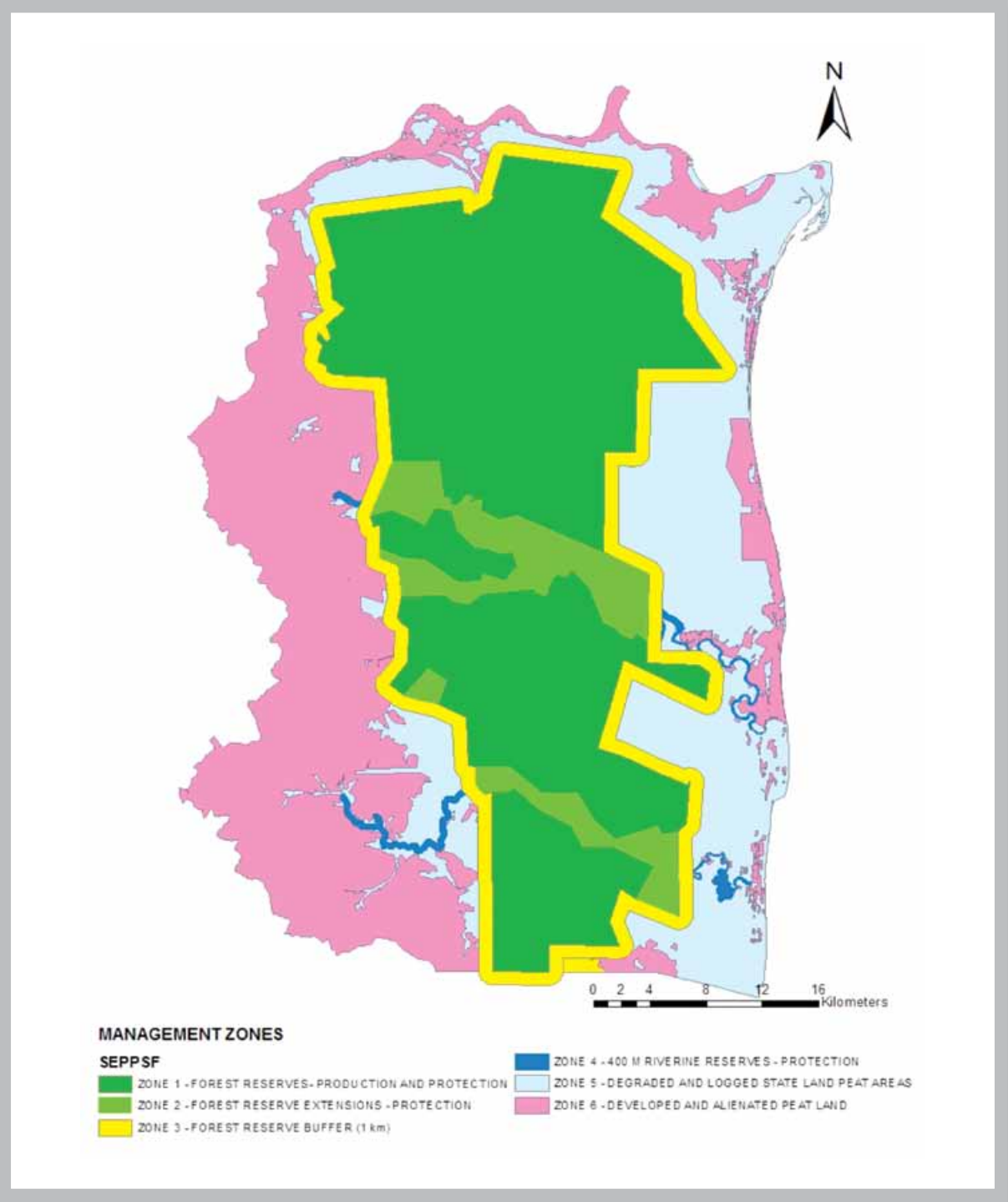


Figure 5.1 Management of SEPPSF which is the main habitat for *G. bancanus* is based on six zones as described in the Integrated Management Plan developed through multi-stakeholders consultation process.

Of recent is the multi-year collaborative Project between ITTO and CITES with financial support from the European Commission (primary donor) together with other ITTO donor countries (the U.S.A, Japan, Norway and New Zealand) with the main objective to ensure that international trade in CITES-listed timber species is consistent with their sustainable management and conservation. In Malaysia under the approved 2008 Project agreement, there are five main activities related to *Gonystylus* species studies carried out in Sarawak and Peninsular Malaysia as listed in Table 5.1.

Table 5.1 A list of ITTO-CITES Project activities undertaken in Malaysia related to the *Gonystylus* species to ensure that trade in CITES-listed timber species is consistent with their sustainable management and conservation.

Activities	Responsible agencies	Objectives
1: Non-detriment findings report on <i>Gonystylus bancanus</i> : a quantitative assessment of <i>G. bancanus</i> in two selected permanent forests of Sarawak	Sarawak Forestry Department	To collect data on the status and stocking of <i>G. bancanus</i> in the production forests of Sarawak.
2: The quantification of dry and wet inland <i>Gonystylus</i> spp. (ramin), <i>Aquilaria</i> spp. (agarwood) and <i>Intsia</i> spp. (merbau) in Peninsular Malaysia	Forestry Department Peninsular Malaysia	(i) to collect information on the distribution, status and stocking of dry and wet inland <i>Gonystylus</i> species (ramin), <i>Aquilaria</i> species (agarwood) and <i>Intsia</i> species (merbau) based on the Fourth National Forest Inventory information in Peninsular Malaysia, and  (ii) to establish ten (10) permanent sample plots (PSPs) to periodically monitor the growth, mortality and recruitment of <i>Gonystylus</i> species (ramin) in Peninsular Malaysia.
3: Generation of spatial distribution maps of <i>Gonystylus bancanus</i> (ramin) using hyperspectral technology and determination of sustainable level of harvest of ramin in production forests of Peninsular Malaysia	Forest Research Institute Malaysia (FRIM)	(i) to generate spatial distribution maps of <i>G. bancanus</i> in Peninsular Malaysia through the use of hyperspectral technology and non-spatial information in a cost-effective manner, and  (ii) to enhance conservation by determining sustainable level of harvest for <i>G. bancanus</i> in production forests of Peninsular Malaysia.



4: The development of <i>Gonystylus</i> spp. (ramin) timber monitoring system using radio frequency identification (RFID) in Peninsular Malaysia	Forestry Department Peninsular Malaysia	To develop a cost-effective ramin timber monitoring system using RFID in Peninsular Malaysia, as well as an automated detection and notification mechanism for tracing non-compliance using computerized handheld data logger with scanner in Peninsular Malaysia.
5: Developing DNA database for <i>Gonystylus bancanus</i> in Sarawak	Sarawak Forestry Department	(i) to study the genetic variation and differentiation of <i>G. bancanus</i> population in Sarawak, and  (ii) to develop a DNA database for <i>G. bancanus</i> to enhance efforts for tracing and tracking of <i>G. bancanus</i> timber

Figures 5.2 – 5.4 show the Malaysia’s Project team members accompanying the independent ITTO-CITES mid-term review team at the project site in Pekan FR, Pahang. A notable finding from the study is the development of technique to map *G. bancanus* in the PSF based on hyperspectral data acquired using remote sensing technique. The hyperspectral data acquired through airborne sensor with wide range of wavelength has the capability to provide detailed information necessary to delineate individual plant species such as *G. bancanus* (Figure 5.5). The results indicated that using hyperspectral data, it is possible to map the *G. bancanus* distribution in the PSF with an accuracy of 85%. Figure 5.5 also shows a typical *G. bancanus* spectral signature graph as detected using handheld spectroradiometer equipment. A sample of *G. bancanus* distribution map is shown in Figure 5.6. Hence by using this technique, it is possible to map *G. bancanus* population in the PSF. It is anticipated that with the hyperspectral technology, the management and conservation of *G. bancanus* population in the PSF can be made more effective.





Figure 5.2 The Project mid-term review team members visited the ITTO-CITES FRIM *G. bancanus* project site at PSF in Pekan FR, Pahang Malaysia.

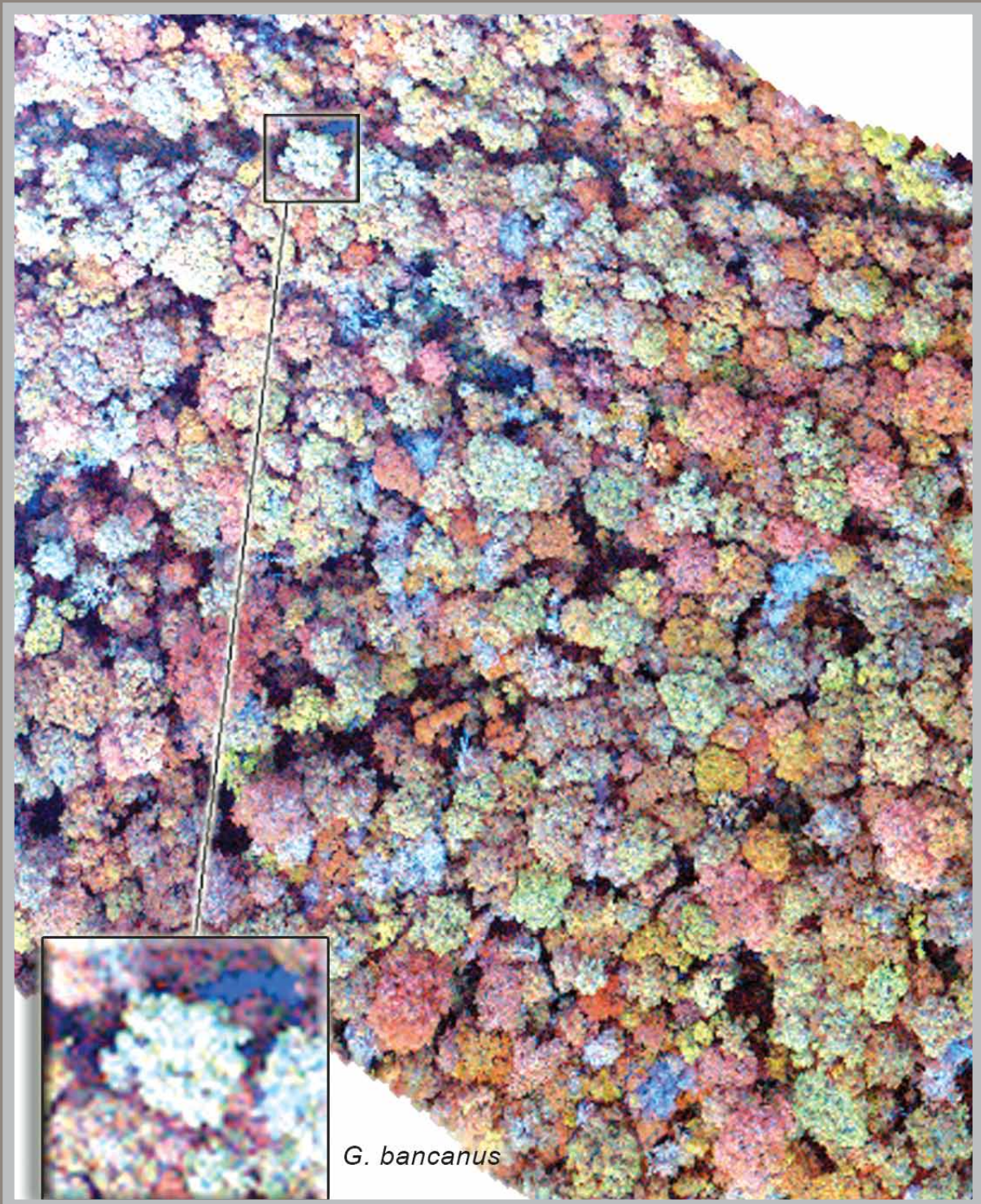




Figure 5.3 The Project team members showing the independent mid-term review team of the ITTO-CITES Project a *G. bancanus* population in the Pekan PSF.



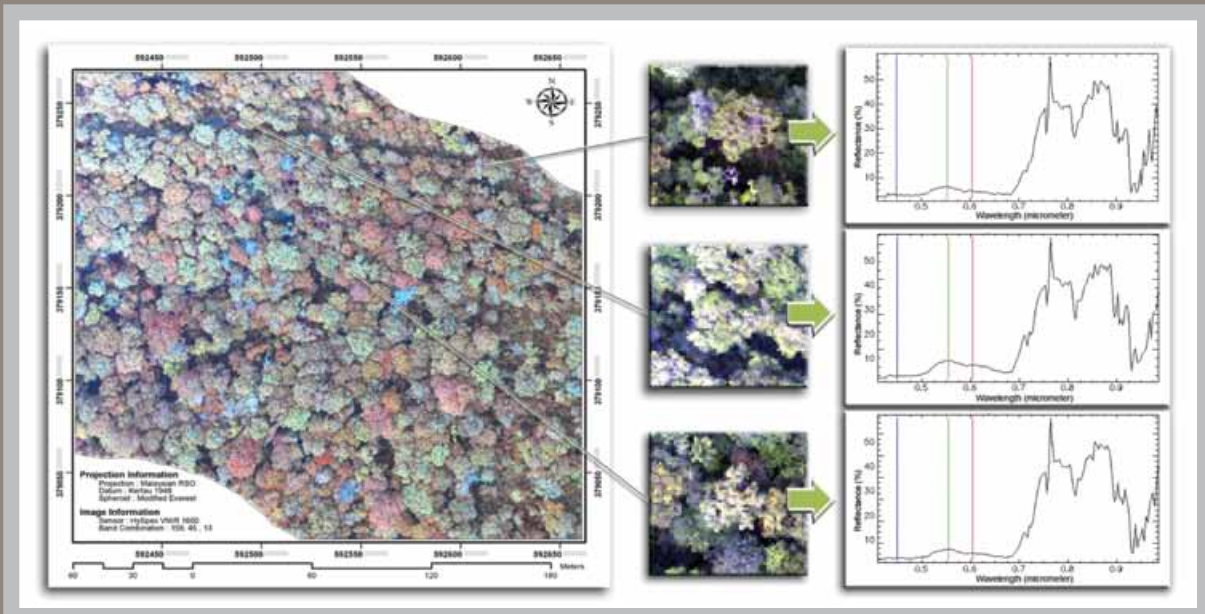
Figure 5.4 The Project team members together with the ITTO-CITES mid-term review team at the edge of the Pekan PSF.



a

Figures 5.5 (a-b) *Gonystylus bancanus* trees as seen in the airborne-hyperspectral image over Pekan FR. The species exhibits distinct spectral signature which can be used to differentiate and map the species in the PSE.





b

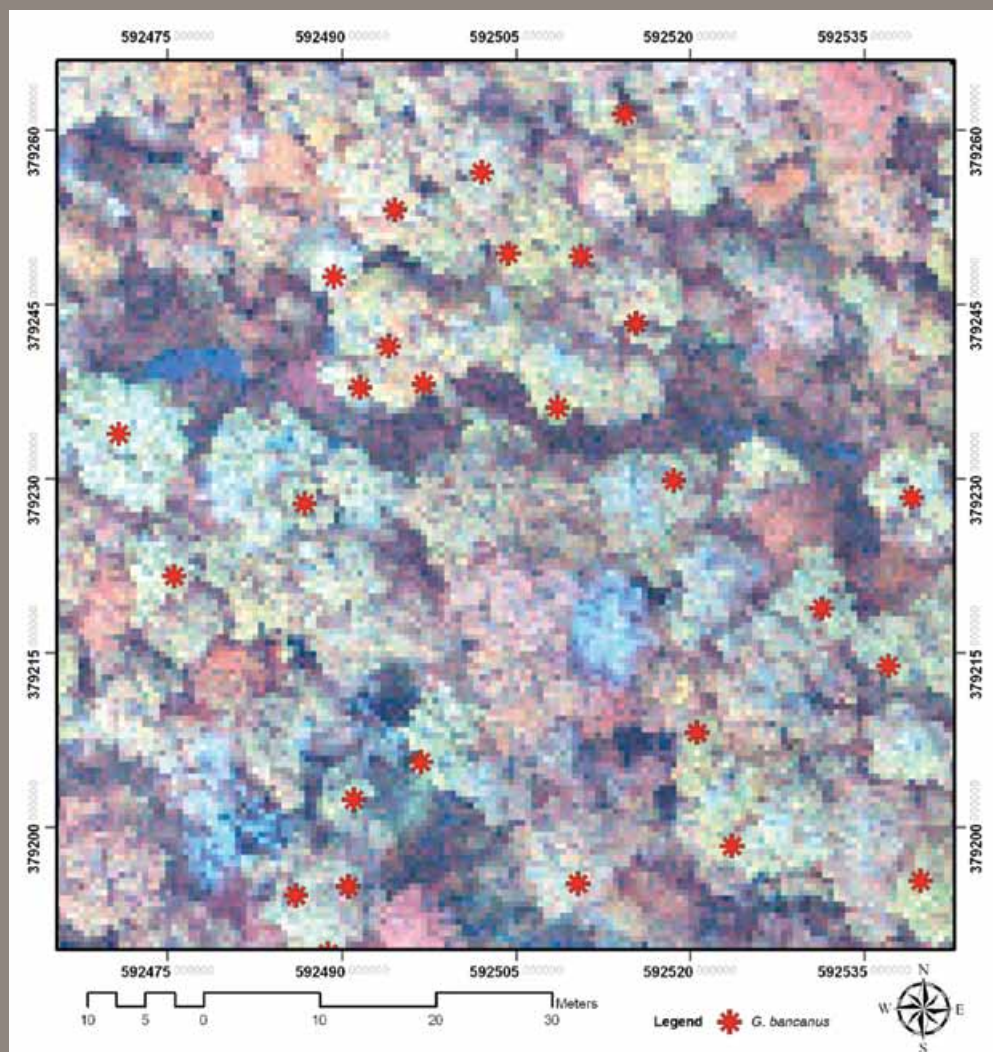


Figure 5.6 The distribution of *G. bancanus* population (red markings) in the PSF captured using airborne hyperspectral image.





The Forestry Department Peninsular Malaysia undertakes a study on the development of *Gonystylus* species (ramin) timber monitoring system using radio frequency identification (RFID) in Peninsular Malaysia. The study focuses on the used of latest technology to develop a cost-effective *G. bancanus* timber monitoring system using RFID in Peninsular Malaysia, as well as an automated detection and notification mechanism for tracing non-compliance using computerized handheld data logger with scanner. Figure 5.7 shows the tag and equipment used for tagging and storing of *G. bancanus* information under the RFID technique.



Figures 5.7 (a-b) Tag and equipment used for tagging and storing of *G. bancanus* information using the RFID technique.



## 5.2 Species conservation

As part of a conservation strategy, information about the identities, characteristics and requirements of plants and the places where they were found (ecosystems) need to be properly recorded and kept in a herbarium. A herbarium is a collection of dried, pressed, and preserved plants mounted on paper sheets, properly labeled, systematically arranged and available for reference or study. For conservation and educational purposes, a set of *G. bancanus* plant specimen was collected and systematically kept in FRIM herbarium (Figure 5.8). The specimen was properly recorded indicating among others the collector's name, date of collection and the locality (Figure 5.9).



Figure 5.8 A sample of *G. bancanus* voucher specimen collected and kept in FRIM herbarium as a record for conservation and educational purposes.



## FLORA OF PEAT SWAMP, PAHANG

Collection No : N-66

Collectors : Shamsul Khamis *et al.*

Date : 12 November 2005

Det : Shamsul Khamis

Family : THYMELAEACEAE

Species : *Gonystylus bancanus* (Miq.) Kurz

Vernacular Name : Ramin melawis

Locality : Nenasi Forest Reserve, Pekan-Pahang

Habitat : Peat Swamp

### Notes:

- Tree to 27 m tall, sometimes even bigger
- Usually found in lowland peat swamp forests

Figure 5.9 Detail information recorded and kept in the herbarium together with the *G. bancanus* voucher specimen for identification purposes.

The practice of *in-situ* conservation of *G. bancanus* is important in order to ensure its sustainability in the PSF even after the forest has been selectively logged. It is also important to plant *G. bancanus* seedlings in degraded areas after logging such as along the loggings trail as had been practiced in the Pekan PSF (Figure 5.10). The seedlings were planted in 2002 and after almost eight years the trees grow to about four meters in height.





Figure 5.10 An eight-year-old *G. bancanus* along an old logging road in Pekan PSF. The planted tree grows healthily and indicates that it is possible to practice *in-situ* conservation of this species in logged-over PSF.



*Ex-situ* conservation can be practiced by planting the *G. bancanus* trees outside of their normal habitat. FRIM has successfully planted *G. bancanus* on non-peat soil in 1993. The stand has an annual growth diameter at about 0.9 cm year<sup>-1</sup> (Figure 5.11).



Figure 5.11 17-year-old healthy *G. bancanus* trees planted on non-peat soil in FRIM showcase a successful *ex-situ* conservation effort.







SKID TRAIL



**chapter 6**

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# Conclusion



## CHAPTER 6.0 CONCLUSION

The idea behind publishing this book is to share some of the interesting facts about *G. bancanus*. Hopefully, this book will help to raise public awareness and offer another source of information in support of efforts to ensure the long-term survival of this interesting species. It is anticipated that by knowing its ecological characteristics, distribution pattern and ecosystem requirements, the management of this species in natural PSF environment can be undertaken effectively in tandem with the sustainable management concept adopted by the Forestry Department in managing the forest resources in this country.



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## *Gonystylus bancanus* – jewel of the peat swamp forest

This book is one of the outputs of ITTO-CITES of FRIM activity. The main intention of publishing this book is to create a higher degree of public awareness on the various aspects of *Gonystylus bancanus* – a peat swamp forest species currently listed in the CITES Appendix II. *Gonystylus bancanus* or locally known as ramin melawis is not only the main species of *Gonystylus*, but also a major timber species of peat swamp forests. The species is amongst the main commercial timbers produced from the forests of Malaysia and Indonesia. Even though in general *G. bancanus* has received more attention in terms of research compared to other *Gonystylus* species, it is still insufficient. Therefore, as the most important timber species of peat swamp forests, its comprehensive information is direly needed to be used in managing and conserving the species. This pictorial book provides some important information on *G. bancanus* written in six chapters. Information on the distribution, ecological characteristics, silvicultural practices, sustainable harvesting, timber characteristic, utilization, management and conservation of the species are briefly described, coupled with relevant photographs. Information provided in this book will help to improve the management and conservation of this peat swamp forest species for the betterment of mankind.



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