

ACTIVITY REPORT

Non-detriment Findings Report on *Gonystylus bancanus* – A Quantitative Assessment of *G. bancanus* in Two Selected Permanent Forests of Sarawak

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**Non-detriment Findings Report on
Gonystylus bancanus – A Quantitative
Assessment of *G. bancanus* in Two
Selected Permanent Forests of Sarawak**

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ACTIVITY IDENTIFICATION

Activity Title	: Non-detriment Findings Report on <i>Gonystylus bancanus</i> – A Quantitative Assessment of <i>G. bancanus</i> in two selected Permanent Forests of Sarawak
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SUMMARY

An assessment on *Gonystylus bancanus* was conducted in two areas of peat swamp forests in the Permanent Forest Estate of Sarawak namely, Kayangeran Forest Reserve (FR) and Saribas Lupar Protected Forest (PF). Both sites have been logged in the early sixties. Thirty eight (38) and nine (9) transects were established in Kayangeran FR and Saribas Lupar PF respectively.

A total of 1,154 stems were recorded in the transects covering an area of 22.05 ha in Kayangeran FR and Saribas Lupar PF. However, only four trees with stem diameter at breast height (DBH) \geq 10 cm were recorded. The seedling and sapling density in Saribas Lupar PF was 144.26 and 165.25 ha⁻¹ respectively while the densities for seedlings and saplings in Kayangeran FR was 3.4 and 7.2 ha⁻¹ respectively.

About 54% of the seedlings were less than 1.3 m in height while 46% of seedlings were taller than 1.3 m but less than 1.0 cm in DBH. Saplings from the diameter group of 1.0 to 5.0 cm comprised 97% whereas 3% were from the diameter class from 5.1 to 9.9 cm. The tree stocking of *G. bancanus* in the studied areas was very low with 0.15 tree ha⁻¹ in Kayangeran FR and 0.33 tree ha⁻¹ in Saribas Lupar PF.

The mean volume for *G. bancanus* is estimated at 0.33 m³ ha⁻¹ for the two studied sites. With such low volume, harvesting of *G. bancanus* in Kayangeran FR and Saribas Lupar PF is thus not recommended.

1.0 INTRODUCTION

1.1 Peat swamp forests of Sarawak

The peat swamp forests in Sarawak are distributed along the coastline and lowland areas behind the mangrove forest (Fig. 1). They are characterized by being inundated by brackish fresh water almost year-round. Even during the dry-season of the year, June to September, the water table can be as high as the ground level. The pH of the organic peat soil material is as low as 4.0 and highly acidic. Anderson (1961) classified the peat swamp forest in Sarawak and Brunei into six distinct forest types or “Phasic Communities” (PC) which are differentiated based on the species composition and structure of the vegetation:-

PC 1: Mixed swamp forest: *Gonystylus bancanus*, *Dactylocladus stenostachys*, *Copaifera palustris*, and 4 other species of *Shorea* besides *Shorea albida*

PC 2: Alan forest: *Shorea albida*, *Gonystylus bancanus* and *Stemonurus umbellatus*.

PC 3: Alan bunga forest: *Shorea albida*.

PC 4: Padang alan forest: *Shorea albida*, *Litsea palustris*, *Parastemon spicatum*, *Combretocarpus* and *Calophyllum obliquinervium*.

PC 5: *Tristaniopsis*, *Parastemon*, *Palaquim* association.

PC 6: Padang keruntum: *Combretocarpus rotundatus* and *Dactylocladus stenostachys*.

PC 1, 2 and 3 are composed of tall and large trees with height ranging from 30-50 m. These are the most productive peat swamp forests where the State derived its timber and forest products since 1940s. PC 5 is a dense pole-like forest with low-canopy and PC 6 is open savanna woodland.

Logging in peat swamp forests (PSF) started in 1940s primarily for ramin and was an important activity in many areas in Kuching, Sri

Aman, Sarikei, Sibuan, Bintulu and Miri Divisions. The logging activities played a major role in developing many of the towns in the State particularly in the coastal region. According to the Sarawak Annual Report (Anon., 1952; FAO, 1974) Britain, Europe and Japan were the main importing countries. Although the logging activity in PSF has now been superseded by logging in the hill dipterocarp forests, it still contributes to the timber royalties for the State.

In recent years, large tracts of PSF have been developed for agricultural purposes. The acreage of PSF in Sarawak has dwindled from 1.455 million hectares (ha) in the seventies to 320,161 ha within the Permanent Forest Estate (PFE) in 2004 (Lee 2005). It is thus necessary to manage the remaining PSF in a sustainable manner and the annual harvest volume for *G. bancanus* be obtained from accurate scientific data through inventories in the production forests. This information together with the information on biological characteristics, ecology, regeneration, trade and management is necessary for the Non Detriment Finding (NDF) report.

1.2 Gonystylus bancanus

Ramin is an endemic species in the peat swamp forests in Southeast Asia region (Airy Shaw, 1954; Whitmore, 1973). The preferred scientific name for ramin is *Gonystylus bancanus* (Miq.) Kurz. Its common names are variable from region to region. In Brunei, it is known as ramin and melawis; Indonesia as ramin; Kalimantan as Merang, Gaharu buaya; Sumatera as gaharu buaya; Peninsular Malaysia as ramin; and in Sarawak it is known as ramin telur, lunak, and garu buaya. The accepted universal trade name today is ramin. *G. bancanus* is a valuable commercial timber species which is typically found in the PSF of Borneo (Sarawak, Sabah, Brunei and Kalimantan) and Peninsular Malaysia. It is a major component of forest type 3.1 in PSF in Sarawak (Anderson, 1964) but is also found in other forest types except Padang Keruntum Forest where the population is very low (Anderson, 1972). Ramin has been known to regenerate poorly in natural and logged forests but very limited

studies have been carried out to assess the biological requirement for the survival of the species (Lee, 2005).

Sarawak is an important producer of ramin in Malaysia from the 1950s to 1970s and for a long time it was the major timber extracted from the PSF for export together with *Dactylocladus stenostachys* (Jongkong). Ramin has been recognized internationally for its high quality timber for making furniture, moulding, and surface-veneer for plywood and panel products. Demand hastened the exploitation of PSF for ramin and other timber species of high commercial value. In May 1980 the ban on the export of ramin logs from Sarawak came into effect although the export of timber products processed from ramin was not affected by the order (Anon. 1980). In 2005 ramin was up-listed from Appendix III to Appendix II of CITES at the COP meeting in Bangkok for the conservation of the species.

This study only focused on the operational forests areas especially in the Phasic Community 1 where *G. bancanus* is dominant.

1.3 Specific objective

To collect data on the status and stocking of *G. bancanus* in the production forests of Sarawak

Output 1.1: Status and stocking of *G. bancanus*

Output 1.2: Sustainable harvest quota of *G. bancanus*

2.0 METHODOLOGY

2.1 Study sites

The selection of the studied sites is based on the following criteria: the areas must be in Permanent Forest Estate of Sarawak with occurrence of *G. bancanus* in the peat swamp forests; the sites must be geographically separated; and the peat swamp forests should not be too fragmented. The location of the two selected sites is as in Figure 2.

Kayangeran Forest Reserve (FR)

Kayangeran FR has an area of 3,067 ha. and is situated in the Limbang Division. The forest was first logged in the early sixties but was not silviculturally treated like the other PSF in the PFE of Sarawak. The past occurrence of fire in the north western part of the Forest Reserve in 1997 resulted in the growth of ferns notably *Stenochlaena palustris* and *Dicranopteris curranii* thereby suppressing the growth of other tree species. The Forest Reserve is accessible by road from Lawas and is flanked by Batang Lawas on the eastern side.

Saribas Lupar Protected Forest (PF)

Saribas Lupar PF has an area of 11,364 ha. and is situated in the Betong Division. The forest was first logged in the early sixties and has been treated silviculturally except in areas (mostly in forest types 3.6 and 3.7) where *Shorea albida* population exceeded more than 60% of the remnant stand. This site has very limited forest type 3.1 as most of the forest was under forest type 3.6.

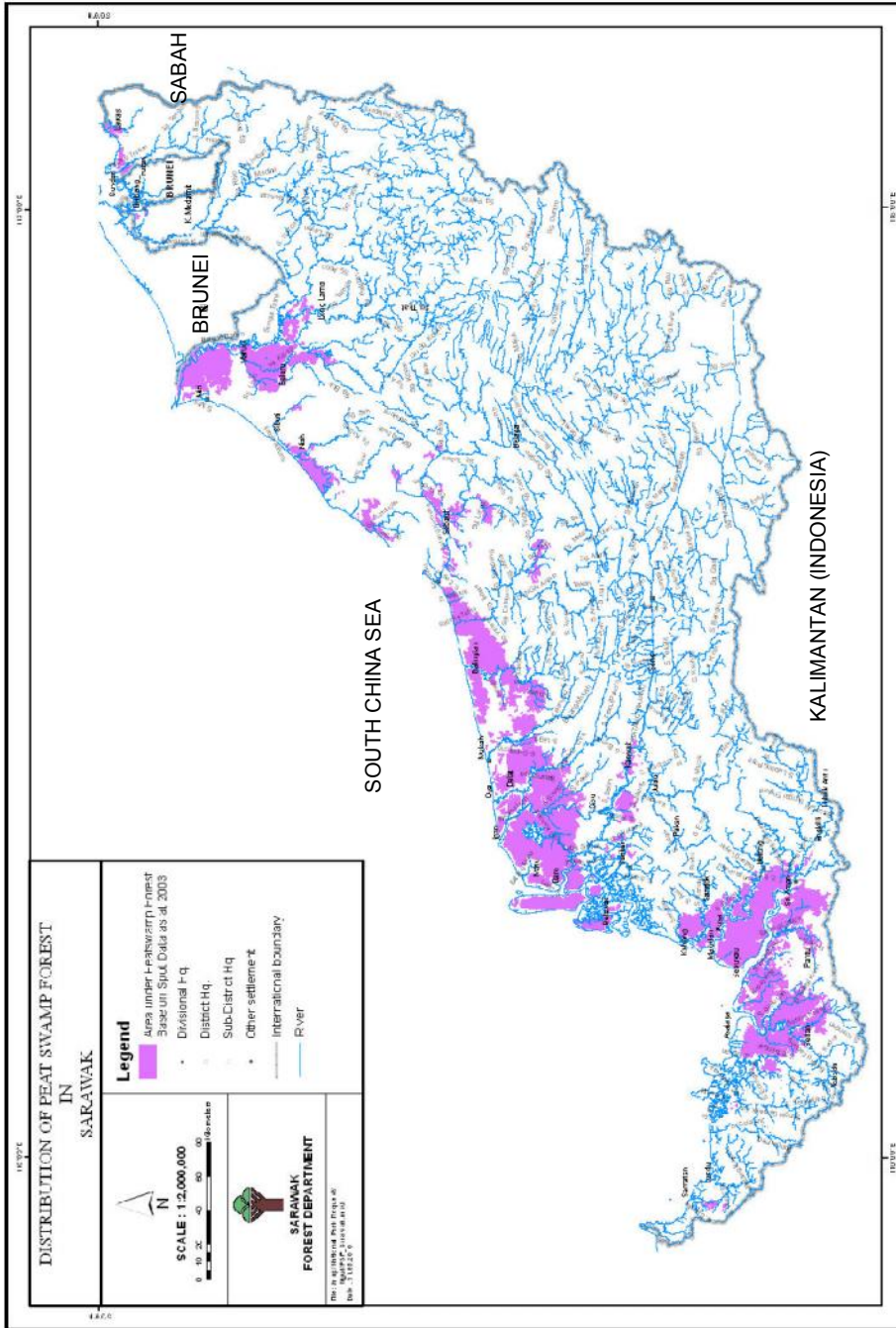


Figure 1 Distribution of the peat swamp forests in Sarawak.

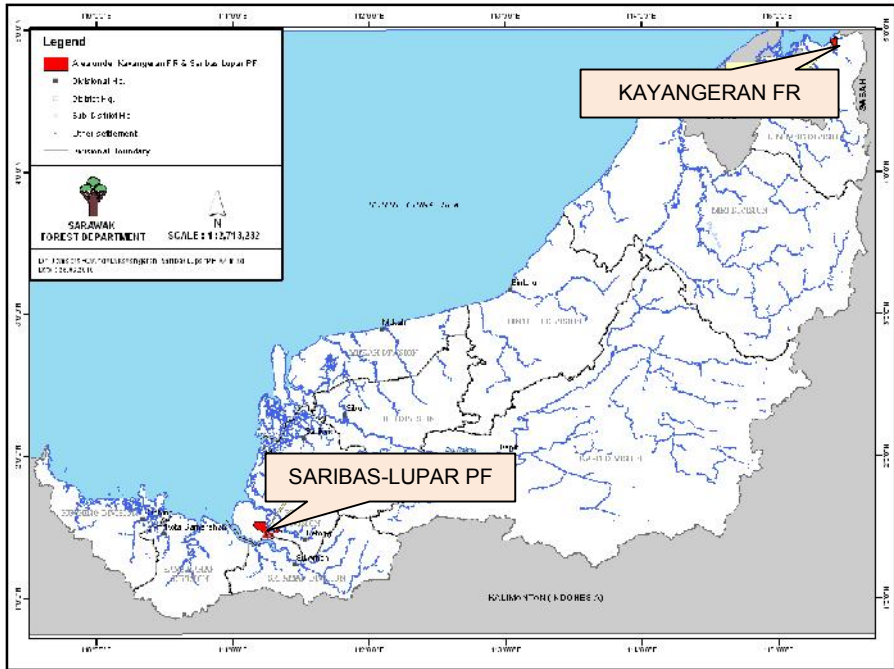


Figure 2 Location of Kayangeran Forest Reserve and Saribas Lupar Protected Forest in Sarawak.

2.2 Sampling design

The methodology used was similar to that used by the Forest Department Sarawak in carrying out the diagnostic sampling, and the establishment and enumeration of sample plots in logged-over forest. The practice of linear transect samplings was followed which involved laying the base lines across the peat swamp forest and establishing randomized transects perpendicular to the base line. The location of the base lines and length of transects were predetermined in the office.

In the field, the transect would start at 20 m from the edge of the river or stream bank or immediately from existing rail lines. A sampling intensity of 1% was used due to the scant occurrence of forest type 3.1 and 3.1E in the two study sites and was calculated based only on forest type 3.1 series. Along each transect, quadrats of 10 m x 10 m were marked out. All living stems of *G. bancanus* within the quadrat were enumerated.

The stems were categorised according to the three categories:

- i) A tree - with stem diameter at breast height (DBH) ≥ 10 cm
- ii) Sapling - with DBH ≥ 1.0 cm but less than 10 cm
- iii) Seeding - height ≥ 20 cm but DBH less than 1.0 cm

A total of nine transects ranging in length from 100 to 150 m with a width of 10 m was laid out in Saribas Lupar PF and 38 transects of 500 m x 10 m were established in Kayangeran FR. The length of the transects in Saribas Lupar was not fixed due to the limited distribution of the targeted forest type. A total of 22.05 ha was sampled in the two study sites with 3.05 ha in Saribas Lupar PF and 19.0 ha in Kayangeran FR.

2.3 Measurement of parameters

The diameter at breast height (DBH) was measured for all trees, saplings and seedlings with height > 1.3 m. Other parameters recorded were:

- tree and seedling height using a Clinometer and a measuring pole respectively.
- upper stem diameter for a tree using a pentaprism
- stem identity class (SIC) to determine the condition of the tree, sapling or seedling
- crown illumination and crown form.

This is in accordance with the procedure established by Tan (2002). The field parameters were recorded in standard field cards and the field data entered into MS Excel spreadsheets.

3.0 RESULTS AND DISCUSSION

3.1 Distribution of seedlings, saplings and trees

Currently, there is no timber licensee operating in the Kayangeran Forest Reserve. A total of 38 and 9 transects were established in forest type 3.1 in Kyangeran FR and Saribas Lupar PF respectively (Table 1). Table 2 and Figure 3 below summarize the number of *G. bancanus* stems recorded from the two areas which a total record of 1,154 trees, saplings and seedlings. Eighty-two percent (82%) of the total stems was recorded from Saribas Lupar PF while the remaining 18% was from Kayangeran FR.

Table 1 Number of transects established in the study sites

Sites	Total Area (ha)	Forest type 3.1 (ha)	Number of Transects	Total Area sampled (ha)
Kayangeran FR	3,067	2,384	38	19.0
Saribas Lupar PF	11,364	208	9	3.05
Total	14,431	2,592	47	22.05

The results from Table 2 indicated that the logged-over forest in Saribas Lupar PF was better stocked with seedlings and saplings of *G. bancanus*. It recorded 3.5 times more saplings than that of Kayangeran FR while for seedlings, it has 6.7 times more than Kayangeran FR (Figure 3). Saribas Lupar PF is estimated to have 310 stems ha⁻¹ whereas Kayangeran FR would have only 11 stems ha⁻¹ of *G. bancanus*.

Table 2 Summary of *G. bancanus* stems assessed in the two selected PFE (Kayangeran FR and Saribas Lupar PF)

	Kayangeran FR				Saribas Lupar PF				Total Stems
	Sapling	Seedling	Tree	Total	Sapling	Seedling	Tree	Total	
Total	140	66	3	209	504	440	1	945	1154
% of total stems	12.1	5.7	0.3	18.1	43.7	38.1	0.1	81.9	100
ha⁻¹	7.2	3.4	0.1	10.7	165.2	144.3	0.3	309.8	-

The assessment data were grouped into trees, saplings and seedlings to determine which diameter class dominates in terms of the number of stems or frequency of occurrence in the two sites. The groupings are as shown below:-

G 1 = seedling height \geq 20 cm but less than 1.3 m (height is measured)

G 2 = seedling height is $>$ 1.3 m and DBH $<$ 1.0 cm (DBH and height measured)

G 3 = sapling between DBH 1.0 to 5.0 cm

G 4 = sapling between DBH 5.1 to 9.9 cm

G 5 = trees with DBH \geq 10.0 cm

Table 3 shows that 644 saplings were assessed from the studied areas of which 625 (96.9%) of them were in the lower diameter size (G 3) with DBH less than 5.1 cm as shown in Fig 4. In contrast, only 19 saplings (3.1%) were found with DBH from 5.1 to 9.9 cm (G 4). The distribution of the saplings is distinctly concentrated in the lower diameter range of 1.0 to 5.0 cm while a small fraction of saplings has DBH larger than 5.0 cm.

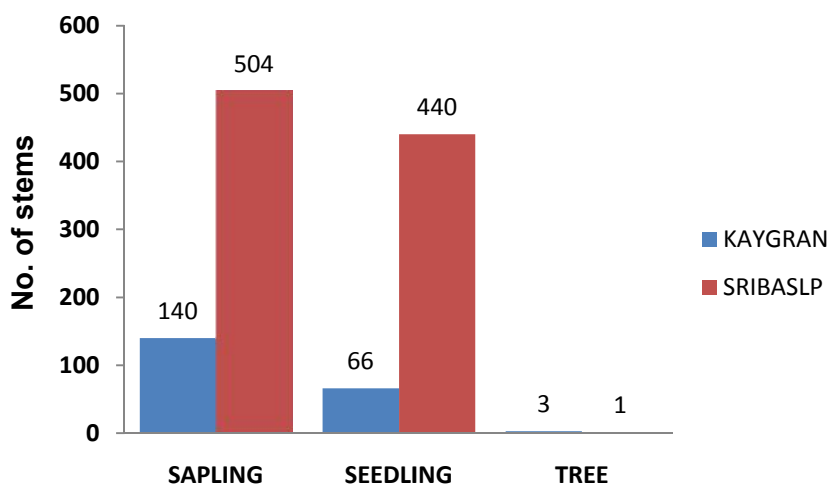


Figure 3 Number of *G. bancanus* saplings, seedlings and trees in Kayangeran FR (KAYGRAN) and Saribas Lupar PF (SRIBASLP).

From the result, it is noted that the trend of the diameter class distribution is the same for both sites. That is, saplings of the lower diameter group from 1.0 to 5.0 cm outnumbered those in the higher diameter group (5.1 to 9.9 cm).

Table 3 Summary of *G. bancanus* stems according to diameter size classes at Kayangeran FR and Saribas Lupar PF.

Locations	Kayangeran FR		Saribas Lupar PF		Total no. of stems	% of Total
	No. of stems	No. of stem/ha	No. of stems	No. of stem/ha		
SEEDLING	66	3.38	440	144.26	506	43.8
G 1: < 1.3 m ht	28	1.44	245	80.33	273	-
G 2: DBH < 1.0 cm	38	1.95	195	63.93	233	-
SAPLING	140	7.18	504	165.25	644	55.8
G 3: DBH 1.0-5.0 cm	135	6.92	490	160.66	625	-
G 4: DBH 5.1-9.9 cm	5	0.26	14	4.59	19	-
TREE	3	0.15	1	0.33	4	0.4
G 5: DBH ≥ 10.0 cm	3	0.15	1	0.33	4	-
Grand Total	209	10.72	945	309.84	1154	-
% of Grand total	18.1	-	81.9	-	-	100

For seedlings, 506 seedlings were assessed from the two studied areas. Slightly more than half of these seedlings amounting to 273 (54%) were less than 1.3 m in height (G 1), while 46% or 233 seedlings were taller than 1.3 m but less than 10 mm in DBH (G 2) (Table 3). Saribas Lupar PF has slightly greater number of seedlings in G 1 (seedling < 1.3 m in height) than in G 2 (seedling > 1.3 m in height)

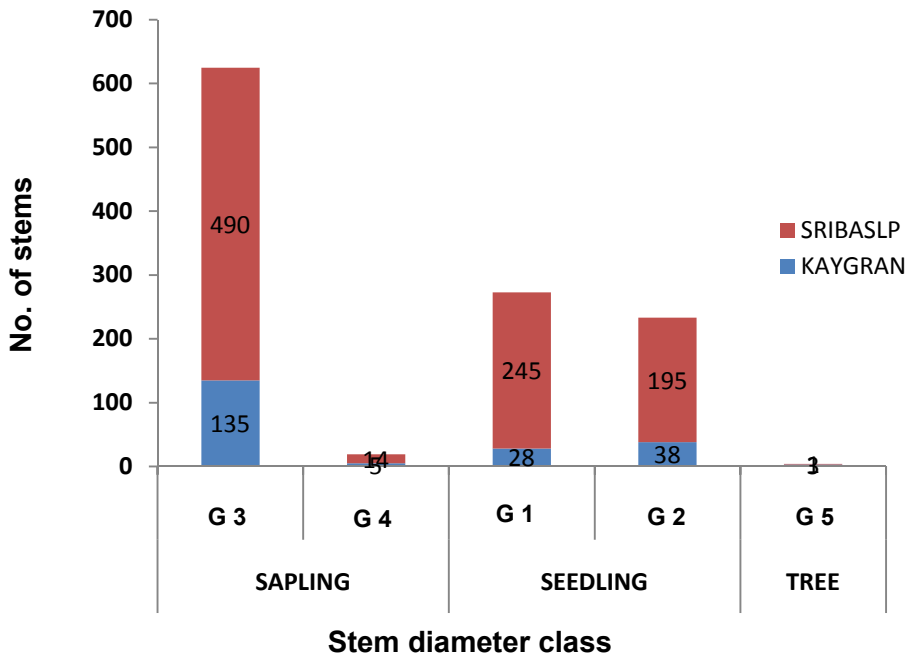


Figure 4 Number of *G. bancanus* stems according to diameter classes at Kayangan FR and Saribas Lupar PF.

3.2 Stem conditions

From the total number of stems recorded in the two sites (1,154), 649 or 56.2% of the stems were deformed, defective, fallen or broken (Table 4). These stems may be living but chances for them to recover and grow to a healthy tree are slim. Of the total, 505 stems or 43.8% were considered as healthy stems.

These stems may develop into mature trees if the environmental conditions for growth remain favourable. The ultimate survival rate of these stems whether - problematic or healthy, will need long-term monitoring and silvicultural attention in the PSF. Without them, the chances of them growing up to mature stand will not be favourable and unpredictable.

Table 4 Stems conditions for *G. bancanus* in the two sites

No.	Stems conditions	Total	% of Total
1	Tree alive standing	4	0.3
2	Sapling alive standing	225	19.5
3	Seedling alive standing	276	23.9
	Sub-total of healthy stems	505	43.8
4	Sub-total of stems fallen, deformed, defective, broken stem, broken stump, etc	649	56.2
	Total	1,154	100

3.3 Stand density of *G. bancanus*

The estimated stand densities per hectare, stocking and volume of *G. bancanus* trees are shown in Table 5. By ratio of stand densities, only one tree could be found in every 6.5 ha in Kayangeran FR while in Saribas Lupar PF, one tree occurs in every 3.05 ha. It is expected that there are 472 trees in Kayangeran FR and 3,726 trees in Saribas Lupar PF. The stocking densities for *G. bancanus* in the study sites are considered as low.

Tan (2008) reported that the occurrence of ramin trees ≥ 10.0 cm diameter was very low with one tree ha^{-1} in Sebuyau PF and Sedilu PF. In addition, Sia (2005) found that the stand density of *G. bancanus* varied from a relatively high density of 24 stems ha^{-1} at Naman FR to 1 stem ha^{-1} at Retus PF in the logged-over peat

swamp forests of Sarawak. He also noted that most localities had just 1 stem ha⁻¹ (or fewer) for the 10 – 20 cm DBH class.

Table 5 Estimated stand density (DBH>10 cm) and volume of *G. bancanus* (DBH>30 cm) for the two sites in Sarawak.

No	Sites	Total Area (ha)	No. of ramin trees assessed	Area sampled (ha)	Stocking density per ha	Estimated stocking of ramin with DBH>10 cm	Estimated volume for ramin with DBH>30 cm
1	Kayangeran FR	3,067	3	19.0	0.1538	472	98.856 m ³
2	Saribas Lupar PF	11,364	1	3.05	0.3279	3,726	780.373 m ³

The stand densities for *G. bancanus* in the peat swamp forests of Kuching, Sibul, Bintulu and Miri Divisions was reported earlier by Chai (1989) as 9.6, 6.7, 0.8 and 8.6 trees ha⁻¹ respectively during the diagnostic sampling study carried out in 1989 throughout Sarawak to determine the species compositions and the forest conditions (residual stands) after timber harvesting. These stand densities were much higher than those of Kayangeran FR and Saribas Lupar PF both of which have less than one tree ha⁻¹.

3.4 Volume calculation

There were only four trees recorded during the study with the following dimensions:

DBH (cm)	33.8	16.3	10.5	10.0
Trunk height (m)	18.3	15.0	7.0	5.3

The volume estimation is calculated based on the Smalian's formula (Smalian, 2010). The volumetric formula used in log calculation is expressed as cubic volume:

$$V = [(B+b)/2]L$$

where B = the cross-sectional area at the larger end of the log, b = the cross-sectional area at the smaller end of the log, and L = log length. The DBH (B) used for volume calculation in this study is 30 cm, upper stem diameter (b) at 10 cm (the least allowable size), and trunk height (L) is 8.0 m. The volume for *G. bancanus* is estimated at 0.628 m³ per tree.

Volume stocking in Kayangeran FR

From Table 5, it implies that 472 trees (> 10 cm DBH) are expected to be found in Kayangeran FR. Of this, one third (157 trees), is estimated to be larger than 30 cm DBH. This assumption is based on reports indicating that this species consistently lack trees of intermediate diameter size class in the logged-over peat swamp forests. The remaining two thirds are expected to take another 25 years or more to grow from 20 cm to 30 cm DBH at the rate of 0.44 cm per annum at maximum (Sia, 2005).

The estimated stand density and volume stocking for *G. bancanus* in Kayangeran FR was 98.856 m³ over an area of 3,067 ha. Such a low volume of *G. bancanus* stocking is considered uneconomical for harvesting.

Volume stocking in Saribas Lupar PF

The same criteria used in estimating the stand density and volume stocking for *G. bancanus* in Kayangeran FR were also used for Saribas Lupar PF. Of the total estimated 3,726 trees in Saribas Lupar PF (Table 5), one third (1,242 trees) is expected to be of DBH > 30 cm. This is equivalent to 780.373 m³ over an area of 11,364 ha and is considered to be low at less than 1.0 m³ ha⁻¹.

Sia (2005) found that the volume from the yield plots established in PSF of Sarawak ranged from <1 m³ ha⁻¹ in Retus PF to 30 m³ ha⁻¹ in Simunjan FR. From the current results, harvesting of *G. bancanus* should not be conducted in the two selected sites as the mean stand density for this species in these areas was below one tree ha⁻¹ and the volume estimated is less than 0.33 m³ ha⁻¹.

4.0 CONCLUSIONS

A total of 1,154 stems of *G. bancanus* were measured in 47 transects covering an area of 22.05 ha in the two selected sites. Of the total stems, only four trees were recorded. There were nearly equal numbers of saplings (644) and seedlings (505) in the transects.

In Saribas Lupar PF, the density of *G. bancanus* seedlings and saplings is 144.26 and 165.25 ha⁻¹ respectively while in Kayangeran FR it is about 3.4 and 7.2 ha⁻¹ respectively. Saribas Lupar PF is better stocked with saplings and seedlings than Kayangeran FR.

When the saplings from the two sites were grouped into diameter classes, 1.0 to 5.0 cm and 5.1 to 9.9 cm, 97.0% of the total saplings were found in the lower diameter group of 1.0 to 5.0 cm. Less than 3% of the total saplings was in the diameter size from 5.1 to 9.9 cm.

Analysis of the stem conditions indicated that 56.2% of the total stems measured had defects of some kind. It is unlikely that these would grow to become mature trees. The other 43.8% of the stems was considered healthy. As more than half of these stems will not survive to mature trees, efforts on silvicultural treatment and reforestation in the logged-over PSF with *G. bancanus* should be carried out.

The stocking of *G. bancanus* trees in the study areas was very low with 0.15 tree ha⁻¹ and 0.33 ha⁻¹ in Kayangeran FR and Saribas Lupar PF respectively. The total estimated stand in Kayangeran FR was 472 trees and Saribas Lupar PF with 3,726 trees.

The total stocking for stems with DBH \geq 30 cm at Kayangeran FR would yield about 98 m³ and Saribas Lupar PF about 780 m³. With the mean stand density for *G. bancanus* at less than one tree ha⁻¹ and the volume estimated at 0.33 m³ ha⁻¹, the two selected areas are thus not suitable for harvesting of *G. bancanus*.

5.0 RECOMMENDATIONS

The findings from the two sites also showed a low occurrence of *G. bancanus* particularly for Kayangeran FR which could be related to the past logging intensity and the underlying ecological and environmental factors. It is recommended that a more intensive assessment be conducted in both sites to obtain a better understanding of the stocking and volume of this species.

The current data obtained from the two areas in Sarawak is not sufficient to determine the sustainable harvest quota for *G. bancanus* in these areas. It is proposed that a more comprehensive assessment on *G. bancanus* be carried out in other PSF in the PFE. Enrichment planting of *G. bancanus* in some areas with sparse population of this species is recommended so that these would grow to mature trees for harvesting in the future.

6.0 IMPLICATIONS FOR PRACTICE

Both areas have abundance of young seedlings and small saplings compared to trees, indicating good regeneration. However with a mean annual increment of 0.44 cm y^{-1} for *G. bancanus* and only one tree of $\text{DBH} \geq 30.0 \text{ cm}$ being recorded, harvesting in Kayangeran FR and Saribas Lupar PF should be suspended until the forest recovers with more mature trees of appropriate sizes. Additionally, logging practices in the PSF should be reviewed to ensure that sustainable harvesting is practised and that sufficient mother trees of *G. bancanus* remain in the logged-over PSF to perpetuate the species. Areas that are not suitable economically for harvesting could be converted to conservation areas for *G. bancanus*.

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ANNEXES

ANNEX I. Number of saplings, seedlings and trees (*G. bancanus*) in each transect at Kayangeran FR and Saribas Lupar PF

Transect No.	KAYANGERAN FR				SARIBAS LUPAR PF				Total No. Of Stems
	Sapling	Seedling	Tree	Total	Sapling	Seedling	Tree	Total	
1F					79	31		110	110
1G					31	37		68	68
2F					10	6		16	16
2G					159	149		308	308
3F					8	2		10	10
3G					148	204		352	352
4F					2	1		3	3
5F					2	3		5	5
P1					65	7	1	73	73
T1	5	1		6					6
T11	5			5					5
T12	5	1		6					6
T13	5			5					5
T14	15	10		25					25
T15	9	5		14					14
T16	47	35	2	84					84
T17	10	5		15					15
T18	1	3		4					4
T19		1		1					1
T2		1		1					1
T20	12			12					12
T24	3			3					3
T25	1			1					1
T28	1			1					1
T3	3			3					3
T4	1		1	2					2
T6	4			4					4
T6R	12	4		16					16
T8	1			1					1
Total	140	66	3	209	504	440	1	945	1154

Note: Transects with no record are excluded

ANNEX II. Photographs



Peat swamp forest at Kayangeran Forest Reserve



Gonystylus bancanus seedling



Peat swamp forest at Saribas Lupar Protected Forest



Establishment of transect



Measurement of diameter breast height