GROWING STOCK, DISTRIBUTION, AND CONSERVATION OF RAMIN IN INDONESIA

TECHNICAL REPORT NO. 01

ITTO PPD 87/03 REV. 2 (F)

IDENTIFICATION OF *GONYSTYLUS* SPP. (RAMIN) POTENCY, DISTRIBUTION, CONSERVATION AND PLANTATION BARRIER

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Photo by Study Team and National Expert

PREFACE

Data and information on growing stock, distribution and conservation of ramin have been collected from five provinces in Indonesia: Riau, Jambi, South Sumatera, Central Kalimantan, an West Kalimantan. The printed and unprinted materials were collected from various sources, such as provincial and district forest services, forest concessionaires, and Ministry of Forestry. Additional data and information were also collected through literature search from universities, NGO and other research institution.

Based on the existing data and information, status of ramin growing stock, distribution and conservation are summarized as below:

(1) Ramin habitats have been severely degraded. Initial area of peat swamp forest in five provinces (Riau, Jambi, South Sumatera, West Kalimantan, and Central Kalimantan) was approximately 12,526,000 ha (in 1983), recent satellite image interpretation showed the extent of peat swamp forest reduced to only 6,716,000 ha or 53,6 % from earlier area.

(2) Total growing stock of ramin in five propinces, assuming potential area for ramin remains 80%, and illegal logging 10 %, is estimated to 14,757,221 m^3 or 11,3 % from initial growing stock (as 1983), Habitat degradation reached 46,4 % from total area of 1983.

(3) Some studies showed that ramin seedling in primary forest was quite abundance, varied from 166 - 4,000 seedling per hectare, and less abundant for saplings that varied from only 20-217 sapling per hectare. In log over areas the figure varied from 0 - 4,000 seedling per ha and 0-480 sapling per hectare. In natural condition, the density of pole stage is usuallly lower than that of trees. Ramin at pole stage have been harvested for many purposes.

(4) Forest concession have significant role in ramin corservation. This includes the application of silvicultural system, the establishment of conservation area for plant and wildlife conservation, and the establishment of ramin plantation in enrichment planting program.

(5) Conservation efforts to save ramin have been done through the addition of conservation areas, the buffer zone, forest fire prevention, the research trials related to artificial regeneration of ramin. Other important efforts include combating illegal logging and illegal trading of ramin.

The above data, especially on existing growing stocks still need further verification and careful examination.

The project thanks to Dr. Tukirin Partomihardjo, Senior scienties of National Institute of Science (LIPI), Dr. Tonny Soehartono (Directorate General of Forestry Planning), Dr. Samedi (CITES Management Authority, Ministry of Forestry), Dr. Irawati (CITES Scientific Authority, National Institute of Science, LIPI) and Dr. Kade Sidiyasa, senior researchers of the Loka Litbang Satwa Primata FORDA who have given comments and suggestions to improve the content of the Technical Report and also to Dr. Ismayadi (senior researcher of FORDA) who has proof read this Technical Report. Contributions from other whose name are not mentioned are also greatly appreciated

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ABSTRACT

Ramin is a trade name of tropical wood and trees belonging to genus Gonystylus family of Thymelaeaceae. The number of species within the genus Gonystylus is about 19-28 species. In Indonesia, five provinces namely Riau, Jambi, South Sumatera, Central Kalimantan and West Kalimantan are known as ramin main producers.

Ramin is value commercial wood it is used for furniture, interior decoration, stick, frames, dowels and other products. Because of its high quality of wood, the demand of this species has increased. Over-exploitation of ramin has been occuring, the demand is far beyond its growth and regeneration, and has threatened the sustainability of this species. The sustainability of ramin is under threat also due to silviculture of the species that has not been totally known. Currently, illegal harvesting also main causes of the destruction of ramin population. Other major threat to ramin forest is forest degradation. Much of the peat swamp forest area has been subject to degradation caused by conversion to other uses and forest fires. The rate of deforestation ranges from 700,000 to 1,200,000 ha per year.

To conserve this species In Indonesia, logging ban was imposed in 2001. After 2001, in order to control trade by only concessionaires that holding certificate of Sustainable Forest Management, harvesting and exporting of ramin are based on annual harvest quota set by Goverment of Indonesia. Concerned with the considerable decline in the Indonesian population of ramin, Indonesia included Gonystylus spp. In Appendix III of CITES in April 2001. Furthermore, in October 2004, Indonesia proposal for up-listing ramin into Appendix II of CITES was accepted at the 13th Convention of Parties (COP) in Bangkok.

Results of this study show that in nature, population of ramin in influenced by peat depth. Range of density and volume of ramin in every province varies depending on habitat, extent of surveyed area and year of observation. Ramin with diameter of 20 - 30 cm in five provinces varies from 0.02 - 5.08 trees/ha with volume of 0.08 - 10.48 m^3/ha, or average of 4.3 trees/ha with volume of 5.3 m^3/ha. Volume of ramin to total volume of all species (diameter 40 cm >) the highest was 12.41%. After harvesting of all trees with diameter > 40 cm, remaining stands of ramin, the highest was 68 % with volume 47.26 % of initial potency in primary forest.

There has been ramin habitat degradation. From initial area of peat swamp forest in five provinces (Riau, Jambi, South Sumatera, West and Central Kalimantan) that covered12,526,000 ha (in 1983), currently the extent of peat swamp forest is 6,716,000 ha or 53.6 % from total area extent in 1983.

Ramin forest is under management of conservation areas and forest concessions. Forest concessions that manage ramin on production forests have been applying silviculture system of Indonesian Selective Cutting and Planting (TPTI). Ramin management in forest concession has caused low regeneration of ramin in nature. The number of trees have been reduced up to 70 %, poles have been harvested for many purposes and lack of seedlings due to low survival rate on open areas.

Estimation to total growing stock with assumptions that potential area for ramin 80% and illegal logging 10%, five provinces is estimated for 14,757,221 m^3 or 6.8% from growing stock in 1983. Habitat degradation reached 46,4 % from total area in 1983. 31.1 % of ramin habitat is on conservation areas, with potency 27.1 % of all estimated ramin potency.

Reduction in ramin population is caused by high demand in ramin trade. Trade data show inconsistency figures. Difference in export and production figures might be caused by illegal logging and illegal trade. To overcome illegal trade issue and for conservation of ramin, Indonesia has made effort to include ramin trade through CITES. Moratorium of ramin harvesting has been applied since 2001, and only one forest concession (PT. Diamond Raya Timber) has been provided ramin production permit through application of sustainable forest management.

Some forest concessions that have ramin potency after moratorium are assumed to conserve ramin standing stock. However, due to technical issues, some forest concessions with time extension permit, have stopped their operation. This condition has led to increasing number and intensity of illegal logging, because no more control for the area and infrastructure belong to forest concession is still available to make easy illegal logging.

Other potential threat to sustainability of ramin habitat is forest fire. Fires have caused considerable losses not only to ramin population but also to general ecosystem of peat swamp forest.

Conservation efforts to conserve ramin have been done through the increase in conservation areas including management of buffer zone and forest fire prevention and control, application of some regulation, research and studies related to artificial regeneration of ramin such as through nursery raised seedlings, cutting, seedlings from wild and even by tissue culture research. Other important effort is also combating illegal logging and illegal trading through coordination with related institutions, NGO and active participation in CITES discussion.

To determine the best action for sustainability of ramin in the future, it is important to identify current condition of ramin, especially in five provinces, regarding its potency, distribution and conservation, as the objective of this ITTO funded activity. This study mainly collected secondary data to achieve output 1.1. Complete Data on Ramin Potency and Conservation Status. Results of this study show that although some conservation efforts have been done, there have been ramin habitat degradation and reduction of ramin potency, mainly due to forest conversion. illegal logging and trade, in-appropriate system of forest concession and forest fires.

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ABBREVIATIONS

AAC	Annual Allowable Cut
BKSDA	Natural Resources Conservation Institute
BPS	National Bureau of Statistics
CITES	Convention on International Trade of Endangered Species of Wild Flora and Fauna
DRT	Diamond Raya Timber
FNCRDC	Forest and Nature Conservation Research and Development Center
FORDA	Forestry Research and Development Agency
HPH	Forest Concession
IPB	Bogor Agricultural University
IPK	Log Utilization Permit (Logging Permit)
ITTO	International Tropical Timber Organization
IUCN	International Union Conservation of the Nature and Natural Resources
KPPN	Germ-Plasm Conservation Area
LGC	Land Grant College
LHC	Cruising Report Results
LIPI	Indonesian Sciences Authority
NGO	Non Government Organization
PHPA	Forest Protection and Natural Conservation
Prosea	Plant Resources of South East Asia
PT	Limited Company
RKL	Five Yearly Working Plan
RKT	Annual Working Plan
SPHAL	Certificate on Sustainable Natural Forest Management
TPTI	*Indonesian Selective Cutting and Planting*

I. INTRODUCTION

Ramin is a trade name of tropical wood or trees belonging to genus *Gonystylus* family of Thymeleaceae. The number of species within the genus *Gonystylus* is about 30 species. Fifteen species of *Gonystylus* spp. are listed under the world list of threatened species based on the IUCN Category (2000), in which *Gonystylus* spp. are classified as vulnerable species.

Gonystylus spp. has a wide range botanical distribution, extending from the Malay Peninsula, Indonesia (except East Java and the Lesser Sunda Islands), the Philippines and Papua New Guinea and eastward to some of the Pacific Islands, such as Solomon Islands, Vanuatu, Fiji and to the west of the Nicobar Island. In Indonesia, ramin basically grows on peat swamp forests of Sumatra and Kalimantan. Five provinces of Indonesia known as main producers of ramin are Riau, Jambi, South Sumatra, West, and Central Kalimantan (Figure 1.1).

According to Airy Shaw (1954), ramin is local name for the species of *Gonystylus bancanus, G. velutinus, G. micranthus,* and *G. xylocarpus.* However in this study, ramin refers mainly to *Gonystylus bancanus* Kurz, a species that naturally grows in peat-swamp forest as its habitat. In Sumatera and Kalimantan ramin are found in peat or freshwater swamp forests, and the existence and abundance of this species correlated strongly with the peat depth. At the study sites in Central Kalimantan, the most abundant ramin trees exist at peat land with more than 600 cm depth (Istomo, 1998).

The whitish timber of ramin is highly prized and used for high quality furniture, interior decoration, stick, frames, dowels and other high quality products. The demand of this species is far beyond its growth and regeneration capability. Over-exploitation of ramin has been occurring and has threatened the sustainability of this species. The sustainability of ramin is also under threat due to silviculture of the species that has not been totally known. Currently, illegal harvesting and illegal trade are the main causes of the destruction of ramin population.

Other major threat to ramin forest is forest degradation. Much of the peat swamp forest area has been subject to degradation caused by conversion to other uses and forest fires. Conversion of more than one million hectare of peat swamp forest into mega rice field in Central Kalimantan is an example of peat swamp forest degradation. However, the rate of deforestation is not accurately known, though various estimates have been made, ranging from 700,000 to 1,200,000 ha per year for all forest types (Murphy, 2001).

To conserve this species In Indonesia, logging ban was imposed in 2001 by the issue of the decree of the Minister of Forestry No. 127/2001. Since 2001, harvesting and export of ramin have been based on annual harvest quota set by the Government of Indonesia. The quota is provided to forest concessions that hold certificate of Sustainable Forest Management (SFM). In addition, based on the Decree of the Minister of Forestry No. 168/2001, no ramin export in the forms of log and sawn timber is allowed.

Concerned with the considerable decline in the Indonesian population of ramin exacerbated by illegal logging and illegal trading, Indonesia included *Gonystylus* spp. in Appendix III of CITES in April 2001. As CITES is an instrument governing international trade of listed species, Indonesia considered the listing of *Gonystylus* spp. in Appendix III of CITES was an appropriate measure. Moreover, the implementation of the listing has been hampered by problems related to lack of understanding and familiarity with CITES procedures, lack of coordination and species identification. Therefore, Indonesia proposed the up-listing of *Gonystylus* spp. into Appendix II of CITES, under which, a 'non-detriment finding' (NDF) would be required for exports of the genus. Indonesia

proposal for up-listing ramin into Appendix II of CITES was accepted at the 13th Convention of Parties (COP) in Bangkok, in October 2004.

Other conservation efforts have been done including establishment of conservation areas, application of some regulations, research and studies related to artificial regeneration of ramin, combating illegal logging and illegal trading. However, threats to sustainability of ramin are still high, and this may lead to extinction of this species.

To determine the best action for sustainability of ramin in the future, it is important to identify current condition of ramin, especially in five provinces (Jambi, Riau, South Sumatera, West Kalimantan and Central Kalimantan), regarding its potency, distribution and conservation status, as the objective of this ITTO funded activity.

This study mainly collected secondary data to achieve output 1.1. Complete Data on Ramin Potency and Conservation Status. Data were collected from secondary data and direct investigation, including interview to personnel in the field and offices. Types of data included published/ unpublished publications, journals, magazines, bulletins, research results, newspapers, maps, satellite imageries, internet and other information. Data were collected from institutions such as libraries, Ministry of Forestry, Province and District Forest Services, Statistical Agencies, Ministry of Trade and Industry, Universities, NGO and other institutions. These data were collected, analyzed and synthesized to obtain distribution of the species, potency and conservation status of the ramin. In addition, maps of vegetation cover that have been interpreted based on landsat satellite images were marked to calculate potency of secondary and primary peat swamp forest. These maps were also overlaid with forest concession maps to identify distribution of ramin.

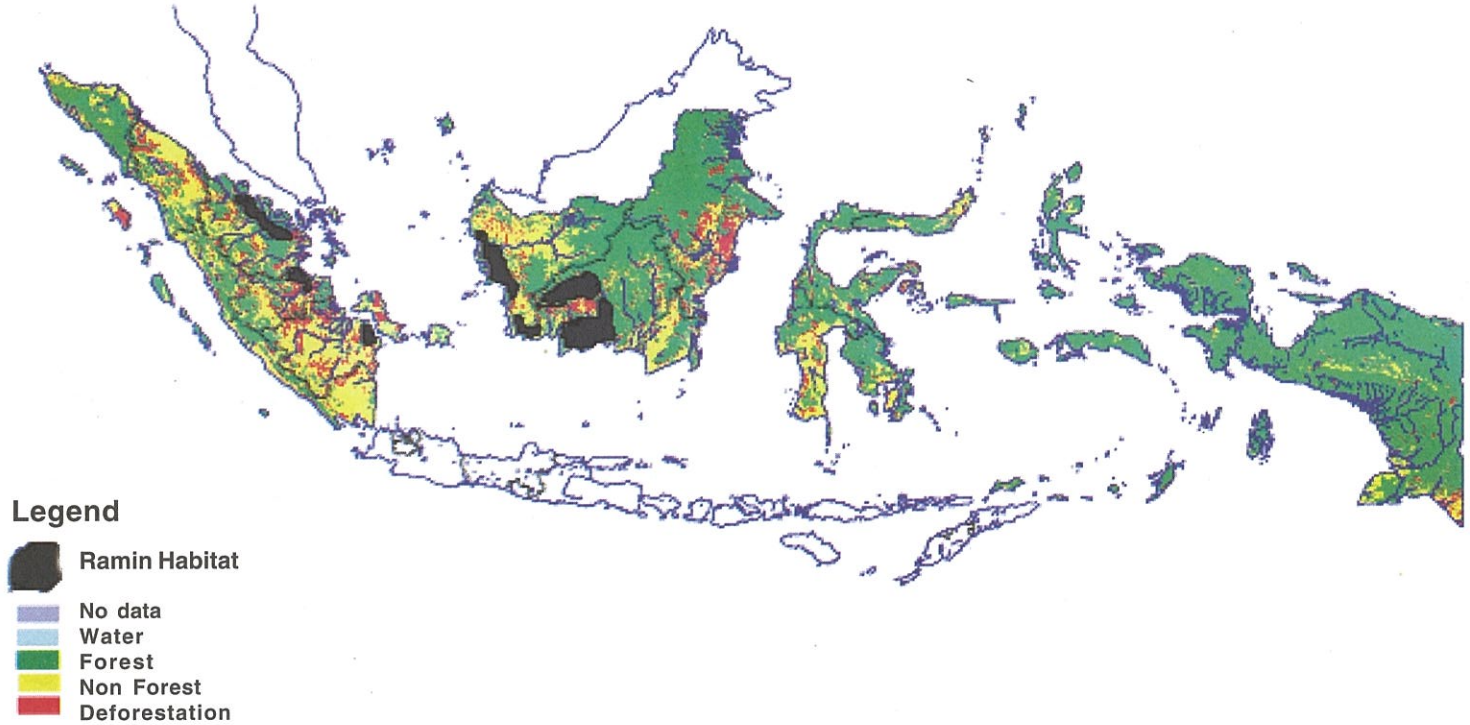


Figure 1.1. Map of Ramin Distribution in Indonesia

II. BIOLOGY OF RAMIN

2.1. Characteristic of the Species

Ramin belongs to the genus *Gonystylus* and is a member of Family Thymeleaceae, Order Myrtales, Class Magnoliopsida, Phyllum Tracheophyta. The most common ramin species in Indonesia and as the object of this study mainly refers to *Gonystylus bancanus.*

Generally, ramin tree can reach height of 40 – 50 m, with diameter of 30 – 120 cm. In the forest, ramin stands form main canopy layer. It has cylindrical bole, straight, branch-less up to 21 m in height. Usually with no buttresses or thick if present and sometimes fluted at base. Bark surface smooth to cracked, dull gray to red-brown or dark brown in color, occasionally with white patches. Inner bark yellow, brown, pink or orange. Root system with knee-roots (*pneumatophora*). Morphological character of *Gonystylus bancanus* is shown in Figure 2.1 (Source : Soerianegara and Lemmens, 1994).

Most population of ramin show aggregate dispersion with individuals in group, and between groups there are no or few individuals. This aggregation relates to the dispersal pattern of fruits. The fruits usually disperse only under the parent trees.

Some studies show that ramin trees have irregular flowering and fruiting seasons. After long dry season followed by rainy season, ramin trees produce a lot of fruits, however in the following year, even within interval of 2-3 years no fruits are produced. Moreover, if the fruits fall onto forest floor, there are animals such as squirrels and rats eat the seeds. Therefore this will reduce natural regeneration process (Daryono, 1996). According to Akbar (1995) ramin regeneration also has difficulty due to fruiting season that occurs in rainy season so that there are many fruits fall and decay before germinating.

Flowering season of ramin trees varies from region to region with irregular interval. Usually, flowering season occurs in February – March, but there are trees that flowering in May and October (Soediarto *et al.* 1963). After 2 - 3 moths following flowering season, usually ramin tress produce fruits. In West Kalimantan, ramin flowering in August – October and fruiting in October - December. The fruits ripe between October to mid January (Alrasyid and Soerianegara, 1976). However, some trees fruiting in may – June and the fruits ripe in April (Soediarto *et al.* 1963). Each fruit contains 1- 3 seeds and each kilogram of dry seeds contains 250 - 270 seeds (Alrasyid and Soerianegara, 1976).

Figure 2.1. Figures of *Gonystylus bancanus* Kurz, 1. tree, 2. twig, 3. flower, 4. sectioned flower and 5. fruit (left) and leaves of ramin (middle) and crown of ramin (right)

2.2. Regeneration

Results of some studies show that ramin trees have low natural regeneration capability. This is proven by lack of seedlings under parent trees. Population of ramin shows abnormal tendency, which is more large individuals compared with smaller trees (Sutisna *et al,* 1988, Daryono, 1996).

In undisturbed forest, population of seedlings can reach ± 4,000 seedlings/ha. Although natural population of seedlings in undisturbed forest is quite abundance, planting from wild seedlings is not recommended. This is caused by higher mortality rate compared with seedlings from cutting and nursery raised seeds (Alrasyid & Soerianegara, 1976). Moreover, population of seedlings in logged over areas usually becomes low although previously in this forest area the population was quite high (Sutisna *et al.,* 1988). The low population of seedlings in disturbed areas might be caused not only by habitat disturbance but also herbivore abundance that usually increase within the disturbanced forest.

In order to establish ramin plantation, procurement of seedlings can be carried out by several methods, namely nursery raised seedlings, seedlings collected from wild and cutting. Meanwhile, procurement of seedlings from tissue culture has encountered some difficulties, and the project is in progress, being carried out by Bogor Agriculture University (IPB) and Indonesian Institute of Science (LIPI).

2.3. Characteristics of Wood and Its Utilization

Ramin wood is a lightweight to moderately heavy hardwood. The heartwood is white to yellowish-white or yellow, sometimes weathering to straw-color, and not distinctly demarcated from the 3-6 cm thick sapwood. The density is 460-840 kg/m3 at 15% moisture content. The grain is straight or shallowly interlocked, texture moderately fine to coarse. The wood surface is slightly lustrous and lacks a conspicuous figure.

Ramin is easy to work with hand tools as well as machines. It is easy to saw and plane in both green and dry condition. It can easily be worked into smooth molding. Ramin wood is non-durable. The wood is susceptible to *blue stain* and *ambrosia beetle* attack. These pests usually attack fresh wood (still wet after cutting or sawing). Damage due to these pests will reduce quality of wood and subsequently sale value (Figure 2.3). To prevent blue stain attack, the wood should be dried up to moisture content of less than 25%. The resistance to dry-wood termites and wood-rotting fungi is poor.

The whitish timber of ramin is highly prized and popular as a decorative cabinet timber. More generally it is also suitable for furniture, interior decoration such as wall paneling, light flooring, toys, turnery, broom handles and other non-impact handles, venetian blinds, dowels, rulers, picture frames and drawing boards. Ramin is also used for general light construction such as door and window frames, moldings, skirting, ceilings, partitions, stair treads and counter tops. Various other applications are planks, barrels, boxes and shipboards. Being highly susceptible to various attacks, the timber should always be used under cover. Ramin is very suitable for veneer, plywood and block-board manufacture and can be made into a satisfactory quality of particle board.

Because of its luxurious appearance, wood properties and easy to work ramin timber is highly in demand. Few species can substitute ramin for such wide range uses. Some species such as rubberwood *(Hevea brasiliensis* Wild.) and Jelutung *(Dyera costulata* Miq. Hook. f.) have been identified to possess similar properties to ramin, but due to the difficulty to work and not as smooth as ramin in appearance, these species cannot replace ramin in international trade.

2.4. Distribution

Indonesia belongs to *phitogeography* area of Malesia, which has the most extensive tropical rain forest in the world after Brazil. This relates to very rich diversity of flora and variation in forest formation. Ramin is one of the genus *Gonystylus* that belong to family *Thymeleaceae. Gonystylus* has uneven distribution in every island. Towards the East the diversity of *Gonystylus* becomes smaller.

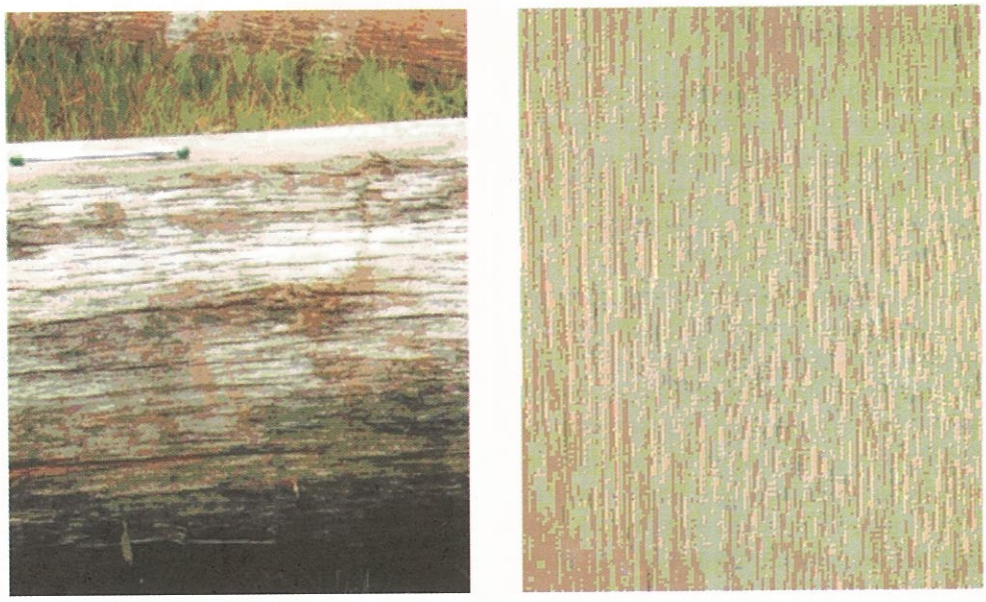


Figure 2.2. Texture of ramin log bark (Photo by Bismark) and wood

Figure 2.3. After harvested, ramin wood is susceptible for attack by blue stain fungi (Photo by Bismark)

Borneo and Sumatra are two big islands that have important distribution of *Gonystylus* group. Even in some remaining primary forests of peat swamp forests of Kalimantan and Sumatra, the vegetation is still dominated by *Gonystylus* besides dominant species of *Dipterocarp* family. Based on field information, in Kalimantan there are still many species of *Gonystylus*, especially in forest area of West Kotawaringin Barat District, meanwhile in Sumatera, the distribution of *Gonystylus* is dominant in peat swamp forest of East Coast of Central Sumatra.

The genus *Gonystylus* which consists of about 30 species are distributed almost throughout the Malesian area with the exception of East Java and the Lesser Sunda Islands. Eastward, the distribution area extends towards the Solomon Islands, Nicobar and Fiji. The vast majority of

species is found on Borneo (27 species). Table 2.1. shows the distribution of each species (Soerianegara and Lemmens, 1994; CITES, 2004).

Table 2.1. Geographic distribution of *Gonystylus* (bold letters distributed in Sumatera)

No.	Species	Distribution	Habitat	Remark
1.	***Gonystylus acuminatus* Airy Shaw**	Borneo, Malay Peninsula & Sumatra	Primary rain forest at 150 m	Small tree 25 m by 50 cm
2.	*Gonystylus affinis* Radlk.	Malay Peninsula & Borneo (Sarawak-Kalimantan)	Open rain forest up to 240 m	Small tree up to 24 m
3.	*Gonystylus afinis* Radlk var. elegans Shaw	Malay Peninsula & Borneo (Sarawak-Kalimantan)	Open rain forest up to 240 m	Small tree up to 24 m
4.	*Gonystylus areolatus* Domke ex Airy Shaw	Borneo (SW Borneo)	Low land rainforest	Shrub/small tree
5.	*Gonystylus augescens* Ridl.	Borneo (SW Sarawak, W. Kalimatan)	Low land rain forest	Small tree,
6.	***Gonystylus bancanus* (Miq.) Kurz.**	Mal.Penin. SE. Sumatra, Bangka, Borneo	Peat swamp forest, sometimes pure stand	Morphologically and ecologically marked species
7.	***Gonystylus borneensis* (Tiegh.) Gilg.**	Borneo (C. Kalimantan), Sumatra (Tapanuli)	Low land rain forest	Shrub/small tree diameter up to 60 cm
8.	***Gonystylus brunescens* Airy Shaw**	Malay Peninsula (E. coast), Borneo, Sumatra (Riau)	Non-inundated rain forest up to 345 m	Small tree 10-20 m
9.	*Gonystylus calophylloides* Airy Shaw	Borneo (NE Sarawak)	Bank of rocky stream at 210 m	Small tree up to 6 m
10.	*Gonystylus calophyllus* Gld	Borneo (W. Sarawak)	Low land rain forest	Shrub/small tree
11.	***Gonystylus confusus* Airy Shaw**	Malay Peninsula & N. Sumatra (Aceh)	Non-inundated rain forest	Small tree 30 m by 60 cm
12.	*Gonystylus consanguineus* Airy Shaw	Borneo (Sabah, Sarawak, Kalimantan)	Primary and disturbed forest	Medium tree 16–40 m
13.	*Gonystylus costalis* Airy Shaw	Borneo (C. Sarawak)	Primary rainforest on ridge sandy clay soil at 210 m	Small tree 4.5 m
14.	*Gonystylus decipiens* Airy Shaw	Borneo (C. Sarawak)	Primary forest sand-stone below 500 m	Medium 25-30 m
15.	*Gonystylus eximius* Shaw	Kew Bulletin 1973		
16.	***Gonystylus forbesii* Gilg**	Sumatra (Mentawai) & S. Borneo	Non-inundated ever green sea level-1210m	Medium 40 m by 85cm

Table 2.1. Continued

No.	Species	Distribution	Habitat	Remark
17.	*Gonystylus glaucescens* Airy Shaw	Borneo (E. Kalimantan)	Sandstone ridge at 400 m	Small tree 10 m
18.	*Gonystylus keithii* Airy Shaw	Borneo (Sandakan, Kalimantan-Sintang)	Non-inundated rain forest up to 410 m	Shrub/small tree 25m by 90 cm
19.	*Gonystylus lucidulus* Airy Shaw	Borneo (NE Sarawak, Brunei)	Lowland Dipterocarp forest (30 – 270 m)	Medium tree up to 36 m
20.	***Gonystylus macrophyllus* (Miq.) Airy Shaw**	Nicobar, Malesia wide spread ex. C.E. Java & LS Island	Low land primary forest, medium altitude.	Medium tree, 45 m tall by 1 m diameter soft wood
21.	***Gonystylus maingayi* Hook.f.**	Borneo, Malay Peninsula & Sumatra	Primary rain forest up to 150 m (*peat swamp*)	Small tree up to 27 m
22.	*Gonystylus micranthus* Airy Shaw	Borneo (Sarawak) S.Kalimantan	Unknown / Primary lowland forest *marsh*	Small tree 18 m by 60 cm
23.	*Gonystylus nervosus* Airy Shaw	Borneo (SW, NE Sarawak)	Primary rain forest on limestone hills	Small tree 4-5 m
24.	*Gonystylus nobilis* Airy Shaw	Borneo (W Central Sarawak)	Primary lowland Dipterocarp	Medium tree 24 m
25.	*Gonystylus pendulus* Airy Shaw	Borneo (SW Sarawak)	Evergreen rain forest at 360 m	Small tree 10 m by 12 cm
26.	*Gonystylus reticulatus* (Elm.) Merr.	Philippines	Evergreen rain forest	Small slender tree
27.	*Gonystylus spectabils* Airy Shaw	Borneo (C. Sarawak, Kalimantan Bulungan)	Presumably rain-forest on ridge at 195	Medium tree 24 m
28.	*Gonystylus stenocepalus* Airy Shaw	Borneo (Sarawak)	Unknown (primary forest)	Small tree
29.	***Gonystylus velutinus* Airy Shaw**	Sumatra, Bangka Belitung and Borneo	Primary rain forest low alt. non-inundation	Medium 35 m by 70 cm
30.	*Gonystylus xylocarpus* Airy Shaw	W.Borneo (Sarawak and adjacent areas)	Rain forest at low altitude (heat forest)	Small tree to medium

Note: Borneo: Sabah, Sarawak (Malaysia), Brunei Darussalam and Kalimantan (Indonesia).

Currently, *Gonystylus bancanus* has been degraded due to over-exploitation that threats the sustainability of the species. Under this condition, *Gonystylus bancanus* in nature has led to extinction, therefore this species is categorized as vulnerable species (IUCN, 2000).

Based on herbarium collection of Botany and Forest Ecology, Forest and Nature Conservation Research and Development (FNCRDC), Bogor, the distribution of *Gonystylus* genus especially *G. bancanus* is more dominant in Kalimantan compared to Sumatra. From the result of data

collection based on forest type, it showed that distribution of *Gonystylus bancanus* is restricted in peat swamp forest type, meanwhile other species of *Gonystylus* spp. can adapt to forest condition of dry forest, hilly forest, along the river and stony hill (Appendix 1). The distribution of *Gonystylus* spp. according to data from herbarium of Forest Research and Development Center, Bogor, and data from forest concessions and conservation areas are shown on Maps in Appendix 9.

Distribution of ramin in every province based on data from Forest Concessionaries (HPH) is presented in Appendix 2. Table 2.2 shows distribution of ramin in conservation areas.

Table 2.2. Distribution of ramin and its habitat in conservation areas

No.	Name of Protected Area	District/Province	Area (ha)
1.	Kerumutan Game Reserve	Indragiri Hilir, Indragiri Hulu, Riau	120,000
2.	Tasik Belat Game Reserve	Siak, Riau	2,500
3.	Danau Pulau Besar Game Reserve	Siak, Riau	25,000
4.	Bukit Batu Game Reserve	Bengkalis, Riau	24,000
5.	Tasik Besar Game Reserve	Pelalawan, Riau	3,200
6.	Tasik Serkap Game Reserve	Pelalawan, Riau	6,900
7.	Berbak National Park	Tanjung Jabung Timur, Jambi	162,000
8.	Sembilang National Park	South Sumatera	202.896
9.	Padang Sugihan Game Reserve	South Sumatera	86.932
10.	Mandor Nature Reserve	Pontianak, West Kalimantan	3.080
11.	Muara Kendawangan Nature Reserve	Ketapang, West Kalimantan	150.000
12.	Gunung Palung National Park	West Kalimantan	90.000
13.	Danau Sentarum National Park	West Kalimantan	80.000
14.	Tanjung Puting National Park	Kotawaringin Barat, Central Kalimantan	415.000
15.	Sebangau National Park	Pulang Pisau, Central Kalimantan	600.000
16.	Natural Laboratory of peat Swamp Forest	Pulang Pisau, Central Kalimantan	50.000
17.	Nyaru Menteng Arboretum	Palangka Raya, Central Kalimantan.	65

2.5. Habitat Preference and Association with Other Species

The species of ramin are typically found in primary, non-inundated rain forest at low and medium elevations, reaching 1200 m altitude in Sumatra and 1500 m in Borneo and the Philippines (Soerianegara and Lemmens, 1994). Different from other species, the most important commercial species *G. bancanus* can be found naturally on peat swamp forest, including lowland fresh water swamp forest and coastal peat swamp forest. In Sarawak, Sumatra and Brunei, *G. bancanus* is an important component of coastal peat-swamp forest, where it occurs in both the peripheral mixed of swamp forest and *Shorea albida* Sym. forest and pole-sized peat-swamp forest. It is also found in heath forest. In mixed swamp forest *G. bancanus* is often the most abundant large tree with up to 20 trees/ha with a diameter above 50 cm and is locally the single dominant species.

Figure 2.4. Ramin habitat in logged over area of PT Putra Duta Indah Wood, Jambi (Photo by Bismark).

There have been found that the existence and abundance of ramin correlated strongly with the peat depth (Soerianegara, 1996). Study in Central Kalimantan by Istomo (1998) showed that ramin was found in peat depth of more than 120 cm, the deeper the peat layer, more ramin was found. In peat soil with depth of 350 cm, percentage of ramin was start to dominant (more trees found compared to other species) up to more than 600 cm peat depth. In peat soil with thickness of 120 - 300 cm, percentage of ramin trees (diameter ³15 cm) to other species was about 12% with total trees of 16 trees/ha and volume 26.53 m^3/ha. Meanwhile in more than 350 cm peat depth, the percentage was 30%, total trees 55 trees/ha and volume 105.48 m^3/ha. This study proved that peat depth of >300 cm was suitable for forest with protection function as well as good habitat for high economic value species of ramin.

Peat lands are categorized as marginal lands and prone to disturbances. Peat land degradation is usually attributed to logging and forest fire. Andriesse (1988) cited by Istomo (1998) noted that peat development is only 0.5 – 1.0 mm per year, while the peat decrease reaches 1.5 – 3.0 cm per year.

In most habitat, ramin is principally associated with several peat *Shorea* spp. species, *Copaifera palustris* and *Dactylocladus stenostachys* (Jongkong). The later may in some places be more abundant than *G. bancanus* (Prosea, 1995). Other associates encountered are: *Dyera lowii* (jelutong), *Palaquium* spp. (nyatoh), *Cratoxylum arborescens* (geronggang), *Agathis borneensis* (kauri), *Durio* spp. (durian), *Dipterocarpus* spp. (keruing) and *Dryobalanops* spp. (kapur). In a few heath forests G. *bancanus* is often found in association with *Calophyllum* spp. (bintangor) and its diameter is usually less than 75 cm.

Ramin in Riau based on cruising result has community association with meranti (*Shorea* spp.), durian burung (*Durio* spp.), bintangur (*Calophyllum retusum*), balam (*Alseodaphne macrocarpa*), rengas (*Gluta renghas*), arang-arang (*Dyospiros paniculata*), pisang-pisang (*Nezzetia parviflora*), punak, jangkang, medang (*Cryptocarya* spp.), geronggang (*Cratoxylon* spp.), and darah-darah (*Horsfeldia olobularis*).

In Central Kalimantan, especially in Forest Concession of Koperasi Serba Usaha Bajenta (1999) ramin has association with geronggang (*Cratoxylon* spp.), bintangur (*Calophyllum* spp.), jelutung (*Dyera c ostulata*), alau (*Dacrydium pectinatum*), nyatoh (*Palaquium* spp.), kayu malam (*Diospyros pseudomalabarica*), tumuh (*Combretocarpus rotundatus*), kapur naga (*Dryobalanops* s pp.), pisang-pisang (*Mezzetia leptopoda*), mahang (*Tetrastroemia* spp.) jambu (*Eugenia* spp.), and gemur (*Alseodaphne coriacea*). Some tree species associated with ramin in West Kalimantan among others are geronggang (*Cratoxylon arborescens*), punak (*Tetramerista glabra*), belangiran (*Shorea balangeran*), kapur (*Dryobalanops* spp.), bintangur (*Calophyllum* spp.) and gelam tikus (*Melaleuca leucadendron).*

III. GROWING STOCK

3.1. Potency of Peat Swamp Forest

Peat swamp forests as ramin habitat in Indonesia are mainly found in five provinces namely Riau, Jambi, South Sumatera, West Kalimantan and Central Kalimantan. From the figure presented by the Directorate of Forestry Planning (1983), in Indonesia, total area of Ramin-potential peat-swamp forest was about 13 million hectare (Table 3.1), with the most extensive in Central Kalimantan (5.5 million ha), West Kalimantan (3.7 million ha), and Riau (2.2 million ha).

Table 3.1. The extent of ramin habitat in Indonesia in 1983

No	Province	Area extent (Ha)
1	Riau	2,222,000
2	Jambi	397,500
3	South Sumatera	684,750
4	West Kalimantan	3,731,100
5	Central Kalimantan	5,491,250
6	South Kalimantan	154,000
7	Central Sulawesi	486,500
8	Maluku	166,800
	Total	13,333,100

Source : Directorate of Forestry Planning (1983)

Vegetation maps (See Appendix 8) based on landsat imageries interpretation issued by Forestry Planning Agency (2002), show distribution of swamp forest in Indonesia. Total area of peat swamp forest in five provinces as main habitat of ramin (Riau, Jambi, South Sumatera, West Kalimantan and Central Kalimantan) was 6,716,000 ha, (Table 3.2). In 1983, total area for five provinces was 12,526,000 ha (Table 3.1). This comparison shows reduction of potential areas of ramin in five provinces to be 53.6 % of initial potency. From total peat swamp area of 6.716.000 ha, 30.9 % or 2,078,600 ha is conservation area, as important aspect for sustainability of forest, environment and biodiversity.

Data from Table 3.1 and 3.2 show that there has been major degradation of peat swamp forest in Indonesia. Much of the peat swamp forest area has been subject to degradation caused by conversion to other uses, forest fires and other human activities. Conversion of one million hectare of peat swamp forest into mega rice field in Central Kalimantan is example of peat swamp forest destruction. Other forest destruction is forest fire. In 1997/1998 for instance, a massive fire burned more than 1.5 millions ha of forest in Sumatera and Kalimantan as the worst incidence of forest fire on peat-swamp forest. Study in Sumatera showed that 11-18 % of total area burned was peat swamp forest

Table 3.2. Total peat swamp forest area in 5 provinces of Indonesia in 2002

No	Province	Area (x 1000 ha)				Percentage of Conservation Area
		Primary Peat Swamp Forest	Secondary Peat Swamp Forest	Total Peat Swamp Forest	Conservation area	
1	Riau	12,861	130	12,991	241.6	17.1
2	Jambi	237	125	362	162.0	44.8
3	South Sumatera	35	11	46*	289.8	-
4	West Kalimantan	91	1641	1,732	320.4	18.5
5	Central Kalimantan	228	2,932	3,160	1,065.0	33.7

Source : Forestry Planning Agency 2002)*
Remark : Low estimation; Wet Land Program in Lubis nd Suryadiputra (2003) stated 1.5 million ha of total peat swamp forest in South Sumatera.

(Subagyo, 2003, Lubis and Suryadiputra, 2003). Human activities also cause peat swamp forest destruction. For examples, in Berbak National Park (Jambi), 40 % of the area has been degraded by illegal logging and in Mandor Game Reserve 1,000 ha of the area has turned into sand field (Kompas, 26 March 2005 and 25 June 2005).

The World Bank estimated that in 1985 to 1997, annual forest degradation in Indonesia reached of about 1.5 million for all forest types (Telapak - EIA, 2000), similar to estimation by Murphy (2001) with estimation of 700,000 to 1,200,000 ha of forest destruction per year.

3.2. Ramin Growing Stock

It was reported that in 1983, the growing stock of productive ramin peat swamp forest of West and Central Kalimantan with the extent of over 1 million ha had an average standing stock of 30 m^3/ha in West Kalimantan and 25 m^3/ha in Central Kalimantan. The annual allowable cut (AAC) was determined at 696.000 m^3/year for West Kalimantan with a potential of 480 000 m^3/ year, and at 865.000 m^3/year with a potential of 600.000 m^3/year for Central Kalimantan (Soerianegara and Lemmens, 1994).

Table 3.3 and 3.4 show initial standing stocks of ramin and average the lowest and the highest for diameter 35 cm and 50 cm up, for five provinces as major ramin producers in 1983. The Tables indicate that the highest ramin standing stock was in Kalimantan (West and Central Kalimantan). West and Central Kalimantan also recorded the highest average of total number of trees per hectare, meaning that these areas were potential areas of ramin.

More recent assessment to ramin standing stock in 1997 showed that the population throughout Indonesia has considerably declined (Soehartono and Mardiastuti, 2002), as a result of unsustainable past harvest. Estimation of Ramin population in Indonesia in 1997 was issued by Bureau of Planning (1997) as shown in Table 3.5. The table shows that density of trees and poles was quite low compared with data in 1983, and data in 1997 shows that the number of poles was low compared with trees. This means that if trees with diameter of 35 cm up have been cut, the growing stock would be low after harvesting. Low density of poles also showed that regeneration speed and growth of ramin in nature was very slow.

Information on current ramin growing stock is also required because in Indonesia, after up-listing of ramin in Appendix II of CITES, there is only one forest concession in Indonesia (PT Diamond Raya Timber in Riau) that has been provided quota as ramin producers. Other forest concessions that actually have ramin have stopped their operations due to technical and administrative

Table 3.3. Initial stocks of Ramin based on provinces in 1983

No	Province	Initial standing stock (x 1000 m^3)	
		Diameter > 35 cm	Diameter > 50 cm
1	Riau	9,228.6	6,191.7
2	Jambi	2,127.5	1,293.1
3	South Sumatera	3,221.0	2,266.0
4	West Kalimantan	38,564.5	27,707.0
5	Central Kalimantan	76,106.6	50,390.3
Total		129,248.2	87,848.1

Source : Directorate of Forestry Planning (1983)

Table 3.4. Ramin in Sumatera and Kalimantan according to diameter in five provinces in 1983.

No	Province	The highest and the lowest Ramin per ha			
		Diameter > 35 cm		Diameter > 50 cm	
		N	V	N	V
1	Riau	0.02 - 5.59	0.14 - 13.37	0.00 -2.59	0.00 - 9.57
2	Jambi	0.00 - 0.78	0.80 - 11.15	-	-
3	South Sumatera	0.14 - 9.35	0.27 - 23.97	0.06 - 5.51	0.16 - 19.22
4	West Kalimantan	0.02 - 21.87	0.05 -72.02	0.02 - 12.21	0.02 - 55.68
5	Central Kalimantan	0.02 - 39.78	0.01 - 66.51	0.03 - 13.49	0.02 - 46.04

Source : Directorate of Forestry Planning (1983)
Note : N = Number of trees per ha; V = Volume of trees m^3/ha

difficulties (especially no permit from Ministry of Forestry although these forest concessions have been provided time extension for operation). This condition has led to occurrences of illegal logging and illegal trade as important destruction factor to forest sustainability and more particularly to ramin growing stock.

Inventory of ramin as the object of this ITTO activity in 2005, is mainly carried out through collection of secondary data. Ramin growing stock was collected and analyzed from secondary data as the result of cruising carried out by forest concessions to propose its Annual Cutting Plan (RKT). Data of ramin were gained from forest concessions that were still active in 1995-2002. Meanwhile for data of ramin in 2002 – 2004, were based on report of cruising result from two active forest concessions namely PT Diamond Raya Timber that has quota to harvest ramin in Riau and PT Putra Duta Indah Wood in Jambi that is still active (Table 3.10).

Detail data from cruising result in some forest concessions were collected in this study and provided in Appendix 3-6, meanwhile summary of these data from forest concessions in five provinces from the year 1995 – 2002, for the highest and the lowest stocks per hectare as well as actual average stocks are shown in Table 3.6 and 3.7. Analysis to calculate average growing stock of number and volume of ramin was also carried out for five provinces, Riau, Jambi, South Sumatera, West Kalimantan and Central Kalimantan as presented in Table 3.7.

Table 3.8 shows average percentage of remaining ramin trees to total ramin trees if all trees with diameter 40 cm up were harvested, and percentage of ramin volume to total trees with diameter 40 cm up (data 1995 – 2002). The Table shows that average ramin trees left after harvesting were more than 50 percent, meaning that there were more trees with small diameter (< 40 cm). Moreover, average volume of ramin to total trees harvested

Table 3.5. Estimation of Ramin population in Sumatera and Kalimantan in 1997

Province	No. of Poles /ha	No. of Trees /ha	Volume of trees (m^3/ha)
1. Riau	0.06	1.92	3.30
2. South Sumatera	0.01	040	0.48
3. Jambi	0:00	0.50	0.95
4. Central Kalimantan	0.09	1.09	1.07
5. West Kalimantan	0.02	0.31	0.39

Source : Bureau of Planning, (1997) in Suhartono and Mardiastuti (2002)

Table 3. 6. The highest and the lowest ramin stock according to the result of cruising by forest concessions (data 1995 – 2002)

Province	Diameter 20 – 39 cm		Diameter > 40 up	
	N/ha	V/ha	N/ha	V/ha
Riau	0.02-4.29	0.10-8.69	0.21-10.48	0.04-19.26
Jambi	0.28-2.44	0.36-2.45	0.38-4.08	0.86-11.03
South Sumatera	1.0-4.0	0.52-2.28	0.40-6.67	0.97-12.26
West Kalimantan	0.29-3.72	0.44-5.65	0.37-4.42	0.97-11.12
Central Kalimantan	0.23-5.08	0.08-2.23	0.18-3.62	0.34-6.56

Source : Cruising Report of forest concessions (data 1995-2002), analyzed by Study Team
Remark: N = Number of trees per hectare ; V = Volume of trees m^3/ha

Table 3.7. Average ramin stock according to the result of cruising by forest concessions (data 1995 – 2002)

Province	Diameter (Cm)					
	20 – 39		> 40		Total	
	N	V	N	V	N	V
Riau	1.87	1.01	1.98	4.69	3.85	5.7
Jambi	2.11	1.75	2.11	4.83	4.22	6.58
South Sumatera	3.75	1.20	2.92	3.50	6.67	4.70
West Kalimantan	2.69	1.31	1.83	6.10	4.52	7.41
Central Kalimantan	1.31	0.65	0.92	1.53	2.23	2.18

Source : Cruising Report of forest concessions (data 1995-2002), analyzed by Study Team
Remark: N = Number of trees per hectare ; V = Volume of trees m^3/ha

Table 3.8. Average percentage of remaining ramin trees after harvesting to total ramin trees and percentage of ramin volume to total trees with diameter 40 cm up according to the result of cruising by forest concessions, (data 1995 – 2002)

Province	Percentage of remaining ramin trees in LOA (%)		Percentage of ramin volume to total trees (diameter > 40 cm)
	N	V	
Riau	50.67	24.73	8.25
Jambi	57.83	21.58	8.19
South Sumatera	66,0	29.0	8.83
West Kalimantan	39.32	24.96	4.98
Central Kalimantan	68.0	47.26	12.41

Source : Cruising Report of forest concessions (data 1995-2002), analyzed by Study Team

was about 8%, or in 1995 - 2002 ramin trees were no longer dominant in forest concession areas.

Based on data of average growing stock (Table 3.7) and current extent of peat swamp forest (Table 3.2), and also considering growing stock, population, volume and illegal logging, current Growing stock of ramin trees with diameter of 20 cm up for five provinces is estimated as shown in Table 3.9. Extent of potential ramin habitat for primary and secondary peat swamp forest is assumed only 80% from total area, and 20 % of which has been illegally logged. Estimation of ramin growing stock in secondary forest is based on data on logged over areas, which the remaining trees were those with diameter of 20-39 cm, as parent trees available after harvesting. It is also assumed that 30% of trees in LOA have been illegally logged.

Estimation of current growing stock is 14,757,221 m^3 or 11.3 % from growing stock in 1983 as shown in Table 3.9,. However, establishment of conservation areas that achieve 30.9% of total current habitat supports rescue of ramin population. The lowest population of ramin was found in South Sumatera. This is due to small remaining forest areas as ramin habitat, and high intensity of illegal logging as shown in Table 3.17.

Description of current condition was taken from PT Diamond Raya Timber in Riau Province as the only concession that has been provided permit to harvest ramin. Report from Integrated Team (2003), from sample plots on 2002 cutting plot in Forest Concession of PT Diamond Raya Timber, Riau, there were found that population of Ramin in study area was 4-5 trees (diameter $\geq$ 10 cm) per hectare or 400 - 500 trees per cutting block (100 ha). Pattern of diameter class distribution showed abnormal distribution, with more big trees (diameter > 40 cm) compared with smaller diameter (diameter 10 – 39 cm).

Average data of current condition based on report of Integrated Team (2002, 2003 and 2004) and data from PT Putra Duta Indah Wood, Jambi, as the only forest concession on peat swamp forest that is still in operation are shown in Table 3.10. The Table shows that growing stock in Riau (PT Diamond Raya Timber) is higher than in Jambi (PT Putra Duta Indah Wood). Meaning that PT Diamond Raya Timber is suitable to be provided quota for ramin harvesting based on current regulation of CITES.

Table 3.9. Estimation of current growing stock of ramin trees (diameter > 20 cm) in five provinces

Province	Growing Stock	Habitat		Total
		Primary Peat Swamp Forest	Secondary Peat Swamp Forest	
Riau	N	385.795,50	3.612.591,05	3.998.386,60
	V	567.457,80	1.783.931,46	2.351.389,26
Jambi	N	407.553,70	755.272,52	1.162.826,22
	V	638.448,50	653.731,77	1.292.180,30
South Sumatera	N	55.098,56	205.212,00	260.310,56
	V	38.315,20	67.058,80	105.374,08
West Kalimantan	N	328.575,50	6.126.419,53	6.455.495,03
	V	517.306,95	3.362.659,75	3.879.966,20
Central Kalimantan	N	395.016,40	6.048.654,70	6.443.671,10
	V	504.974,20	6.623.833,70	7.128.312,88

Remark : Analyzed by Study Team
N = Number of trees per hectare ; V = Volume of trees m³/ha

Table 3.10. Average current growing stock of ramin in Riau and Jambi

Province / Concession Area	Diameter (Cm)			
	20 – 39		> 40	
	N	V	N	V
Riau (PT Diamond Raya Timber)	1.22	0.81	4.48	12.96
Jambi (PT Putra Duta Indah Wood)	1.46	1.01	0.44	0.95

Source : Cruising Report of forest concessions (data 2002-2004), analyzed by Study Team
Remark : N = Number of trees per hectare ; V = Volume of trees m³/ha

3.3. Regeneration Potential

Several studies have shown that in primary forest the number of big trees was more abundant compared with pole stage. This might be caused by competition of sunlight and site. Less sunlight on primary forest that could penetrate to forest floor caused small trees (pole stage) to gain less sunlight. As the result those small trees were suppressed, the branches system could not develop optimally and even the trees might die. For examples, study by Soerianegara (1996) in Central Kalimantan found that ramin in the stage of tree was dominant compared with other species, as shown in Table 3.11, and Istomo (1998) showed this tendency with the comparison of important value index of ramin at all stages to other species (Table 3.12.)

Table 3.11. Density of every stage of ramin compared with other species on primary peat swamp forest as ramin habitat.

Stage	Density (individual/ha)		
	Ramin	All species	Percentage
Seedling	786	11643	6.75
Sapling	217	2480	8.75
Pole	9	377	2.39
Tree	41	346	12.43

Source : Soerianegara (1996)

Table 3.12. Vegetation stage and species association in ramin habitat of Central Kalimantan.

Stage	Total Species per ha	Dominant Species	IVI of Dominant Species	Rank of Ramin
Seedling	24	*Tetrameristra glabra*	29.88	5
Sapling	27	*Baccaurea bracteata*	31.99	5
Pole	28	*Palaquium rostratum*	43.07	14
Tree	40	*Gonystylus bancanus*	40.65	1

Source : Istomo (1998)

Study by Daryono (1996), also showed that density of ramin tree was dominant for all stages in primary peat swamp forest of PT Arjuna Wiwaha Forest Concession (PT Tanjung Raya Group) in Central Kalimantan (Table 3.13.).

Table 3.13. Density of ramin in primary forest compared with other species in primary peat swamp forest of PT Arjuna Wiwaha Forest Concession, Central Kalimantan

Stage	Density of ramin/ha	% of ramin to all species density	% of ramin to commercial species density
Seedling	12.000	4.8	52.1
Sapling	200	1.8	7.5
Pole	10	1.0	3.1
Tree	45	12.7	24.3

Source : Daryono (1996)

Table 3.11, 3.12. and 3.13. show that seedlings were abundant in primary forest, and poles were the smaller in number especially compared with the number of trees.

Data from primary forest of PT Diamond Raya Timber are presented in Table 3.14. The table shows that density of ramin in pole stage is the smallest in number compared with other stages.

Table 3.14. Average number of ramin trees per hectare (N/ha) in primary forest of PT Diamond Raya Timber, Riau

Stage	N/ha	
	RKT 2004	RKT 2005
Seedling	562	166
Sapling	20	58
Pole	0.80	3.3
Tree	12.51	2.46

Studies in some forest concessions and conservation areas also show similar tendency of slow ramin regeneration by low level of seedling abundance (by Important Value Index) as presented in Table 3.15

Table 3.15. Level of ramin domination (IVI) in some primary forest of forest concessions and conservation areas

Stage	Important Value Index (IVI) (%)		
	Primary Forest of Central Kalimantan*	Primary Forest of Jambi*	Conservation Area**
Seedling	9.75	-	-
Sapling	13.79	15.86	-
Pole	23.23	27.31	3.81
Tree	22.71	43.38	37.4

*Remark : * From reports of cruising results by forest concessions in Central Kalimantan (2000 -2001) and Jambi (2002)*

*** Mandor Game Reserve, West Kalimantan (Faculty of Agriculture Researcher Team, 1990) Analyzed by study team*

In disturbed forest such as logged over areas, illegal logging areas and burned over areas, condition of ramin regeneration depend on severity of disturbances as shown in the following Tables.

Study by Daryono (1996) in Forest Concession Area of PT Arjuna Wiwaha Forest Concession (PT Tanjung Raya Group) in Central Kalimantan showed that exploitation has reduced ramin trees. On one year old logged over area, there were no trees and poles of ramin found. On 10 years old logged over area, seedlings were found quite abundance. Study by Suwarso (1996) in Forest Concession of P T. SBA Wood Industry, S outh Sumatera showed negative impact of illegal logging and exploitation on regeneration of ramin as presented in Table 3.17. Study in PT Diamond Raya Timber showed current condition of ramin regeneration on logged over areas as shown in Table 3.18.

Table 3.16. Density of ramin on various ages of logged over areas

Stage/Density	Year after harvesting *)			
	Fo	F1	F5	F10
Tree				
Density/ha	45	0	42.5	12.5
% of all species density	12.7	0	16.8	3.6
% of commercial species density	24.3	0	34.7	7.3
Pole				
Density/ha	10	0	20	0
% of all species density	1.0	0	2.9	0
% of commercial species density	3.1	0	7.1	0
Sapling				
Density/ha	200	480	320	360
% of all species density	1.8	6.5	2.2	3.0
% of commercial species density	7.5	42.8	7.2	18.7
Seedling				
Density/ha	12,000	6,000	3,000	14,000
% of all species density	4.8	3.5	1.8	8.2
% of commercial species density	52.1	14.3	11.5	35.0

Source : Daryono (1996)
*Remark: *) Fo = Primary forest , F1, 5, 10 , log over area of 1, 5 and 10 years old*

Table 3.17. Impact of forest management and illegal logging to growing stock and composition of ramin at some forest conditions in forest concession area of PT SBA Wood Industries, South Sumatera.

Stage/ Forest Condition	Freq.	RF (%)	Dens.	RD (%)	Dom.	RD (%)	IVI (%)	Rank/Total
Tree								
Primary Forest	0.19	13.18	6.67	14.44	1.28	15.76	43.38	3/19
LOA	0.14	10.37	3.75	9.55	0.37	7.46	27.39	4/17
After Illegal Logging	0.02	5.71	0.04	5.06	0.07	5.08	15.86	4/7
After Illegal Logging and LOA	0.04	16.67	1.00	16.67	0.05	16.49	49.82	4/7
Pole								
Primary Forest	0.04	14.29	4.00	14.29	0.02	7.60	36.17	6/6
LOA	-	-	-	-	-	-	-	0/3
After Illegal Logging	-	-	-	-	-	-	-	0/1
Sapling								
Primary Forest	0.04	10.00	16.00	8.32	-	-	18.33	4/13
LOA	0.02	8.33	8.00	7.69	-	-	16.03	4-8/8
After Illegal Logging	-	-	-	-	-	-	-	0/3
Seedling								
Primary Forest	-	-	-	-	-	-	-	0/12
LOA	-	-	-	-	-	-	-	0/10
After Illegal Logging	-	-	-	-	-	-	-	0/11

Source : Suwarso (1996), analyzed by Study Team

Table 3.18. Average number of ramin (N/ha) in logged over areas of PT Diamond Raya Timber

Stage	N/ha	
	LOA 2003	LOA 2004
Seedling	400	172
Sapling	160	56
Pole	1.67	20
Tree	1.67	4

Source : Integrated Team (2003, 2004), analyzed by Study Team

From the result of cruising in some forest concessions, the number of ramin trees was quite high in secondary forest or logged over areas. Example of secondary forest composition is shown in Table 3.19 with comparison ramin dominance in illegal logging area and burned over area.

Table 3.19. Important value index of ramin in some forest conditions

Stage	Important Value Index (%)		
	Secondary Forest [1]	Illegal logging [2]	Burned over area [3]
Seedling	2.54	-	-
Sapling	18.92	-	49.82
Pole	34.05	-	-
Tree	58.32	15.86	-

1) *Ramin potency in secondary forest of West Kalimantan (LHC reports)*
2) *Study of illegal logging in South Sumatera (Suwarso, 1996)*
3) *Study of regeneration on post fires areas by Pratiwi (2002)*

3.4. Ramin Wood Production

In 1991-1992 Indonesian average production of ramin was 900,000 m³/year (CITES, 1994). About ten years later, the production declined to about 300,000 m³ in 1998. The decline continued to about 130,000 m³ in 2000 (Figure 3.1). However for the year of 2000 there was discrepancy on the data. Official figure from the Ministry of Forestry showed that the total annual allowable cut (AAC) for Ramin was only 24,000 m³ (even though the National Bureau of Statistics recorded the production of that year more than 130,000 m³) and zero in the year 2001. However, stockpiles inventory undertaken after the impose of logging ban, found that more than 400,000 m³ (log equivalent from timber in the forms of logs, sawn timber, molding, dowels and finished products) timber products. It was suspected that such a discrepancy was caused by illegal timber produced from outside the allowable cut (CITES, 2004).

Since 2001 official production of ramin wood has been based on annual allowable cut of PT Diamond Raya Timber, Riau, as the only forest concession that has been provided quota to produce ramin. The quota were 8000 m³ in 2002 and 2003, 13,469 m³ in 2004, and 14,082 m³ in 2005.

Trend of decline of ramin wood production in Indonesia is also shown from the annual production of log calculated from production by concession units, as shown in Table 3.20.

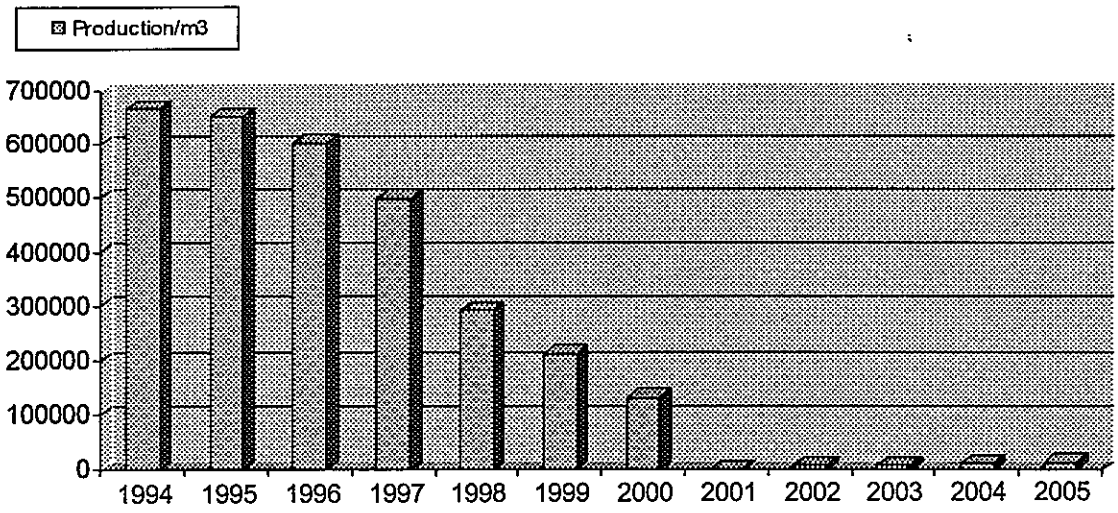


Figure 3.1 Indonesian annual production of ramin (Source: BPS various years, National Bureau of Statistics; Directorate General of Forest Protection and Nature Conservation in CITES, 2004)

Table 3.20. Log production in five provinces in 1995 – 2004 (m^3)

Year	Province					Percentage of ramin (%)
	Riau	Jambi	South Sumatera	West Kalimantan	Central Kalimantan	
1995	2,430,162	844,034	589,589	1,675,851	5,435,557	6.06
1996	2,220,419	939,582	977,716	1,266,580	5,089,426	5.73
1997	3,201,305	753,357	582,429	1,348,097	5,130,326	4.52
1998	1,307,654	482,080	285,912	1,368,025	4,214,513	3.81
1999	4,882,514	1,551,598	436,083	1,033,669	4,198,990	1.75
2000	2,258,162	724,005	1,979,720	244,477	1,281,432	2.02
2001	1,410,858	2,036,250	1,866,037	120,901	593,499	0
2002	2,056,535	123,153	1,151,321	86,828	602,676	0.20
2003	101,111	18,053	-	174,828	1,594,812	0.42
2004	11,433	13,024	-	29,212	1,066,923	0.45

Source : Forestry Planning Agency (2005), analyzed by Study Team

3.5. Trade

Before logging ban in 2001, Indonesia was the most important exporter, followed by Sarawak and Peninsular Malaysia. Major production areas were central and southern Sumatera, Riau, West Kalimantan and, particularly, Central Kalimantan. Ramin trade during 10 years (1965-1975) in form of logs, from West Kalimantan was 4.729.075 m^3, from Central and South Kalimantan were 1.493.635 m^3 exported to Italy, Japan, Taiwan, South Korea, Hongkong, Singapore, Australia, Britain, Germany, Netherlands and Belgium. In the early 1980s Ramin was the most important species in Indonesia for sawn wood exports. The average annual export in 1983 was 598,000 m^3 with a value of US$ 119 million. In 1987 the export of sawn Ramin was 299,000 m^3 with a value of US$ 86 million, and in 1988 was 224,000 m^3, with a value of US$ 74 million (Prosea, 1995).

Based on BPS data as quoted by FWI (2002), during period of 1995 to 2001 total export Ramin from Indonesia was 49.04 million kg (equal to 30.895 million m^3), valuing at US$ 51.62 million, or average of 7 million kg/year.

Value, volume and average ramin price at the seven biggest importer countries of ramin from Indonesia based on data from BPS and comparison from data of investigation by EIA (FWI, 2002) are presented in following Tables.

Table 3.21. Value, volume and average ramin price at the seven biggest importer countries of ramin from Indonesia (BPS Data)

Year/ Value	Country							Total
	Japan	Taiwan	Italy	Singapore	China	Hongkong	USA	
1995	10,517.541	3,775,250	3,922,804	2,573,699	122,036	642,345	276,534	22,942,046
1996	6,220,469	3,922,804	1,793,290	369,956	166,203	248,353	46,250	12,170,433
1997	6,457,052	1,545,914	1,914,236	575,427	555,269	209,889	589,395	12,460,598
1998	0	0	0	0	41,421	0	181,985	249,087
1999	0	0	0	0	10,039	49,010	0	69,738
2000	6,381	102,472	0	0	0	19,470	0	150,203
2001	889,483	298,476	370,849	20,778	522,520	390,829	969,403	3,462,338
Value ($)	24,090,926	8,285,089	8,001,178	3,539,860	1,417,488	1,559,896	2,063,567	48,958,004
Vol. (kg)	19,495,732	11,090,157	7,957,956	2,776,377	2,255,276	1,775,089	1,516,084	46,866,671
$/kg	1.236	0.747	1.005	1.275	0.629	0.789	1.361	1.019

Source : BPS in FWI (2002)

Table 3.22. Value, volume and average ramin price at the seven biggest importer countries of ramin from Indonesia (Investigation by EIA)

Year/ Value	Country							Total
	Japan	Taiwan	Italy	Hongkong	USA	China	Singapore	
1995	10,530,151	3,775,250	3,775,250	642,345	3,775,250	3,775,250	3,775,250	30,048,746
1996	6,220,469	2,557,030	1,793,290	248,353	46,250	166,203	369,956	11,401,551
1997	6,460,508	1,545,914	1,914,235	209,889	605,030	555,269	649,104	11,939,949
1998	2,225,512	509,327	2,293,812	319,700	5,050,422	625,263	220,610	11,244,646
1999	2,786,731	546,549	1,796,633	1,136,797	3,886,816	836,207	298,172	11,287,905
2000	1,588,205	233,962	87,420	2,469,752	2,003,332	571,094	25,587	6,979,352
Value ($)	29,811,576	9,168,032	11,660,640	5,026,836	15,367,100	6,529,286	5,338,679	82,902,149
Vol. (kg)	24,248,353	11,847,413	11,227,720	6,653,412	7,957,324	4,602,098	3,773,269	70,309,589
$/kg	1.229	0.774	1.039	0.756	1.931	1.419	1.415	1.223

Source : Investigation by EIA in FWI (2002)

Tables 3.21 and 3.22 show that the biggest importer countries of ramin from Indonesia were Japan (41%), Taiwan (24%), Italy (17%), Singapore (6%), China (5%), Hongkong (4%) and USA (3%), with average price of more than US$ 1/kg. Data from Tables also show that the figure based on investigation by EIA was higher compared with official data from BPS. This might be caused by illegal trading.

The impact of trade on the population and habitat as seen on the decrease of productions and exports volume by Indonesia has been obvious that the international trade has driven to an over-exploitation of such a high value resource. In order to prevent ramin extinction from logging, illegally or legally, there has been applied trade regulation through mechanism of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). This international convention under administration of United Nation has the objective to support conservation of ramin species in its natural habitat through control in international trade.

Since 2002, the only permitted exports of ramin were from PT Diamond Raya Timber, PHKA reported a total of 3770 m3 of ramin products were exported legally – with CITES Export Permits. To implement determination of quota, integrated team has been established. The team consists of members from related institutions namely LIPI (Indonesian Institute of Sciences), as coordinator, Forestry Research and Development, IPB (University), local University and staff from the company.

Although ramin trade has been regulated through CITES instrument, but illegal trading is still the issue that threat ramin sustainability. Study by FWI (2002) show that ramin illegal trading has changed from log into sawn timber after application of logging ban since 2001. Illegal ramin woods were processed in sawmills into sawn timber and illegally traded by mixing with other wood species with comparison of 2:10.

Figure 3.2. Illegal sawn timber of ramin seized by Forestry Office of Jambi Province in 2005 (Photo by Bismark)

IV. CONSERVATION ASPECT

4.1. Conservation of the Species

4.1.1. Role of Forest Concession for Ramin Conservation

Production forests in Indonesia are managed by Forest Concessions. Management system for ramin forest is the system of Indonesian Selective Cutting and Planting (TPTI). This system has been set to ensure sustainability of forest and production, if it is carried out properly according to correct guidance of TPTI. General limit diameter of tree to cut is 50 cm with cutting cycle of 35 years and remaining at least 25 healthy trees with diameter 35 cm up per hectare as core trees. However for swamp forest, limit diameter of tree to cut is 35 cm due to rare big trees in swamp forest. Furthermore, regulation has been made for conservation of ramin, with ramin trees to be cut should have diameter of at least 40 cm and should be remained in the forest sufficient core trees (Director General of Forest Utilization decree No.564/Kpts/IV-BPHH/1989 renewed by DG of Forest Utilization decree No. 24/ Kpts/IV-set/1996).

In TPTI system, one forest concession area is divided into cutting blocks. One cutting block has an extent of about 100 ha. For sustainability of forest, every year, forest concession is only allowed to harvest in several cutting blocks, depending total area of forest concession and production forest, which have been designated upon approval of Annual Cutting Plan (RKT) by Provincial Forestry Office. With this management system, for rotation of 35 years, theoretically one cutting block will be harvested again after 35 years. Although there is no specific silviculture system for peat swamp forest, if current system of TPTI is applied correctly, it would ensure sustainability of peat swamp forest as ramin habitat. Furthermore, after ramin trees with diameter 40 cm up were cut, remaining ramin trees with diameter < 40 cm and 25 healthy commercial trees as core trees were left and now are available as parent trees. These parent trees would support ramin species conservation.

Due to high pressure on ramin trees, since 2001, logging ban has been applied for ramin, and the species has been included in Appendix II of CITES since October 2004. Therefore, officially forest concession that is allowed to harvest ramin and provided quota for ramin production is forest concession that applies sustainable forest management in its practices.

Moreover, according to regulation (Minister of Forestry decree No. 252/1993), in its area arrangement, forest concession should establish conservation area for plant and wildlife conservation. This area should exist as requirement and indicator that the area is managed according to the system of sustainable forest management. This area is known as conservation area in forest concession. To keep diversity of genetic resources including ramin, genetic resource area (ASDG) should be designated as *in situ* conservation area in every production forest, consisting of seed source trees in permanent production forest, covering 100 hectare for every five yearly plan (RKL) and germ-plasm conservation area (KPPN) in permanent production forest covering 100 - 300 hectare for every Forest Concession.

Actually, forest concessions have very important role in conservation of ramin. However, the regulation has not been applied properly. Utilization of ramin has been applied by over-harvesting and harvesting from outside cutting blocks without sufficient regeneration effort. No forest concession has determined conservation area except establishment germ-plasm conservation area (KPKN) by PT Diamond Raya Timber in Riau province as the only Forest

Concession that has permit of ramin utilization in Indonesia. The concession has determined germ-plasm conservation area (KPPN) totaling 350 ha as Biodiversity conservation area, wildlife pocket and field laboratory.

Figure 4.1. Germ-plasm conservation area (KPPN) in PT Diamond Raya Timber, Riau (left) and ramin parent tree in forest concession of PT Putra Duta Indah Wood, Jambi (right)

In-situ protection of ramin as well as other associated tree species would increase conservation area of the species. With consideration for conservation of ramin, it is required to activate forest concessions that have ramin. Active forest concessions would ensure that conservation of the species is maintained and monitoring is easy to be applied. This would also improve protection effort and conservation of ramin outside conservation area. Moreover, some Forest Concessions that are still active have made some efforts to produce seedlings. For examples, PT Diamond Raya in Riau has made trial by planting of ramin from shoot cutting seedlings. In 2003, PT Putra Duta Indah Wood in Jambi procured 14,000 ramin seedlings from wild to rehabilitate post fire area of Berbak National Park. This activity was continued by phase II planting of 6000 seedlings and phase III by 2000 seedlings. Moreover, in 2005 PT Putra Duta Indah Wood would make plantation of 5,000 ramin seedlings for enrichment of 200 ha logged over area.

Considering Forest Concession's important role for sustainability of seed sources and remaining ramin trees, it is required special policy in management of Forest Concession area. Forest concessions that have extended permit should be supported to apply sustainable forest management. Major issue that threat sustainable forest management is illegal logging. This issue should be overcome integratedly by involving related institutions. Community in surrounding forest area should be involved to improve productivity of peat forest through rehabilitation and development of social forestry by planting of mix species ramin with other leading local species.

4.1.2. Establishment of Conservation Areas

Conservation of peat swamp forest ecosystem as ramin habitat has been continued by establishment of nature reserves, arboretum, peat land nature laboratory, and national park. The management is carried out by Nature Resource Conservation Institute (BKSDA), educational institutions, local government, and NGO. Some conservation areas as ramin habitat that have been established in some provinces are shown in Table 4.1.

These conservation areas are known as habitat for ramin, however, in most areas there are no data of inventory regarding ramin. Estimation of growing stock is based on assumptions that 80% of conservation areas have ramin vegetation, of which, 10% has been illegally logged. Growing stock per hectare is approached from data of cruising result report from the nearest forest concession.

Although many conservation areas have been established, threats to sustainability of these areas have been becoming more intense. Major threats are due to illegal logging, over exploitation, forest fires, mining and other habitat degradation.In Mandor Nature reserve, West Kalimantan, in 1990, ramin was found in primary forest with important value index for tree 37.40% and pole 3.81%. No ramin was found in secondary forest (Faculty of Agriculture Researcher Team 1990). Currently, due to illegal logging, forest fire and illegal mining, there was no ramin or other species regeneration. Even, peat swamp forest has changed into sand fields and ponds as the result of soil piling process for gold mining.

Table 4.1. Ramin growing stock in conservation areas

Province	Name of Conservation Area	Area (ha)	No. Trees	Volume (m^3)
Riau	Kerumutan Game Reserve	120,000	236,604	501,316
	Tasik Belat Game Reserve	2,500	7,124	10,444
	Danau Pulau Besar Game Reserve	24,000	71,424	104,441
	Bukit Batu Game Reserve	24,000	68,567	100,263
	Tasik Besar Game Reserve	3,200	9,142	13,368
	Tasik Serkap Game Reserve	6,900	19,713	28,826
	Senepis National Park	60,000	93,405	128,066
Jambi	Berbak National Park	162,000	509,039,5	733,528,2
South Sumatera	Sembilang National Park	219,120	230,733	332,487
Central Kalimantan	Tanjung Puting National Park	414,000	697,505	624,804
	Sebangau National Park	589,000	510,892	373,287
	Nyaru Menteng Arboretum	65	57	41
West Kalimantan	Mandor Nature Reserve	3,080	10,491	16,757
	Muara Kendawangan Nature Reserve	150,000	510,948	816,100
	Danau Sentarum Nature Reserve	80,000	272,506	434,253

Establishment of conservation areas was mainly due to conservation of habitat for endangered wildlife, such as establishment of Senepis National Park on area 60,000 ha in Riau, as habitat of sumatran tiger (*Phantera tigris sumatrae*). However, there is advantage by establishment of conservation area. It also means extension of habitat for important flora species such as ramin. In Kalimantan, insitu conservation for ramin is important because ramin trees area also used by orang utan *(Pongo pygmaeus)* and Bekantan (*Nasalis larvatus*), as endangered and rare species that are only found in Indonesia, as source of food, nesting place and cover.

In Jambi, Berbak National Park Berbak has been managed through support of management planning for its buffer zone. Its part of buffer zone area has direct border with Forest Concession of PT Putra Duta Indah Wood. Management of buffer zone area was confirmed by the issue of Governor decree No. 320 /1990 regarding confirmation and management of buffer zone of Berbak National Park. However, there has been issue of national park management due to illegal logging, and search for jelutung gum (*Dyera costulata*) to national park through rail-road in Forest Concession. The report said that 40 % of national park area has been damaged due to illegal logging and forest fires (*Kompas*, March, 2003).

In Berbak, management of national park has carried out improvement of damage habitat by planting of ramin seedlings, totaling 22,000 seedlings. The seedlings were supplied by Forest Concession of Putra Duta Indah Wood, as buffer zone of the national park. By considering the success of enrichment of ramin species in Forest Concession area, it is expected that the success will also occur in national park. Main issue to achieve high survival of ramin plantation is its ecological dependency to shade and humidity. In this case, forest fires that often occur might result in unfavorable condition for the growth of ramin plantation.

4.1.3. Application of CITES Instrument

CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) is an instrument that governs international trade of listed species. The species are categorized in three appendices.

Appendix I, Endangered and threatened species. Trade of this species should comply with special regulation in order to keep its sustainability. Trade of this species is restricted to only from the result of breeding with exception for education and scientific research.

Appendix II. Species that is currently not yet endanger but it will threat sustainability of this species if trade and exploitation is not strictly regulated. This is to prevent utilization that is not in line with sustainability principle.

Appendix III. Each country determines regulation to the species according to its authority in order to prevent or to limit exploitation. There is cooperation relationship among member countries to monitor trade of the species.

Concerned with the considerable decline in the Indonesian population of ramin exacerbated by rampant illegal logging, Indonesia unilaterally included *Gonystylus* spp in Appendix III of CITES in April 2001. Regarding implementation in Indonesia, the listing of *Gonystylus* spp. was driven by concern about the rapid decline in the population of the genus caused principally by rampant illegal logging. Although conceding that illegal logging was partly a domestic problem, Indonesia was of the view that international demand and trade were also triggers for such activities. As CITES was an instrument governing international trade of listed species, Indonesia considered the listing of *Gonystylus* spp in Appendix III of CITES to be an appropriate measure.

Since the implementation of the listing was being hampered by problems related to a lack of understanding and familiarity with CITES procedures, inter-agency coordination and species identification, the workshop was informed that Indonesia was considering proposing the uplisting of *Gonystylus* spp into Appendix II of CITES, under which a 'non-detriment finding' (NDF) would be required for exports of the genus. Indonesia indeed proposeed this uplisting, and the proposal was accepted at the 13th Convention of Parties (COP) in Bangkok, October 2004. Therefore ramin is now included in Appendix II of CITES.

4.1.4. Technology to Develop Ramin Seedlings for Rehabilitation

Due to low ramin natural seedlings on logged over areas as the impact of environmental conditions such as openness of the area and microclimate change, efforts have been done to produce seedlings of ramin for rehabilitation purpose. To produce ramin seedlings, several methods have been trialed, namely, nursery raised seedlings, wild seedlings, and cutting (shoot cutting, stem cutting) and stump. Meanwhile, procurement of seedlings through tissue culture although have encountered some difficulties,

is in progress through research by Faculty of Forestry IPB and LIPI.

- **Nursery Raised Seedlings**

Procurement of seedlings from seed nursery has difficulties such as low germination rate of seeds and difficulty to find ramin seeds from nature. Ramin seeds belong to recalcitrant seeds with low viability rate and easy to decay. To obtain good plantation, seeds are collected from parent trees with good appearance in term of height and diameter, straightness of stem and health. Good seeds are gained from quite ripe fruits characterized by orange reddish color and picked directly from the trees. Seeds can also be collected from falling fruits, but previously under the tree, the place should be cleaned and wet part should be piled.

For collection, seeds should be cleaned from fruit skin, fruit body and its *arillus*, then seeds are collected temporarily in dry place. After dry enough, trees are stored in tight can place, to avoid seed respiration that reduces seed quality. Cans that contain seeds can be stored up to 15 - 30 days with germination rate of 50 - 80 percent. Seeds can also be stored temporarily in plastic bag containing damp sawdust in well air-conditioned room (18-20°C). With this method, seeds viability can be maintained with germination rate of 80-90% for 1-2 weeks.

Plastic bags used for planting the seeds after being holed are filled with soil or peat and arranged in seedbeds. Ramin seeds are planted 1.5 cm deep with cotyledon facing downward in plastic bag that has been filled with media and kept for humidity. Seedbeds in nursery are placed in north-south direction, 1 meter width and 6 meter long. Distance between seedbeds is 80 cm - 100 cm for easy maintenance. These seedbeds are roofed leaning towards west and the floor is raised 20 cm high from ground surface to avoid inundation during rain. After seedlings have 3 - 5 leaves, with height of about 30 cm, the seedlings can be moved to the field.

- **Cutting**

Procurement of seedlings through cutting can be done by 15 cm long shoot cutting collected from young plantation or cutting garden (7 - 9 years). Number and extent of leaves are reduced and applied with growth hormones and fungicides at its base. Then, cutting is planted on fine sand media and it is provided shade to screen about 95% of direct sunlight. Watering is carried out through fine sprinkler 3-4 times daily. With this method, roots of cutting are gained 40 - 65% after 5-9 months.

In PT Diamond Raya Timber, Riau, planting trial of ramin seedlings from shot cutting has been done on open areas former log collection area, skidding road and logged over areas under shade. Some 120 seedlings have been planted and after one month, survival rate achieved 100 % (Integrated Team, 2003).

Figure 4.2. Trial of ramin shoot cutting (6 months old) (Photos by Titi K)

Ramin seedlings can also be made from stem cutting. Materials of cutting are directly collected from parent trees in pole size and from wild seedlings 40 - 60 cm height. Wild seedlings are collected from field, meanwhile cutting materials from pole size trees are cut from good quality branches, free from disease, have *oculus* and strong. Packing of cutting materials from source area uses damp sack. Upon arrival in nursery, cuttings are cut to size of 12 cm long and average diameter of 6 mm. Cutting is made by crossing perpendicular to stem direction. Each cutting is expected to contain 1 - 2 oculus. Cutting is made using cutter special for cutting, and if there are leaves, the leaves are cut into a half of total length.

- **Stump**

Another method to produce ramin seedlings is by making stump. Stump is made from seedlings with height of about 35 cm (Alrasjid and Soerianegara, 1976). Good seedlings for stump are from seedlings with height of 35 – 75 cm, root length of 20 cm and stem of 10 - 20 cm. To make stump, root of seedling is cut into about 10 cm. Stem is also cut by remaining 2 leaves. Stump is then planted in poly-bag containing peat media and placed in transparent plastic hood. Growth hormones such as Rootone F and fungicide at the base are applied. After root and stem buds grow, plastic hood is opened and seedlings are maintained for 6 month, then ready to be planted in the field.

- **Wild Seedlings**

Wild seedlings are collected from the field with height of less than 25 cm and contain 3 – 7 leaves. Before collecting the seedlings from the field, peat media in poly-bag should be prepared under shade that screen direct sunlight by 90%. The media is mixed with charcoal dust 1/10 of the weight of peat media. Wild seedlings that have been put into plastic bag are placed in well shade seed beds. After 3-5 months, seedlings are ready to be planted in the field.

Figure 4.3. Nursery of ramin from wild seedlings (Photo by Titi K)

Figure 4.4. Procurement of wild seedling and planting of ramin on post fire area in PT Putra Duta Indah Wood, Jambi (Photo by Bismark)

4.1.5. Regulation and Policy in Conservation of Ramin

Although peat swamp forest has been utilized since long time ago, there is no special sylviculture system for peat swamp forest. This is a challenge for forestry sector in management of peat swamp forest with new concept, especially for management of forest concession in its extension period. Basic rules used in management of peat swamp forest are as follows:

1. Director General of Forestry decree No. 35/ Kpts/ DD/I/1972 regarding guidance of Indonesian selective cutting, clear cutting with natural regeneration and its monitoring guidances.
2. Director General of Forest Utilization decree No: 564/Kpts/IV-BPHH/1989 regarding guidance of Indonesian selective cutting.
3. Director General of Forest Utilization decree No: 24/Kpts-Set/96 regarding change in limit diameter cutting, cutting cycle, and diameter of core trees for peat swamp forest.
4. Presidential decree No. 32 /1990 regarding management of protection area.
5. Act No. 5 /1990 regarding conservation of bio-natural resources and Its ecosystem
6. Act No. 41 /1999 regarding Forestry

An important effort by Ministry of Forestry to suppress illegal trade of wood (especially ramin), was application of policy in moratorium of ramin harvesting through Ministry of Forestry decree No 127/Kpts-V/2001, dated on 11 April 2001 regarding moratorium of harvesting and trade of ramin *(Gonystylus* spp*)*. This policy has been applied due to sharp declined in ramin production and illegal logging that has encroached conservation area as indication of lack of potency outside conservation area. This regulation was followed by Minister of Forestry decree No. 168/Kpts-IV/2001 on 11 June 2001 regarding Utilization and Distribution of Ramin Wood (as follow up of decree No. 127/Kpts-V/2001).

Other important policy relate to ramin conservation has been carried out since 2001 by Director General of Forest Protection and Nature Conservation (PHPA) as Management Authority of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in Indonesia that proposed to CITES secretariate in Switzerland to include ramin in Appendix III of CITES through letter of Director General of PHKA No. 292/ D]-V/KKH/2001 on 12 April 2002. Therefore import of ramin wood from Indonesia was controlled by countries of CITES members. Furthermore, Indonesia was considering proposing the uplisting of *Gonystylus* spp into Appendix II of CITES, and the proposal was accepted at the 13th Convention of Parties (COP) in Bangkok, October 2004. Therefore ramin is now included in Appendix II of CITES.

There have been many regulations and policies to conserve ramin, but ramin is still under threat. This is due to weakness in application of such regulations (law enforcement) as well as illegal logging and illegal trade that disregard all regulations.

4.2. Threats to Sustainability of Ramin

Sustainability of ramin is under threat due to many problems the most important include (1) the silviculture of ramin that has not been totally known (2) illegal logging (3) habitat degradation and (4) forest fires.

4.2.1. Natural Regeneration and Silviculture of Ramin

In effort to conserve ramin through natural regeneration, some difficulties have been encountered. Ramin trees have irregular flowering and fruiting seasons. Generally, ramin trees produce fruits after reaching diameter of more than 35 cm. Germination rate of ramin seeds will reduce to 50% after 2-3 weeks in storage. Fruits that fall onto forest floor are often eaten by animals or decay before germinating, and this will reduce natural regeneration process.

Ramin trees also have low natural regeneration capability. Population of ramin shows abnormal tendency, which is more large individuals compared with smaller trees (Sutisna *et al,* 1988, Daryono, 1996). In undisturbed forest, population of seedlings is quite abundance, however in logged over areas the number of seedlings usually becomes low due to habitat disturbance and eaten by herbivores.

From observation of seedling in one year old logged over area of PT. Diamond Raya Timber in 2002, it was found average of 100 ramin seedlings per hectare with frequency of 4%. There was no sapling found. This condition was influenced by coverage of forest crowns. The growth of ramin seedling on certain level requires direct sunlight.

On five years old logged over areas no ramin seedlings were found. This condition showed that there was no more supply of seeds from parent trees. Ramin seedlings in sapling stage were obviously remaining seedlings from before harvesting. In cutting block area of 2002, there were found 13 ramin seedlings per parent tree and 0.4 saplings per parent tree (Integrated Team, 2003).

Figure 4.5. Natural ramin seedlings found 10 m from parent tree in PT Putra Duta Indah Wood, Jambi. (Photo by M. Bismark)

Due to high economic value of ramin, it has increased the extraction of ramin from nature. Meanwhile, ramin is known as slow growing species. Trial of ramin planting in logged over areas showed that after 3 years ramin only reached average height of 12.2 cm, with survival rate of 53% (FWI, 2002). Observation from some permanent measurement plots in PT Diamond Raya Timber Riau, showed slow growing of ramin with mean annual increament of only 0.375 cm/tree/year (*Rinaldi, pers. com.*). Therefore there has been no balance between growth and utilization. Difficulties in management of ramin forest especially related to low regeneration capability, difficulties to procure ramin seedlings for enrichment or planting due to characteristic ramin seeds as recalcitrant seeds, and unknown characteristics of regeneration.

In Indonesia, ramin is managed and harvested under the Indonesian Selective Cutting and Planting System, using a diameter of 50 cm as a limit and a cutting cycle of 35 years. The system requires at least 25 healthy trees 35 cm up diameter to be left as core trees. In reality, logging of ramin is difficult as it occurs in swamp forest. Special access is required through swampy areas. Railroad system that is constructed for log transportation usually cut many poles for road construction. During logging activities the felled trees usually destroy seedlings and saplings. Therefore, harvesting not only reduce the number of trees but also diminish the quantity of young trees.

Exploitation of ramin trees by forest concessions in swamp forest is carried out by semi mechanic system. Study by Dulsalam and Sumantri (1990) showed that Exploitation waste of ramin in six (6) Forest Concessions in West Kalimantan and East Kalimantan was 11.1 – 21.2% or average 16.6% (with exploitation factor of 0.8), consisting of stump waste 2.9% and stem waste 13.7%. Average exploitation waste in West Kalimantan was 20.05% and in East Kalimantan was 12.6%. The difference was caused by heavier field condition in West Kalimantan. To reduce waste, technique of harvesting, utilization and handling of ramin after harvesting should be improved.

4.2.2. Illegal Logging and Trading

Production forests in Indonesia are managed by forest concessions. Due to degradation in forest potency and habitat, high production cost, bureaucracy and illegal logging many Forest Concessions in swamp forest that have been provided permit extension, have stopped their operation. In Riau, only one Forest Concession is still in operation and also one in Jambi. Similarly also occurs in two other provinces known as ramin producers, West Kalimantan and Central Kalimantan. Moreover, policy by local government to issue logging permit (IPK) has also led to forest degradation and reduction of ramin potency.

In Riau Province for example from 30 Forest Concessions that have ramin, some have been provided permit extension. However, they have stopped the operation because their documents such as Five Yearly Plan (RKL) and subsequently Annual Work Plan (RKT) have not been approved by Ministry of Forestry.

Figure 4.6. Wood from illegal logging (some are ramin) have been seized by Nature Resource Conservation Institute (BKSDA) Riau (left) and Provincial Forestry Office of Jambi (right) (Photo by Bismark)

Non-active forest concessions that have infrastructure in the field have triggered the occurrences of illegal logging, because no one is responsible for management, and the area seems to be belong to no one. Even on some forest concessions that are still in operation, illegal logging occurs and cannot be controlled such as some cases in PT Putra Duta Indah Wood Jambi. Case in Forest Concession of PT Putra Duta Indah Wood in Jambi Province after prohibition of ramin harvest in 2001, price of ramin wood increased and triggered illegal logging by community in Forest Concession area. It was estimated that 10.000 m^3 ramin from illegal logging has been sent out in 2002 – 2003. Now, it is difficult to find potential ramin trees as parent trees in LOA PT Putra Duta Indah Wood.

Figure 4.7. Wood from illegal logging transported using railroad in Forest Concession of PT Putra Duta Indah Wood, Jambi (Photo by Bismark).

Impact of illegal logging to ramin was studied by Suwarso (1996) in Forest Concession of PT SBA Wood Industries in South Sumatera. On area that has been illegally logged, no ramin trees were found although the trees were found in primary forest. Statistical records from Central Kalimantan province (year 2000) showed level of illegal logging for ramin up to 7 %, and 10 % for total log production (Central Kalimantan in Figure, BPS, 2002).

Illegal logging occurs not only in active and non-active Forest Concession, but more occurrences in conservation areas such as national park. For example in Berbak National Park in Jambi, 40 % of the area has been damaged mainly by illegal logging and forest fire (*Kompas*, March 2005). In Central Kalimantan, Tanjung Puting National Park as habitat of orang utan and bekantan, has high ramin population. There has been serious issue of illegal logging in this area, as this has gained high concern from international community. Illegal loggers have logged ramin from many locations in this national park area. Even, illegal logging has reached location of orangutan research area in Camp Leakey, far in remote area (Telapak – EIA, 2000).

Illegal logging obviously causes losses. It causes rapid diminishing resource, meanwhile the community as a whole does not receive much benefit. When the forest is illegally logged, no taxes are paid to provide for development projects. Those who work as loggers tend to come from the poorer sectors of the community, and the work is not a long-term and stable source of income.

The harvest of ramin is heavily driven by international trade and eventually has led to an over-exploitation of such a high value resource. The wide range uses of the timber also makes the species valuable in international market, with average price of more than US$ 1/kg. High demand also has trigerred illegal logging. High tendency of illegal logging is shown for example from unbalance data of ramin timber trade between Indonesia and Taiwan as in Table 4.3.

Table 4.2. Note of ramin trade from Indonesia to Taiwan

Parameter	Year		
	1997	1998	1999
Report by Taiwan for ramin that enters Taiwan from Indonesia (in m^3)	721,828	1,986,867	8,124,507
Report by Indonesia for ramin that enters Taiwan from Indonesia (in m^3)	1,730,003	659,894	611,002

Source : Telapak – EIA, 2001.

4.2.3. Habitat Degradation

Other major threat to ramin forest is forest degradation. Much of the peat swamp forest area has been subject to degradation caused by conversion to other uses and forest fires. Conversion of more than one million hectare of peat swamp forest into mega rice field in Central Kalimantan is example of peat swamp forest degradation. However, the rate of deforestation is not accurately known, though various estimates have been made, ranging from 700,000 to 1,200,000 ha per year for all forest types (Murphy, 2001).

Shallow peat soils (between 2-3 m) have been classified as conversion forest such as for conversion to agriculture, although these areas belong to marginal lands and incidence of crop failure is very high. These areas have been subject to clear cutting and commercial logging. Canals are usually made to facilitate log transport, and this activity has drained the peat dome, leading to subsidence, peat oxidation and fires.

The following Table shows peat swamp forest degradation in provinces known as ramin producers.

Other threat to degradation of ramin habitat is conversion of forest to other uses. This is shown from data of forest utilization that include forest area available for conversion in ramin producer provinces. Table 4.4 shows that forest areas that can be converted for each province are 28.07 % in Riau, 34.27 % in Jambi, 2.47 % in South Sumatera, 4.19 % in West Kalimantan and 17.69 % in Central Kalimantan. Conversion of these areas will obviously cause degradation of forest also as ramin habitat.

Other important issue related to habitat degradation is establishment of forest plantation on permanent production forest. Clear cutting to this area will cause degradation to ramin population and will increase susceptibility to forest fire.

Table 4.3. Degradation of peat swamp forest in Indonesia

Province	Area (ha)	
	1983[1)]	2002[2)]
Riau	2,222,000	1618,000
Jambi	375,500	362,000
South Sumatera	684,750	46,000
West Kalimantan	3,731,120	1,732,000
Central Kalimantan	5,491,230	3,160,000

Sources : 1) Directorate of Forestry Planning (1983)
2) Forestry Planning Agency (2002)

Table 4.4. Total extent of forest area in five provinces as ramin producers based on Landsat satellite imageries in 2003

No.	Province	Permanent Forest (x 1000 ha)				Conversion Forest	Total
		Protection Forest	Conservation area	Production Forest	Limited Production Forest		
1.	Riau	243.50	236.30	1.226.70	1.334.80	1.184.20	4.227.60
2.	Jambi	96.00	349.10	574.80	211.10	422.00	1.231.00
3.	South Sumatera	226.70	239.10	204.30	29.00	17.70	716.80
4.	West Kalimantan	1.770.40	1.184.10	952.20	1.490.70	294.80	4.694.40
4.	Central Kalimantan	762.60	516.40	3.670.70	2.851.80	1.677.00	9.478.50

Source : Ministry of Forestry (2004)

4.2.4. Forest Fire

Main issue that threats forest sustainability in Indonesia is forest fire. For example in 1997/1998, with the occurrence of El-Nino, has caused drought in Southeast Asia and forest fires in some regions of Indonesia. More than one million hectare of forest area has burned in Sumatera and Kalimantan. Rowell and Moore (1999) reported total loss due to forest fires that reach USD *9.7 billions.* Damage due to 1997/1998 forest fire to peat swamp forest as ramin habitat is shown in Table 4.5.

Table 4.5. Damage of peat swamp forest due forest fire in 1997/1998

Location	Area extent (ha)	Burned Area	Percentage (%)
Berbak National Park (Jambi)	162,000	18,000	11
Sembilang National Park (South Sumatera)	219,000	40,000	18
PT Putra Duta Indah Wood (Jambi)	61,000	8,850	14.5

Sources : Lubis and Suryadiputra (2003), Subagyo (2003)

Peat swamp forest is one of the forest types in Indonesia characterized by thick organic layers, organozol soil type and high rainfall or wet climate. Main danger that threats sustainability of peat forest is fire that may kill all vegetation, difficult to extinguish and produce dense smoke (smoke pollution). All forest fires in peat swamp forest of Sumatera and other areas are caused by human activities. Fire occurrences are supported by climate condition such as long drought that causes dryness in peat soil, because in normal condition peat soil is always wet and inundated with water. Some activities that have been recorded to cause forest fire in peat soils are as follows:

- Conversion of peat forest into forest plantation by slash and burn to be planted with trees to produce pulp and paper.
- Burning of areas for construction of skidding road with railway system on peat land.
- Conflict of interest between concession holder and community.
- Slash and burn system applied by farmers as traditional agriculture system *(shifting* cultivation) for land clearing and planting.

The practice of traditional farming system to produce local paddy in Sumatera known as Sonor. This system is applied in dry season by burning for land preparation. In 1997/1998 thousands hectares of peat lands are burned for sonor practice with average extent of each family was 5 ha (Ruchyat and Suyanto, 2001).

In normal condition, peat soil is saturated with water and difficult to bum. In dry season, water table reduces and organic material of peat dries-out, easy to burn. Fire in peat land is generally initiated with surface fire; furthermore the fire spreads into under the surface or under ground to burn organic materials or vegetation debris. Therefore, type of fire in peat land consists of both surface fire and ground fire. Fire in peat soil as ground fire is difficult to detect because the fire burns organic materials and creeps under the ground. Often, fire location is fall with smokes that obstruct vision and causing pollution.

Impact of peat fire can be seen from characteristic of peat and the function of peat ecosystem, as swamp ecosystem that has special function for stability of living environment. Impact of peat land fire according to Arsyad (1997) based on characteristic of peat and its ecosystem function is as follows:

- Reduce regulating function of carbon; Peat contains about 50 - 60 % C, 0.5 - 2.5 % N, 0. 1 - 0.4 % S, with bulk density of 300 - 400 kg per cubic meter. Every hectare of 20 cm deep peat that burn will release at least 1,100 ton COx, 3.9 ton NOx, 1.8 ton SOx to the air as well as some methane and aerosol. Total gases released to the air during peat fire depend on the extent and deep of burned peat. These gases are green house gasses that have impact to climate change (global warming).
- Reduce hydrological function. Peat in swamp areas is water reservoir that increases water storage capability of watershed area. Peat has the function as water regulator to keep fluctuation of water flow in wet season and dry season. Peat fire will reduce hydrological function (reservoir function) and may cause flood and drought.
- Reduce adsorption function. Peat and peat ecosystem have capability to adsorb toxic materials to environment such as mercury, lead, cadmium, arsenic, zinc, and selenium. These

materials are adsorbed by peat therefore it does not poison water and environment. For years peat have adsorbed these materials and distributed evenly in every part of peat. If peat bums, adsorption function of peat will reduce and these materials will release and flow into water and environment as threat to live in this environment.

- Smoke pollution. Peat fire will produce dense smoke. The smoke will cause health problem as well as air and land transportation.
- Reduce buffer zone function. In coastal area, buffer zone function of peat between fresh water system and salty water system is very important. Destruction in peat area will cause damage to the entire ecosystem.
- Reduce production function. Peat forest, although has low fertility, in some locations are habitat for fancy wood trees such as ramin (*G. bancanus*) and Jelutung (*Dyera costulata*). Fire obviously will kill all vegetation in peat soil. Peat area that burns regularly will be dominated by undergrowth species such as grasses and ferns and pioneer species such as gelam (*Melaleuca cajuputi*).

In relation with fire, although peat forest is usually wet, in dry season fire is a potential threat to sustamability of peat forest. Fire in peat forest may kill forest stands and its suppression effort is difficult to be done. Therefore, prevention effort is important to be applied. The practice of peat forest conversion into forest plantation should be prohibited. As for construction of canals for log transportation, it should be stopped.

Figure 4.8. Peat fire in forest concession of PT Putra Duta Indah Wood, Jambi that produces dense smoke

According to current regulation, concession holder in peat swamp forest should provide tools and equipment for forest fire prevention and control. Such tools and equipment should be procured and well maintained. It is also required fire control personnel, adequate in number, and well trained, to prevent and extinguash small fire before it becomes big wild fire.

4.3. Proposed Activities for Ramin Conservation

In order to overcome the issue of ramin utilization, and improve conservation efforts, some activities should be done integratedly. In detail, the activities are shown in Table 4.6.

Table 4.6. Proposed activities for ramin conservation

No.	Issue	Activity	Executor
1.	Habitat degradation	No more conversion of peat swamp forest to other utilization	Government
2.	Problems of enforcement on wild harvest and trade monitoring including from within Protected Area	Improvement of law enforcement in utilization and trade of ramin Re-inventory stock of ramin wood in the field	DG of PHKA Local Forestry Offices Forda
	Issues on current species distribution and population in the wild	Establish permanent plot. Scientific study of ramin, distribution and potency as input for policy making	LIPI Local Forestry Offices Company, Consession Forda
3.	Issues on standing stock assessment of ramin in the wild	Re-inventory of ramin in each ramin location (Province/District)	Active ramin FC Active non-ramin FC Ex-FC by Forda
4.	Issues on regenerating and rehabilitation	Determination of parent trees that produce seeds, continue observation and study on planting technique of ramin in the field and development of ramin plantation.	FC Forda Universities
5.	Issues of illegal harvesting ramin from Protected Area	No tolerance of harvesting on Conservation Area.	
6.	Issues related to harvest level/ sustainable harvest	Improvement Silviculture System of peat swamp forest especially ramin per-region Evaluation to ramin permanent plot (PUP)	Forda DG of Forest Utilization Universities
7.	Issues on enforcing quota of ramin	Improvement of monitoring on utilization of ramin quota by Local Forestry and authority to KSDA to monitor trade of flora belong to Appendix III.	Local Forestry Office DG of. PHKA
8.	Practical solution to enhance the effective enforcement for both harvest and trade (domestic and international)	Control on distribution of ramin in the country or export.	Local Forestry Office DG of Custom DG of PHKA
9.	Issues on policy of total ban for harvesting ramin in the wild	Evaluate the effectiveness of moratorium.	Minitry of Forestry (coordinator) DG of Custom Min. of Trade LIPI

Table 4.6. Continued

No.	Issue	Activity	Executor
10	Terminology of illegal trade in ramin	Coordination to define Illegal Trade	Min. of Trade DG of Custom Minitry of Forestry
11	How to harmonize the statistical records among the relevant agencies	Coordination between Min. of Forestry, Trade and Custom in relation with the use of HS (Harmonized System) Code.	DG of. BPK DG of. PHKA DG of Custom Min. of Trade
12	Identify the key issues on enforcement collaboration with the neighboring countries	Agenda for discussion in ASEAN countries	ASEAN Secretariat
13	Solution to the existing counter/barter trade between Indonesia and the neighboring countries	Discussion between DG of Custom and Ministry of Trade regarding implementation of Barter Trade.	DG of Custom Min. of Trade

Note :
PHKA = Forest Protection and Nature Conservation
BKSDA = Natural Resource Conservation Institute
Forda = Forestry Research and Development Agency
LIPI = Indonesian Science Authorithy

V. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusions

1. Ramin is a trade name of tropical wood and trees belonging to genus *Gonystylus* family of *Thymelaeaceae*. It has very high quality of wood, therefore the demand of this species is very high and has threatened the sustainability of this species.
2. Indonesia is natural habitat of ramin (*Gonystylus* spp). Five provinces in Indonesia, namely Riau, Jambi, South Sumatera, Central Kalimantan and West Kalimantan are known as ramin producers.
3. Ramin genus is found in habitat from swamp forest, low-land forest, to high land forest. Especially for *Gonystylus bancanus* Kurz as main object of this study, the habitat is in peat swamp forest.
4. There has been ramin habitat degradation. From initial area of peat swamp forest in five provinces (Riau, Jambi, South Sumatera, West and Central Kalimantan) that covered 12,526,000 ha (in 1983), current data from the result of satellite imageries interpretation showed the extent of peat swamp forest of 6,716,000 ha or 53.6 % from total area extent in 1983.
5. In nature, population of ramin is influenced by the depth peat. The highest population of ramin is found on peat soil with more than 3m depth. Range of density and volume of ramin in every province varies depending on habitat, extent of surveyed area and year of observation. Ramin with diameter of 20 – 39 cm in five provinces varies from 0.02 – 5.08 trees/ha with volume of 0.08 – 10.48 m^3/ha, or average of 4.3 trees/ha with volume of 5.3 m^3/ha. Volume of ramin to total volume of all species (diameter > 40 cm) the highest was 12.41%. Remaining stands of ramin after harvesting, the highest was 68 % with volume 47.26 % of initial stock.
6. Estimation to ramin growing stock with assumptions that potential area for ramin 80%, and illegal logging 10%, growing stock in five provinces is estimated to 14,757,221 m^3 or 11.3 % from that reported in 1983. Habitat degradation reached 46.4 % from total area in 1983. 31.1% of ramin habitat is on conservation areas, with 27.1% of all estimated growing stock.
7. Some studies showed that ramin seedlings in primary forest was quite abundance, varied from 166 – 4,000 seedlings per hectare, and less for saplings that varied from 20-217 saplings per hectare. On logged areas the figures varied from 0 – 4,000 seedlings and 0 - 480 saplings per hectare. In natural condition, ramin pole stage is usually lower than trees. Poles also have been harvested for many purposes. Ramin also belongs to slow growing species with increament of only 0.375 cm/tree/year.
8. Reduction in ramin population is also caused by high demand in ramin trade. Trade data of ramin from Indonesia show reduction in official figures of trade, 652,158 m^3 in 1995, 0 m^3 in 2001 and 13,469 m^3 in 2004 as official quota. However some studies have proven the occurrences of illegal trading.
9. Ramin forest is under management of conservation areas and forest concessions. Forest concessions that manage ramin on production forests have been applying silviculture system of Indonesian Selective Cutting and Planting (TPTI). Although there is no specific sylviculture system for ramin forest, limit diameter of ramin to cut is 40 cm up meanwhile for general swamp forest species, limit diameter is 35 cm.
10. Forest concessions has significant role in ramin conservation. This includes application of TPTI system, establishment of conservation area for plant and wildlife conservation, as well as efforts by forest concessions to establish

ramin plantation for enrichment planting. Due to technical issues, some forest concessions with extension permit have stopped their logging operation. This condition has led to increasing number and intensity of illegal logging, because no more control for the area and infrastructure belong to forest concession is still available to make easy illegal logging.

11. To overcome illegal trade issue and for conservation of ramin, Indonesia has made effort to include ramin trade through CITES. Currently ramin is in Appendix II of CITES. Moratorium of ramin harvesting has been applied since 2001, and only one forest concession (PT Diamond Raya Timber) has been provided ramin production permit through application of sustainable forest management.
12. Conservation efforts to conserve ramin have been done through increase in conservation areas including management of buffer zone and forest fire prevention and control, application of some regulations, research and studies related to artificial regeneration of ramin such as through nursery raised seedlings, cutting, seedlings from wild and even by tissue culture research. Other important effort is also combating illegal logging and illegal trading through coordination with related institutions, NGO and active participation in CITES discussion.
13. Although conservation efforts have been done, ramin is still under threat mainly due to conversion of peat swamp forest to other land uses, illegal logging and trading, and forest fires.

5.2. Suggestions

1. No more conversion of peat swamp forest especially with ramin abundance into other land uses.
2. A need to make accurate inventory on growing stock and distribution of ramin in the field to determine necessary steps in management and conservation of ramin.
3. Provide incentives to ramin potential forest concessions to operate with special regulations that ensure sustainability of ramin in its area.
4. Improve system in ramin trade to prevent illegal trading.
5. Real action to combat illegal logging and activities to prevent forest fires.
6. More control to conservation areas.

REFERENCES

Airy Shaw. 1954. Thymelaeaceae-Gonystyloideae. In C.G.G.J. Van Steenis (*Editor*) Flora Malaysiana. Ser. I. Vol. IV. Noordhoff-Koef. NV. Jakarta. p. 358 – 365

Akbar, A. 1995. Possibility of ramin (*Gonystylus bancanus*) Vegetative Regeneration Using Cutting for Procurement of Forest Plantation Materials. Forest and Nature Conservation Research and Development, Bogor. Forest Research Bulletin. No. 584. p. 1 - 9.

Alrasyid, H dan I. Soerianegara. 1976. Temporary Guidance for Planting of Ramin (*Gonistylus bancanus* Kurz). Report No. 231. Forest Research Institute. Bogor.

Arsyad, S. 1997. Fire in Peat Land. Paper at the Post Forest Fire Workshop. Kehati Foundation. Jakarta.

Bhara Induk, PT. 2000. Annual Work Plan (RKT) of PT Bhara Induk. Riau

Biology Team. 2000. Data Analysis of Vegetation. Environmental Impact Assessment Report of Forest Concession of LGC Muhammadiyah University, Palangka Raya, Kotawaringin Timur District, Central Kalimantan.

BPS. 2000a. Jambi in Figures. BPS-Statistics. Jakarta.

BPS. 2000b. South Sumatera in Figures. BPS-Statistics. Jakarta.

BPS. 2001a. Central Kalimantan in Figures. BPS-Statistics. Jakarta.

BPS. 2001b. Statistics of Forest Concession Estate. BPS-Statistics Indonesia.

BPS. 2003. Riau in Figures. BPS-Statistics. Jakarta.

Budaya Hutan Alam, PT. 2000. Enironmental Monitoring Plan. Kapuas District, Central Kalimantan.

CIMTROP. 2002. Biophysical Characteristics of Area Between Sebangau and Katingan

CITES. 1994. Trade in Plants Specimen of Ramin *Gonistylus bancanus*. Document Submitted at the 9th meeting of the Conference of the Parties of CITES. Fort Landerdale, USA. November. 1994. Unpublished.

CITES. 2004. Convention on International Trade in Endangered Species of Wild Fauna and Flora : Appendices I and II of CITES Thirteenth meeting of the conference of the Parities. 3 – 14 October 2004. Bangkok. Thailand.

Currey, D. dan A. Ruwidriyanto. 2000. Illegal logging in Indonesia, South East Asia and International Consumption of Illegal Timber in Timber Trafficking. Environmental Investigation Agency and Telapak Indonesia.

Currey, D. dan A. Ruwidriyanto. 2002. Illegal logging in Tanjung Puting National Park. Environmental Investigation Agency and Telapak Indonesia.

Daryono. 1996. Condition of Standing Stock and Natural Regeneration of Peat Swamp Forest after Loging ant Its Propagation Technique. Discussion of Research Results to Support Sustainable Forest Utilization. Cisarua 11-12 March 1996. Forest and Nature Conservation Research and Development Center, Bogor.

Dexter Kencana Timber, PT. 2001 and 2002. Annual Work Plan (RKT) of PT Dexter Kencana Timber. Riau

Diamond Raya Timber, PT. 1999. Annual Work Plan (RKT) of PT Diamond Raya Timber. Riau

Directorate of Forestry Planning. 1983. Potency and Distribution of Commercial Wood in Indonesia. Ramin Book 3. Directorate General of Forestry, Ministry of Agriculture. Jakarta.

Dulsalam and I. Sumantri. 1990. Exploitation Factor of Meranti and Ramin Wood in Natural Forest of Outside Java. Journal of Forestry Research and Development. Vol. VI, No. 3. December 1990. Jakarta.

Essa Indah Timber, PT. 1996 and 1998. Annual Work Plan (RKT) of PT Essa Indah Timber. Riau

Expra Baru, PT. 1992 and 1997. Annual Work Plan (RKT) of PT Expra Baru. Riau.

Faculty of Agriculture Researcher Team. 1990. Vegetation Analysis of Flora and Fauna in Game Reserve Area Mandor, West Kalimantan. Report of Research by Faculty of Agriculture of Tanjung Pura University, Pontianak, West Kalimantan

Forestry Planning Agency. 2002. Vegetation Maps of Riau, Jambi, South Sumatera, West Kalimantan and Central Kalimantan. Ministry of Forestry. Jakarta.

Forestry Planning Agency. 2005. Data of Log Production from Natural Forest Concession per Province 1991-2004. Jakarta.

Forest Watch Indonesia. 2002. Ramin : Domestic and International Trade. Forest Watch Indonesia. Bogor.

Harapan Baru Wood Co, PT. 1995 and 1997. Annual Work Plan (RKT) of PT Harapan Baru Wood Co. Riau

Integrated Team. 2002. Report on The Result of Field Assessment of Ramin Potency (*Gonystylus bancanus* Kurz.) in Forest Concession (HPH) of PT Diamond Raya Timber for 2002 Annual Work Plan (RKT).

Integrated Team. 2003. Report on The Result of Field Assessment of Ramin Potency (*Gonystylus bancanus* Kurz.) in Forest Concession (HPH) of PT Diamond Raya Timber for 2003 Annual Work Plan (RKT).

Integrated Team. 2004. Report on The Result of Field Assessment of Ramin Potency (*Gonystylus bancanus* Kurz.) in Forest Concession (HPH) of PT Diamond Raya Timber for 2004 Annual Work Plan (RKT).

Istomo, 2004. Ecology and Management of Ramin in Indonesia. Paper presented at the National Workhop on Trade in Ramin in Indonesia. Bogor (Unpublished).

Istomo. 1998. The Distribution of Ramin Ramin (*Gonystylus bancanus* Kurtz.) in the Peat Forest (Case study in PT Inhutani III. Central Kalimantan). Laboratory of Forest Ecology. Faculty of Forestry. Forest Management Bulletin: p. 33 – 39.

ITTO Tropical Forest Update. 2004. Tri-national workshop on trade in the commercial timber species, ramin (*Gonystylus* spp.).

IUCN. 2000. 2000 Red List at Threatened Species. IUCN. Gland. Switzerland.

Kangly Lumber, PT. 1998. Annual Work Plan (RKT) of PT Kangly Lumber. Riau

Karya Delta Permai, PT. 1999. Environmental Impact Assessment (former Forest Concession of PT. Dacridium II), Barito Utara District, Central Kalimantan.

Karya Indah Sakti Mandiri. PT. 2000. Environmental Impact Assessment, Barito Selatan District, Central Kalimantan.

Kertas Basuki Rachmat, PT. 1998. Environmental Impact Assessment of Timber Estate, Ketapang District, West Kalimantan.

Kompas. 26 March 2005. 40 Percent of Berbak National Park has been Encroached. Kompas, Saturday,.

Kompas. 26 June 2005. 1,000 ha of Mandor Game Reserve turned into sand field. Saturday, 26 June 2005.

Koperasi Serba Usaha Bajenta, 2000. Environmental Impact Assessment, District Kapuas, Central Kalimantan

Kosmar Timur Raya, PT. 2001 Annual Work Plan (RKT) of PT Kosmar Timur Raya. Riau

Lawang Haring Perkasa, PT. 1999. Environmental Impact Assessment, Kotawaringin Timur District, Central Kalimantan.

Lim, T.W., T. Suhartono and Chen H.K. 2004. Framing the Picture : The Measurement of Ramin Trade in Indonesia, Malaysia and Singapore. Traffic. South East Asia Report.

Lubis, I and I.N.N. Suryadiputra. 2003. Efforts in Integrated Management of Burned Over Peat Swap Forest in Berbak-Sembilang Area. *In* Suyatno, U. Chokkalingam and P. Widodo, *eds.*) Proceeding of Workshop: Fire in Peat Land of Sumatera: Issues and Solutions. CIFOR.

Minister of Forestry Decree. 2001. Ammendment to Minister of Forestry Decree No. 168/Kpts-IV/2001. Regarding Utilization of Ramin (*Gonystylus* spp.).

Ministry of Forestry. 2004. Staregic Data of Forestry. Ministry of Forestry. Jakarta.

Moharison Pawan Khatulistiwa, PT. 2000. Environmental Impact Assessment of Forest Concession of PT Moharison Pawan Khatulistiwa, Ketapang District, West Kalimantan.

Muhammadiyah University, LGC. 2000. Environmental Impact Assessment, Kotawaringin Timur District and Kotamadya Palangkaraya, Central Kalimantan.

Multi Eka Jaya, PT. 1996. Annual Work Plan (RKT) of PT Multi Eka Jaya. Riau

Murphy, D. 2001. The 1998 Fall of Suharto has Set Off Logging Boom in Indonesia's National Parks. The Christians Science Monitor, August 23, 2001.

National Timber, PT. 1998. Annual Work Plan (RKT) of PT National Timber. Riau

New Union Timber, PT. 1997. Annual Work Plan (RKT) of PT New Union Timber. Riau.

Perkasa Baru , PT. 1997. Annual Work Plan (RKT) of PT Perkasa Baru. Riau.

Prastyono, T. Hardi T.W. and B. Ismail. 2004. Ramin (*Gonystylus* spp.) : Leading Species Vurnerable to Extinction. Sylvatropika. Forestry Research and Development Agency. p. 7 – 9.

Pratiwi. 2002. Impact of Forest Fire and Some Efforts to Rehabilitate Post Forest Area in Swampy Forest, Sungai Kumpeh, Jambi. Forest Research Bulletin No. 630/2002. Bogor.

Prosea. 1995. Ramin. Information Sheet of Prosea (10): 56-58. Prosea. Bogor.

Putra Duta Indah Wood, PT. 2003, 2004 and 2005. Annual Work Plan (RKT) of PT Putrra Duta Indah Wood. Jambi.

Riau Putra Bersama, PT. 2000. Annual Work Plan (RKT) of PT Riau Putra Bersama. Riau.

Rimba Karya Indah, PT. 1994, 1995, 1997, 1998, 1999, and 2001. Annual Work Plan (RKT) of PT Rimba Karya Indah. Jambi.

Rokan Permai Timber, PT. 2001. Annual Work Plan (RKT) of PT Rokan Permai Timber. Riau.

Rokinan Timber Corp, PT. 1999. Annual Work Plan (RKT) of PT Rokinan Timber Corp. Riau.

Rowell, A dan P.F. Moore. 1999. Global Review of Forest Fire. WWF-IUCN.

Ruchyat, Y and S. Suyanto. 2001. Economic Characteristics in Swamp Area in relation with Forest and Land Fires in Sumatera. In Proceeding of One Day Seminar of Underlying Causes and Impact of Forest and Land Fires in Sumatera, Bandarlampung.

Sejati Riau I, PT. 1994. Annual Work Plan (RKT) of PT Sejati Riau I. Riau.

Setia Alam Jaya, PT.1993. Environmental Impact Assessment, Kapuas District, Central Kalimantan.

Silva Bina Timber Co, PT. 1997. Annual Work Plan (RKT) of PT Silva Bina Timber Co. Riau.

Silva Sakti, PT. 1996. Annual Work Plan (RKT) of PT Silva Sakti. Riau.

Siregar, M and A. Ruskandi. 2000. Study on Ecology of Game Reserve Forest of Muara Kendawangan, West West Kalimantan. Technical Report on Inventory and Characteristic of Natural Resources. Research Center for Biology, LIPI, Bogor.

Soediarto, R., R. Soetopo dan Lukito, D. 1963. Remarks on Ramin (*Gonystylus* spp). Forest Product Research Institute, Bogor.

Soehartono, T and A. Mardiastuti. 2002. CITES Implementation in Indonesia. Nagao Natural Environment Foundation. Jakarta.

Soehartono, T. 2003. Sustainable trade in agar wood and ramin from Indonesia. Paper presented at the National Strategy on Conservation and Trade of Trees in Indonesia. LIPI, Bogor.

Soerianegara, I and R.H.M.J. Lemmens (Eds). 1994. PROSEA. Plant Resources of South East Asia 5 (1) Timber Trees : Major commercial timbers. PROSEA. Bogor.

Soerianegara, I. 1996. Evaluation and Determination of Ramin Forest Management System based on Sustainability. Collection of Researches. Faculty of Forestry, IPB. Bogor.

Sri Buana Dumai, PT. 1997. Annual Work Plan (RKT) of PT Sri Buana Dumai. Riau.

Subagyo, H.S. 2003. Experience of PT Putra Duta Indah Wood in Handling of Forest Issue in Production Forest. *In* Suyatno, U. Chokkalingam and P. Widodo, *eds.*) Proceeding of Workshop: Fire in Peat Land of Sumatera: Issues and Solutions. CIFOR.

Sumber Mitra Jaya, PT. 2000. Environmental Impact Assessment of Timber Estate, Kotawaringin Timur District, Central Kalimantan.

Sungai Rangit, PT. 2000. Environmental Impact Assessment, Kapuas District, Central Kalimantan.

Suripto. 2005. Eradicating Illegal Logging. Republika, Wednesday 16 March 2005.

Sutisna, U., H.C. Soeyatman and M. Wardani. 1988. Analysis of Tree Species Composition of Peat Swamp Forest in Tangkiling and Sampit, Central Kalimantan. Forest Research Bulletin No. 497: 41 - 56

Suwarso. 1996. Peat Swamp Vegetation Damage Due to Illegal Logging in Forest Concession Area. Case Study in Forest Complex of Tanjung Koyan, Sungai Lumpur, OKI, South Sumatera. Magister Science Thesis IPB. Unpublished.

Telapak-EIA. 2000. Illegal Logging in Tanjung Puting National Park. An Update on the Final Cut Report.

Telapak-EIA. 2001. Timber Trafficking, Illegal Logging in Indonesia, Southeast Asia and International Consumption on Illegal Timber.

The Best One Uni Timber, PT. 1994. Annual Work Plan (RKT) of PT The Best One Uni Timber. Riau.

Triomas FDI, PT. 1998. Annual Work Plan (RKT) of PT Triomas FDI. Riau.

Triomas FDI, PT. 1999. Annual Work Plan (RKT) of PT Triomas FDI. Riau.

Ubbi Mekar, PT. 2000. Annual Work Plan (RKT) of PT Ubbi Mekar. Riau.

Yos Raya Timber, PT. 1997. Annual Work Plan (RKT) of PT Yos Raya Timber. Riau.

Appendix 1. Distribution of *Gonystylus* spp. based on collection of herbarium by Forest and Nature Conservation Research and Development Center (FNCRDC)

KALIMANTAN

No.	Species	Collection Number	Local Name	Distribution	Alt. (m asl).	Year Collected	Dbh	Height (clear bole)	Total Height
1	2	3	4	5	6	7	8	9	10
1	*G. affinis* A.Shaw.	bb. 6415	Banit	Landak, Ngabang, West Kalimantan.	40	28-11-1924	32 cm	14 m	26 m
2	*G. bancanus* Kurz	bb. 6362	Garu buaya	Kubu padi, Pontianak, West Kalimantan	15	8-4-1924	35 cm	16 m	22 m
3	*G. bancanus* Kurz	bb. 7007	Jangkang adung	Sekadau, West Kalimantan	16	18-7-1924	35 cm	18 m	22 m
4	*G. bancanus* Kurz	bb. 7158	Medang karau	Ambawang, Pontianak, West Kalimantan	1	14-9-1924	30 cm	14 m	26 m
5	*G. bancanus* Kurz	bb. 7455	Garu buaya	S. Malik, Muara Kajang, West Kalimantan	10	15-10-1924	40 cm	20 m	30 m
6	*G. bancanus* Kurz	bb. 7930	Garu buaya	Bangkal, Sampit, Central Kalimantan	5	18-1-1925	35 cm	14-m	19 m
7	*G. bancanus* Kurz	bb. 9447	Merang	Dayak, Kapuas, West Kalimantan	7	28-10-1925	35 cm	15 m	27 m
8	*G. bancanus* Kurz	bb. 9672	Medang karau	Batu layang, Pontianak, West Kalimantan	4	8-2-1926	33 cm	22 m	32 m
9	*G. bancanus* Kurz	bb. 10006	Merang	Montalat, Muara Teweh, Central Kalimantan	10	16-7-1926	45 cm	17 m	27 m
10	*G. bancanus* Kurz	bb. 12696	Medang keran	Suka lanting, Pontianak, West Kalimantan	5	27-6-1928	18 cm	18 m	26 m
11	*G. bancanus* Kurz	bb. 12696	Siriangin	Sebatang, Pontianak, West Kalimantan	2	16-8-1928	30 cm	22 m	28 m
12	*G. bancanus* Kurz	bb. 16645	Menyau	Kamp. Ginis, Desa Mawa, Sanggau, West Kalimantan	100	11-4-1932	30 cm	15 m	18 m
13	*G. bancanus* Kurz	bb. 19249	Garu bunia	Sei Baru, Dayak, Central Kalimantan	12	30-9-1934	40 cm	14 m	24 m
14	*G. bancanus* Kurz	bb. 25250	Pulai miyang	Kamp. Palong, Kelapa pati, Bengkalis, Riau	0,5	22-8-1938	45 cm	26 m	37 m
15	*G. bancanus* Kurz	bb. 32396	Garu buaya	Sampit, Central Kalimantan	3	28-9-1940	44 cm	22 m	38 m
16	*G. bancanus* Kurz	bb. 35085	Medang heran/Ramin	Parit surabaya, Pontianak, West Kalimantan	-	7-9-1969	50 cm	30 m	40 m
17	*G. bancanus* Kurz	bb. 35791	Medang heran	Parit surabaya, Pontianak, West Kalimantan	1	6-9-1969	35 cm	25 m	40 m
18	*G. bancanus* Kurz	bb. 35804	Medang heran/Ramin	Parit surabaya, Pontianak, West Kalimantan	-	7-9-1969	50 cm	21 m	45 m
19	*G. bancanus* Kurz	bb. 35805	Ramin getah merah	Parit surabaya, Pontianak, West Kalimantan	-	7-9-1969	60 cm	25 m	50 m
20	*G. bancanus* Kurz	bb. 35822	Medang heran/Ramin	Sei deres, Pontianak, West Kalimantan	-	8-9-1969	26 cm	25 m	38 m
21	*G. bancanus* Kurz	bb. 35853	Ramin/Medang heran	Sei bulan, Pontianak, West Kalimantan	-	11-9-1969	80 cm	27 m	40 m
22	*G. bancanus* Kurz	bb. 36215	Ramin putih	Teluk belanga, Pontianak, West Kalimantan	-	30-1-1970	40 cm	20 m	27 m
23	*G. bancanus* Kurz	bb. 36216	Ramin putih	Teluk belanga, Pontianak, West Kalimantan	-	30-1-1970	30 cm	19 m	25 m
24	*G. bancanus* Kurz	bb. 36219	Ramin kuning	Teluk belanga, Pontianak, West Kalimantan	-	4-2-1970	55 cm	30 m	35 m
25	*G. bancanus* Kurz	bb. 36222	Ramin putih	Teluk belanga, Pontianak, West Kalimantan	-	4-2-1970	35 cm	-	25 m
26	*G. bancanus* Kurz	bb. 36228	Ramin kuning	Teluk belanga, Pontianak, West Kalimantan	-	8-2-1970	55 cm	32 m	40 m

1	2	3	4	5	6	7	8	9	10
27	*G. bancanus* Kurz	bb. 36237	Ramin merah	Teluk belanga, Pontianak, West Kalimantan	-	12-2-1970	60 cm	30 m	45 m
28	*G. bancanus* Kurz	bb. 36239	Ramin putih	Teluk belanga, Pontianak, West Kalimantan	-	12-2-1970	55 cm	36 m	45 m
29	*G. bancanus* Kurz	bb. 36286	Ramin/Gaharu	Pilang, Kuala Kapuas, Central Kalimantan	8	27-9-1970	60 cm	30 m	42 m
30	*G. bancanus* Kurz	bb. 36408	Merang	Ketapang, Barito utara, Central Kalimantan	40	10-1-1971	35 cm	16 m	25 m
31	*G. bancanus* Kurz	bb. 36534	Ramin	Teluk belanga, Sukalading, Pontianak, West Kalimantan	-	16-9-1971	-	-	-
32	*G. bancanus* Kurz	bb. 36538	Ramin	Teluk belanga, Sukalading, Pontianak, West Kalimantan	-	22-9-1971	-	-	-
33	*G. bancanus* Kurz	bb. 37118	Ramin	Manahang, Kapuas ulu, West Kalimantan	50	21-6-1977	30 cm	18 m	29 m
34	*G. bancanus* Kurz	bb. 37124	Ramin	Beringin, Sei Mendawak, Pontianak, West Kalimantan	15	22-7-1977	50 cm	24 m	32 m
35	*G. bancanus* Kurz	bb. 37189	Arang, k	Sebulu, Sei Sendawan, Tenggarong, East kalimantan	-	10-12-1977	38 cm	15 m	28 m
36	*G. bancanus* Kurz	bb. 37453	Medang kerang	Kuala mandor, Mempawah, West Kalimantan	-	10-10-1981	75 cm	20 m	27 m
37	*G. brunescens* A.Shaw.	bb. 8311	Seriangun	Jerungkang, Sukadana, West Kalimantan.	25	25-5-1925	38 cm	12 m	22 m
38	*G. brunescens* A.Shaw.	bb. 28350	Mahabai binjak	B. Melaban kecit, Melawi, West Kalimantan.	345	25-6-1939	45 cm	9 m	21 m
39	*G. brunescens* A.Shaw.	bb. 29629	Lemiar	B. Gontuk hayan, Nanga Betung, Melawi, West Kalimantan.	250	11-10-1939	39 cm	12 m	22 m
40	*G. brunescens* A.Shaw.	bb. 31633	Gerima	B. Mungguk, Nanga Betung, Melawi, West Kalimantan.	175	29-1-1940	53 cm	19 m	23 m
41	*G. brunescens* A.Shaw.	bb. 35008	Garu buaya	Sampit, Central Kalimantan.	-	10-1-1952	50 cm	13 m	20 m
42	*G. brunescens* A.Shaw.	bb. 35247	Melingkut pepah	Semulung ulu, Kapuas ulu, West Kalimantan	40	17-11-1953	41 cm	12 m	28 m
43	*G. brunescens* A.Shaw.	bb. 35248	Melingkut pepah	Semulung ulu, Kapuas ulu, West Kalimantan	40	17-11-1953	44 cm	15 m	21 m
44	*G. brunescens* A.Shaw.	bb. 36321	Pala hutan	Gn.Rapen, Mukut, Muara Teweh, Central Kalimantan	75	15-10-1970	8 cm	-	9 m
45	*G. brunescens* A.Shaw.	bb. 37108	Melingkut	Sei bunut, Manakang, Kapuas ulu, Central Kalimantan	50	20-6-1977	20 cm	15 m	24 m
46	*G. brunescens* A.Shaw.	bb. 37320	Pala, k	Sei Kenamai, Gn Rantan, Buntok, Central Kalimantan	-	18-3-1979	40 cm	22 m	36 m
47	*G. brunescens* A.Shaw.	bb. 37345	Pala	Sei Kenamai, Gn Rantan, Buntok, Central Kalimantan	-	24-3-1979	50 cm	15 m	25 m
48	*G. forbesii* Gilg.	bb. 8153	Merang	Tuwei baru, Dayak ulu, Central Kalimantan	40	7-3-1925	55 cm	23 m	33 m
49	*G. forbesii* Gilg.	bb. 9931	Bakumbal	Karuing, Sampit, Central Kalimantan	10	11-6-1926	82 cm	25 m	37 m
50	*G. forbesii* Gilg.	bb. 10210	Bakumbal	Tehang, Sampit, Central Kalimantan	12	28-7-1926	55 cm	18 m	28 m
51	*G. forbesii* Gilg.	bb. 11217	Dedarah putih	Sungai rumah, Salembatu, Bulungan, East Kalimantan	150	6-4-1927	70 cm	18 m	27 m
52	*G. forbesii* Gilg.	bb. 16577	Serkaya	Ma. Ancalong, Kutai barat, East kalimantan	-	25-3-1932	70 cm	24 m	33 m

1	2	3	4	5	6	7	8	9	10
56	*G. forbesii* Gilg.	bb. 23083	Anggelam lampong	G. Ruyung niung, Kutai Barat, East kalimantan	75	27-8-1937	45 cm	11 m	19 m
57	*G. forbesii* Gilg.	bb. 28329	Pauh balang	B. Melabah kecit, Melaw, West Kalimantan.	475	21-6-1939	50 cm	26 m	37 m
58	*G. forbesii* Gilg.	E. 4923	-	R. Puhus, Kutai barat, East kalimantan	100	14-11-1925	60 cm	-	30 m
59	*G. keithii* A.Shaw.	bb. 11685	Letung	Sungai Bengalun kabiran, Bulungan, East kalimantan	150	27-7-1927	45 cm	17 m	26 m
60	*G. keithii* A.Shaw.	bb. 11885	-	Pelawan, Sangkulirang, Kutai Timur, East kalimantan	75	18-9-1927	40 cm	16 m	23 m
61	*G. keithii* A.Shaw.	bb. 12148	-	Inaran, Berau, East kalimantan	100	25-10-1927	60 cm	17 m	26 m
62	*G. keithii* A.Shaw.	bb. 17893	Banitan gunung	Malinau, Tidung, East kalimantan	15	11-6-1933	40 cm	12 m	17 m
63	*G. keithii* A.Shaw.	bb. 26329	Sampah songkop	Catit, B. Tengkuyung, Melawi, West Kalimantan	370	25-10-1938	40 cm	12 m	22 m
64	*G. keithii* A.Shaw.	bb. 26450	Suwai	Catit, B. Tengkuyung, Melawi, West Kalimantan	340	1-12-1938	48 cm	15 m	23 m
65	*G. keithii* A.Shaw.	bb. 26459	Bepisang	Catit, B. Tengkuyung, Melawi, West Kalimantan	410	4-12-1938	47 cm	8 m	15 m
66	*G. keithii* A.Shaw.	bb. 34791	Emalitan	Sg. Kerajaan Sangkulirang, Kutai timut, East kalimantan	20	18-6-1951	46 cm	17 m	25 m
67	*G. macrophylla* A.Shaw.	bb. 6363	Medang haran	Kubu padi, Pontianak, West Kalimantan	5	8-4-1924	33 cm	12 m	18 m
68	*G. macrophylla* A.Shaw.	bb. 16647	Garu betul	Bonti, Sanggau, West Kalimantan.	100	12-4-1932	75 cm	14 m	24 m
69	*G. macrophylla* A.Shaw.	bb. 18575	Garu buaya	Negri Baru, Matan ilir, West Kalimantan.	2	6-4-1934	46 cm	18 m	24 m
70	G *macrophylla* A.Shaw.	bb. 35083	Melingkut	Sei mengkurai, Sintang, West Kalimantan	40	22-2-1953	36 cm	12 m	19 m
71	*G. macrophylla* A.Shaw.	bb. 36317	R.gunung/ G.Gunung	Gn.Rapen, Mukut, Muara Teweh, Central Kalimantan	-	15-10-1970	10 cm	5 m	11 m
72	*G. velutinus* A.Shaw.	bb. 10626	Pale	Maruwai, Puruk cahu, Central Kalimantan.	80	4-12-1926	30 cm	18 m	23 m
73	*G. velutinus* A.Shaw.	bb. 11184	-	S. Rumah, Salim Batu, Bulungan, East Kalimantan.	150	2-4-1927	60 cm	20 m	28 m
74	*G. velutinus* A.Shaw.	bb. 17012	Babingkal	Sanggau, West Kalimantan.	10	30-5-1932	20 cm	10 m	17 m
75	*G. velutinus* A.Shaw.	bb. 18655	Minyak,k.	Mangsang, Musi Ilir, Sumsel.	15	12-8-1934	60 cm	18 m	23 m
76	*G. velutinus* A.Shaw.	bb. 31632	Besiluh	B. Mungguk, Betung, Melawi, West Kalimantan.	175	29-1-1940	52 cm	31 m	43 m
77	*G. velutinus* A.Shaw.	bb. 34398	Bangkirai warek	Sungai Wain, Balikpapan, East kalimantan	40	15-10-1950	58 cm	27 m	37 m
78	*G. velutinus* A.Shaw.	bb. 35022	Seranai	Sungai Tiram, Kutai Timur East kalimantan	40	15-4-1952	28 cm	20 m	24 m
79	*G. velutinus* A.Shaw.	bb. 35848	Medang samak	Sei bulan, Pontianak, West Kalimantan	-	11-9-1909	50 cm	26 m	36 m
80	*G. velutinus* A.Shaw.	bb. 36236	Ramin laki2, Siangun	Teluk belanga, Pontianak, West Kalimantan	-	9-2-1970	65 cm	-	25 m
81	*G. velutinus* A.Shaw.	bb. 16908	Lempong	Muyup, Kutai Barat, East kalimantan.	30	7-5-1932	45 cm	22 m	30 m

1	2	3	4	5	6	7	8	9	10
86	*G*, sp.	bb. 10942	Pala, Pasai	Ma. Supan, Puruk cahu, Central Kalimantan	200	22-3-1927	35 cm	20 m	22 m
87	*G*. sp.	bb. 2074	Garu buaya	S. Pamulian, Sampit, Central Kalimantan	-	7-12-1920	-	-	-
88	*G*. sp.	bb. 25148	Pelipisan	Sei Pengi, Jembayan, Kutai barat, East kalimantan	6	2-7-1938	35 cm	3 m	20 m
89	*G*. sp.	bb. 26993	Seriangun	Nungu naning, Sukadana, West Kalimantan	-	14-2-1939	40 cm	14 m	22 m
90	*G*. sp.	bb. 34672	Ampuji	Sangkulirang, Sg. Menumbar, Kutai timur, East Kalimantan.	20	11-6-1931	54 cm	15 m	25 m
91	*G*. sp.	E. 3852	-	Kemul, Kutai Barat, East kalimantan	1200	10-9-1925	40 cm	-	20 m
92	*G*. sp.	E. 4785	-	L.Hub, Kutai barat, East kalimantan	150	10-11-1925	50 cm	-	25 m

Sumatera

No.	Species	Collection Number	Local Name	Distribution	Altitude (m asl).	Year Collected	Dbh	Height (Clear bole)	Total Height
1	2	3	4	5	6	7	8	9	10
1	*G. bancanus* Kurz.	E. 281	Geronggang	Bayunglincir, Banyuasin, Palembanmg	10	1917-1923	-	-	-
2	*G. bancanus* Kurz.	bb. 5317	Pulai mijang	Bengkalis, Riau	2	19-5-1923	-	-	-
3	*G. bancanus* Kurz.	bb. 6309	Balung kulit	Karimun, Riau	15	24-11-1923	-	-	-
4	*G. bancanus* Kurz.	bb. 10273	Lapis kulit	Tempuling, Indragiri, Riau	10	17-9-1926	65 cm	25 m	38 m
5	*G. bancanus* Kurz.	bb. 11491	Mata keli	Sei Palas, Labuhan Batu, Sumut	5	2-7-1927	40 cm	27 m	35 m
6	*G. bancanus* Kurz.	bb. 12877	Gaharu buaya	Simpang, Jambi	45	13-11-1928	50 cm	25 m	32 m
7	*G. bancanus* Kurz.	bb. 12975	Pulai miang	Serapung, Kelumang, Bengkalis, Riau	-	25-5-1928	50 cm	17 m	24 m
8	*G. bancanus* Kurz.	bb. 17377	Balun kulit	Simpang kanan Sumatra, Karimun, Riau	10	16-3-1933	44 cm	24,3 m	33,75 m
9	*G. bancanus* Kurz.	bb. 17366	Setalam = Pulai miyang	Sei Kembung, Bengkalis, Riau	1	29-4-1933	62 cm	29 m	42 m
10	*G. bancanus* Kurz.	bb. 17367	Setalam = Pulai miyang	Sei Kembung, Bengkalis, Riau	1	5-5-1933	55 cm	20 m	35 m
11	*G. bancanus* Kurz.	bb. 17547	Setalam = Pulai miyang	Perangas, Selat panjang, Riau	10	24-6-1933	40 cm	26 m	36 m
12	*G. bancanus* Kurz.	bb. 17553	Setalam = Pulai miyang	Selat panjang, Tebing Tinggi, Bengkalis, Riau	-	12-7-1933	40 cm	23 m	32 m
13	*G. bancanus* Kurz.	bb. 17547	Medang keran	Negeri Baru, Matan, West Kalimantan	1	4-12-1934	111 cm	19 m	26 m
14	*G. bancanus* Kurz.	bb. 25777	Lapis kulit, Garu buaya	Kamp. S. Cinaho, Pagarumbai, Riau	8	7- 10-1938	54 cm	21 m	28 m
15	*G. bancanus* Kurz.	bb. 26503	Pulai miyang	Klapa pati, Bengkalis, Riau	0,5	30-11-1938	52 cm	16 m	34 m
16	*G. bancanus* Kurz.	bb. 26504	Pulai miyang	Klapa pati, Bengkalis, Riau	0,5	30-11-1938	55 cm	21 m	36 m
17	*G. bancanus* Kurz.	bb. 26505	Pulai miyang	Klapa pati, Bengkalis, Riau	0,5	30-11-1938	51 cm	22 m	34 m
18	*G. bancanus* Kurz.	bb. 26506	Pulai miyang	Klapa pati, Bengkalis, Riau	0,5	30-11-1938	62 cm	18 m	32 m
19	*G. bancanus* Kurz.	bb. 28679	Lapis kulit	Pangkalan kasai, Kritang, Riau	5	2-8-1939	55 cm	22 m	31 m

1	2	3	4	5	6	7	8	9	10
20	*G. bancanus* Kurz.	bb. 29111	Lapis kulit	Pulau gelang, Indragiri, Riau	4	4-9-1939	39 cm	22 m	30 m
21	*G. bancanus* Kurz.	bb. 37040	KeRamin/Plemiang	P. Rupat utara, Dumai, Riau	4	9-6-1977	70 cm	32 m	41 m
22	*G. bancanus* Kurz.	bb. 37083	Ramin	Desa Pelawan/Nasi2, Bengkalis, Riau	-	25-6-1977	60 cm	28 m	35 m
23	*G. bancanus* Kurz.	bb. 37144	Pulai miang	Sei Anak ayam, Bengkalis, Riau	-	16-6-1977	60 cm	28 m	42 m
24	*G. bancanus* Kurz.	bb. 37157	Ramin	Rangsang, Mentawan, Selat panjang, Riau	-	17-6-1977	46 cm	29 m	40 m
25	*G. bancanus* Kurz.	bb. 24045	Medang ramuan	Sungai besar, Kuantan, Riau	120	8-4-1938	35 cm	12 m	25 m
26	*G. confusus* A.Shaw.	bb. 2588	Sitebai	Langsa, Aceh	50	20-1-1922	130 cm	20 m	30 m
27	*G. confusus* A.Shaw.	bb. 9787	Banitan	Tamiyang, Aceh	-	6-6-1926	58 cm	14 m	24 m
28	*G. forbesii* Gilg.	bb. 17448	Puceha tutup	Siberut, Mentawai, Sumbar	100	13-10-1932	50 cm	21 m	36 m
29	*G. forbesii* Gilg.	bb. 17451	Puceha tutup	Siberut, Mentawai, Sumbar	40	15-9-1932	75 cm	19 m	27 m
30	*G. forbesii* Gilg.	bb. 19311	Kelat (?)	P. Mursala, Aek Labuhan Talang, Sumut	200	23-11 1934	44 cm	28 m	38 m
31	*G. forbesii* Gilg.	bb. 19315	Medang (?)	P. Mursala, Aek Labuhan Talang, Sumut	190	23-11 1934	50 cm	20 m	28 m
32	*G. forbesii* Gilg.	bb. 19326	Jao-jao	P. Mursala, Aek Labuhan Talang, Sumut	75	27-11-1934	50 cm	18 m	30 m
33	*G. forbesii* Gilg.	bb. 27516	Pisang, k	Danau mengkuang, Indragiri ulu, Riau	60	20-4-1939	35 cm	12 m	22 m
34	*G. forbesii* Gilg.	bb. 37230	Alim, k	Padang lawas, Sei Geronggang, Tapsel., Sumut	150	25-7-1978	20 cm	8 m	15 m
35	*G. forbesii* Gilg.	SWK/I-33	Meranti kembang	Painan, Sumbar	-	8-11-1921	65 cm	20 m	28 m
36	*G. macrophylla* A.Shaw.	bb. 17468	Pacehatutup	Sibeiguna, P. Siberut, Sumbar.	30	26-10-1932	70 cm	27 m	42 m
37	*G. macrophylla* A.Shaw.	bb. 37278	-	Dusun Aro, PT. IFA, Jambi	-	16-2-1979	35 cm	28 m	35 m
38	*G. macrophylla* A.Shaw.	bb. 4293	Garu, pinang ba'i	Simalur, Aceh	-	12-3-1919	46 cm	25 m	34 m
39	*G. macrophylla* A.Shaw.	bb. 12163	Pinang baek	Butar, Singkil, Aceh	-	27-11-1927	110 cm	21 m	32 m
40	*G. macrophylla* A.Shaw.	bb. 36846	-	Kruing sak, Loksemawe, Aceh	-	14-9-1973	28 cm	22 m	-
41	*G. macrophylla* A.Shaw.	bb. 37412	Pulai miang	Sei Sembilan, Dumai, Riau	-	20-9-1980	45 cm	28 m	36 m
42	*G. maingayi* Hook.f.	3 PT - 552	Bemban itan	Gn. Megang, Lematang Ilir, Palembang	75	April 1922	30 cm	15 m	26 m
43	*G. maingayi* Hook.f.	3 PT - 853	Bemban itan	Gn. Megang, Lematang Ilir, Palembang	75	7-12-1922	47 cm	15 m	24 m
44	*G. maingayi* Hook.f.	bb. 6469	Tapia	Kajo kundur, Sungai Talang, Sumbar	1000	18-3-1924	40 cm	17 m	22 m
45	*G. maingayi* Hook.f.	bb. 6617	Tapil	Munggung, Payakumbu, Sumbar	1210	12-11-1923	40 cm	13 m	29 m
46	*G. velutinus* A.Shaw.	1 P.T. 17	Minyak,k.	Bayung Lincir, Banyuasin, Palembang	15	Agust 1922	45 cm	25 m	35 m
47	*G. velutinus* A.Shaw.	1 P.T. 21	Minyak,k.	Bayung Lincir, Banyuasin, Palembang	15	Agust 1921	71 cm	25 m	35 m
48	*G. velutinus* A.Shaw.	3 P.T. 812	Ulu tupai	Gn Megang, Lematang Ilir, Palembang	75	20-10-1922	51 cm	20 m	32 m
49	*G. velutinus* A.Shaw.	bb. 3020	Banitan mirang	Lubuk Binjai, Rejang, Bengkulu	150	22-3-1922	40 cm	13 m	24 m
50	*G. velutinus* A.Shaw.	bb. 5685	Meranti Tanduk	Perbutua, Padang Lawas, Tapanuli, Sumut.	804	12-6-1923	50 cm	24 m	35 m

1	2	3	4	5	6	7	8	9	10
51	*G. velutinus* A.Shaw.	bb. 7836	Munamang	Aer Limau, Muntok, Bangka	-	28-12-1924	40 cm	12 m	25 m
52	*G. velutinus* A.Shaw.	bb. 8392	Membitisan	Bantan, Beliting, Bangka	20	22-4-1925	35 cm	15 m	18 m
53	*G. velutinus* A.Shaw.	bb. 10576	Durian utan	Gadung, Bangka	20	25-11-1926	40 cm	15 m	25 m
54	*G. velutinus* A.Shaw.	bb. 33957	Nameng	Lobok besar, Bangka	5	26-8-1949	38 cm	26 m	34 m
55	*G. velutinus* A.Shaw.	bb. 34112	-	Perlang, Bangka	50	30-10-1949	74 cm	25 m	31 m
56	*G. velutinus* A.Shaw.	bb. 36158	Sondai	Perawang, Bengkalis, Riau	4	29-11-1969	-	-	-
57	*G.* sp.	bb. 2560	Medang jompo	Langsa, Aceh	50	18-1-1922	83 cm	29 m	34 m
58	*G.* sp.	bb. 2582	Steubay	Langsa, Aceh	50	20-1-1922	52 cm	24 m	36 m
59	*G.* sp.	bb. 24047	Balaun ijuk	Sungai besar, Kuantan, Riau	120	8-4-1938	33 cm	9 m	18 m
60	*G.* sp.	bb. 27439	Lapis kulit	Muara pejangki, Indragiri ulu, Riau	60	7-4-1939	40 cm	12 m	19 m
61	*G.* sp.	SWK/II-3	Sirantih kuji	S.Dareh, Oud Agam, Sumbar	1200	28-2-1923	50 cm	16 m	23 m

Appendix 2 Distribution of ramin in some provinces based on cruising report of several Forest Concessions (HPH)

No.	Name of HPH	District, Province	Area (ha)	Status of HPH
	Riau Province			
1.	PT Bhara Induk	Indragiri Hilir, Riau	47,687	Holding permit
2.	PT Dexter Kencana Timber	Indragiri Hulu, Riau	48,500	Returning the concession
3.	PT Diamond Raya Timber	Rokan Hilir, Riau	90,956	Active
4.	PT Essa Indah Timber	Rokan Hilir, Riau	52,524	Permit was cancelled in 2003
5.	PT Expra Baru	Bengkalis, Riau		Not active
6.	PT Harapan Baru Wood Co.	Indragiri Hilir, Riau		Not active
7.	PT Kangly Lumber	Bengkalis, Riau		Not active
8.	PT Kosmar Timur Raya	Dumai, Riau	55,000	Not active
9.	PT Multi Eka Jaya	Bengkalis, Riau	50,000	Not active
10.	PT National Timber	Bengkalis, Riau		Not active
11.	PT New Union Timber	Dumai, Riau	40,500	Not active
12.	PT Perkasa Baru	Bengkalis, Riau	115,000	Not active
13.	PT Riau Putra Bersama	Bengkalis, Riau		Holding permit
14.	PT Rokan Permai Timber	Rokan Hulu, Riau		Holding permit
15.	PT Rokinan Timber Corp.	Dumai, Riau	56,000	Not active
16.	PT Sejati Riau I	Dumai, Riau	38,000	Not active
17.	PT Silva Bina Timber Co.	Rokan Hilir, Riau	82,500	Not active
18.	PT Silva Sakti	Rokan Hilir, Riau		Not active
19.	PT Sri Buana Dumai	Dumai, Riau	70,000	Not active
20.	PT The Best One Uni Timber	Pelalawan, Riau	230,000	Not active
21.	PT Triomas FDI	Siak, Riau	100,000	Not active
22.	PT Ubbi Mekar	Indragiri Hilir, Riau	85,000	Not active
23.	PT Yos Raya Timber	Pelalawan, Riau	97,000	Holding permit
	Jambi Province			
24.	PT Putra Duta Indah Wood	Tanjung Jabung Timur, Jambi	61.000	Active
25.	PT Rimba Karya Indah	Tanjung Jabung Timur, Jambi	87.000	Holding Permit
26.	PT Tamiaka Eka Surya	Tanjung Jabung Barat, Jambi		Not active
	West Kalimantan Prvince			
27.	PT.Bantanan Eka Jaya	Sambas, West Kalimantan	15.000	Non Active
28.	PT. Moharison Pawan Khatulistiwa	S. Pawan Ketapang, West Kalimantan		Non Active
29.	PT.Marsela Wana Sekawan	S. Pawan, West Kalimantan		Non Active
30.	PT.Raja Rimba	S. Selakau & Sebangkau, West Kalimantan		Non Active
31.	PT.Tri Kakka	S. Tuwan, S. Belida, West Kalimantan		Non Active
32.	PT. Lanjak Deras Jaya Raya	S. Embaloh, S. Leboyan, West Kalimantan		Non Active
33.	PT. Tanjung Pura Bhakti	S. Kumba, West Kalimantan		Non Active
34.	PT.Sumber JBU	S. Matan, s. Tulak & S. Kualan, West Kalimantan		Non Active
35.	PT.Bumi Raya Utama	S.Palin, S.Embau, S.Sibau, S.Tengar, West Kalimantan		Non Active
36.	PT.Papa Guna	D. Semubung, D. Selegan, West Kalimantan		Non Active
37.	PT.Tawang Meranti	S. Tawang & S. Ketungau, West Kalimantan		Non Active
38.	PT.Tunas Indo Timber	S. Nusiku, S. Nyara & S. S. Embang, West Kalimantan		Non Active
39.	PT.Benua Indah	S. Embaloh, West Kalimantan		Non Active
40.	PT.Pelita Rimba Alam	S. Sekh & S. Nalijah, West Kalimantan		Non Active
41.	PT. Inyutas	S. Semandang, West Kalimantan		Non Active
42.	PT. Jamaker Kalbar	S. Terabung, West Kalimantan		Non Active
43.	PT. Rimba Agung Utama	S. Senakung, West Kalimantan		Non Active
44.	PT Aria Jaya	S. Kubu Padi & S. Pancaroba, West Kalimantan		Non Active
	Central Kalimantan Province			
45.	PT.Budaya Hutan Alam	Sokokojang, Central Kalimantan	49.373	Non Active
46.	PT.Sumber Mitra Jaya	Telaga Pulang, Central Kalimantan	49.390	Non Active
47.	PT.Sungai Rangit	Bukit Rawi, Central Kalimantan	49.100	Non Active
48.	PT. Setia Alam Jaya	S.Kapuas, Central Kalimantan	45.000	Non Active
49.	PT.Karya Inti Sakti Mandiri	Buntok, Central Kalimantan	43.700	Non Active
50.	PT. Lawang Haring Perkasa	Kotawaringin Timur, Central Kalimantan	10.000	Non Active
51.	PT. Inhutani III	S.Mentayo, Central Kalimantan	25.000	Non Active
52.	PT.Karya Delta Permai	S. Barito, Central Kalimantan	88.000	Non Active
53.	LGC.Univ.Muhammadiyah	Pakangkaraya, Central Kalimantan	46.230	Non Active
54.	PT.Sumber Mitra Jaya	-	-	-
55.	PT Budaya Hutan Alam	-	-	-

Appendix 3. Ramin in forest consession in Riau Province

Forest Concession (HPH)	RKT (Yr)/ Extent (ha)	20 – 29 cm		30 – 39 cm		40 cm up	
		N	V	N	V	N	V
Bhara Induk	00/01 1,100	1.27	0.20	1.05	0.90	5.98	10.90
Dexter Kencana Timber	97/98 1,000	0.48	-	0.7	0.49	1.28	3.22
Dexter Kencana Timber	2002 100	0.91	0.40	1.54	1.04	1.19	2.06
Dexter Kencana Timber	2001 800	0.23	0.09	0.86	0.69	0.81	2.62
Diamond Raya Timber	99/00 2,000	0.90	-	2.26	2.24	6.60	16.50
Essa Indah Timber	96/97 1,300	0.28	-	0.20	0.25	3.60	11.95
Essa Indah Timber	98/99 1,350	0.14	-	0.21	0.20	1.47	3.64
Expra Baru	97/98 1,400	1.24	0.57	1.44	1.23	1.57	2.91
Expra Baru	92/93 800	0.51	-	0.32	-	0.21	-
Harapan baru Wood Co.	95/96 1,200	0.83	-	0.72	0.70	0.14	0.25
Harapan Baru Wood Co.	97/98 1,380	7.16	3.44	9.21	5.25	10.48	19.26
Kangly Timber	98/99 1,000	0.75	0.54	0.34	0.25	3.01	5.67
Kosmar Timur	2001 625	0.01	-	0.01	0.01	0.01	0.04
Multi Eka Jaya	96/97 500	0.25	0.11	0.24	0.09	0.26	0.35
National Timber II	98/99 800	0.30	0.08	0.27	0.27	0.21	0.41
New Union Timber	97/98 500	0.02	0.01	0.02	0.02	0.04	0.08
Perkasa Baru	97/98 500	0.24	-	0.39	0.43	0.42	1.23
Riau Putra Bersama	00/01 1,600	0.11	-	0.16	0.13	0.13	0.25
Rokan Permai Timber	2001 1,350	0.11	0.05	0.09	0.09	0.16	0.33
Rokan Permai Timber	2001 900	0.12	-	1.02		0.4	-
Rokinan Timber	99/00 800	0.02	0.08	0.02	0.02	0.07	0.30
Sejati Riau I	94/95 1,000	0.95	-	0.97	-	2.40	6.90
Silsa Saki	96/97 1,500	2.88	-	1.41	1.37	4.49	11.28
Silva Bina Timber Co.	97/98 1,400	0.65	0.21	0.84	0.56	0.13	0.36
Sri Buana Dumai	97/98 1,650	0.26	0.07	0.15	0.13	0.08	0.14
The Best One Uni Timber	94/95 3,000	1.86	0.83	1.00	1.00	0.60	1.66
Triomas FDI	98/99 3,200	0.85	0.03	0.41	0.38	0.54	1.00
Triomas FDI	99/00 1,050	0.13	0.06	0.77	0.72	1.24	2.27
Ubbi Mekar	2000 900	1.83	0.97	1.39	1.71	2.56	9.39
Yos Raya Timber	97/98 1,650	1.26	-	1.28	0.77	2.67	4.39
Average		0.89	0.46	0.97	0.78	1.76	4.26

Appendix 4. Ramin in Forest Concession in Jambi Province

Forest Concession (HPH)	RKT (Year)	Extent (Ha)	15 – 39 cm		40 cm up	
			N	V	N	V
Rimba Karya Indah	1994/1995	1,200	2.29	1.30	3.57	8.15
Rimba Karya Indah	1995/1996	1,444	0.78	0.36	3.30	7.73
Rimba Karya Indah	1997/1998	900	2.44	1.91	3.35	8.20
Rimba Karya Indah	1998/1999	900	3.06	2.30	4.08	11.03
Rimba Karya Indah	1999/2000	800	3.18	2.45	2.60	6.06
Rimba Karya Indah	2001	800	1.53	1.02	1.00	2.29
Putra Duta Indah Wood	2003	1,600	1.83	-	0.53	1.05
Putra Duta Indah Wood	2004	1,600	1.19	-	0.40	0.93
Putra Duta Indah Wood	2005	1,600	1.37	-	0.38	0.86
Average			1.96	1.56	2.13	5.14

Appendix 5. Ramin in Forest Concession in West Kalimantan Province

Forest Concession	Location	RKT (Yr)	Extent (ha)	20 – 39 cm		40 cm up	
				N	V	N	V
PT.Marsela Wana Sekawan	S.Pawan	94/95	1270				1.69
PT.Raja Rimba	S. Selakau & S. Sebangkau	-	-				9.53
PT.Tri Kakka	S. Tuwan - S.Belida	94/95	1000				1.13
PT. Lanjak Deras Jaya Raya	S. Embaloh & S.Leboyan	94/95	700				0.72
PT. Tanjung Pura Bhakti	S. Kumba	94/95	2000				2.90
PT.Sumber JBU	S.Matan, S.Tulak, & S.Kualan	94/97	2000			0.58	12.86
PT.Bumi Raya Utama	S.Palin, S.Embau, S.Sibau, S.Tengar	94/99	7997,4	0.47	0.26	1.01	6.20
PT.Papa Guna	D.Semubung-D.Selegan	96/97	1050			0.53	1.32
PT.Tawang Meranti	S.Tawang & S.Ketungau	94/95	2150			0.49	0.97
PT.Tunas Indo Timber	S.Nusiku, S.Nyara & S.Embang	93/97	2160			0.35	4.06
PT.Benua Indah	S.Embaloh Luas	94/99	520				2.69
PT.Pelita Rimba Alam	S.Sekh & S.Nalijah	96/97	550			2.69	4.39
PT. Inyutas	S. Semandang	96/97	300			0.78	5.25
PT. Jamaker	S. Terabung	96/97	1250			0.37	1.16
PT. Rimba Agung Utama	S. Senakung	96/97	300			1.17	4.29
PT Aria Jaya	S.Kubu Padi & S. Pancaroba	96/97	1375			4.42	11.12
PT.Mahairson Pawan Khatulistiwa	Amdal	2000	-		5.65		2.41
PT.Mahairson Pawan Khatulistiwa	-	2000	-	3.72	1.26	0.08	0.15

Appendix 6. Ramin in Forest Concession in Central Kalimantan Province

Forest Concession	Location/ RKT (Yr)/ Extent (ha)	20 – 29 cm		30 – 39 cm		40 cm up	
		N	V	N	V	N	V
PT.Karya Inti Sakti Mandiri		0.47	0.2	0.38	0.32	0.36	0.48
PT.Sungai Rangit							
Kop.Serba Usaha Bajenta							
LGC Univ.Muhammadiyah							
PT.Karya Delta Permai							
PT.Sumber Mitra Jaya		0.18	0.04	0.05	0.04		
PT.Lawang Haring Perkasa		0.96	0.31				
PT. Inhutani III		0.96	0.41	0.77	0.66	0.71	0.98
PT. Setia Alam Jaya		2.0	0.83	1.5	1.08	0.18	0.34
PT.Budaya Hutan Alam		2.65	0.78	2.43	1.45	3.62	6.56

Appendix 7. Important value indices of ramin in some forest concessions of Central Kalimantan

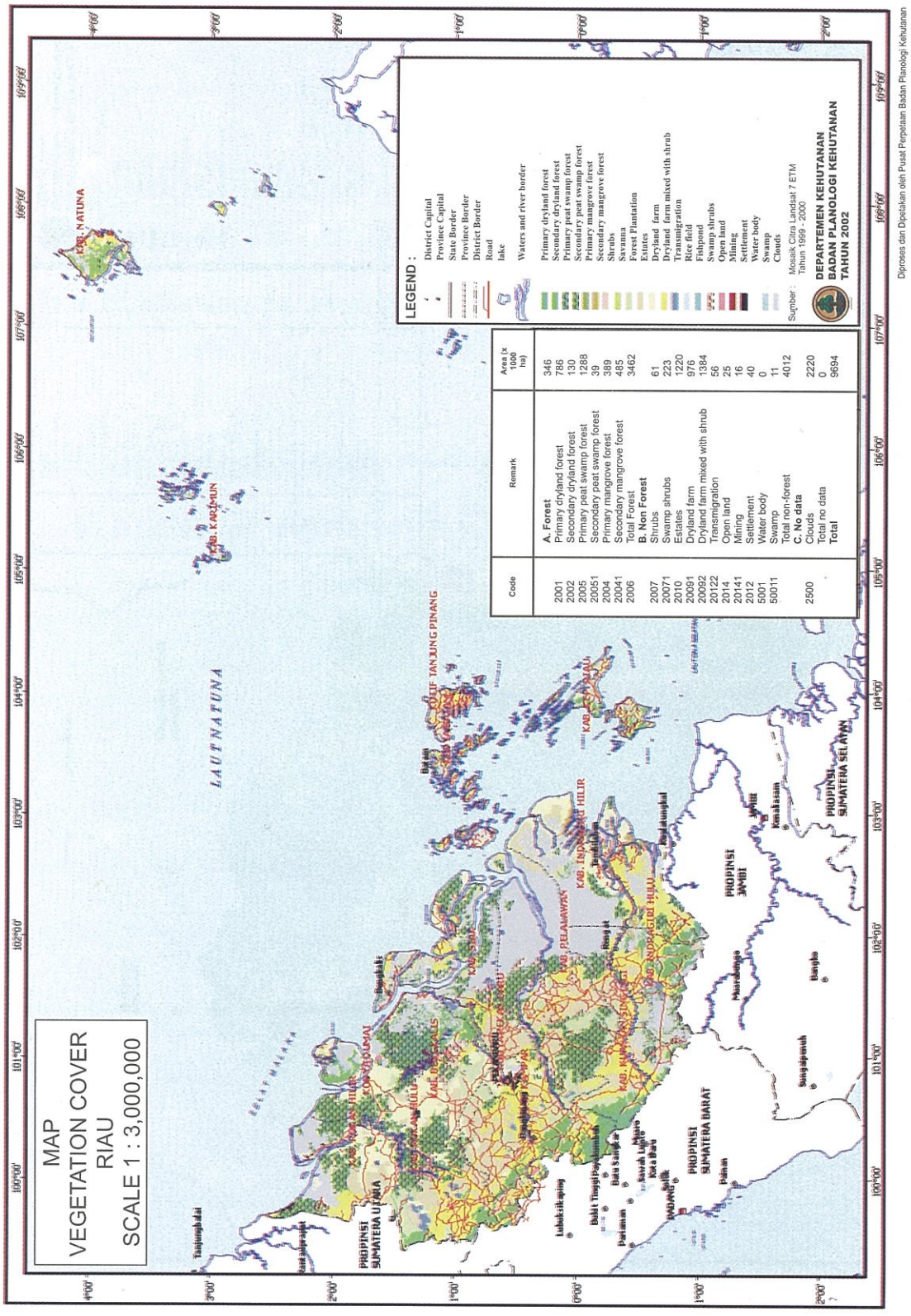
Forest Concession	Location/ Source (Yr)/ Extent (ha)	Important Value Index (%)			
		Seedling	Sapling	Pole	Tree
PT.Karya Inti Sakti Mandiri	- EIA/2000 -	10.18	30.27	9.89	38
PT.Sungai Rangit	Line 1 Line 2 Line 3 EIA/2000 -	9.25 - 1.28	10.41 11.15 1.19	3.07 39.96 36.27	22.94 - -
Kop.Serba Usaha Bajenta	- EIA/2000 -	8.42	10.14	16.17	42.62
LGC Univ.Muhammadiyah	- EIA/2000 -	15.06	10.12	24.21	-
PT.Karya Delta Permai	- EIA/2000 -	-	-	-	6.62
PT.Sumber Mitra Jaya	Line 1 Line 2 Line 3 Line 4 EIA/2000 -	1.28 1.42 23.29 17.63	8.14 1.19 19.34 22.22	2.69 0.57 36.27 39.96	1.77 4.16 23.02 42.61
PT.Lawang Haring Perkasa	- - -				
PT. Inhutani III	- - -				
PT. Setia Alam Jaya	- - -				
PT.Budaya Hutan Alam	- EIA/2000 -				
Secondary Forest					
PT.Karya Inti Sakti Mandiri					
PT.Sungai Rangit					
Kop.Serba Usaha Bajenta	- EIA/2000 -	2.54	18.92	34.05	58.32
PT.Karya Delta Permai					
PT.Sumber Mitra Jaya					
PT.Lawang Haring Perkasa					
PT. Inhutani III					
PT. Setia Alam Jaya	- Mirmanto/2003 -				0.66
PT.Budaya Hutan Alam					

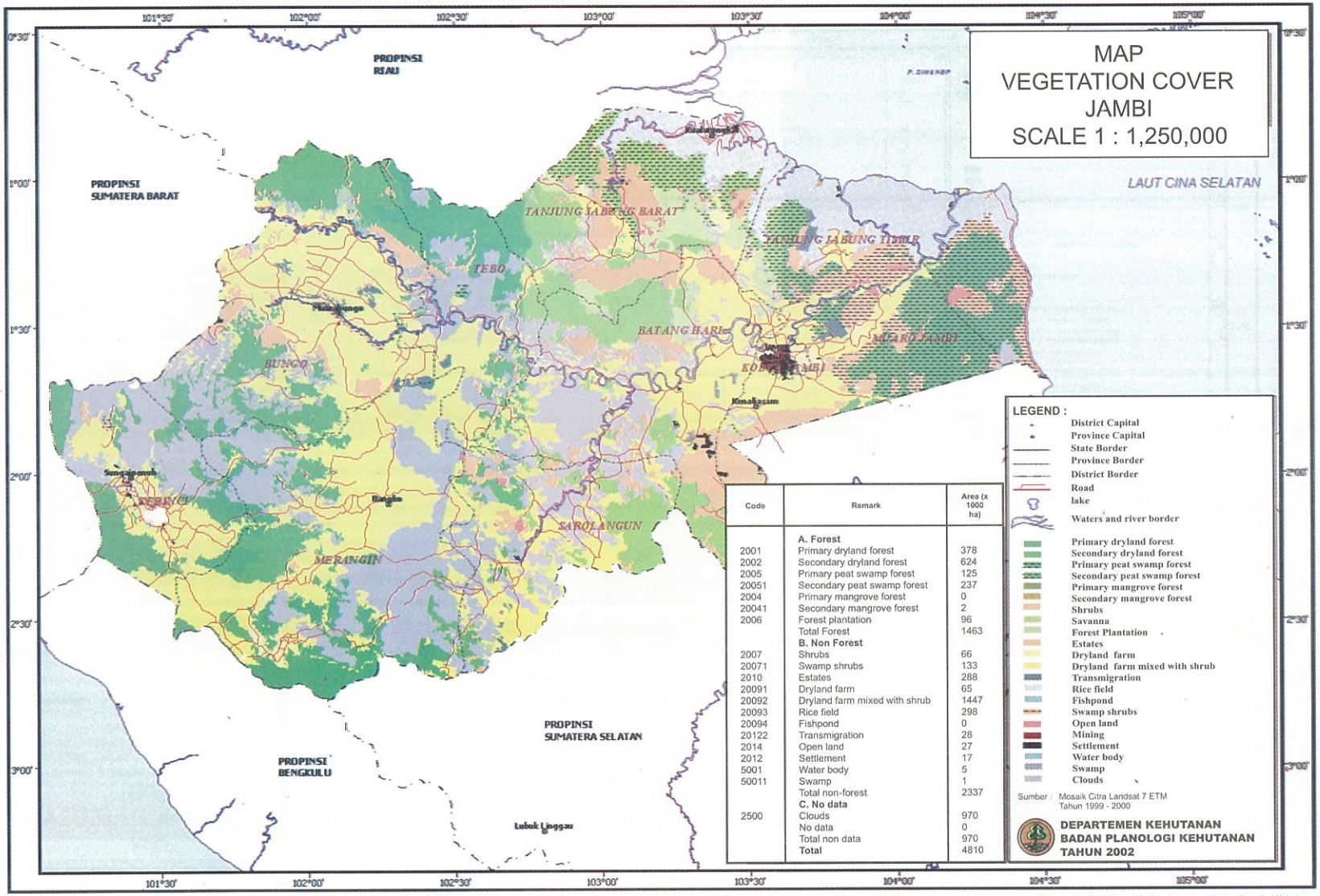
Note : EIA = Environmental Impact Assessment

Appendix 8. Maps of vegetation cover that shows peat swamp forest in five provinces of Indonesia

Map 1.	Map vegetation cover Riau, Scale 1 : 3,000,000
Map 2.	Map vegetation cover Jambi, Scale 1 : 1,250,000
Map 3.	Map vegetation cover South Sumatera, Scale 1 : 1,500,000
Map 4.	Map vegetation cover West Kalimantan, Scale 1 : 2,500,000
Map 5.	Map vegetation cover Central Kalimantan, Scale 1 : 2,500,000

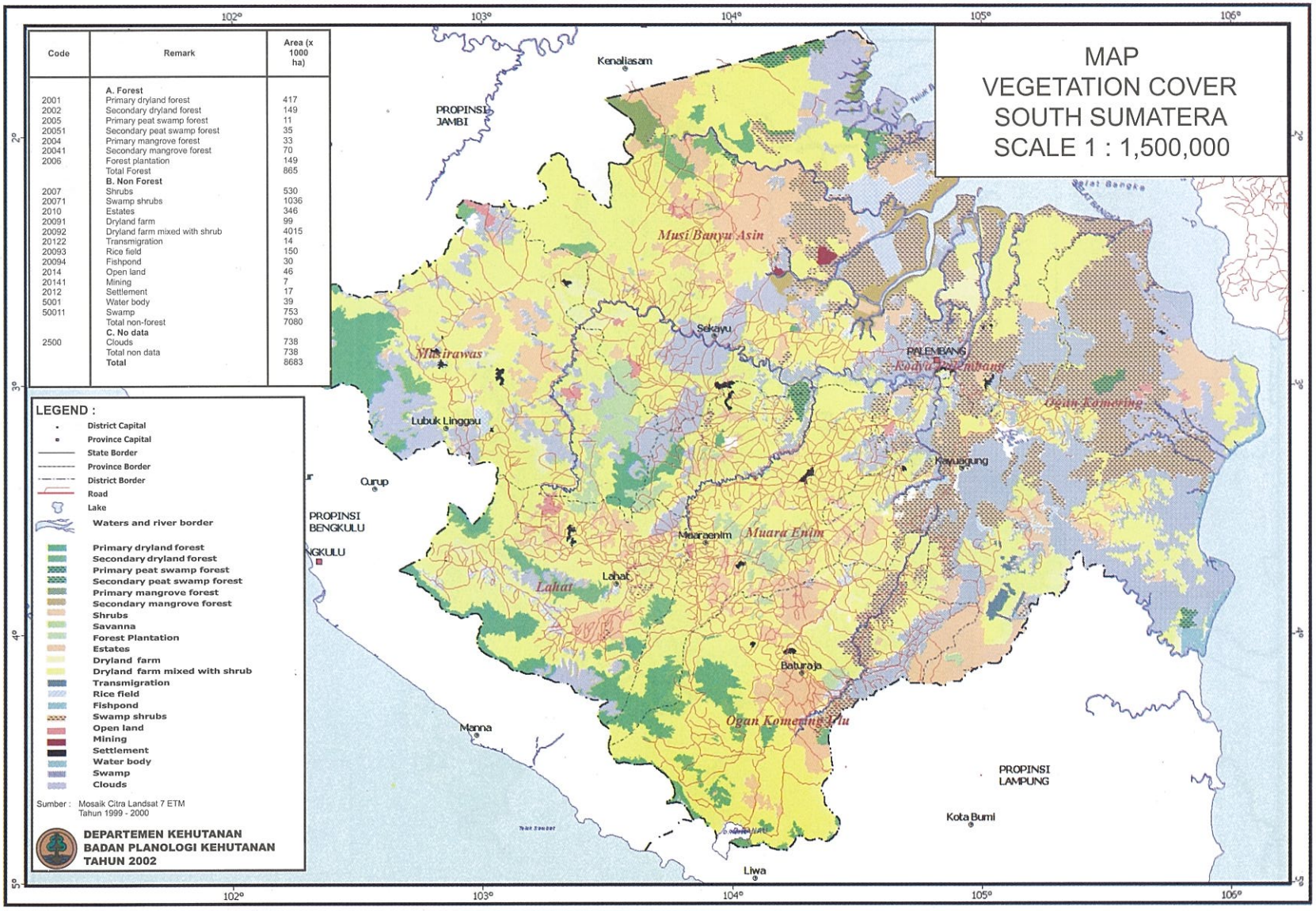
Map Vegetation Cover



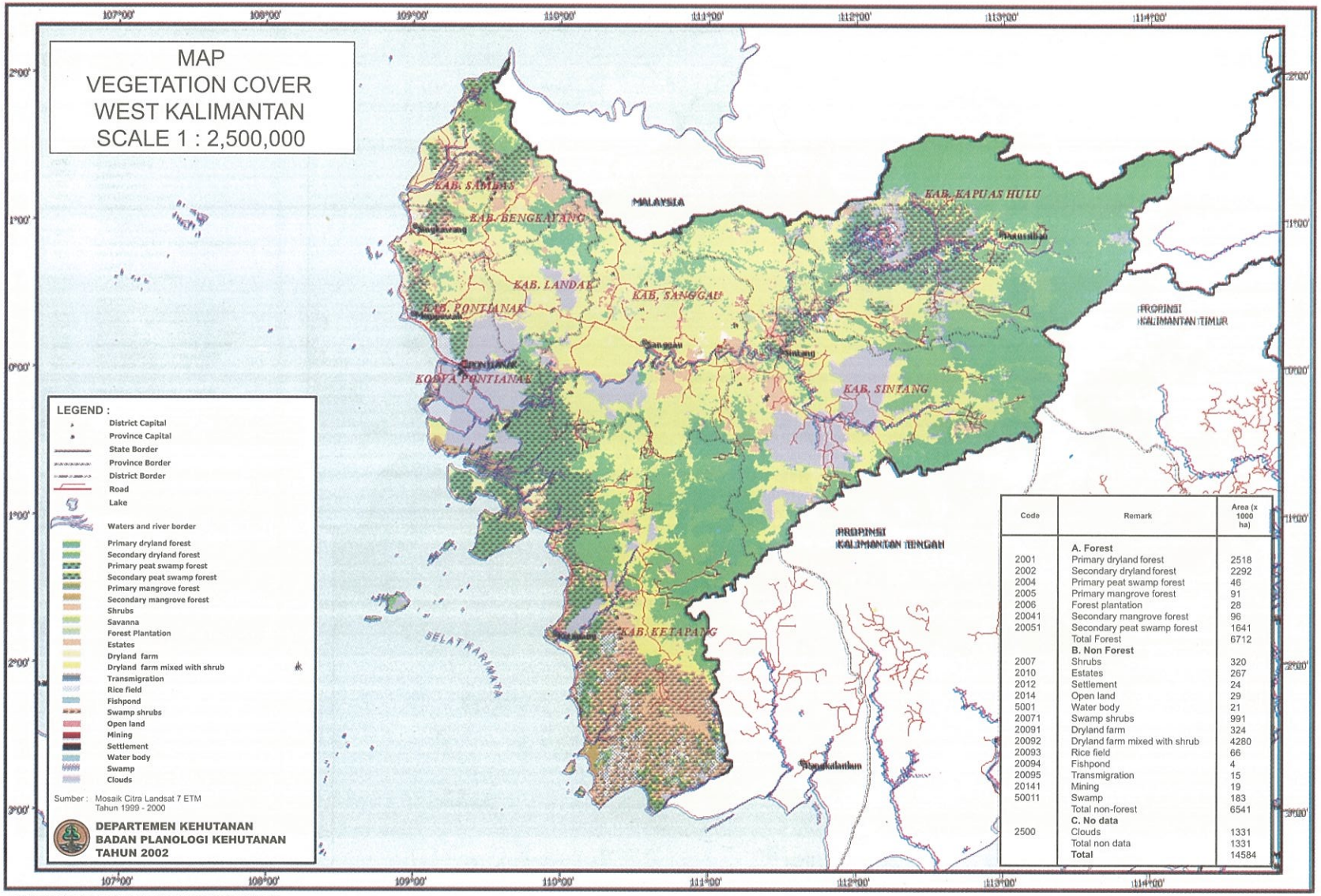


Code	Remark	Area (x 1000 ha)
	A. Forest	
2001	Primary dryland forest	378
2002	Secondary dryland forest	624
2005	Primary peat swamp forest	125
20051	Secondary peat swamp forest	237
2004	Primary mangrove forest	0
20041	Secondary mangrove forest	2
2006	Forest plantation	96
	Total Forest	1463
	B. Non Forest	
2007	Shrubs	66
20071	Swamp shrubs	133
2010	Estates	288
20091	Dryland farm	65
20092	Dryland farm mixed with shrub	1447
20093	Rice field	298
20094	Fishpond	0
20122	Transmigration	28
2014	Open land	27
2012	Settlement	17
5001	Water body	5
50011	Swamp	1
	Total non-forest	2337
	C. No data	
2500	Clouds	970
	No data	0
	Total non data	970
	Total	4810

Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan

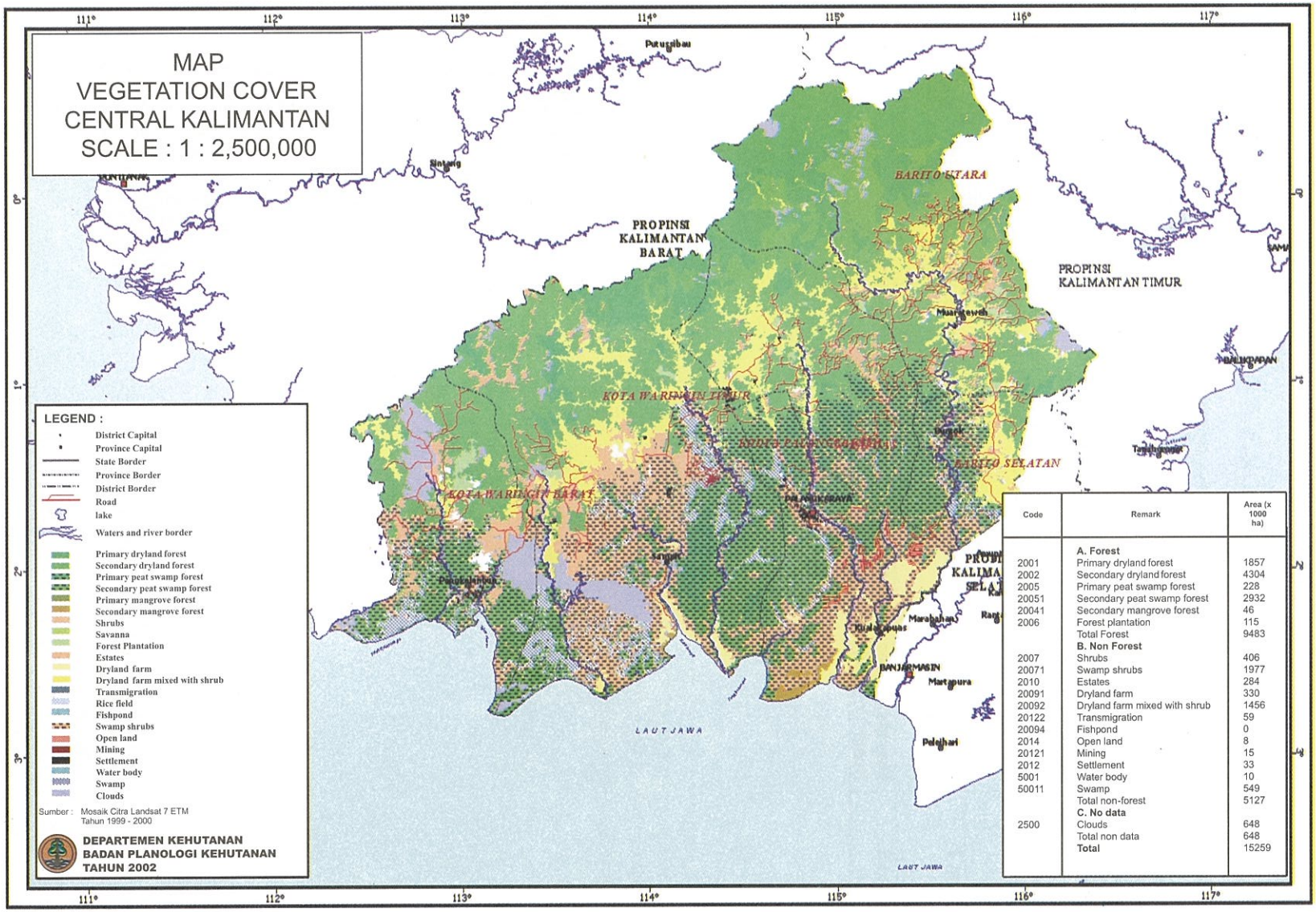


Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan



Code	Remark	Area (x 1000 ha)
	A. Forest	
2001	Primary dryland forest	2518
2002	Secondary dryland forest	2292
2004	Primary peat swamp forest	46
2005	Primary mangrove forest	91
2006	Forest plantation	28
20041	Secondary mangrove forest	96
20051	Secondary peat swamp forest	1641
	Total Forest	6712
	B. Non Forest	
2007	Shrubs	320
2010	Estates	267
2012	Settlement	24
2014	Open land	29
5001	Water body	21
20071	Swamp shrubs	991
20091	Dryland farm	324
20092	Dryland farm mixed with shrub	4280
20093	Rice field	66
20094	Fishpond	4
20095	Transmigration	15
20141	Mining	19
50011	Swamp	183
	Total non-forest	6541
	C. No data	
2500	Clouds	1331
	Total non data	1331
	Total	14584

Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan



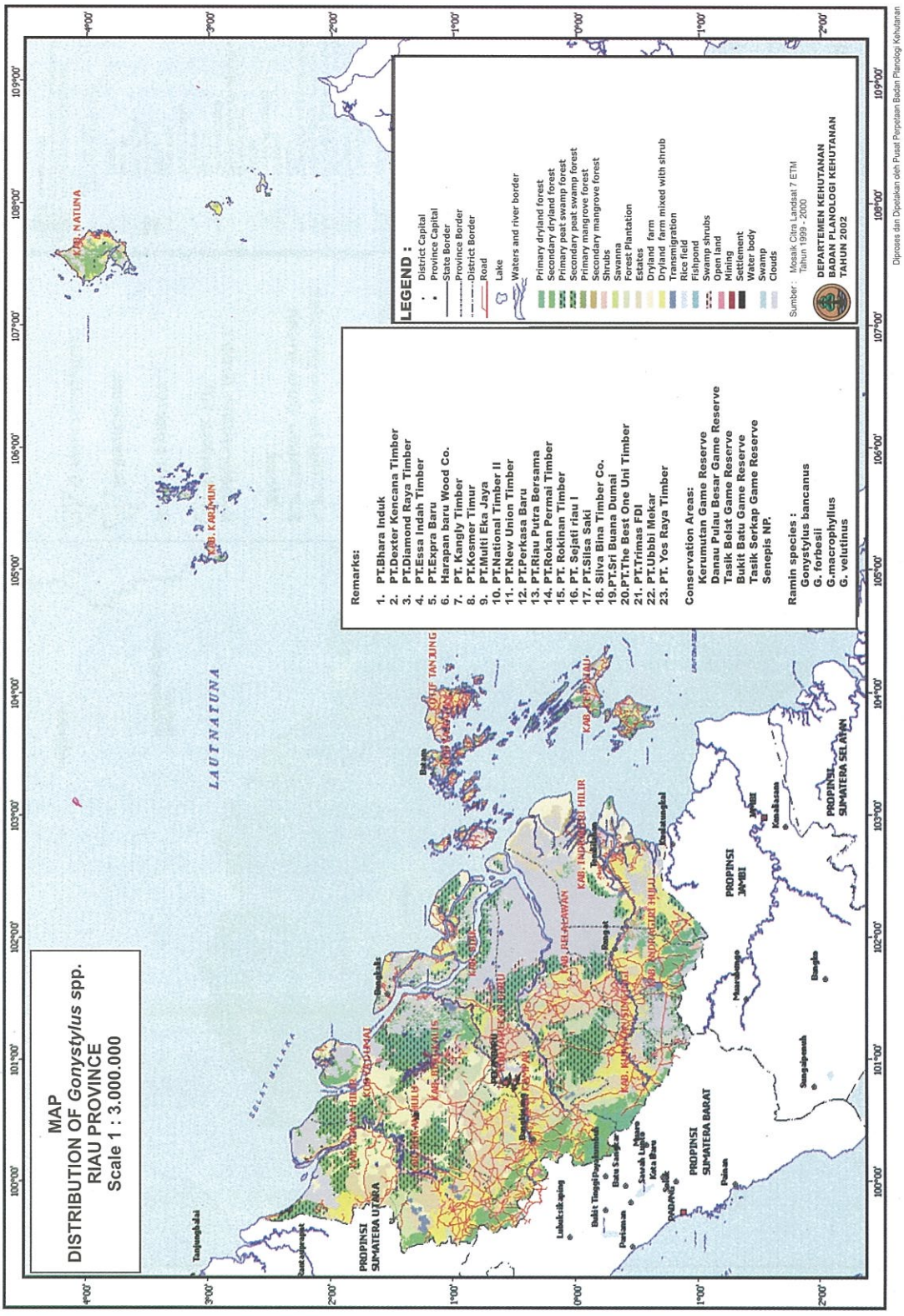
Code	Remark	Area (x 1000 ha)
	A. Forest	
2001	Primary dryland forest	1857
2002	Secondary dryland forest	4304
2005	Primary peat swamp forest	228
20051	Secondary peat swamp forest	2932
20041	Secondary mangrove forest	46
2006	Forest plantation	115
	Total Forest	9483
	B. Non Forest	
2007	Shrubs	406
20071	Swamp shrubs	1977
2010	Estates	284
20091	Dryland farm	330
20092	Dryland farm mixed with shrub	1456
20122	Transmigration	59
20094	Fishpond	0
2014	Open land	8
20121	Mining	15
2012	Settlement	33
5001	Water body	10
50011	Swamp	549
	Total non-forest	5127
	C. No data	
2500	Clouds	648
	Total non data	648
	Total	15259

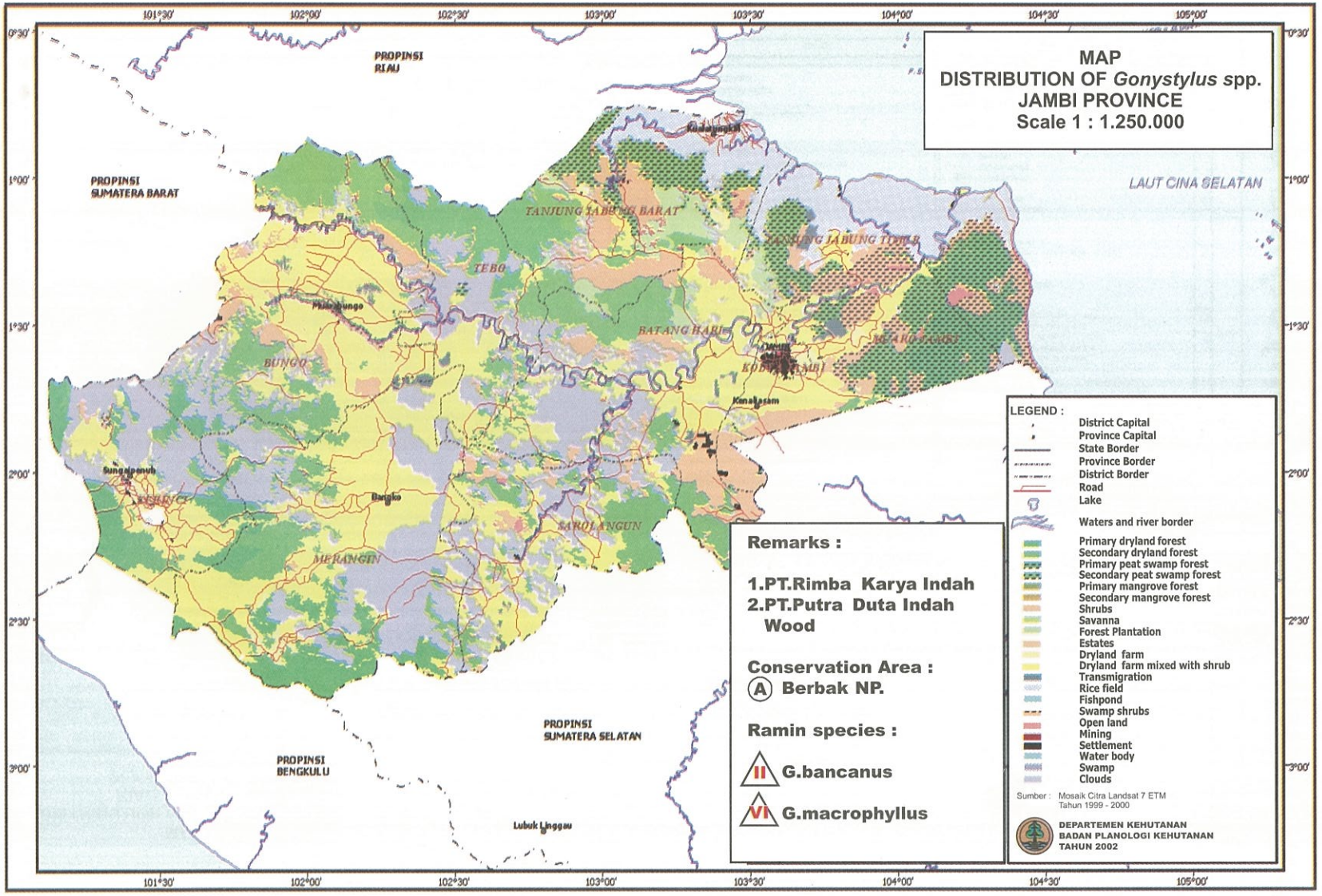
Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan

Appendix 9. Maps of *Gonystylus* spp. distribution in five provinces of Indonesia

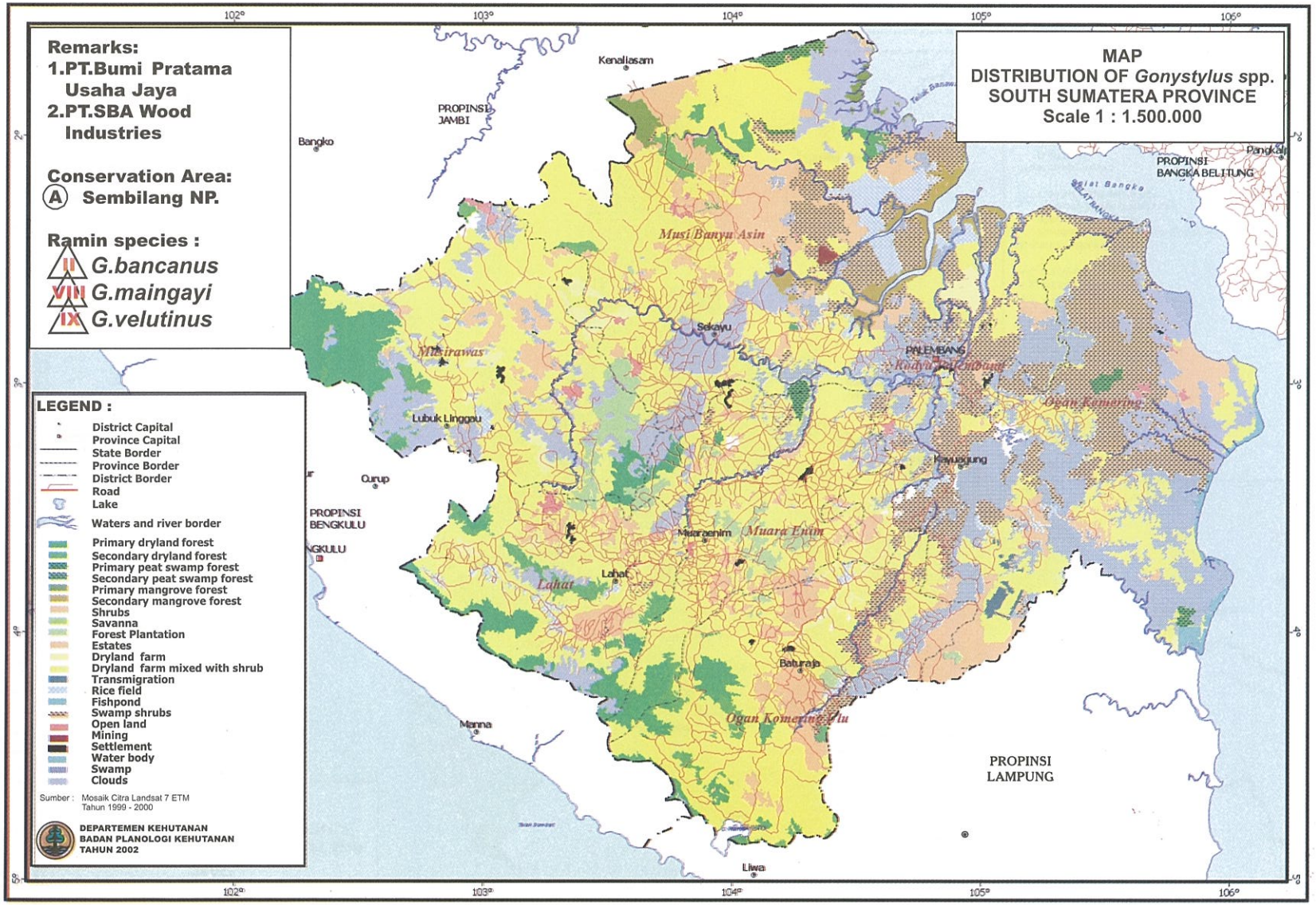
Map 1.	Map distribution *Gonystylus* spp. Riau province, Scale 1 : 3,000,000
Map 2.	Map distribution *Gonystylus* spp. Jambi province, Scale 1 : 1,250,000
Map 3.	Map distribution *Gonystylus* spp. South Sumatera province, Scale 1 : 1,500,000
Map 4.	Map distribution *Gonystylus* spp. West Kalimantan province, Scale 1 : 2,500,000
Map 5.	Map distribution *Gonystylus* spp. Central Kalimantan province, Scale 1 : 2,500,000

Map Distribution of *Gonystylus* spp.

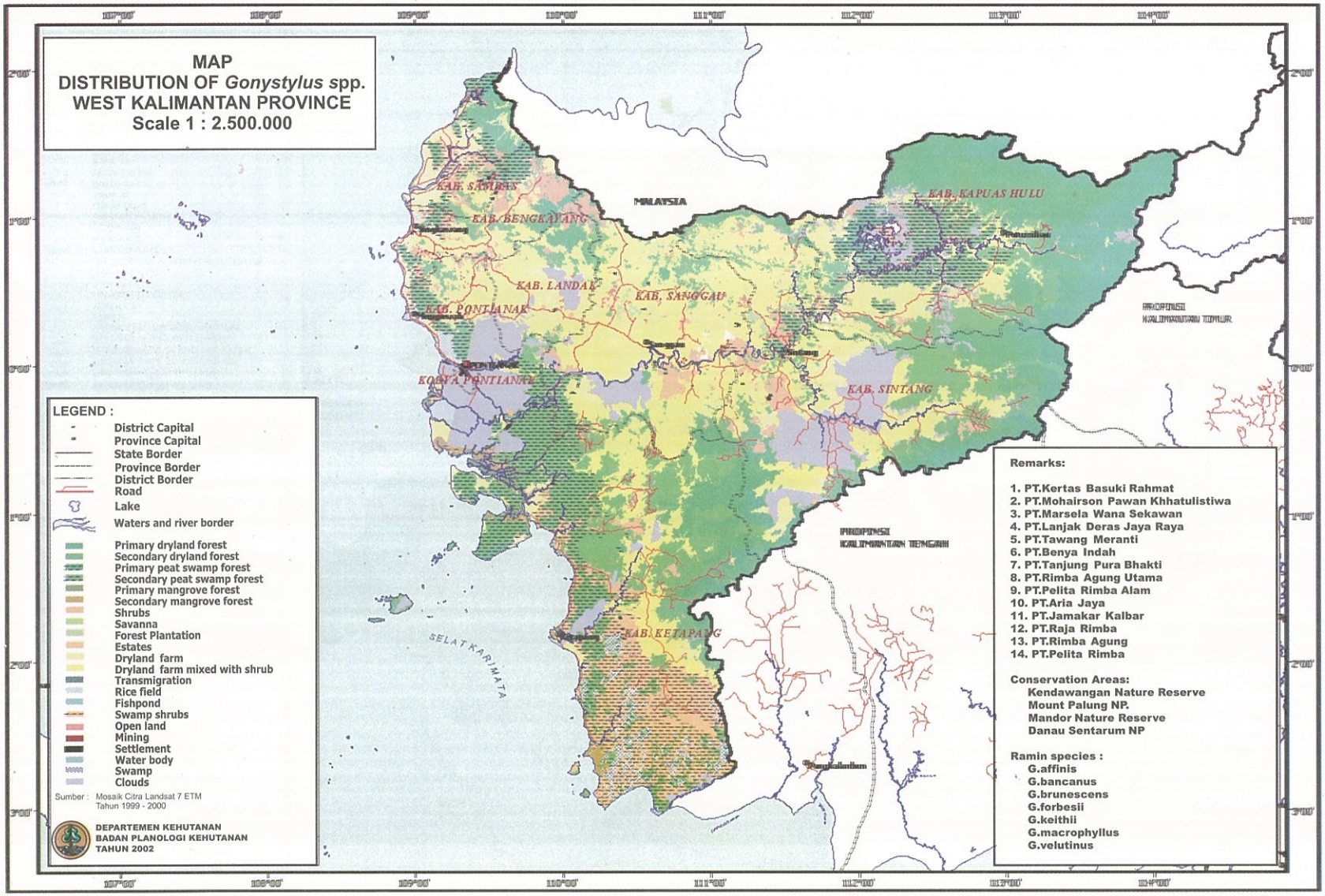




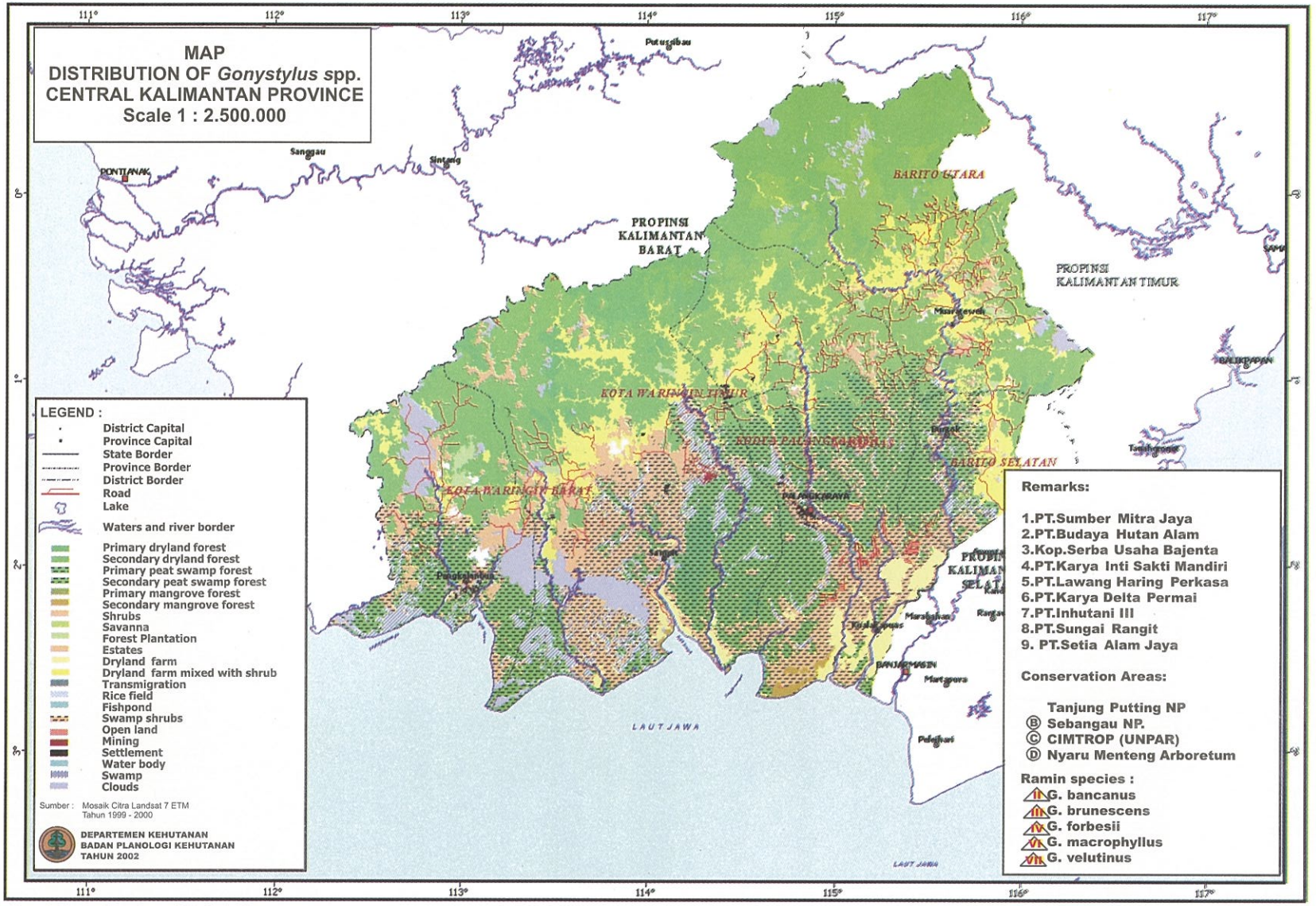
Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan



Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan



Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan



Diproses dan Dipetakan oleh Pusat Perpetaan Badan Planologi Kehutanan