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Cambodia Tree Seed Project

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Cambodian Tree Species

Monographs



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Cambodia Tree Seed Project

Institutional Capacity Building of the Tree Seed Sector

Foreword

Maintenance of forest genetic resources is of crucial importance to sustainable development. However, global forest loss and degradation is resulting in a dramatic loss of biological diversity and options for utilisation and development. Cambodia is no exception, with several valuable indigenous tree species presently vulnerable to extinction at species, and in particular, at population level.

The Royal Government of Cambodia therefore gives high priority to reforestation activities. A pre-requisite for success in dealing with indigenous trees is knowledge of these species. Increased species-level knowledge will promote their conservation through increased planting and use of valuable indigenous tree species.

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CONTENTS

Foreword

Abbreviations

A. Flora of Cambodia	1
1. Introduction	1
2. Botanical Work in Cambodia.....	1
Bibliography	4
B. Species Monographs	5
1. <i>Dalbergia oliveri</i>	7
2. <i>Aquilaria crassna</i> Pierre	9
3. <i>Dalbergia cochinchinensis</i> Pierre	12
4. <i>Gardenia ankorensis</i> Pit	14
5. <i>Afzelia xylocarpa</i> (Kruz.) Craib.....	16
6. <i>Pterocarpus macrocarpus</i> Kurz.....	18
7. <i>Dysoxylum loureiri</i> Pierre.....	21
8. <i>Diospyros cruenata</i> Thwaites	23
9. <i>Lasianthus kamputensis</i> Pierre ex. Pit	25
10. <i>Diospyros bejaudii</i> Lecomte	27
11. <i>Fagraea fragrans</i> Pit	29
12. <i>Dasymaschalon lamentaceum</i> Finet et Gagnep.....	31
13. <i>Shorea cochinchinensis</i> Pierre	33
14. <i>Hopea helferi</i> (Dyer) Brandis	35
15. <i>Pinus merkusii</i> Jungh et de Vries.....	37
16. <i>Garcinia hanburyi</i> Hook.f.	40
17. <i>Cinnamomum cambodianum</i> Lecomte	42
18. <i>Sterculia lychnophora</i> Hance.....	44
19. <i>Cananga latifolia</i> (Hook.f. & Thomson) Finet & Gagnep	46
20. <i>Albizia lebbeck</i> (L.) Benth.	48
21. <i>Hopea odorata</i> Roxb.	51

ABBREVIATIONS

a.s.l.	Above Sea Level
ARA	Working Group on Rainforest, Germany
CAT	Cat Action Treasury
CI	Conservation International
CTSP	Cambodia Tree Seed Project/DANIDA
In dbh	Diameter at breast height
FA	Forestry Administration
FAO	Food and Agriculture Organization, United Nations
FFI	Fauna and Flora International
IUCN	the World Conservation Union
GOs	Governmental Organizations
MAFF	Ministry of Agriculture, Forestry and Fisheries
NGOs	Non Governmental Organizations
RCG	Royal Government of Cambodia
WCS	Wildlife Conservation Society
WWF	World Wild Fund for Nature

A. FLORA OF CAMBODIA

1. Introduction

In the Indochina Region, a number of tree species are vulnerable to extinction at the species and population levels. It is also recognized that the maintenance of forest genetic resources is essential to sustainable development. Thus various countries are endeavouring to conserve the genetic diversity of useful and economically important tree species that are native to the region.

The first list of 21 priority tree species for gene conservation in Cambodia was established during the Second Forest Gene Conservation Meeting on January 29, 2002, organised by Cambodia Tree Seed Project. The identification and selection of priority tree species was based on the value of present and future uses of various plants, their relevance to contemporary tree planting programmes and subsistence economies, as well as their conservation status.

The aim of this paper is to provide a descriptive profile of selected priority species regarding their natural history, ecological requirements, natural distributions, present-day distributions, uses, genetic characteristics, vulnerabilities, and conservation status.

2. Botanical Work in Cambodia

Generally speaking, botanical work in Cambodia has been very limited. Until recently, our understanding of the country's flora and vegetation reflected the *ad hoc* activities of a small number of botanists and foresters. Most of these authors have studied a limited number of vegetation types, sites, or ethnobotanical aspects of Khmer culture, and most of these works were produced before the political and economic implosion of Cambodia in the 1970s.

Investigations in Cambodia and other parts of French Indochina commenced in the latter part of the nineteenth century, leading to the publication of seven volumes of the definitive *Flore Generale de l'Indochine* (Lecompte 1907-1942). These volumes describe over 8,000 species from Cambodia, Laos, and Vietnam. Supplementary volumes commenced in 1964, with the publication of the *Flore du Camboge, Laos et Vietnam*. By 1994, 27 volumes addressing 71 of the 164 families were published.

Dy Phon (1981, 1982) indicates that Cambodia possesses 2,308 of the 8,000 species described in the *Flore Generale de l'Indochine*. These 2,308 species belong to 852 genera in 164 families, and include:

Gymnosperms:	7 genera	14 species
Monocotyledons:	219 genera	488 species
Dicotyledons:	626 genera	1,806 species

Taxonomic revisions that have been published over the last few decades suggest that many more species will certainly be discovered. Current estimates place the total number of plant species in Cambodia, Laos and Vietnam from 12,000-15,000 (IUCN, 1995). The full

list for Cambodia is expected to exceed 3,000 species (Dy Phon, 2002, pers. comm.), with expectations that at least 700 additional species will be described as new to science in the country. It may be assumed that a minimum of ten percent of these species will be endemic to the country. The World Conservation Monitoring Centre 2000 estimates 8260 plant species in Cambodia, 10% endemic of which will be endemic. There is, therefore, still considerable scope for further documentation of the flora of Indochina. This is thought to be particularly true for Cambodia, which has never undertaken a systematic, national inventory of its flora.

Dy Phon (1970, 1971) provides the only systematic vegetation survey that considers all vascular flora of an area. Her treatise of the flora and vegetation of the Bay of Kampong Som, Phnom Bokor of the Elephant Mountains, and the Kirirum plateau, as well as Ashton's (1964) brief descriptions of the coastal hinterlands of the Cardamom Mountains, represent the more substantial botanical works in Cambodia.

Dy Phon's work has been complemented by a range of forest inventories and surveys of medicinal and other useful plants (eg. Ashton 1964; Eav Bov Bang 1970; FAO 1970; Martin 1973, 1997; and Rollet 1962, 1972a, 1972b and 1972c). Forest inventories were not accompanied by assessments of the full range of plant resources, and no naturalist has ever described forest areas over 1,100 meters elevation in Cambodia. Rollet (1972c) provides, however, a preliminary listing of some common genera at higher altitudes. Legris and Blasco (1971, 1972) and Dy Phon (1981) have synthesise much of this information to provide a national overview of Cambodia's vegetation types and their principle species. More recently, McDonald et al. (1997) conducted a detailed survey of the flora of the Tonle Sap floodplain, and in 1998, FAO undertook the establishment of a forest inventory process with MAFF/FA. From 1998 to the present, the FA, in cooperation with international environmental NGOs such as FFI, ARA, CAT, WCS, WWF, and CI, have conducted conservation surveys. The result of these activities has led to some updates to the Cambodian check list of especially fauna, and to lesser extent of flora. They have also established three new protected zones in the Cardamom Mountain region.

Cambodian forests are dominated by species of Dipterocarpaceae, Leguminosae, Lythraceae, or Fagaceae, and in some places Pinaceae, Podocarpaceae, or bamboo. Lowland floras of Cambodia are typical of the *Indochinese* Floristic Province (and as such, contrasts with that of Chinese, Indo-Burmese, and Indo-Malayan Biogeographical Provinces), whilst the highland floras share a closer affinity with those of the Indo-Malayan region (Dy Phon 1982).

Legris and Blasco's (1972) vegetation map remains the most ecologically sensible map for Cambodian forests, even though considerable deforestation and degradation has occurred since the time of their study. This earlier map has recently been reviewed, and is commercially available through the French company ECOCART, though not yet available in Cambodia.

Whilst in recent times botanical research has increased, many species are yet to be documented. In view of the rapid depletion of the forest resources, such work is of great importance in order to identify useful species before they are lost. Such information will lead to the identification of appropriate options for different forest management systems.

High market prices and demands for commercial trees are leading to the extinction of rare and endangered species in Cambodia. As forest resources continue to be depleted,

indigenous seed sources are also degraded, thereby reducing potentials of forest regeneration in Cambodia. In order to begin to address this issue, 21 tree species have been selected for gene conservation. Gaps in our current knowledge of priority species are evident in this document; and in addition, botanical studies indicate that many species within the country have not been documented.

Human and financial resources remain very limited within the country, but it is important to strengthen capacity for gene conservation and reforestation activities in order to better manage and conserve priority species and sustain the natural resource base. Without such measures, future generations may not have the chance to benefit from these species.

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B. SPECIES MONOGRAPHS

1. *Dalbergia oliveri*

Taxonomy and Commercial Grade

Cambodian name	: Neang Nuon
Scientific name	: <i>Dalbergia oliveri</i>
Synonym	: <i>Dalbergia dongnaiense</i> Pierre <i>Dalbergia bariensis</i> Pierre
Family	: Fabaceae
Sub-family	: Faboideae
Commercial Grade-Cambodia	: Luxury

Distribution and Habitat: Present throughout Cambodia, Laos, Thailand and Vietnam (Dy Phon, 2000), trees of *Dalbergia oliveri* occur individually or in groups of 5 – 10 trees, and usually in evergreen tropical forests or semi-deciduous forests that are dominated by *Lagerstroemia* and dipterocarps. The species is usually found at low altitudes (< 900 m), and generally in moist areas, along streams and rivers, and on hill sides. Trees can tolerate some level of shade at an early age, but they generally prefer light. Individuals of this species often produce many seeds, but natural regeneration is often poor due to low germination rates or disadvantageous weather and site conditions. Trees generally grow slowly in both natural and man-made forests (CTSP, 2001).



Within Cambodia, this species is found in Kratie, Preah Vihear, Kampong Thom, Ratanakiri, Stung Treng, Pursat and Siem Reap (Khorn, 2002; see map).

Gene-Ecological Zones: Northern Cardamoms (B), Northwestern Lowlands (D), Central Lowlands (d), Lower Mekong Floodplain (E), Central Annamites (G).

Botanical Description: *Dalbergia oliveri* is a medium to large tree species that reaches from 20-25 (-35) m high (CTSP, 2001) and produces boles from 50-60 cm in dbh in dense forests of Ratanakiri (So Thea, 2002, per. comm). The wood is hard and heavy, with a wood density of 1.07-1.15. The wood produces attractive veins (CTSP, 2001) and is resistant to termites. Commercial varieties differ according to the colour of wood, some which are rose-yellow, brown veined, red with black veins, or purple streaked with yellow (FIPI, 1996). This species branches at an early age and maintains this feature as an adult. It produces compound pinnate leaves that are 15-18cm long, and 8-13 leaflets. Leaflets are 3-5 cm long and 1-2cm wide (CTSP, 2001), and taper narrowly at their tips.

Flowering and Fruiting Habit: Flowering at the end of March to the beginning of June, the fruit ripens at the end of June-November (CTSP, 2001).

Fruit and Seed Description: The fruit, a legume, generally produces 1-2 seeds (CTSP, 2001).



Seed Collection: The seed is mature when the pod has changed in colour to dark brown. However, the beans can also be collected as soon as the pod turns from green to yellow in order to minimize insect predation. Seeds are collected with a tarpaulin underneath the tree as the branches are shaken or cut. Maturity can be confirmed by a cutting test.

Uses: Easy to polish, the wood is widely used for making high quality furniture, luxury cabinets, art and handicrafts, decorations etc.

Current Status: Due to its economic value, *Dalbergia oliveri* is facing serious depletion by illegal cutting. The number of remaining individual trees is very low, and these are disappearing on a local level. In many areas of its natural range, mature and large sized trees are rarely to be found. Efforts to regenerate the species on a large scale have been few and limited. The species is facing the possibility of extinction if no effective protection measures are taken (CTSP, 2001).

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Dalbergia oliveri* as a priority species, and one that is in need of immediate conservation interventions and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

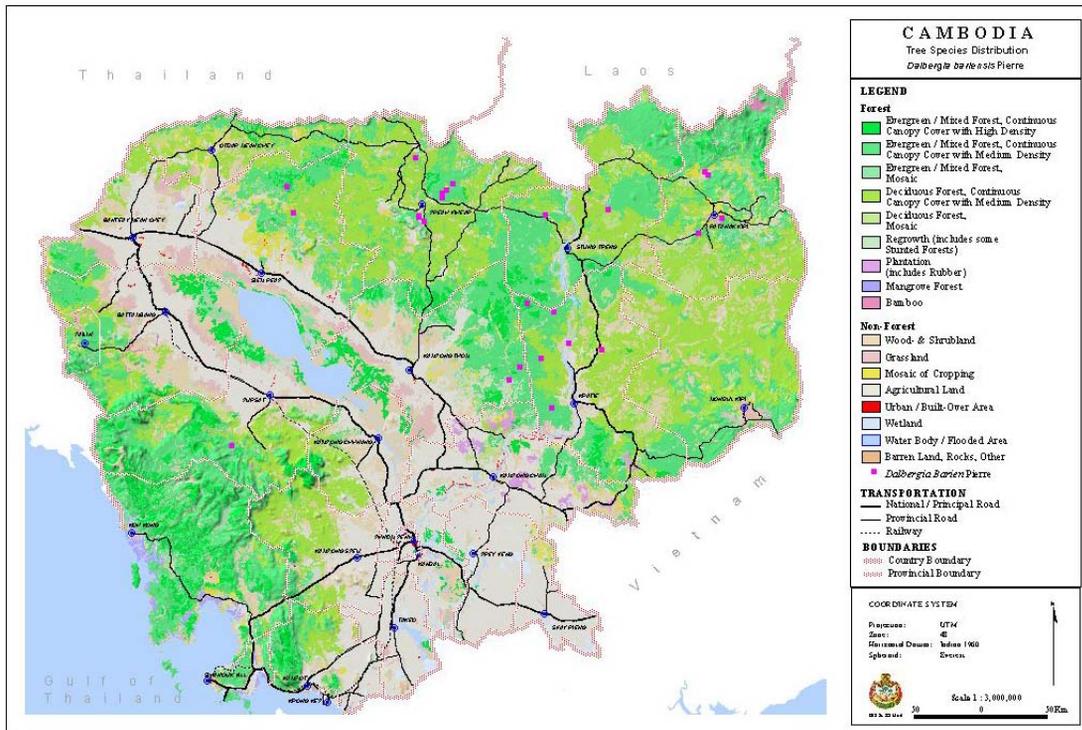
IUCN Classification: EN A1cd



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2. *Aquilaria crassna* Pierre

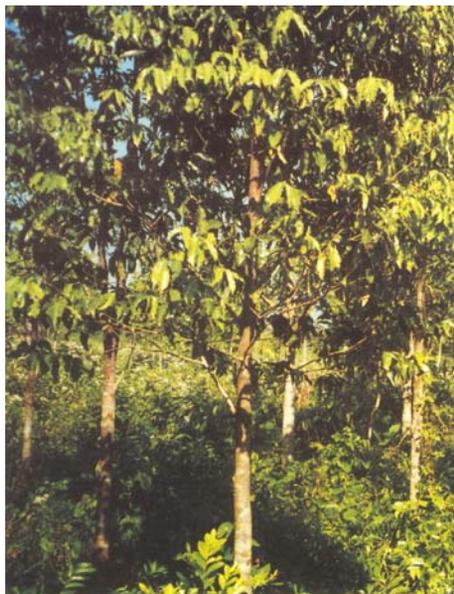
Taxonomy and Commercial Grade

Cambodian name	: Chan Crassna
Scientific name	: <i>Aquilaria crassna</i> Pierre
Synonym	: Argar wood : Eagle wood : Aloe wood or Chankrosna
Family	: <i>Thymelaeaceae</i>
Commercial Grade-Cambodia	: 3rd category

Distribution and Habitat: Various species that produce agarwood (Eaglewood) are found from India to New Guinea, including all Southeast Asian countries and Hainan Island of southern China (Zich and Compton, 2001). It is a light-demanding species, and in Cambodia it is found in Pursat, Koh Kong, Monduliri, Sihanoukville, and Kampong Speu. The species occurs sparsely in primary and secondary forest, and usually on ferrallitic soils with shallow to moderately deep layers (Khorn, 2002; see map).

Gene Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Central Lowlands (d), Southern Annamites (g).

Botanical Description: *Aquilaria crassna* is a timber species with a thin crown and straight stems. It usually reaches from 15-20 m high (CTSP, 2001), but it can grow up to 30-40 m (Dy Phon, 2000), and produce boles from 40-50 cm in dbh. Chan crassna is a light-demanding species that can regenerate under a forest canopy of 0.4 – 0.6 shading. The tree normally grows from 300-800 m a.s.l on deep sandy clay soils (CTSP, 2001), but some individuals have been discovered at 2000 m a.s.l (Singandan et al, 2001). The tree occasionally produces a valuable resin called "Chankrosna" in its stem. Although this resin occurs naturally in only a small percentage of trees in the Thymelaeaceae family, the quality resins are harvested from a several species of *Aquilaria* (Zich and Compton, 2001).



Flowering and Fruiting Habit: Trees begin flowering at an age of 6-8 years, and usually from March-April. Fruits are produced in June-July of the same year. The flowers are small, pale blue-yellow (FIPI, 1996)

Fruit and Seed Description: The fruit is a hard and dry, obovoid capsule which measures from 3-4 cm in diameter. It is covered with short, grayish-yellow hairs (FIPI, 1996).

Seed Collection: Seeds can be collected from the tree or from the ground after shaking the branches. In seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

Sowing and Germination: Initial trial results show that *Aquilaria crassna* is easy to plant and very suitable for plantings under the canopies of mixed stands (CTSP, 2001).

Seedling Production: Some local people in the Districts of Thmar Beng, Modulsima, and Sre Ambil (Koh Kong Province) have collected seeds in natural forests or villages to produce seedlings in home gardens. The seedlings have been distributed to neighbouring villages in order to plant on farmland. At present, these plantations exhibit good growth (CTSP, 2001).

Uses: The accumulation of "Chankrosna" in *Aquilaria* wood is dependant on special physiological conditions that are poorly understood. In 2000, the resin-wood cost USD800-1,500 for 1 kg. The product is in high demand for use in the production of high quality cosmetics, fine art, medicine, and high-value incense (CTSP, 2001). High demand, particularly in Middle Eastern and Asian markets, combined with a decreasing supply, has pushed prices progressively higher to the extent that top grade resin can sell for over USD10,000/kg in end-use markets (Zich and Compton, 2001). The bark produces good fiber for hammocks and paper pulp as well (FIPI, 1996), and the roots can be used for incense. The wood is very fragrant and has been traded since biblical times for use in religious, medicinal and aromatic preparation. In traditional medicine, wood mixed with other drugs is used against malaria (Dy Phon, 2000).

Current Status: Because the wood of Changkrassna is very valuable, and has a high demand in global markets, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Since its natural genetic variability is now endangered, there is need for research on improvement and management. Distribution of the species is scattered, and it is very difficult to find mature trees for seed collection. In Southeast Asian, Agarwood collection is reportedly becoming more difficult year-by-year as supplies of mature trees dwindle (Zich and Compton, 2001).

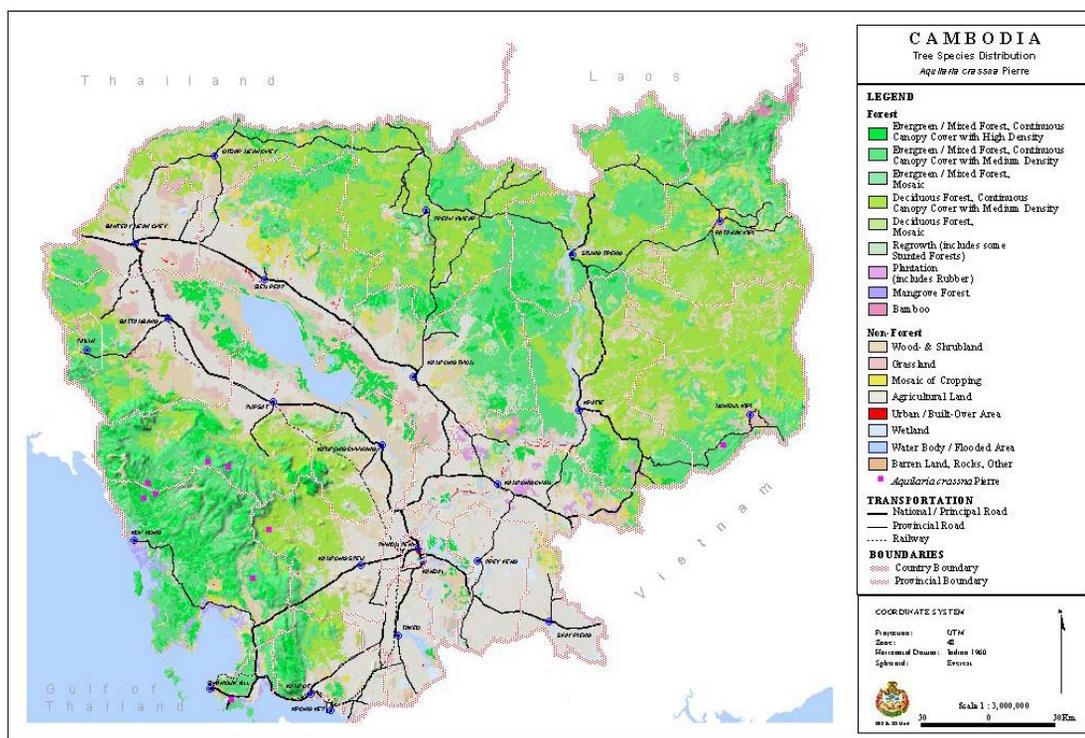
In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Aquilaria Crassna* Pierre as a priority species in need of immediate conservation interventions and appropriate protection.

IUCN Classification: CR A1cd

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3. *Dalbergia cochinchinensis* Pierre

Taxonomy and Commercial Grade

Cambodian name	: Kra-nhourng
Scientific name	: <i>Dalbergia cochinchinensis</i> Pierre.
Syn	: <i>Dalbergia cambodiana</i> Pierre.
Family	: Fabaceae
Sub-family	: Faboideae
Commercial Grade-Cambodia	: Luxury

Distribution and Habitat: Native to Indochina and adjacent countries, this tree species is shade-tolerant when young. It usually occurs sparsely in open and semi-deciduous forests from 400 – 500 m a.s.l., and prefers deep sand, clays, or calcareous soils (Khorn, 2002). This rosewood prefers uniform rainfall that ranges from 1200-1650 mm per year. The species requires high amounts of light to thrive, and is drought tolerant and able to grow on most soils (DFSC, 2000). Within Cambodia, the species is found in Kampong Thom, Preah Vihear, Ratanakiri, Pursat, Siem Reap, Kratie, Koh Kong, Stung Treng, and Modulkiri (Khorn, 2002; see map).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Northwestern Lowlands (D), Central Lowlands (d), Central Annamites (G), Southern Annamites (g).



Botanical Description: *Dalbergia cochinchinensis* is a large evergreen tree species, reaching from 25–30 m in stature and producing boles to 60 cm in dbh. The species is easily recognized by its light yellow bark and ramified canopies. Its wood is hard, durable, and red-coloured with prominent, beautiful veins. It exhibits a density of 1.0-1.8 and is resistant to termites. The plant is identified by its pinnate leaves, which generally have 7 – 9 leaflets, the upper-most of which is the largest (CTSP, 2001). The species regenerates naturally and coppices well, but the growth rate is rather slow (DFSC, 2000).

Flowering and Fruiting Habit: Flowering occurs in May and June, while fruits ripen in November and December (DFSC, 2000).

Fruit and Seed Description: The fruit is long and tapering and generally contains 1 or 2 seeds. The weight of 100 seeds is 18.5 g, and 100 g of seed can provide up to 54,000 propagules (CTSP, 2001).

Seed Collection: The seed is mature when the pod dark brown in colour. The pods are often collected as soon as the colour turns from green to yellow, so as to minimize insect predation. The branches are cut or shaken, and the seeds collected from tarpaulin spread on the ground (DFSC, 2000).

Seed Handling: After collection, the pods are dried in the sun for about three days. The dry pods remain closed and must be cut into one-seeded pieces. A seed thresher could probably extract the seeds effectively, but care should be taken not to damage the seeds (DFSC, 2000).

Sowing and Germination: The plant can also be propagated by air layering, cuttings, and graftings. Stands can be established through natural regeneration or using planting stock (DFSC, 2000).

Uses: Wood can be exported at a high price, and is used for making high quality furniture, art handicrafts, and musical instruments. The root base and root can also be used for high quality art handicrafts (CTSP, 2001).

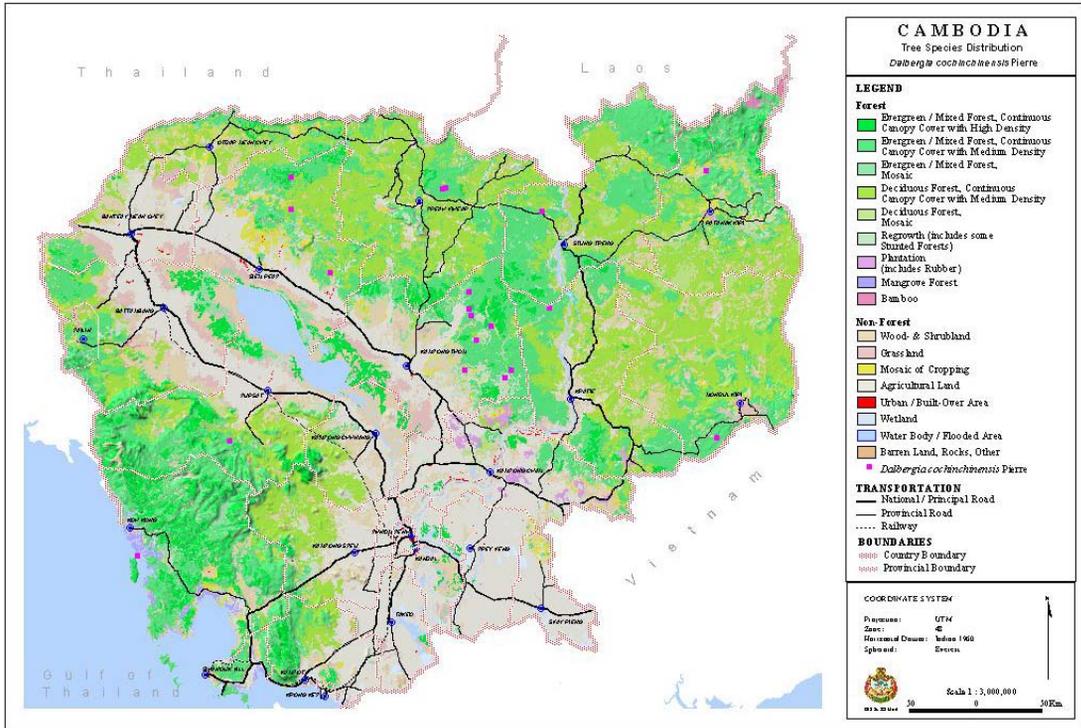
Current Status: *Dalbergia cochinchinensis* has been found during field surveys in concessions (commercial forest), protected areas, and various regions in the Northern Highlands of Cambodia. Illegal cutting in many areas has resulted in few and sparse populations of this species. This presents difficulties in finding germplasm sources within and outside protected forests/national parks.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Dalbergia cochinchinensis* Pierre as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

IUCN Classification: VU A1cd

References:

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- UNEP World Conservation Monitoring Centre, 2002, Red List for Cambodia.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy.



4. *Gardenia ankorensis* Pit

Taxonomy and Commercial Grade

Cambodian name : Dai Khla
Scientific name : *Gardenia ankorensis* Pit
Family : Rubiaceae
Commercial Grade-Cambodia : Luxury

Distribution and Habitat: Distributed in clear forests of Cambodia and Laos (Dy Phon, 2000). This is a light-demanding tree that is both fire and drought tolerant. The species can grow on degraded soils that are impacted by shifting cultivation, forest fire, infertile soil, and severe climates. It usually occurs solitarily among middle- or under-story trees (Khorn, 2002). In Cambodia, it is found in Stung Treng, Kratie, Kampong Thom, Siem Reap, Oddar Meanchey and Kampong Speu, as noted in the map (see below).

Gene-Ecological Zones: Northern Cardamoms (B), Northwestern Lowlands (D), Central Lowlands (d).

Botanical Description: A shrub, 3-4 m tall according to Dy Phon (2000), a short tree to 10 m according to Heang Ponley (2002, per. comm.). The wood is durable and light-purple or blond in colour (Son Pisith, 2002, per.comm). Leaves are simple, and to 5 cm long and 3ccm wide (Heang Ponley, 2002, per. comm).



Seed Collection: Seeds are usually collected from the tree or ground. In seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out under the tree. The optimal time of collection is reached when the majority of the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

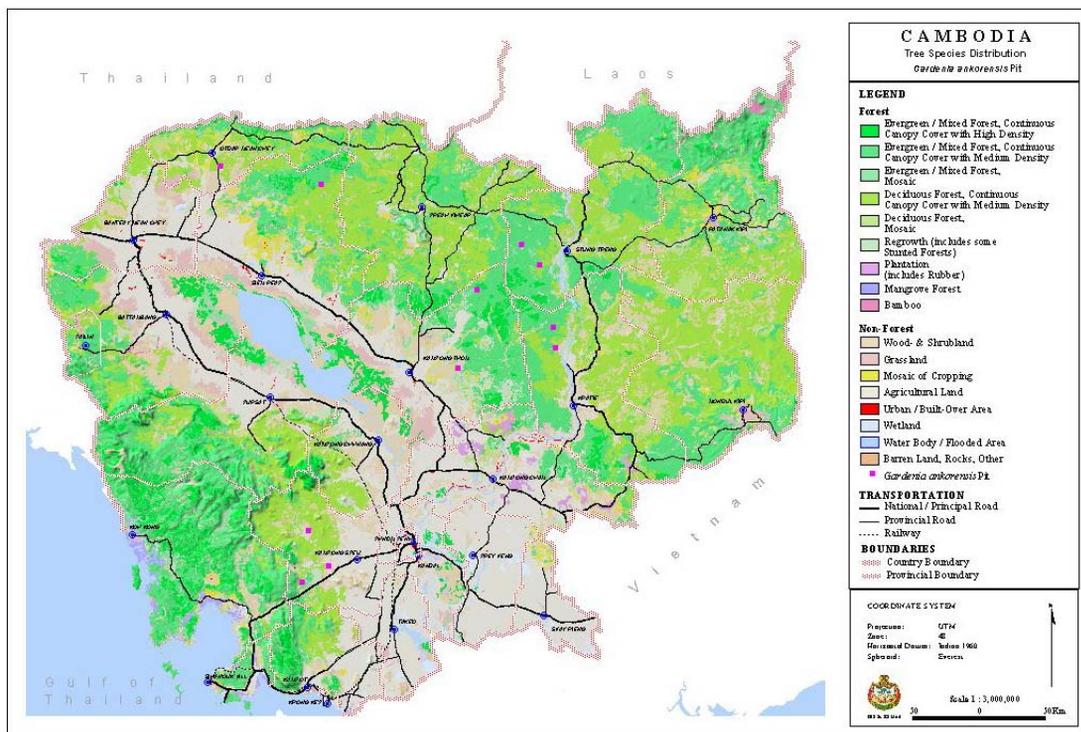
Uses: The wood of this species is used to make luxury furniture, cabinets, musical instruments, handicrafts, and in the preparation of seals and stamps (Dy Phon, 2000). An essence is extracted from the stalks and the leaves to be used as a diuretic (Dy Phon, 2000).

Current Status: Because the wood of this species is similar to ivory, it is very expensive and sold by the kilogramme (Sonn Pisith, 2002, per.comm). As a consequence, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. The distribution of the species is scattered, and most timber is harvested selectively from natural forest. The species is also succumbing to the conversion of riparian woodlands to agricultural lands. The number of mature trees has rapidly reduced, leading to difficulties in seed collection.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy identified *Gardenia ankorensis* Pit as a priority species, and one that is in immediate need of conservation and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in The Cambodia, Trade Names of Commercial Wood, unpublished
- Dy Phon, 2000, Dictionary of Plants used in Cambodia.
- Heng Ponley, Director General of the Department of Traditional Medicinal Plants, Ministry of Health, 2002, per.comm.
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September.
- Son Pisith, 2002, pers. comm.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



5. *Afzelia xylocarpa* (Kruz.) Craib

Taxonomy and Commercial Grade

Cambodian name	: Beng
Scientific name	: <i>Afzelia xylocarpa</i> (Kruz.) Craib.
Synonym	: <i>Pahudia cochinchinensis</i> Pierre
Family	: <i>Fabaceae</i>
Sub-family	: <i>Caesalpinioideae</i>
Commercial Grade-Cambodia	: Luxury

Distribution and Habitat: This species is found in Laos, Thailand, Cambodia and Vietnam. It is a light demanding species, occurring on well-drained flatlands or transitional zones between evergreen and dry open dipterocarp forest, usually from 500 – 700 m a.s.l. The species also occurs above 900 m (Dy Phon, 2000) in mixed forest. The tree is often associated with *Dalbergia oliveri*, *Pterocarpus macrocarpus*, *Lagerstroemia calyculata*, *Dipterocarpus tubinatus* and *Tetrameles nudilora*. Trees occur in a scattered manner in mixed forests, and do not usually form pure stands. Within Cambodia, this species is found in Kampong Thom, Kratie, Stung Treng, Preah Vihear, Siem Reap, Battambang, Ratanakiri, Mondulakiri, Kampot and Pursat (Khorn, 2002; see map).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Tonle Sap Floodplain (C), Redlands (c), Northwestern Lowlands (D), Central Lowlands (d), Central Annamites (G).



Botanical Description: This is a large deciduous, broad-leaved tree species that reaches from 15–20 (-30) m tall, and produces a bole from 0.8 – 1.5 m in dbh. The leaves are pinnate, with 3 – 5 oval leaflets from 5– 6 cm long and 4–5 cm wide. The species regenerates naturally and coppices well (CTSP, 2001).

Flowering and Fruiting Habit: Fruits ripen in March, April and May, and can be collected from the ground. It can remain on the ground for several months without any damage, and its germination ability lasts longer (1–2 years) when seeds are stored in low temperatures (DFSC, 2000).

Fruit and Seed Description: The fruit is big, thick, dark-brown or black, and ligneous when mature. Seeds are oval, hard, dark-brown or black, and 1.5-1.8 cm in diameter. Each kg of seed contains about 110-160 seeds (DFSC, 2000).

Seed Collection: The seeds are mature when the pods turn brown and the seeds are hard and dark. The pods can be collected by climbing the tree, or by spreading a cover on the ground and shaking the branches. Maturity can be confirmed by a cutting test (DFSC, 2000).

Seed Handling: After collection, the pods are dried in the sun on a tarpaulin until they have opened. Shaking or beating the fruit in a bag can extract the seed. It is not certain whether it is necessary to remove the aril before storage to avoid fungal attacks. If the seed is stored with the aril, it is especially important to make sure the seeds are well dried. Removal of the aril will reduce the bulk by about 25% (DFSC000).



Sowing and Germination: Planting stocks or stumps are normally used for stand establishment. Plants can also be propagated by air layering, cuttings, or grafting (DFSC, 2000).

Uses: The wood beng is valuable on account of its rich dark or light-red colours, prominent veins, hardness and durability. The wood is used in various ways, including house construction, cabinet and furniture-making, and high quality handicrafts (CTSP, 2001). The bark is used for tanning animal skins, and also in local medicine and also in veterinary medicine (Dy Phon, 2000). The fatty cotyledons of young seeds are edible (DFSC, 2000).

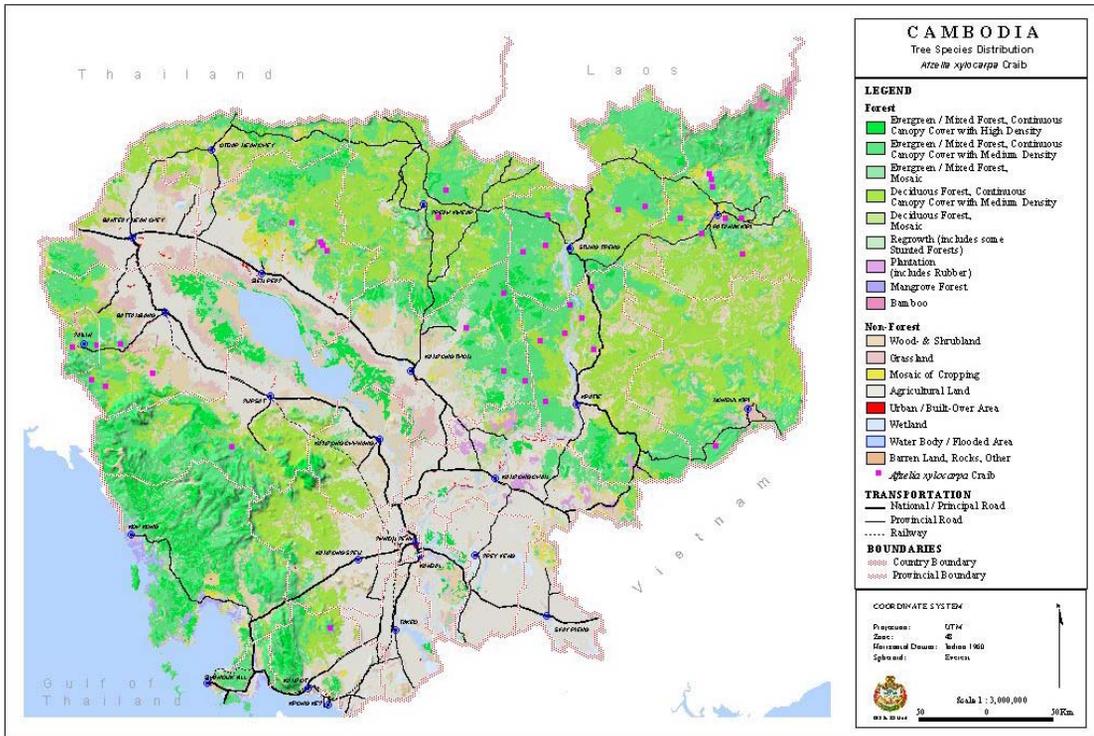
Current Status: Because the wood of *beng* is very valuable, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Within most of its area of distribution, mature trees have been reduced dramatically, and sometimes it is very difficult to find them for seed collection. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second meeting on the Forest Gene Conservation Strategy defined *Afzelia xylocarpa* (Kruz.) Craib. Pierre as a priority species in need of immediate protection and conservation. This species is protected by Cambodian Forestry Law No.35.

IUCN Classification: EN A1cd

References:

- Cambodia Forestry Law No. 35, 25th June 1988
- Cambodia Tree Seed Project (CTSP), 2001, Some Endangered Species of Cambodia, Unpublished
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood, unpublished
- DFSC 2000, Seed Leaflet No.6. *Afzelia xylocarpa* (Kruz.) Craib. Danida Forest Seed Centre (DFSC), September
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- UNEP World Conservation Monitoring Centre, 2002, Red List for Cambodia, Second
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy.



6. *Pterocarpus macrocarpus* Kurz.

Taxonomy and Commercial Grade

Cambodian name	: Thnong
Scientific name	: <i>Pterocarpus macrocarpus</i> Kurz
Family	: Fabaceae
Commercial Grade-Cambodia	: Luxury

Distribution and Habitat: This species is a common constituent of tropical deciduous forests in Cambodia, Laos and Vietnam (FIPI, 1996). In Cambodia the species usually occurs in dense deciduous or cleared forests up to 700 m a.s.l. (Dy Phon, 2000). The species is rarely found in primary forests. The tree is often mixed with many other species, but often occurs as a dominant plant. It is a light-demanding, drought tolerant tree that is suitable for well drained, light textured soils with shallow depths and little humus (Khorn, 2002). It is found in Kampong Thom, Stung Treng, Preah Vihear, Rattanakiri, Kratie, Siem Reap, Kampot, Pursat and Mondulkiri (Khorn, 2002; see map).

Gene-Ecological Zones: Northern Cardamoms (B), Redlands (c), Central Lowlands (d), Eastern Mekong Basin (F), Central Annamites (G), Southern Annamites (g).

Botanical Description: A medium to large tree, *thnong* reaches from 25-30 m high and produces boles from 70-90 cm in dbh (CTSP, 2001). The wood is durable, medium-textured, and has a density of 0.85 (FIPI, 1996). The distinguishing feature of *Pterocarpus macrocarpus* is the colour of the wood, this being a rich red-purple (So Thea, 2002, per. comm). The trunk is straight and cylindrical, and the bark is dark brown and longitudinally fissured. The crown is a dense and globose. New twigs are covered with dense hairs, and become glabrous after development. Leaves are compound, alternate, bi-pinnate, with densely hairy on the petiole. 5-11 alternate are oblong-ovate and taper into a hard point at their tips. The bases of leaflets are rounded and the edges are smooth. The leaflets are glossy-green above and dull below. About 20 densely reticulate pairs of nerves from 7-9 mm long are evident on both surfaces of the leaf. Leaves are shed during the dry season (FIPI, 1996).



Flowering and Fruiting Habit: Small, yellow, aromatic flowers are concentrated on axillary flowering stalks from 10-15 cm long. These are covered with dense brown hairs. The bell-shaped calyx exhibits 5 prominent tips and an outer covering of hairs. The standard petal (or 'flag') is oval and 12-14 mm long. The flower has 10 stamens, and the ovary is densely hairy. Immature fruits contain 2-4 ovules.

Flowering and fruiting times of this species varies according to regions and climates. In Cambodia, flowers generally appear in March-April, and fruit ripens from September-October (FA, 2000). In Myanmar, flowers appear March-May and fruits remain on the tree for several months. In Vietnam, the species flowers from February–April, and fruits are available in December (DFSC, 2000).

Fruit and Seed Description: The fruit is surrounded by thin wing which is flat and round, and around 8 cm in diameter. It has 1-2 chambers and bears 1-2 seeds in each (FIPI, 1996).

Seed Collection: Seeds are usually collected from the tree or from the ground after shaking the branches. In the seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the majority of fruit has turned brown and dry. Maturity can be confirmed by a cutting test (DFSC, 2000).

Seed Handling: To reduce bulk, the wings are removed in the field. The fruit is then dried in the sun. Seed extraction is very labour intensive and in most places not performed (DFSC, 2000).

Sowing and Germination: Seeds start to germinate after 5 days and final germination is usually 70% successful. After 11 days, only 64% of the seeds of wingless fruits germinate. Natural regeneration is best in dry, open forest and in disturbed areas. Vegetative propagation by cutting is possible (DFSC, 2000).

Uses: This species is used in making luxury furniture, cabinetwork, art handicrafts, musical instruments and flooring (FIPI, 1996).

Current Status: In Cambodia, *Pterocarpus macrocarpus* occurs mostly in the North. Most timber is harvested from natural forests and the species is suffering from over-exploitation and agricultural expansions (CTSP, 2001). Its natural habitats are being destroyed, and the species is facing the possibility of extinction if protection measures are not taken.

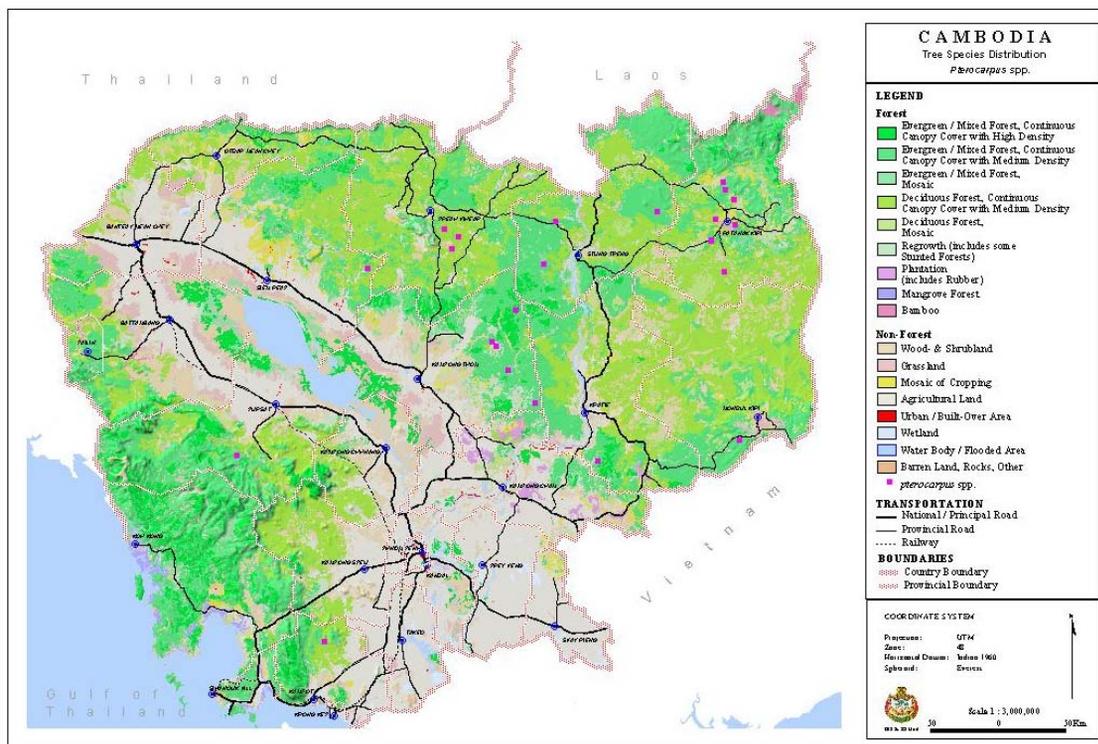
In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Pterocarpus macrocarpus* as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

IUCN Classification: VU A1d

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- Cambodia Tree Seed Project, 2001, Some Endangered Species Of Cambodia, Unpublished
- FA, 2000, Forestry and Wildlife Magazine, No 22
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- DFSC, 2000, Seed Leaflet No. 41, *Pterocarpus macrocarpus* Kurz., Danida Forest Seed Centre, September
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Forest Inventory and Planning Institute (FIPI), 1996, Vietnam Forest Tree

- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- UNEP World Conservation Monitoring Centre, 2002, Red List for Cambodia.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy.
- So Thea, Manager of CTSP, 2002, pers.comm.



7. *Dysoxylum loureiri* Pierre

Taxonomy and Commercial Grade

Cambodian name	: Mrah-prao Phnom
Scientific name	: <i>Dysoxylum loureiri</i> Pierre
Family	: Meliaceae
Commercial grade-Cambodia	: Luxury

Distribution and Habitat: Distributed in lowland forests, especially abundant along the Southwest coast and adjacent highlands of Cambodia. The species is endemic to Cambodia and southern Vietnam (Dy Phon, 2000), and prefers evergreen, primary or secondary forests. It usually on basalt, sandstone, and sandy clay soils (FIPI, 1996). In Cambodia, the species occurs in Koh Kong, Pursat and Kampong Thom (Khorn, 2002; see map).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Northwestern Lowlands (D).

Botanical Description: A large tree up to 20-35 m high, with short-hairy branches. The wood is light yellow in colour, aromatic, incorruptible, but apt to split in high temperatures (Dy Phon, 2000). The leaves are bi-pinnate, the petioles 30-40 cm long. 5-9 leathery leaflets occur in alternate or opposite pairs, ranging from 12-13cm long and 4-4.5 cm wide. Leaflets are round, with an asymmetrical base and acuminate apex. They possess 10-14 pairs of curved-ascending nerves (FIPI, 1996).

Flowering and Fruiting Habit: The flowering branches of *marah-prao* are about half as long as the leaves. Eight stamens are united into a short tube, and these are shortly hair below. The style is umbrella-shaped, and the globular ovary is covered with a dense layer of hairs. Fruits have 3-4 chambers, each bearing 2 seeds. The flower is yellowish in colour, globular, densely short-hairy, and about 3-4cm long. The short-hairy calyx is formed by 4 free sepals, while 4 petals are twice as long as the calyx and short-hairy on the outer surface (FIPI, 1996).

Fruit and Seed Description: The fruit is a short-hairy capsule that opens along 3 valves. Each cell includes 1 seed (FIPI, 1996).

Seed Collection: Seeds are usually collected from the tree or from the ground after shaking the branches. In seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

Uses: The timber is used in house-building, coffins, agricultural and sporting implements, furniture, and as aquilaria wood (FIPI, 1996). The oil is used in traditional medicine as a diuretic and cardiotonic, and is also burned in Buddhist temples (Dy Phon, 2000).

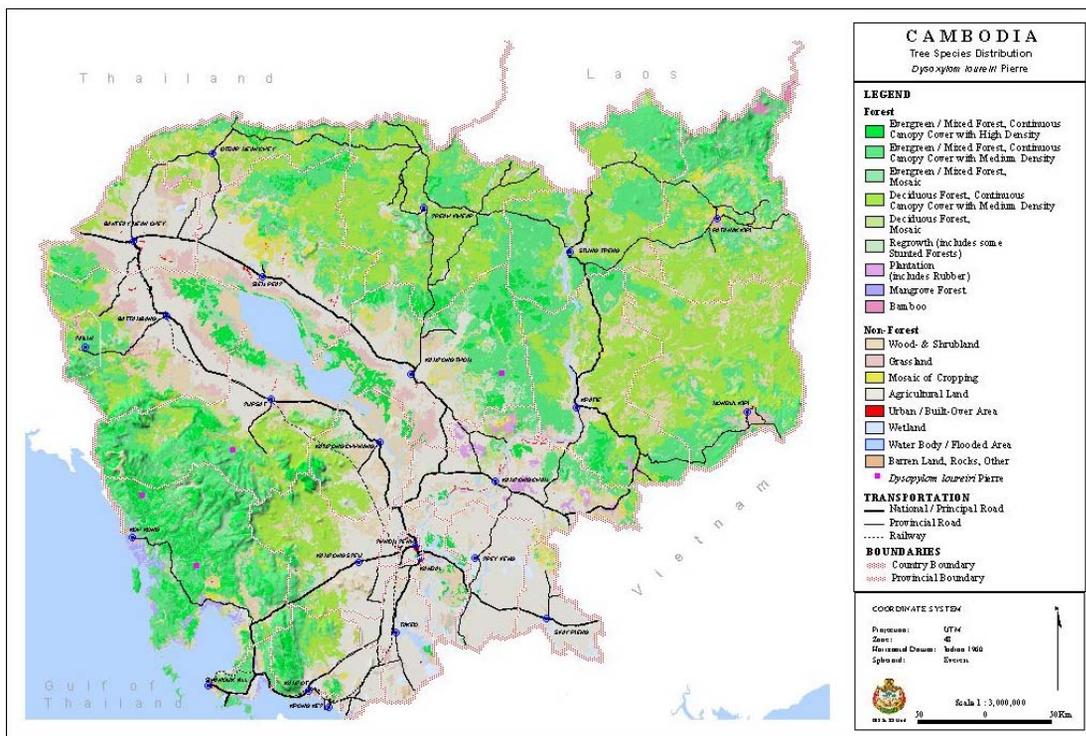
Current Status: Because the wood of *marah-prao* has a high value and is in high demand, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. It now requires adequate protection measures and conservation interventions. The distribution of this species is now scattered, and its habitats have been

destroyed by forestland conversions and selective illegal logging. The number of mature trees are now few, and this results in difficulties in obtaining seed collections.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Dysoxylum loureiri* Pierre as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- FIPI, Forest Inventory and Planning Institute, 1996, Vietnam Forest Trees
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



8. *Diospyros cruenata* Thwaites

Taxonomy and Commercial Grade

Cambodian name	: Cheu kmao
Scientific name	: <i>Diospyros cruenata</i> Thwaites
Family	: Ebanaceae
Commercial Grade-Cambodia	: Luxury

Distribution and Habitat: Found in dense and mixed forests of Eastern Asia.

Gene Ecological Zones: Northern Cardamoms (B), Northwestern Lowlands (D), Eastern Mekong Basin (F), Central Annamites (G).

Botanical Description: A medium to large tree from 8-35 m tall (Dy Phon 2000), and producing boles up to 50 m in dbh (Brandis D., 1987). The colour of the wood is white with black streaks. *Diospyros cruenata* differs from *D. affinis* Thwaites on the basis of its numerous stamens (12-16). The male has apiculate calyx-segments.



Seed Collection: The seed is mature when the pod has changed in colour to dark brown. The pods are often collected as soon as the colour turns from green to yellow to minimize insect predation. Branches are cut or shaken, and the seeds are collected from a tarpaulin that is spread on the ground.

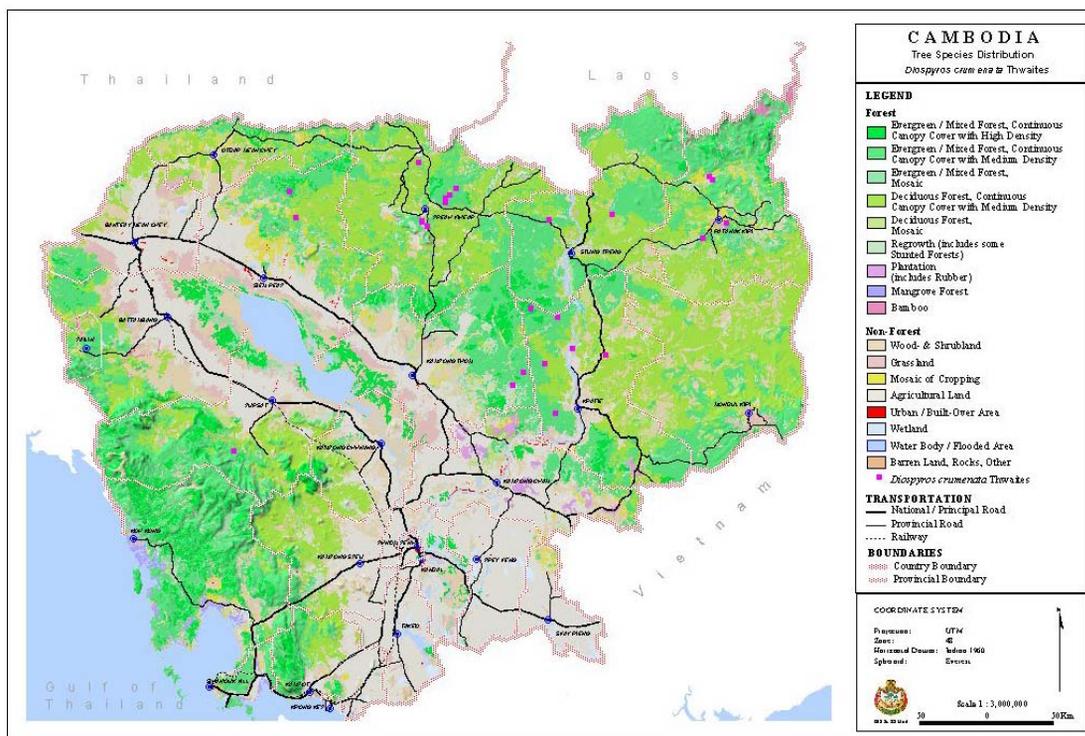
Uses: The wood of *Diospyros cruenata* is valued for the manufacture of ornamental trinkets, and is excellent for firewood (Dy Phon, 2000).

Current Status: Because the wood is very valuable and has very high demand in the market, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habitats have been destroyed by forestland conversions and clear-cutting. Moreover, trees are selectively cut. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Diospyros cruenata* Thwaites Pierre as a priority species in need of immediate protection and conservation. This species is protected by Cambodian Forestry Law No.35.

References:

- Brandis, D, 1987, Indian Trees, London
- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood, unpublished
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Heng Ponley, Director General of the Department of Traditional Medicinal Plants, Ministry of Health, 2002, per.comm.
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



9. *Lasianthus kamputensis* Pierre ex. Pit

Taxonomy and Commercial Grade

Cambodian name	: Romleay chheam
Scientific name	: <i>Lasianthus kamputensis</i> Pierre ex. Pit
Family	: Rubiaceae
Commercial Grade-Cambodia	: Unclassified

Distribution and Habitat: Found in dense forest undergrowth from 300 m a.s.l. in Cambodia and Vietnam (Dy Phon, 2000). In Cambodia, the species is found in Kratie and Kampong Thom ((Khorn, 2002; see map).

Gene-Ecological Zone: Central Lowlands (d).

Current Botanical Description: *Lasianthus kamputensis* Pierre ex. Pit, is a shrub, 1-4m high (Dy Phon, 2000).

Seed Collection: Seeds are usually collected from the tree or ground after shaking the branches. In seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the majority of fruit has changed from green to brownish. Maturity can be confirmed by a cutting test.

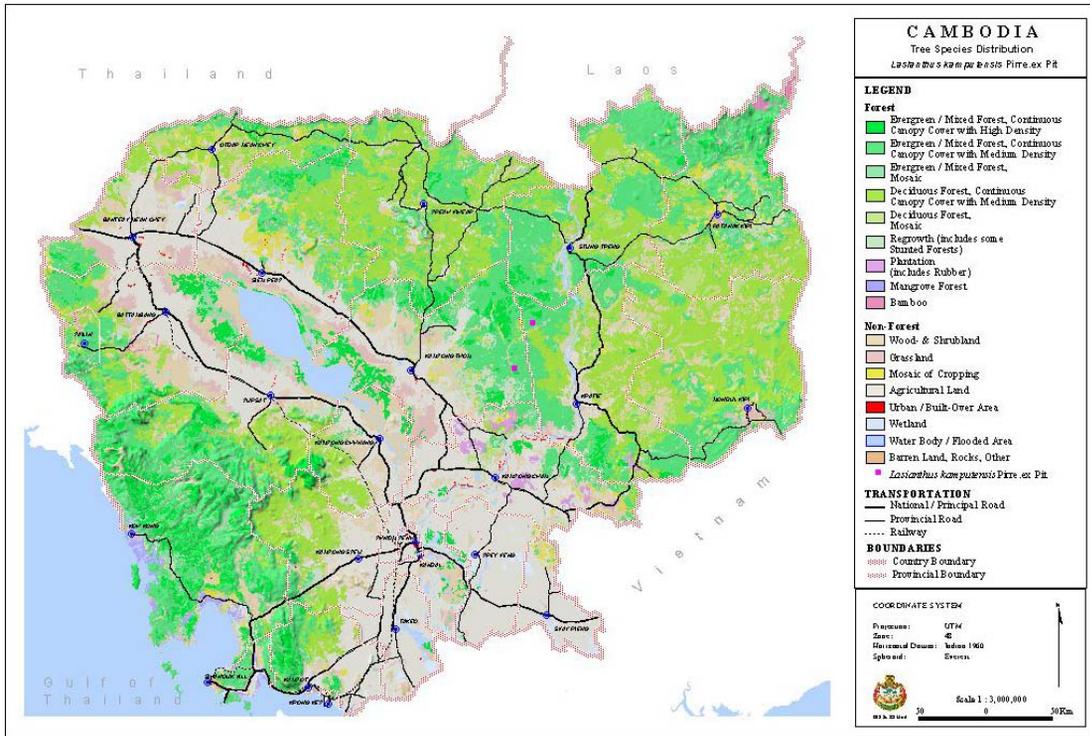
Uses: This species is sometimes cultivated for its beautiful blue flowers. The roots are used in traditional medicine to heal haematomas (Dy Phon, 2000).

Status: As the wood is very valuable and in high demand, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. The species distribution is scattered and its habits have been destroyed by forestland conversions and selective illegal logging. The number of mature trees has been reduced significantly, and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Lasianthus kamputensis* Pierre ex. Pit as a priority species in need of immediate conservation intervention and appropriate protection.

References:

- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants Used in Cambodia
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy.



10. *Diospyros bejaudii* Lecomte

Taxonomy and Commercial Grade

Cambodian name	: Angkat khmao
Scientific name	: <i>Diospyros bejaudii</i> Lecomte
Family	: Ebenaceae
Commercial grade-Cambodia	: Luxury

Distribution and Habitat: *Diospyros bejaudii* Lecomte is found in dense and semi-dense forests of Cambodia, where it is a narrow endemic (Dy Phon, 2000).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Tonle Sap Floodplain (C), Northwestern Lowlands (D), Central Lowlands (d), Southern Annamites (g).

Botanical Description: *Diospyros bejaudii* Lecomte is a medium-sized, evergreen tree species from 10-20 m high. The white wood, with black pigmented heartwood, provides ebony in small proportions (Dy Phon, 2000).

Seed Collection: Seeds are usually collected from the tree or ground. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

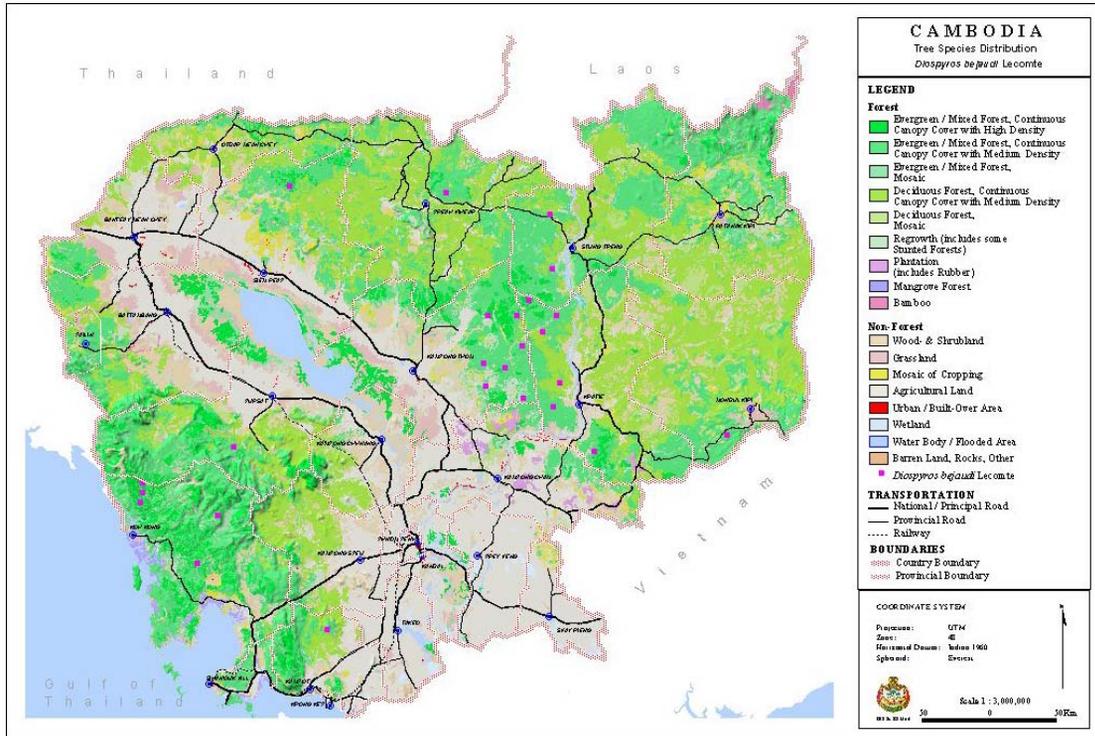
Uses: This species is much in demand for the manufacture of knife handles, and often, musical instruments (Dy Phon, 2000).

Current Status: Because its wood has a high value, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habitat is destroyed through forestland conversion, selective illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Diospyros bejaudii* Lecomte as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September



11. *Fagraea fragrans* Pit

Taxonomy and Commercial Grade

Cambodian name	: Ta trao
Scientific name	: <i>Fagraea fragrans</i> Pit
Family	: Loganiaceae
Commercial grade-Cambodia	: Luxury

Distribution and Habitat: This species is widely distributed in Vietnam, Cambodia, Laos, Thailand, Java, Sumatra, Malaysian Peninsular, and India. In Cambodia, it is usually found in semi-deciduous forests and rarely in dense or open forests (FA,1997). The tree prefers sandy soils that are periodically inundated along streams or rivers, usually below 800 m a.s.l. This is a pioneer species in burnt forestlands (FIPI, 1996). It is found in Koh Kong, Pursat, Stung Treng, Kratie, Kampong Thom, Mondulkiri and Preah Vihear (Khorn,2002; see map).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Central Lowlands (d), Lower Mekong Floodplain (E), Southern Annamites (g).

Botanical Description: An evergreen, medium to large-sized tree, up to 20 m in height, and with boles to 150 cm in diameter. This tree often produces small buttresses at the base. The timber is yellow, very hard and heavy, with a density of 0.85 (FIPI, 1996) to 1.0 (FA, 1997). It is fine-grained and durable in water as well as in open air. The bark is yellowish-gray or brown, longitudinally fissured, with a fibrous inner bark to 1cm thick. The twigs are slender, almost cylindrical, glabrous, nodding, and yellowish-brown when dry. The leaves are simple, entire, elliptic or lance-shaped, the tips pointed, and the base is wedge-shaped. Leaf-blade are 7-12 cm long and 1.5-5 cm wide (FIPI, 1996), glabrous and leathery, and with an evident midrib below. 10-16 pairs of horizontal, parallel lateral veins are evident on both surfaces (FIPI, 1996).

Flowering and Fruiting Habit: Terminal flowering stalks bear 20-30 flowers. Flowers are white and very aromatic, with pedicels from 1-2 cm long. Sepals are 5 and fused into a bell-shaped tube; the petals are 5, unequal in size, and the stamens are 5, exceeding the length of the petals. The ovaries are naked, and produce a style that exceeds the stamens. According to FIPI (1996), flowering occurs from April-June, with fruits from July – November. However, the Forestry Magazine (FA, 1997) states that flowering occurs in February-March and fruiting from May-June.

Fruit and Seed Description: The fruit is a round, sharp-tipped, one-seed berry, reddish in colour, about 1 cm in diameter, bearing angular seeds.

Seed Collection: The seed is mature when the fruits become dark brown. The fruits are often collected as soon as the colour turns from green to yellow to minimize insect predation. Branches are cut or shaken, and the seeds collected from tarpaulin spread on the ground.



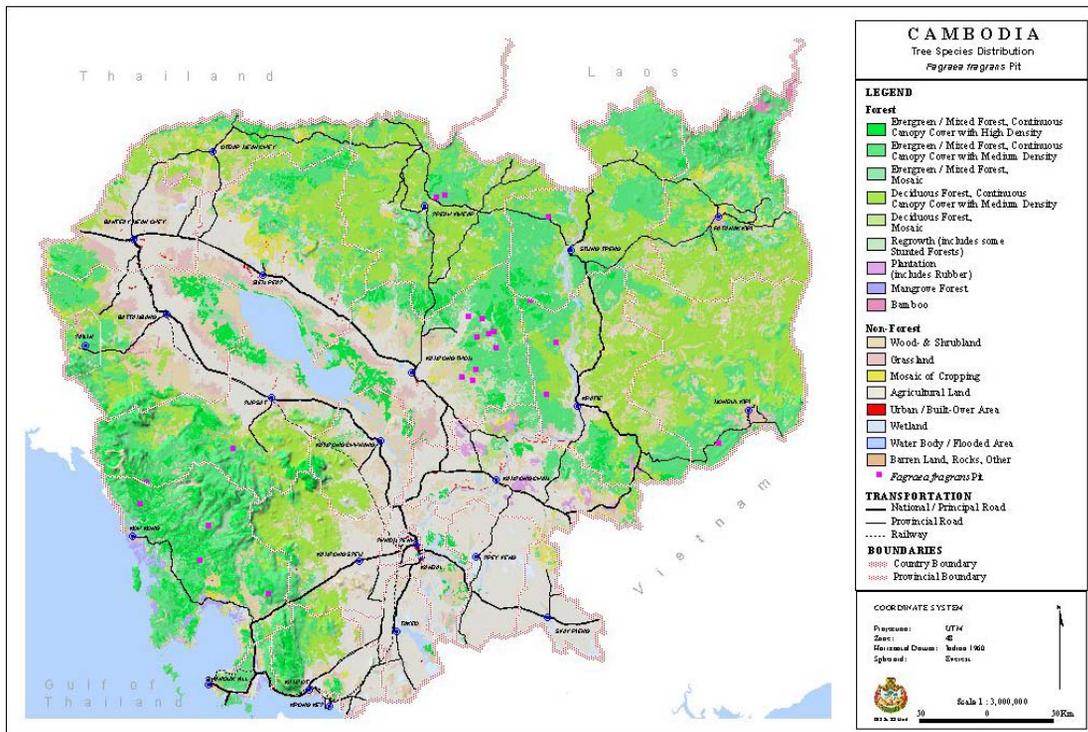
Uses: The wood is used for house pillars in construction, but also in the manufacture of furniture coffins (FIPI, 1996). In Khmer culture, *Fagraea fragrans* Pit is used for making doors and doorframes, particularly in some historic temples (FA, 1997). The bark is used in traditional medicine. The tree can be planted to provide shade (FIPI, 1996).

Current Status: Because this wood is very valuable and in high demand, the species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habitats are being destroyed by forestland conversion and selective, illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Fagraea fragrans* Pit as a priority species, in need of immediate protection and conservation intervention. This species is protected by Cambodian Forestry Law No.35.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 1997, Forestry & Wildlife Magazine, No 15
- FA, 2002, (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood, unpublished
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- FIPI, Forest Inventory and Planning Institute, 1996, Vietnam Forest Trees
- Heng Ponley, Director General of the Department of Traditional Medicinal Plants, Ministry of Health, 2002, per.comm.
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK 12-09-1986: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



12. *Dasymaschalon lamentaceum* Finet et Gagnep

Taxonomy and Commercial Grade

Cambodian name	: Choeng chap phnom
Scientific name	: <i>Dasymaschalon lamentaceum</i> Finet et Gagnep
Family	: Annonaceae
Commercial grade-Cambodia	: Luxury

Distribution and Habitat: This species is normally found in secondary forests and at the edges of dense forests (Dy Phon, 2000). It is presently known from Stung Treng, Mondulkiri, Ratanakiri, Kampong Thom and Preah Vihear (Khorn, 2002; see map).

Gene-Ecological Zones: Central Lowlands (d), Eastern Mekong Basin (F), Central Annamites (G), Southern Annamites (g).

Botanical Description: Shrub, 1-4m tall.

Seed Collection: Seeds of *choeng chap phnom* are usually collected from the tree or ground after shaking the branches. In seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

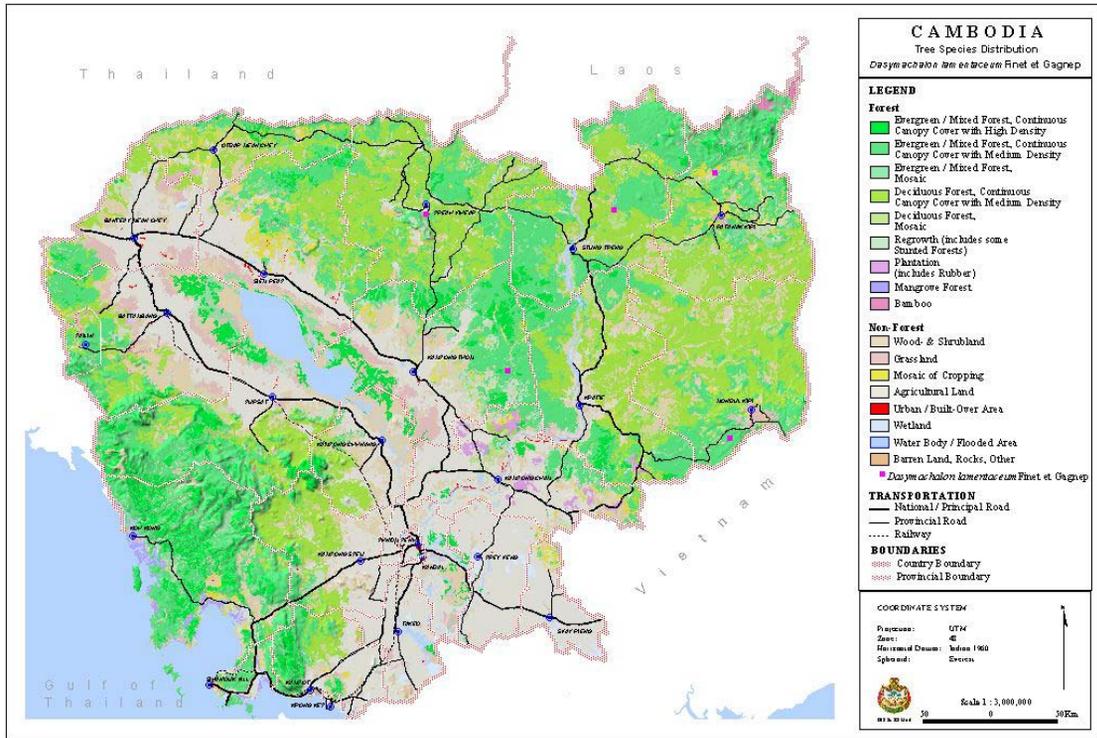
Uses: Leaves are often used as cigarette paper, and ripe fruits are edible. The wood is widely used for the manufacture of high quality furniture, knife handles, and art handicrafts (Dy Phon, 2000).

Current Status: Because the wood is very valuable and in high demand, the species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habits have been destroyed by forestland conversions and selective, illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Dasymaschalon lamentaceum* Finet et Gagnep. as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September



13. *Shorea cochinchinensis* Pierre

Taxonomy and Commercial Grade

Cambodian name	: Porpel
Scientific name	: <i>Shorea cochinchinensis</i> Pierre
Synonym	: <i>Shorea roxburghii</i> G.Don.
Family	: Dipterocarpaceae
Commercial Grade-Cambodia	: 1 st Grade

Distribution and Habitat: *Shorea cochinchinensis* Pierre occurs in Myanmar, Thailand, Laos, Cambodia, Malaysia, Vietnam and the eastern coast of India (Dy Phon, 2000). It is found mainly in mixed deciduous forests or in evergreen forests from 50-1000 m a.s.l (FIPI, 1996). In Cambodia, it is found in Kratie, Pursat, Koh Kong, Ratanakiri, Kampong Thom, Stung Treng, Preah Vihear, Siem Reap and Mondulkiri (Khorn, 2002; see map).

Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Redlands (c), Central Lowlands (d), Central Annamites (G), Southern Annamites (g).

Botanical Description: *Shorea cochinchinensis* is a deciduous, medium to large-sized tree that reaches from 10-25 m high (Dy Phon, 2000). In favourable conditions, it can reach to 30 m in height and produce boles in excess of 200 cm in dbh. Buttresses may be present or absent. The sapwood and heartwood of this species are slightly differentiated by colour; the sapwood is yellowish, while the heartwood is dark yellow or reddish-brown, usually with dark-coloured lines on the surface. The wood is rather hard and heavy, with a density of 0.8-0.93. It is easy to saw and to work. The bark is 2-2.5 cm thick, gray, and rather deeply fissured; the inner bark has brownish concentric bands. The twigs are slender, naked or hairy, and darkly pigmented. Leaves are simple, alternate, oblong to elliptic, with rounded or shortly pointed tips, and rounded bases. They are 18-21cm long and 11-12cm wide on young trees and 8-14cm long and 4-7 cm wide on mature trees, usually naked on both surfaces, but sometimes shortly hairy below. Lateral nerves occur in 14-18 pairs, and the petiole is slender, 1.4-4cm long. The ovate to lance-shaped stipules are 2-4 mm long, hairy, and caducous (FIPI, 1996).

Flowering and Fruiting Habit: Flowering stalks are 8-10 cm long. Flowers have are born on short pedicels and 5 lanceolate or triangular sepals that dry to a blackish hue. The flowers produce 5 white petals around 14.5 mm long and 5 mm wide at the base, and 10-15 stamens with oblong anthers that bear a linear appendage. Ovaries are glabrous and topped with a 3-lobed stigma (FIPI, 1996).

Fruit and Seed Description: This obovate fruits of this species are 12 mm long and 5.5 mm wide, and bear 3 wings from 4.0-8.5 cm long and 1cm wide. The long wing exhibit 11-14 parallel veins, and the two shorter wings reach to 4 cm long (FIPI, 1996).

Seed Collection: Seeds are usually collected from the tree or the ground after shaking the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

Uses: Because of its poor resistance to water, this species is usually used for interior construction and furniture (FIPI, 1996). Still, it is occasionally used for the construction of

boats after soakings. Bark fragments are put into sugar palm juice to delay its fermentation, and sometimes replace the areca nut for betel quid. Extractions of the bark are used in traditional medicine as a cure for dysentery, and sometimes with an admixture of bark from *Sindora siamensis* (Dy Phon, 2000). The tree contains dammar that can be used as a varnish (FIPI, 1996).

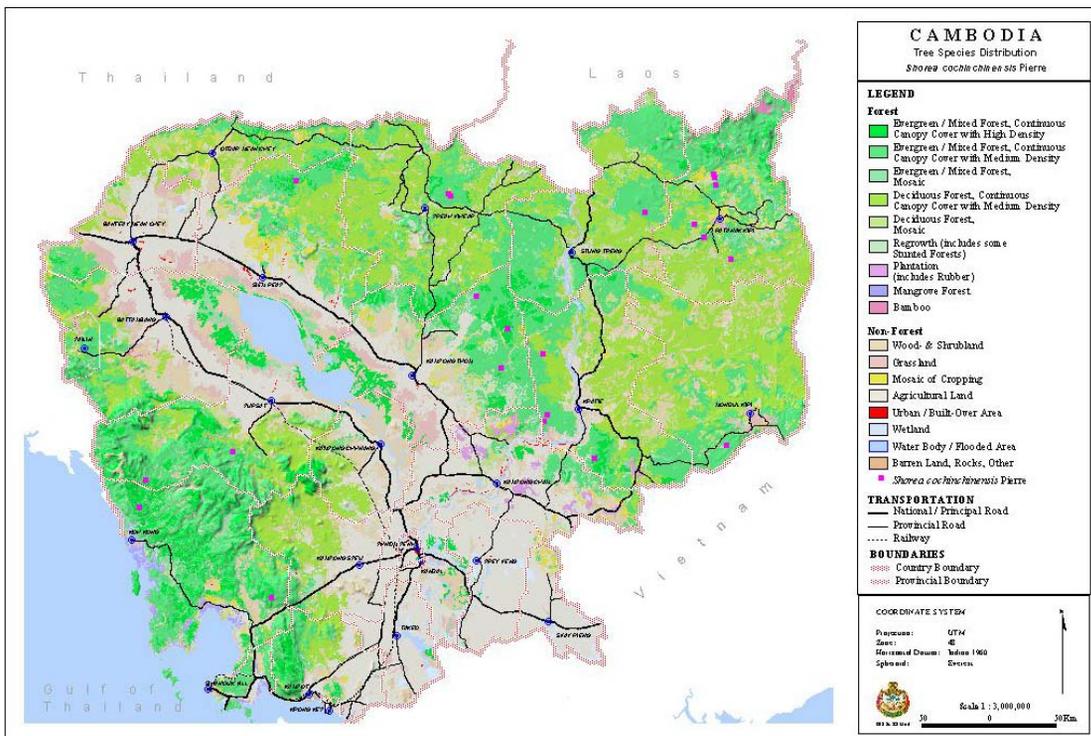
Current Status: Because the wood of this species is very valuable and in high demand, the species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habits have been destroyed by forestland conversions and selective illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Shorea cochinchinensis* Pierre as a priority species in need of immediate conservation intervention and appropriate protection.

IUCN Classification: NE A1cd

References:

- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- FIPI, Forest Inventory and Planning Institute, 1996, Vietnam Forest Trees
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- UNEP World Conservation Monitoring Centre, 2002, Red List for Cambodia, Second
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



14. *Hopea helferi* (Dyer) Brandis

Taxonomy and Commercial Grade

Cambodian name	: Koki dek
Scientific name	: <i>Hopea helferi</i> (Dyer) Brandis
Family	: Dipterocarpaceae
Commercial Grade-Cambodia	: 1 st Grade

Distribution and Habitat: This species has a widespread distribution throughout Southeast Asia. It is often cultivated in the Mekong delta and the Malay Peninsula (Dy Phon, 2002). It is a shade tolerant tree when young, and grows in evergreen forests, usually below 700 m a.s.l. It occurs solitarily or in small groups. The species demands wet and deep soils. In Cambodia, it is found in Stung Treng, Siem Reap, Preah Vihear, Mondulkiri, Kampot and Pursat (Khorn, 2002; see map).

Gene-Ecological Zones: Northern Cardamoms (B), Redlands (c), Northwestern Lowlands (D), Central Lowlands (d), Central Annamites (G), Southern Annamites (g).

Botanical Description: *Hopea helferi* is a medium-sized tree, 8-25 m high, with round, straight stems and a beautiful form. The wood is rather hard, brown-gray or yellowish-brown in colour, easy to work and rarely splitting (Dy Phon, 2002). It produces simple leaves that are 10-14 cm long and 4-6cm wide (Heang Ponley, 2002, per. comm.).

Flowering and Fruiting Habit: Flowers are produced on terminal flowering stalks, and the ovary is naked (Brandis, 1987). The species flowers from January-February and produces mature fruits from March-April (Heang Ponley, 2002, per. comm.).

Seed Collection: The seeds of *Hopea helferi* are mature and ready for collection when the wings have turned to a dark brown and the coat has changed from green to yellow. It is important to time the collections of this species carefully, as seeds that are not fully mature have low viability. The fruit is collected directly by climbing the tree, or by shaking the branches over tarpaulins spread on the ground. Collection from the forest floor should be avoided as these seeds have low viability and are often heavily infected by weevils. Fresh seeds have high moisture content and must be kept in loosely folded bags away from the sunlight during transport and temporary storage.

Seed Handling: Soon after collection in the field the wings of each fruit must be removed manually; while immature and insect-infected fruits are to be discarded.

Uses: This wood is resistant to water and air, and houses constructed from it can last for 7-8 years and boats up to 30 years (Dy Phon, 2000). It is also used to make local carts, handicrafts and cabinets (FA, 2000). Resin is much in demand for the manufacture of varnish (Dy Phon, 2000) and also for making fire-torches for local use.

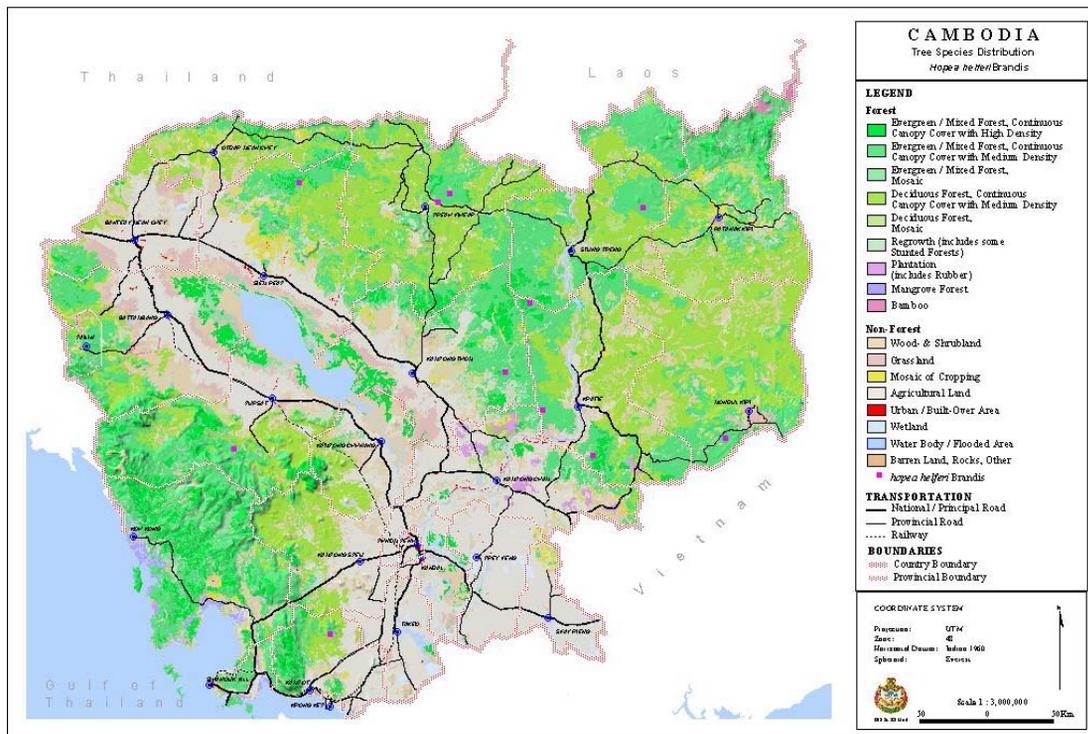
Current Status: Dipterocarp forests in general, and *Hopea Helferi* in particular, are now uncommon due to the over-exploitation and degradation of their habitats. Large populations of this species are now rarely found within forest concession areas. The species often grows in moist forest, and along streams. Thus, when their habitat is destroyed, trees cannot easily regenerate.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Hopea Helferi* (Dyer) Brandis. as a priority species in need of immediate conservation intervention and appropriate protection.

IUCN Classification: CR A1cd.

References:

- Brandis, D, 1987, Indian Trees, London
- Department of Forestry & Wildlife (FA), 2000, Forestry & Wildlife Magazine, No.23
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia.
- Heang Ponley, Director General of Department of Traditional Medicinal Plants, Ministry of Health, 2002, pers. comm
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- RGC, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- Ministry of Agriculture, Forestry and Fisheries, 1988, Cambodia Forestry Law No. 35, 25th June
- UNEP World Conservation Monitoring Centre, 2002, Red List for Cambodia.
- Son Pisith, 2002, pers. comm.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation.



15. *Pinus merkusii* Jungh et de Vries

Taxonomy and Commercial Grade

Cambodian name	: Sral
Scientific name	: <i>Pinus merkusii</i> Jungh et de Vries
Family	: Pinaceae
Commercial grade-Cambodia	: 2 nd Grade

Distribution and Habitat: This species occurs throughout South-East, including Myanmar, Cambodia, Laos, Vietnam, Indonesia (Sumatra) and Philippines (Luzon and Mindoro islands). *Sral* was probably introduced onto the island of Hainan (China) (Hidayat and Hansen, 2002). In Cambodia it is found in large stands or small groups, and usually in mixed deciduous or evergreen forest. The largest stands of *sral* in Cambodia are found on the Kirirom Plateau, and cover a total of 12,000 hectares (Dy Phon, 2000). The species occurs from 30-1800 m a.s.l.. It is a light-demanding, heat- and drought-tolerant tree, growing well on many different types of soil, such as sandy and red soils, and in varying climates (Hidayat and Hansen, 2002). It is slow-growing during the first five years, but grows quickly as an adult (Khorn, 2002). Experience suggests that this is one of the principal tree species to plant on bare or bushy hills, as it provides protection against erosion and land-deformation (FIPI, 1996). It is found in Kampong Thom, Koh Kong, Pursat, Kampong Speu and Mondulkiri, as illustrated on the map below.



Gene-Ecological Zones: Coastal Cardamoms (A), Northern Cardamoms (B), Central Lowlands (d), Southern Annamites (g).

Botanical Description: A large tree from 30-35 m in height (Dy Phon, 2000), producing boles from 60-80 cm in dbh. Old trees can reach to heights in excess of 45 m and produce boles to 140 cm in dbh. Sapwood and heartwood is distinctive, the former being yellowish in colour, whilst the latter is a slightly darker, heavier wood with a density of 0.88-0.96 (FIPI, 1996). Young trees have a pyramid or conical crown form, whereas old trees have a flatter and spreading crown (Hidayat and Hansen, 2002). The trunk is straight, cylindrical, and very resinous. The first year branches are brownish and glabrous. Bark is thick, reddish-brown, with deep longitudinal splits. Cones mature after 2 years, the scales of which are spineless. In the second year, the cone is cylindrical or ovate-elongate, with a pedicel about 1cm long. Scales have a rhomboid surface and a sharp margin, and across the middle of the surface two transversal, longitudinal, relieved lines. Natural regeneration is good, especially on open lands. From 15 years onwards, resin can be extracted from the tree (FIPI, 1996).

Flowering and Fruiting Habit: Male and female cones can be found throughout the year, but reproductive structures usually begin to develop from May-June, resulting in the maturation of cones in October and November of the following year. Hence development of the cones requires 11-15 months (Hidayat and Hansen, 2002).



Fruit and Seed Description: The fruit is a cylindrical cone, 5-10 cm long and 2-4cm wide, up to 10 cm wide after opening. Seeds are produced when the tree is 10-15 years of age, and normally in large quantities. However, there is variation within and between stands (Hidayat and Hansen, 2002). Seeds are dispersed by wind under natural conditions. Ovate seeds are slightly flat, bearing a thin wing (FIPI, 1996), borne at the base of the cone scales, each scale able to support two seeds. Wings are 22-30 mm long and 5-8mm wide, and attach to the seed with hooks that are connected by hygroscopic tissue in the base of the wing. The seed is firmly held while in dry conditions, favouring wind dispersal, but the wing is quickly released when moist conditions suitable for germination are encountered. There are normally 35-40 seeds per cone, and 50,000-60,000 seeds per kilo (Hidayat and Hansen, 2002).

Seed Collection: The optimal time of collection is reached when the majority of cones have changed colour from green to brownish and start to open. Maturity can be confirmed by a cutting test. The cut seed should have a white and solid endosperm filling its entire space. Seed collection is by climbing the trees and picking the cones. A special hook sharpened on both sides can be used for pulling or pushing off the cones, and avoids breaking the twigs (Hidayat and Hansen, 2002).

Seed Handling: Mature, brown cones should be stored in the shade, with good ventilation in gunny bags or on racks for at least one or two days. The cones require after-ripening before seed extraction, as immediate sun-drying of freshly collected cones sometimes causes "case-hardening", meaning that the outer tissues dry too quickly before the inner tissues can lose moisture, and the cone scales fail to open properly. Seeds are extracted by drying the cones in the sun on trays, or on canvas until they open, and during this time, the cones should be stirred to facilitate seed extraction. The common practice of seed extraction by splitting the unripe cone with a knife or cone-cutter is not recommended, as many seeds will be immature and damaged during storage leading to poor germination rates. To ease further seed processing and sowing in the nursery, the wing should be removed from the seed. For small quantities, this can be done manually by rubbing the seed between the hands, or against a screen or roughened surface, or by rubbing in a cloth bag. For large quantities of seed, mechanical methods may be used, for example, seeds can be given 10-15 minutes in a concrete mixer (without water) to loosen the wings. Then 5-10% water is added gradually by spraying, and the seed rotated for approximately 15 minutes more, before cleaning and drying (Hidayat and Hansen, 2002).

Sowing and Germination: Germination starts 7 days after sowing and often reaches 80% after 12-15 days. Seeds can be sown directly in containers (1-2 seeds per container), or

alternatively, in sowing beds to be transferred later into containers, when seedlings are 3-4 cm tall. The growth medium should be a mixture of sand and topsoil from a pine stand with a ratio of 3:1. Mycorrhizal associates are required. Seedling growth takes up to 9-10 months, hence they are slow compared to many other tropical species (Hidayat and Hansen, 2002).

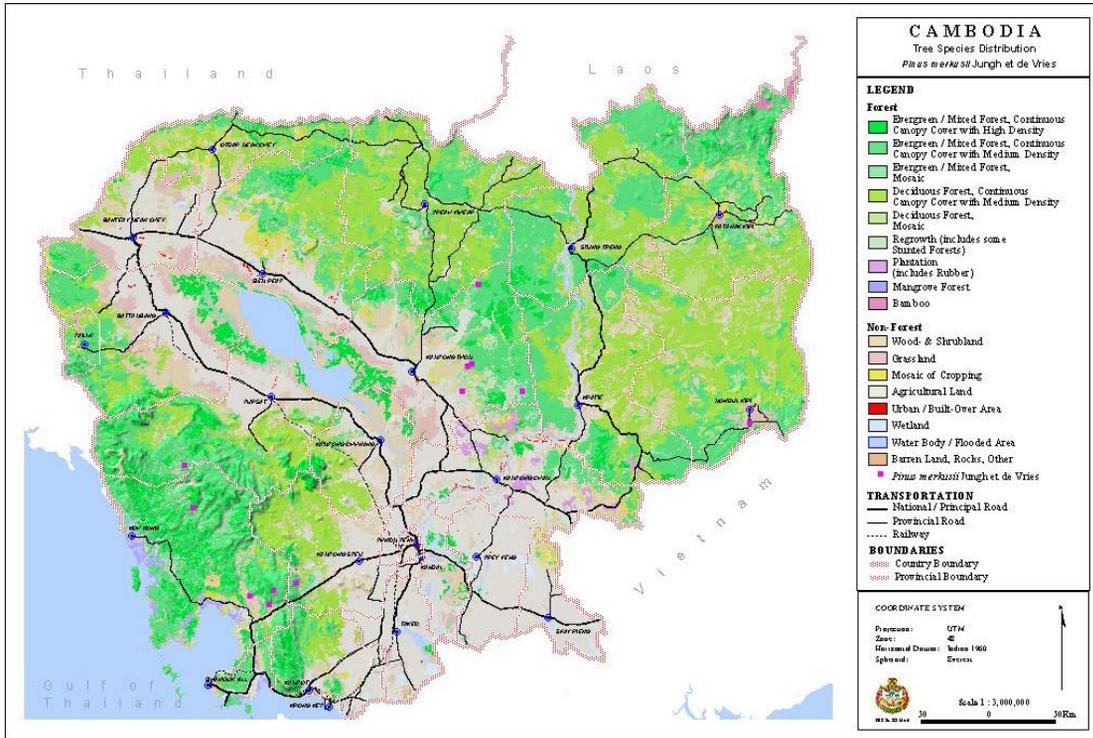
Uses: The wood is used in house construction, joinery, match-making, pulp, common furniture, pit props, electricity poles, shipbuilding, chopsticks, and vehicle-building (FIPI, 1996). The species provides high resin yields and commercial tapping is often practiced. Old trees can yield 30-60 kg of crude gum per year, equalling 20-40 kg of pure resin and 7-14 kg of turpentine (Hidayat and Hansen, 2002). The resin is also used in medicine, paints, printing and the perfume industry. In Cambodia, the resin is also used to make torches. In traditional medicine, the decoction of the dried out resin is used to treat diseases such as furunculosis, abscesses, and bad blood circulation (Dy Phon, 2000). This species is often used for the rehabilitation of degraded areas due to its tolerance to fire and poor soil conditions (Hidayat and Hansen, 2002).

Current Status: As this wood is very valuable and has very high demand in markets, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Distribution is scattered and its habits have been destroyed by forestland conversions and selective illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Pinus merkusii* Jungh et de Vries as a priority species in need of immediate conservation intervention and appropriate protection. Resin tapping (harvesting) is prohibited by Cambodian forestry law (1988) unless special permission is granted by MAFF.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Forest Inventory and Planning Institute (FIPI), 1996, Vietnam Forest Trees
- Hidayat Jajat and Hansen Christian P. (Indonesia Forest Seed Project), 2002, Seed Leaflet No. 60, *Pinus merkusii* Jungh et de Vries, Danida Forest Seed Centre (DFSC), January
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy.



16. *Garcinia hanburyi* Hook.f.

Taxonomy and Commercial Grade

Cambodian name	: Roung
Scientific name	: <i>Garcinia hanburyi</i> Hook. f.
Family	: Clusiaceae
Commercial Grade-Cambodia	: Unclassified

Distribution and Habitat: Found in the dense and secondary forests of Cambodia, Southern Vietnam, and Thailand. The species is often cultivated in Singapore and Java (Dy Phon, 2000). In Cambodia, it is found in Kampong Thom, Koh Kong, Pursat, Kampong Speu and Monduliri (Khorn, 2002; see map).

Gene-Ecological Zone: Central Lowlands (d).

Botanical Description: A broad-leaved tree up to 10-20 m high. All parts of the plant are filled with a thick, sticky juice (Dy Phon, 2000). The leaves are simple, and 10-20 cm long and 4-6 cm wide (Heang Ponley, 2002, per. comm.).

Seed Collection: Seeds are usually collected from the tree or ground after shaking the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish.

Uses: The gamboge (yellow-milky latex) is used in yellow watercolors and in the preparation of alcohol varnish and metal varnishes. In traditional Cambodian medicine, it is used to treat colds and bronchitis, and as a vermifuge. The wood, although not very durable, is used in construction (Dy Phon, 2000).

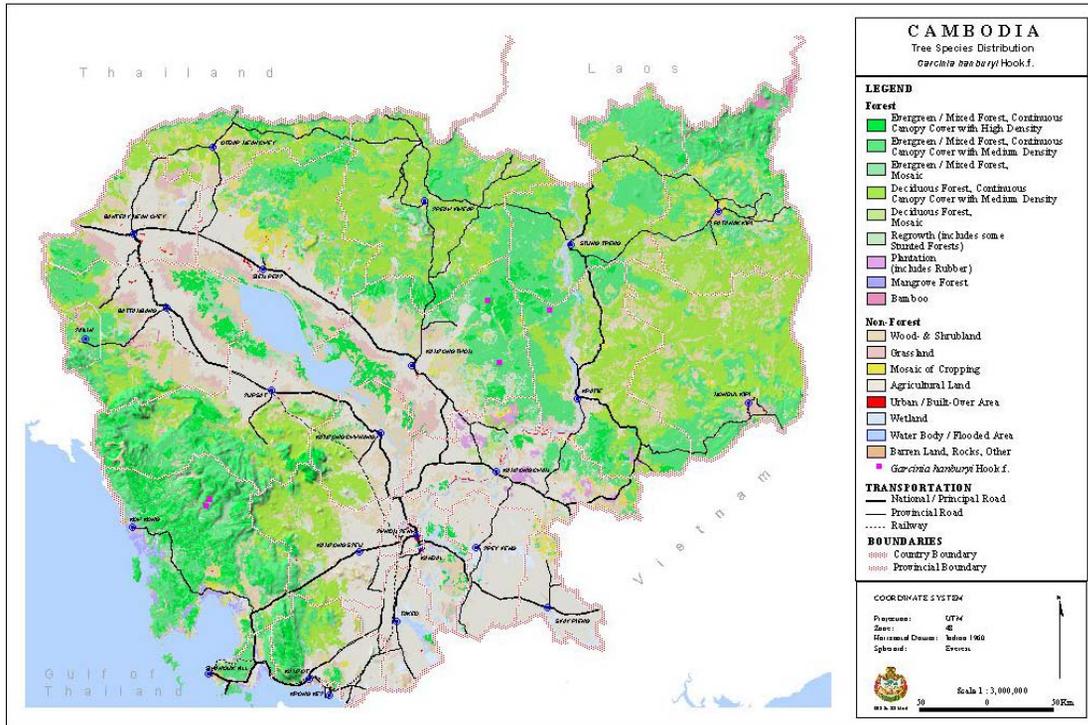
Current Status: As the wood is very valuable and in high demand, the species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habits have been destroyed by forestland conversions and selective logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Garcinia hanburyi* Hook.f. as a priority species in need of immediate conservation intervention and appropriate protection. Resin tapping (harvesting) is prohibited by Cambodian forestry law (1988) unless special permission is granted by MAFF.

References:

- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants Used in Cambodia
- Heang Ponley, Director General of Department of Traditional Medicinal Plants, Ministry of Health, 2002, pers. comm
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia

- Ministry of Agriculture, Forestry and Fisheries (MAFF), 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September



17. *Cinnamomum cambodianum* Lecomte

Taxonomy and Commercial Grade

Cambodian name	: Tep porou
Scientific name	: <i>Cinnamomum cambodianum</i> Lecomte
Family	: Lauraceae
Commercial Grade-Cambodia	: Unclassified

Distribution and Habitat: This species is distributed in wet, dense, piedmont forests from 600-700 m a.s.l. (Dy Phon, 2000). It is also plentiful on the upper slopes of the Bokor and Cardamom Mountains. It has disjunct populations in Ratanakiri and Kampong Thom, as illustrated on the map. This species is endemic to Cambodia (FA, 2000). It is a shade-demanding tree when young, growing well in deep soil. It usually grows in clusters of 5 – 10 trees in the primary of secondary forest, at altitudes below 1,500 m above sea level (Khorn, 2002).

Gene-Ecological Zone: Central Annamites (G).

Botanical Description: *Cinnamomum cambodianum* Lecomte is a large tree from 15-25 m high, producing boles from 30-80 cm in dbh. Its trunk is usually straight, cylindrical, and with a beautiful form. The sapwood and heartwood are not always distinctive, although the sapwood is pale gray and heartwood reddish-gray. The inner bark is 2-4mm thick, and grayish-white in colour. Simple alternate, rounded leaves are 6-15 cm long and 3-8cm wide (FA, 2000). All parts of the stem are aromatic.

Flowering and Fruiting Habit: The flowers are bisexual, and arranged in sub-terminal or axillary stalks.

Fruit and Seed Description: The fruit is egg-shaped and 6-8 mm in diameter. The colour of young fruits is gray-yellow, turning to red-brown when mature.

Seed Collection: Seeds are usually collected from the tree or from the ground by shaking the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

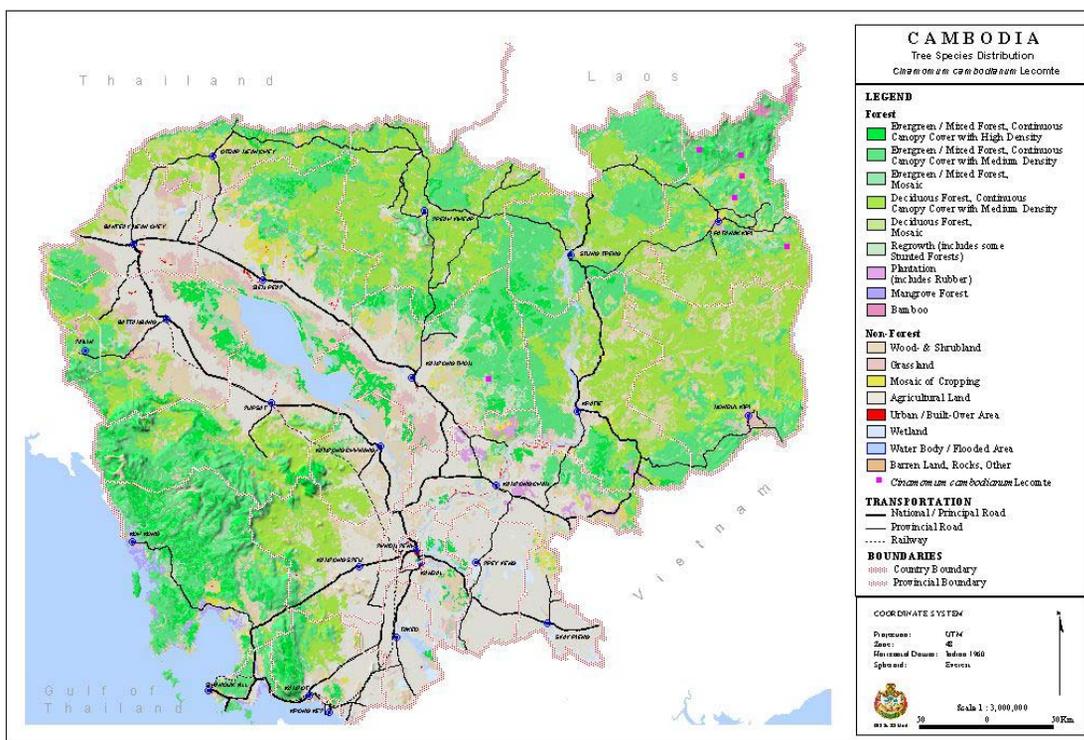
Uses: Timber of this species is used in house construction and as fuelwood (FA, 2000). The bark can be chewed with betel, or used in the kitchen. In traditional medicine, it is used against a variety of diseases, such as indigestion, tuberculosis, and regulation of periods (Dy Phon, 2000).

Current Status: As the wood is very valuable and in high demand. This species is under high pressure from over-exploitation and is in danger of extinction unless measures are taken to provide adequate protection illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Cinnamomum cambodianum* Lecomte as a priority species in need of immediate conservation intervention and appropriate protection.

References:

- Department of Forestry & Wildlife, 2000, Forestry and Wildlife Magazine, No.23, Cambodia
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



18. *Sterculia lychnophora* Hance

Taxonomy and Commercial Grade

Cambodian name	: Samraang
Scientific name	: <i>Sterculia lychnophora</i> Hance
Family	: Sterculiaceae
Commercial Grade-Cambodia	: Unclassified

Distribution and Habitat: A shade demanding species, this versatile tree grows in moist primary and secondary forests above 1700 m a.s.l. It often occurs as a solitary tree on limestone. In Cambodia, it is found in Ratanakiri, Kampot, Pursat and Sihanouk Ville (Khorn, 2002; see map).

Gene-Ecological Zone: Central Annamites (G).

Botanical Description: This is a large, evergreen broad-leaved tree species that can reach up to 18-25 m in height and produce boles from 50-75 cm in dbh. The wood is rather hard and heavy, but easy to saw and to work. Leaves are 12-15 cm long and 8-10 cm wide (Heang Ponley, 2002, per. comm.).



Fruit and Seed Description: The fruit is egg-shaped and from 8-15 mm in diameter. The colour of young fruit is green-yellow, turning to dark-brown when mature (Sonn Pisith, 2002, per. comm).

Seed Collection: Seeds are usually collected from the tree or from the ground after shaking or cutting the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

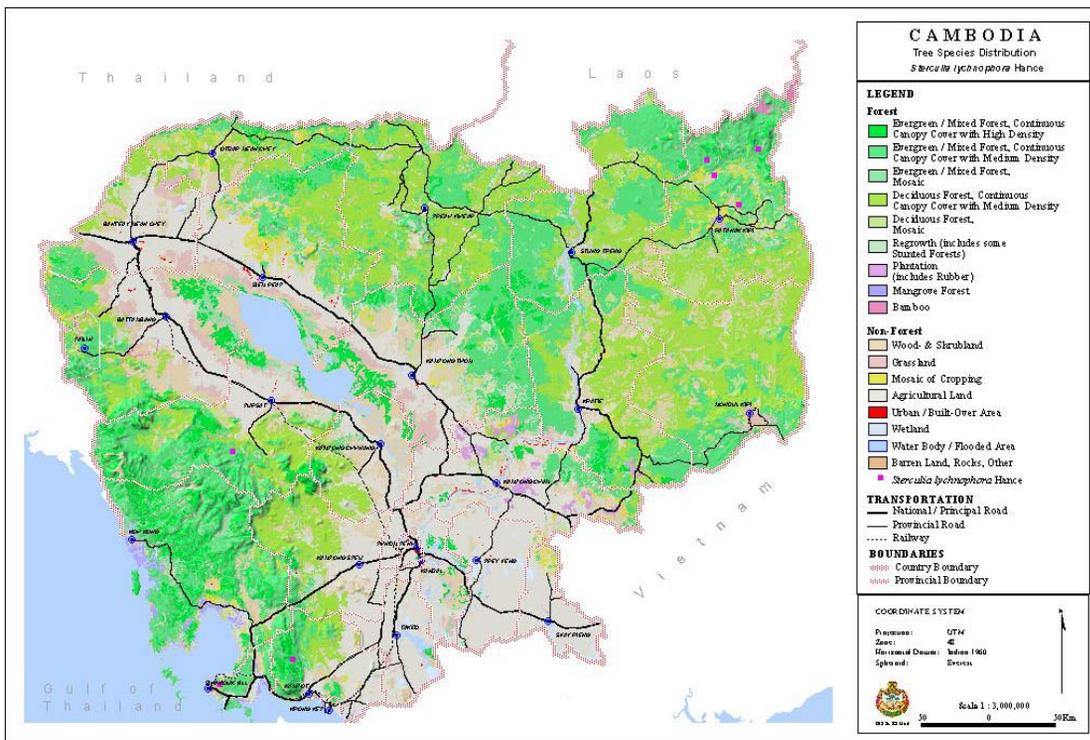
Uses: This species is usually used for house construction and interior furniture, construction of boats, and as firewood. The fruit is edible after soaking, and is in high demand in local and foreign markets for the manufacture of jellied fruits (Sonn Pisith, 2002, per.comm.).

Current Status: Samraang has been heavily exploited, and the trees only flower every 1-3 years (Sonn Pisith, 2002, per.comm.). Hence the number of mature trees is very low. It is often found in protected areas and conserved in some concession areas, but it is threatened by the destructive practice of chopping down the tree to collect the fruit.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Sterculia lychnophora* Hance as a priority species in need of immediate conservation intervention and appropriate protection.

References:

- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood.
- Heang Ponley, Director General of Department of Traditional Medicinal Plants, Ministry of Health, 2002, pers. comm.
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Son Pisith, 2002, pers. comm.
- CTSP Seminar, 29 Jan. 2002 on Forest Gene Conservation Strategy



19. *Cananga latifolia* (Hook.f. & Thomson) Finet & Gagnep

Taxonomy and Commercial Grade

Cambodian name	: Chker sreng
Scientific name	: <i>Cananga latifolia</i> (Hook.f. & Thomson) Finet & Gagnep
Family	: Annonaceae
Commercial Grade-Cambodia	: Unclassified

Distribution and Habitat: Trees are found in clear and semi-dense forests of Cambodia, Laos, Vietnam and Malaysian Peninsula (Dy Phon, 2000). In Cambodia, it is found in Preah Vihear, Siem Reap, Ratanakiri, Kampong Thom, Stung Treng, Pursat and Mondulkiri (Khorn, 2002), as illustrated on the map below.

Gene Ecological Zones: Northern Cardamoms (B), Northwestern Lowlands (D), Central Lowlands (d), Central Annamites (G), Southern Annamites (g).

Botanical description: *Cananga latifolia* (Hook.f. & Thomson) Finet & Gagnep, is a small tree from 8-15 m high. The leaves are alternate and simple, hairy, from 20-30 cm long and 15-20 cm wide. They smell strongly when crushed (Heang Ponley, 2002, per. comm.).



Seed Collection: Seeds are usually collected from the tree or from the ground after shaking the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.



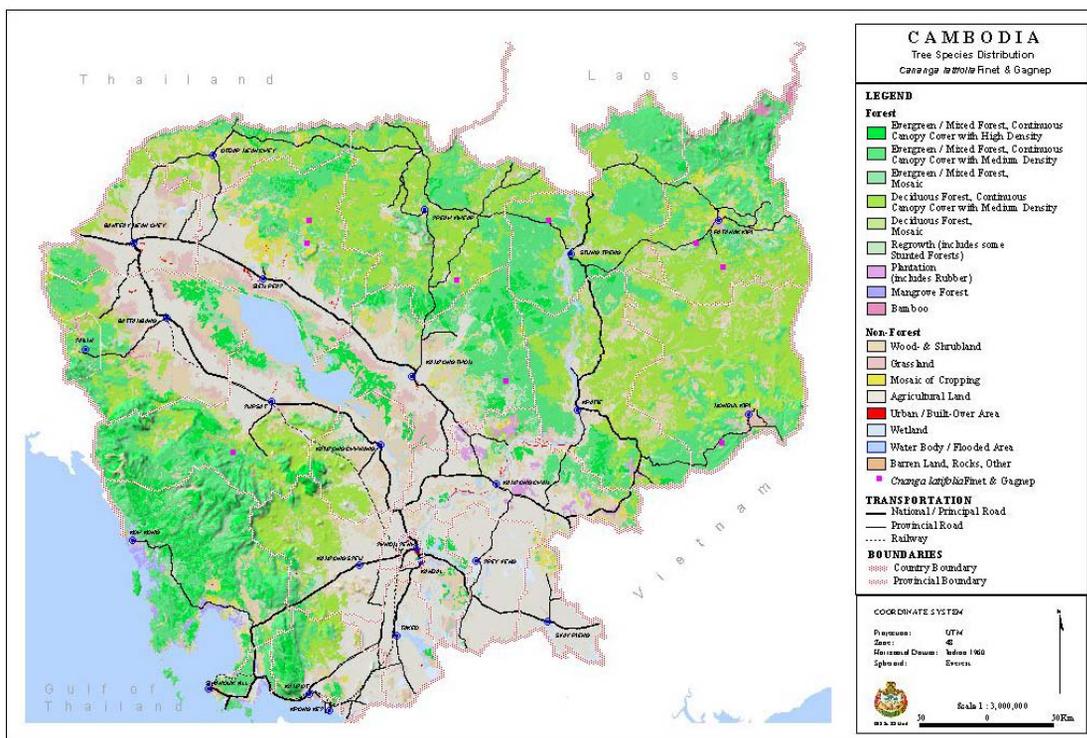
Uses: The fragrant flowers are sometimes used to make necklaces. The wood is not very durable, and is used for temporary structures. The bark is one component of a remedy for dizziness, and the wood's infusions are also employed as a febrifuge (Dy Phon, 2000). The wood is other ways as well in Cambodian traditional medicine (Heang Ponley, 2002, per. comm.)

Current Status: As the wood is valuable and in high demand, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. The distribution of this species is scattered and its habitats have been destroyed by forestland conversions and selective logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy recognized *Cananga latifolia* (Hook.f. & Thomson) Finet & Gagnep. as a priority species and in need of immediate protection.

References:

- Department of Forestry & Wildlife (FA), 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia.
- Heang Ponley, Director General of Department of Traditional Medicinal Plants, Ministry of Health, 2002, pers. comm
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- Ministry of Agriculture, Forestry and Fisheries (MAFF), 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September.



20. *Albizia lebbbeck* (L.) Benth.

Taxonomy and Commercial Grade

Cambodian name	: Chres
Scientific name	: <i>Albizia lebbbeck</i> (L.) Benth.
Family	: Fabaceae
Commercial grade-Cambodia	: Luxury

Distribution and Habitat: *Albizia lebbbeck* (L.) Benth is found in dense deciduous forests in tropical and sub-tropical countries of Asia, such as Laos, Cambodia, Malaysia, Indonesia and Vietnam, Africa (Dy Phon, 2000) and Australia. It has been widely cultivated and is now pantropical. The species grows poorly on heavy clays, but grows well on fertile, well-drained, loamy soils, in areas that receive from 600-2500 mm of rain per year. However, this species is also capable of tolerating years with as little as 300 mm of rainfall. It is normally encountered below 1800 m a.s.l., and prefers mean annual temperatures from 20-35°C. This tree is nitrogen-fixing, and tolerates acidity, alkalinity, heavy and eroded soils, waterlogged soils, and drought. Older trees can survive grass fires and intense night frost, and although these events will kill off aboveground growth of young trees, new growth normally follows (DFSC, 2000). In Cambodia, it is found in Stung Treng, Ratanakiri, Koh Kong, Battambang, Preah Vihear and Kampong Thom (Khorn, 2002; see map).

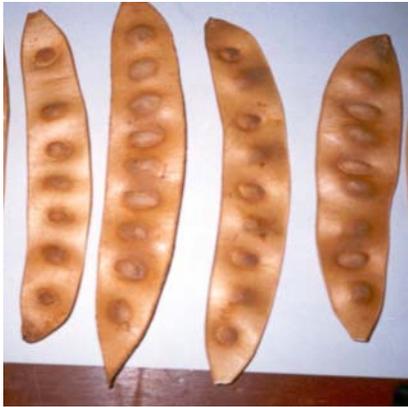


Gene Ecological Zones: Coastal Cardamoms (A), Central Lowlands (d), Central Annamites (G).

Botanical Description: This deciduous tree is 15-20 m tall and sometimes up to 30 m tall (DFSC, 2000). It produces boles from 30-40 cm in dbh (Dy Phon, 2000). The gray, cork-like bark is fissured and somewhat flaky. Compound, bi-pinnate leaves produce 2-4 pairs of pinnae, each of these with 2-11 leaflets. Tree growth is seasonal, with no growth in the early part of the dry season. Leaf loss occurs 2-3 months later, and the tree remains leafless for 1-2 months. Towards the end of dry season growth resumes and flowering begins (DFSC, 2000).

Flowering and Fruiting Habit: Green or creamy-white, fragrant flowers form in large heads around 5-7.5 cm wide. Flowers produce stamens from 1.5-2 cm long. Flowering and seeding occurs in the wet season, and unless the trees have been frequently coppiced, they will produce large amounts of seed every year. Mature pods remain on the tree for 3-4 months. Within its natural area of distribution, flowering occurs September-October and pods mature in May-July. In India flowering is in March-May, with fruit maturing in August-October. In Sudan it flowers in March-May and bears fruit from May-August. In Tanzania ripe pods can be found July-December with a peak in August-October. Pollination is by insects (DFSC, 2000).





Fruit and Seed Description: Fruit pods are indehiscent, pale straw to light brown (at maturity), 15-25 cm long and 3-5 cm wide, papery to leathery, flat and without a constriction between the seeds. Seeds are brown, flat, from 8-10 long and 6-7 mm wide, with 6-12 placed transversely in the pod. There are 7,000- 12,000 seeds per kg (DFSC, 2000).

Seed Collection: The pods are mature when they have turned light yellow and should be harvested when the last patches of green are disappearing. It is important that collection is not delayed as insects can very quickly infest the mature pods. It is possible that early collection followed by after-ripening in the shade could minimize the damage (DFSC, 2000). Seeds are usually collected from the tree or from the ground after shaking the branches. In seed source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the fruits have changed in colour from green to brownish. Maturity can be confirmed by a cutting test.

Seed Handling: Even when the pods are collected early many are insect infested and temporary storage should be as short as possible as the insects develop during this phase. If the pods are collected when they are still green, the bags should be kept open during transport to ensure ventilation. Pods are dried directly in the sunlight until they rattle and become brittle. The seed is extracted by beating or in a flailing thresher, which is very effective for this species. After extraction the seed is dried directly in the sunlight and pod segments and debris are removed in a seed-cleaning machine (DFSC, 2000).

Sowing and Germination: This tree can be established by direct sowing, using container-grown stock or as bare-rooted seedling or cuttings. When sown directly, it is necessary to weed the rows for several years. Germination starts within a few days and is complete in a month (DFSC, 2000).

Seedling Production: To reduce the field establishment period, seedlings can be raised in nursery beds for one year or more and cuttings taken to transplant with about 25 cm root and 10 cm shoot. For production of bare rooted seedlings or cuttings, seeds are sown in lines about 15 cm apart with the seeds spaced about 2-3cm and about 1cm deep. About 40 g seed is required for sowing 1m² of nursery bed. Best seedling development is obtained in full sunlight (DFSC, 2000).

Uses: Timber is in high demand for cabinet-making and other types of interior construction. In local medicine, the flower emollient is used as a poultice to be applied to boils. The bark

and seed astringent are used against diarrhea, dysentery and hemorrhoids. The seed yields oil used as a cure for leprosy (Dy Phon, 2000). This is an excellent fuel-wood and charcoal species. The shallow root system makes it a good soil binder and recommendable for soil conservation and erosion control (DFSC, 2000).

Albizia lebbbeck is one of the most promising fodder trees for semi-arid regions. It has leaves during a large part of the wet season and digestibility of the twigs is considerably higher than that of most fodder trees. The concentration of crude protein is about 20% for green leaves, 13% for leaf litter and 10% for twigs. In vitro digestibility is about 45% for mature leaves, 70% for young leaves and 40% for twigs. Leaves, flowers and pods fall to the ground gradually during the dry season and can be browsed on the ground (DFSC, 2000).

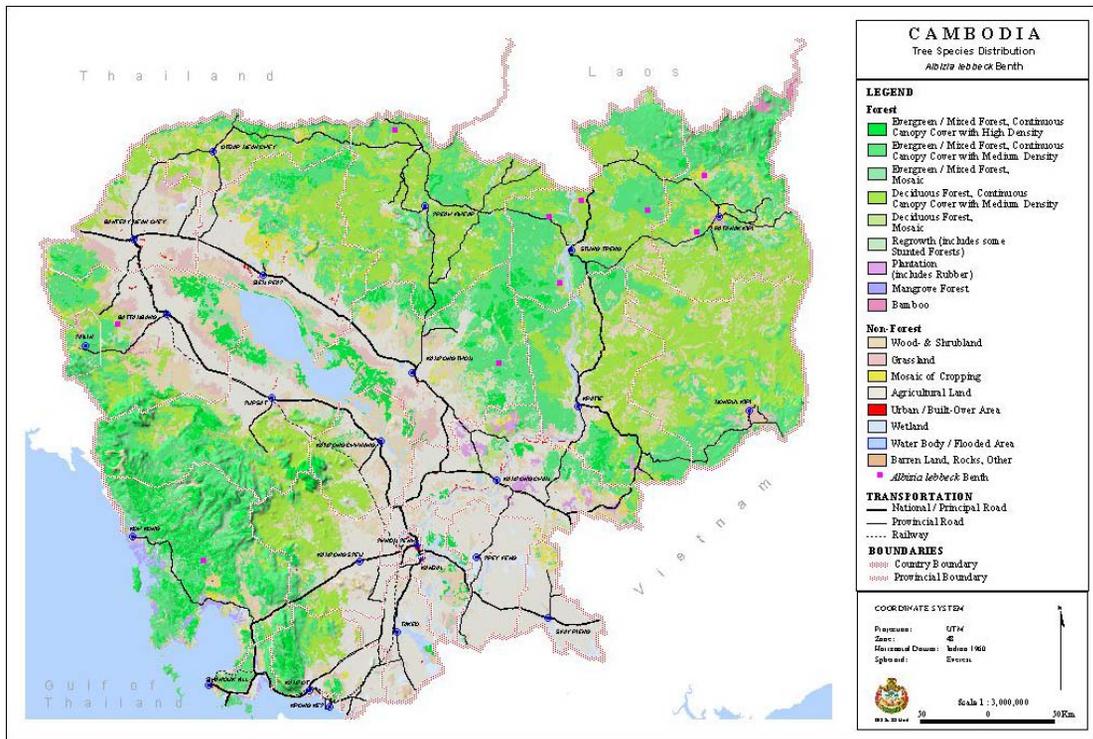
Current Status: Because the wood has a high value and a high demand in the market, this species is over-exploited and in danger of extinction if adequate protection measures are not implemented. Its distribution is scattered and its habits have been destroyed by forestland conversions and selective illegal logging. The number of mature trees has been reduced significantly and it is now difficult to find significant sources of germplasm.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Albizia lebbbeck* (L) Benth as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No.35.

IUCN Classification: EN A1cd

References:

- CTSP, Cambodia Tree Seed Project, 2002, Some Endangered Species Of Cambodia, unpublished
- Cambodian Forestry Law No. 35, 25th June 1988
- FA, 2002 (draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- DFSC, 2000, Seed Leaflet No. 7, *Albizzia lebbbeck* (L) Benth, Danida Forest Seed Centre, September
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
- Khorn, S, 2002, Distribution of Selected Tree Species for Gene Conservation in Cambodia
- Ministry of Agriculture, Forestry and Fisheries, 1986, Decision No. 050 SSR.KSK: Wood Classification and Minimum Diameter for Allowable Cutting, 12th September
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21. *Hopea odorata* Roxb.

Taxonomy and Commercial Grade

Cambodian name	: Koki Masao
Scientific name	: <i>Hopea odorata</i> Roxb.
Plant family	: <i>Dipterocarpaceae</i>
Commercial Grade-Cambodia	: 1 st Grade

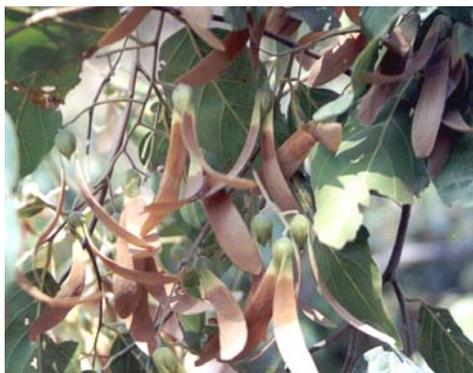
Distribution and Habitat: *Hopea odorata* Roxb. is native to South-East Asia and occurs in the Andaman Islands, India, Myanmar, Laos, Cambodia, Thailand, Vietnam, and northern parts of Malaysia (Dy Phon, 2000). In most of its natural distribution area it is found in lowland tropical forests on deep, rich soils from 0-300 m a.s.l., and often along streams and rivers. The best growth is obtained in areas that receive more than 1200 mm rainfall/year and a mean annual temperature of 25-27 degrees Centigrade.



It grows in a wide range of habitats and is easy to handle as a plantation species. In Cambodia, it grows in closed evergreen forest or in pure stands, either in small groups or alone. It is a shade tolerant tree during the first five years, but later requires sunlight. Due to its sacred essence, in the past, it has only been planted within the grounds of pagodas by a king or monk, although nowadays it is frequently found outside of these areas. It is found in Kratie, Koh Kong, Kampong Thom, Stung Treng, Preah Vihear, Ratanakiri, Mondulkiri and Siem Reap (Khorn, 2002), as illustrated on the map below.

Gene Ecological Zones: Coastal Cardamoms (A), Redlands (c), Northwestern Lowlands (D), Central Lowlands (d), Southern Annamites (g).

Biological Description: *Hopea odorata* Roxb. is a large evergreen tree species, growing up to 45 m tall and producing boles to 120 cm in dbh. The bole is straight and round and can reach from 15-25 m. The wood has a density of 0.5-0.98 at 15% moisture content (DFSC, 2000) and has a light, gray-yellow colour. The bark is black brown and deeply cracked, the leaves simple and alternate (DFSC, 2000), 8-12cm long and 3-6cm wide (FIPI.1996) with a slightly unequal base. This tree has the highest increment among the dipterocarp species, attaining 0.97cm/yr of breast height diameter and 0.51m/yr for height (CTSP, 2001). Natural regeneration often occurs in areas of low shade.



Flowering and Fruiting Habit: Flowering stalks are terminal or axillary, and produce small, unisexual flowers with 5 pinkish, hairy petals. Flowering occurs at more or less regular intervals, usually every two years in trees of more than 8-10 years of age (DFSC, 2000). Flowering occurs from February-March, and fruits ripen from April-May (FIPI, 1996). Fruits are often produced in large quantities, but sometimes only on a few a few branches (DFSC, 2000).

Fruit and Seed Description: The fruit is a round nut with a persistent calyx, and about 1 cm in diameter according to DFSC (2000), or 7-8mm in diameter according to FIPI (1996). The calyx has 5 lobes, two of which produce wings from 5-6cm long and 1-2cm wide. There is only one seed per fruit. The seeds are polyembryonic, with an average of 4 embryos per seed (DFSC, 2000).

Seed Collection: The seeds of *Hopea odorata* are mature and ready for collection when the wings have turned to a dark brown and the coat has changed from green to yellow. It is important to time collection well, as seeds that are not fully mature have low viability. The fruit is collected directly by climbing the tree, or by shaking the branches over tarpaulins spread on the ground. Collection from the forest floor should be avoided as these seeds have low viability and are often heavily infected by weevils. Fresh seeds have high moisture content and must be kept in loosely folded bags away from the sunlight during transport and temporary storage (DFSC, 2000).

Seed Handling: Soon after collection the wings are removed manually and small, immature fruit and insect infected fruit is discarded (DFSC, 2000).

Sowing and Germination: For laboratory testing, the seeds (de-winged fruit) are germinated on moist paper or cotton wool at a temperature of 20-30 C. In the nursery the seeds are sown in seedbeds and transplanted into polyethylene bags after germination. Due to problems with the seed storage, vegetative propagation with cutting is often used. Orthotropic shoots from juveniles (1-4 years old plants) perform best (DFSC, 2000).

Seedling Production: The seedlings perform best under 50% shade. After 6-9 months, when the plants have reached a height of 40-60 cm, they are ready to transplant into the field (DFSC, 2000).

Uses: The wood has a high value because it is resistant to termites, and therefore, is generally used in house construction, railway sleepers, train-carriages, and especially for river and sea boats (CTSP, 2001). It is suitable for planting on degraded lands and is also widely planted as an ornamental and shade tree (DFSC, 2000). The bark has high tannin content, suitable for tanning leather, and produces a resin. It is used to treat diarrhoea, and forms part of a remedy for the treatment of inflammations of the gums and incontinence. It can also replace the areca nut in betel quid. This species is used in the manufacture of Cambodian racing boats. Following rarefaction due to extensive exploitation, it has been replaced by the wood of *Shorea obtusa* Wallich ("Phchek"; Dy Phon, 2000).

Current Status: Dipterocarp forests in general, and *Hopea odorata* forests in particular, are now seriously depleted due to heavy exploitation and degradation of habitats by people and concessions. Large populations of koki masao are now rarely found inside forest concession areas. At present, only scattered trees occur, and therefore, finding mother trees for seed

collection is a difficult task. *Hopea odorata* often grows in moist forests along streams, but when their habitat is destroyed, it cannot regenerate naturally.

In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Hopea odorata* Roxb. as a priority species in need of immediate conservation interventions and appropriate protection.

IUCN Classification: CR A1cd.

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- Cambodian Forestry Law No. 35, 25th June 1988
- CTSP, Cambodia Tree Seed Project, 2001, Some Endangered Species of Cambodia. Unpublished
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- DFSC, 2000, Seed Leaflet, No. 49, *Hopea odorata* Roxb., Danida Forest Seed Centre, November
- FA, 2002 (Draft), List of Trade Names of Commercial Wood in Cambodia, Trade Names of Commercial Wood
- Dy Phon, 2000, Dictionary of Plants used in Cambodia
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