Sime Darby Property

MALAYSIAN THREATENED AND RARE TREE IDENTIFICATION AND LANDSCAPE GUIDELINE

A publication covering 74 IUCN RED List Tree Species of Malaysia prepared by Sime Darby Property in collaboration with specialist organisations

Sustainability & Quality Management (SQM) Department

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The cover page showcases the species Shorea ochrophloia, taken at Genting Tea Estate in year 2013.

PREFACE

The publication of this Malaysian Threatened and Rare Tree Identification and Landscape Guideline is the culmination of six years of R&D by the Sustainability & Quality Management Department of Sime Darby Property Berhad, along with contributions by various academic and professional bodies in Malaysia.

Sime Darby Property Berhad (hence referred to as Sime Darby Property) acknowledges the significant contributions made by The Institute of Landscape Architects Malaysia (ILAM) and The Department of Landscape Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia (UPM), who were engaged in 2015-2016 to undertake a data and imagery verification consultancy to conclude preparation of technical content used in this guideline. In doing so, this guideline, which covers 74 threatened and rare tree species endemic to Malaysia – the list of which is based on both the International Union for Conservation of Nature (IUCN) RED List for trees and the Forest Research Institute Malaysia (FRIM), Malaysia Plant Red List, is believed to be the first of its kind in Malaysia and possibly Southeast Asia.

The intent is for a guide that can be useful for current and future landscape architectural practitioners in improving biological diversity conservation, by providing a semi-technical resource for landscape professionals to increase the sectors' knowledge and ability to first be able to identify and then understand how to utilise these species. Consequently, it is our vision that through a growth in knowledge and awareness about these species and their potential benefits, demand will increase for such species. This in turn will hopefully lead to a higher rate of use of these threatened and rare tree species in urban landscape designs, with the ultimate goal to one day be able to see such species in common use and categorised as least concern tree species. Such a vision also seeks to support Malaysia's National Policy on Biological Diversity 2016-2025, where growing awareness of the potential long-term benefits of an intact, resilient and biologically diverse range of ecosystems is presented for the national well-being and long term sustainability of the nation.

CONTENT

INTRODUCTION

Malaysia is one of the most diverse regions for flora and fauna in the world. The country has an estimated 15,000 species of native plants. Eight thousand two hundred species (about 250 families) are in Peninsular Malaysia and 12,000 species are in Sabah and Sarawak. Out of 8,200 species in Peninsular Malaysia, 2,830 species are trees of which 746 species are endemic, meaning they only occur in a particular geographic area.

These native plant species comprise a variety of forest ecosystem types, which are related to one or more features of its location, notably geology, soil quality, topography and elevation. The ecosystems or range of ecosystems can be considered a naturally continuous ecosystem – starting as inland through wetland forests, lowland dipterocarp forests, montane forests and ending at the coast line as mangrove forests. Mixed dipterocarp forests are the most common and widespread forest type in Malaysia. The value of this forest type, in particular, is based on its plant species composition and diversity. Trees, largely determine the microclimate conditions of the forest. They play an important role in maintaining biodiversity and hence their loss, degradation or changes in their community may strongly affect other species as well as ecological and natural processes.

The changes in land use patterns over recent decades, has transformed many of these ecosystems into a mosaic of habitats. This mosaic includes large and small fragments of primary forests, variously degraded forests that have some components of original forests, and completely deforested and transformed ecosystems. Such situations are considered by many biologists to be the greatest threat to biodiversity and limiting their resilience to climate change. In fact, natural forests are generally better for biodiversity conservation, which can support more species than disturbed land. The protection of biodiversity, therefore, has been recognised as a major aspect of sustainable development. Hence it is important to move beyond simply protecting those natural forests and start recognising the vital role of landscapes in maintaining native biodiversity. As more new landscapes are being developed, their greenspace and green infrastructure become more relevant in sustaining the natural forest resources and very significantly, a genetic base for plant species to be conserved.

Emergent species e.g., *Dipterocarpus* spp, *Dryobalanops* spp. , *Shorea* spp., *Koompassia* sp., *Dialum* sp, *Sindora* sp. etc.

Canopy species e.g., *Hopea* spp., *Vatica* spp, *Dipterocarpus* spp. etc.

Understory species e.g., small trees and shrubs

Forest floor - covered by herbs , ferns, mosses etc.

Figure 1 : Typical Profile of Mixed Dipterocarp Forest

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With this guideline, we hope to provide current and future landscape architects with an effective tool for the identification and use of endangered Malaysian trees species within urban landscape planning. We always strive to make a positive difference to our community within and beyond our townships, and to ensure a well-preserved environment and sustainable world for our children to inherit.

Dato’ Ir. Jauhari Hamidi,
Managing Director,
Sime Darby Property

Mangifera macrocarpa Blume

Local name
Mangga Hutan

Family
Anacardiaceae

BOTANICAL DESCRIPTIONS

Habit
An evergreen tree, big, grows up to 40 m tall. The bark is fissured, grey-brown, while the inner bark is yellow with sticky white sap.

Inflorescence
The flowers are in terminal pyramidal panicles.

Flowers
Unknown, the species flowers infrequently.

Fruits
Fruits are drupe, big, about 8-12 cm long, broadly oblong-globose, yellow flesh and fibrous.

LANDSCAPE USE

Conservation status
Vulnerable

Ecology and distribution
The plant can be found in a wet, lowland rainforest in Thailand, Singapore, Indonesia (Java, Kalimantan, Sumatera), Malaysia (Peninsular Malaysia) and Borneo (Sabah). In Peninsular Malaysia, it occurs in Kelantan, Terengganu, Perak, Pahang, Malacca and Negeri Sembilan.

Diagnostic characters
Coniferous tree
Large tree, up to 40 m tall
Bark - fissured, grey-brown
Fruits - big, drupe and yellow flesh

Management and maintenance
Mangifera macrocarpa is an evergreen tree. It can be found in lowlands and on hill ridges in dense, primary, and evergreen forests. This species is sometimes cultivated, though only rarely, as it flowers and fruits infrequently and the fruit is rarely, if ever, eaten.

The leaves are alternate and linear, stalk 3.5-6 cm long, blade is 15-16 x 2-5.5 cm, apex pointed, base tapered, secondary nerves are 23–44 pairs, faint, nerves and reticulations visible on both surfaces.

Grey-brown, fissured

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The world is moving forward, certainly we need development and urbanisation. Hence, we should work together because balancing between development and sustaining the environment is not a one man action. Religion teaches us to have a role to protect the environment, as a guardian of Mother Earth, the most intelligent beings on earth to have the role to care for our planet and to give it a hug every now and again.

YABhg Tun Abdullah Ahmad Badawi,
Patron,
Landskap Malaysia

Popowia velutina King

Local name
Mempisang

Family
Annonaceae

BOTANICAL DESCRIPTIONS

Habit
A small to medium-sized trees. The bark is lenticellate or fissured.

Inflorescences
Solitary or in clusters, opposite the leaves.

Flowers
Sepals 3, petals 6 and valvate, thick, the inner petals are larger than the outer, the base is shortly clawed, sometimes the inner and the outer petals unite at the base. Stamens are many. The ovaries are few, ovoid to oblong, style very short, and stigma sub-capitate or wedge-shaped.

Fruits
Its fruits are globose or ovoid, subsessile or stalked.

LANDSCAPE USE

Conservation status
Critically Endangered

Ecology and distribution
The plant can be found in a lowland rainforest and is endemic to Malaysia (Peninsular Malaysia).

Diagnostic characters
Medium-sized tree
Bark - fissured
Flowers - small and shiny
Fruits - globose

Management and maintenance
The specific information about management and maintenance for this species is less reported.

The leaves are small, elliptic, shiny, and drying to yellowish-brown, 7x9 – 4x6 cm, with 6-7-nerved and pubescent or tomentose on the undersurface.

Fissured

Did you know?

Malaysia's forests are a unique natural heritage which has evolved over 130 million years, resulting in very rich flora and fauna.

Biodiversity in Malaysia,
Ministry of Natural Resources and Environment publication

Agathis borneensis Warb.

Local name
Damar Minyak

Family
Araucariaceae

BOTANICAL DESCRIPTIONS

Habit
A large, evergreen tree, grows up to 42 m tall. Bark varies; light reddish to reddish-brown, rarely purple, fibrous, soft and brittle. The inner bark is light red to reddish brown, rarely purple, fibrous, soft, brittle; resin fast-flowing, translucent to yellowish-white, sticky, sometimes becomes dark grey or black when hardened. The sapwood is pale red to yellowish-brown; the heartwood is white to light yellow.

Inflorescence
The trees produce cones, oval to globular, about 5-9 x 2-4 cm.

Flowers
Non-flowering plant.

Fruits
Seeds are brown, winged, oblique and obovate.

LANDSCAPE USE

Conservation status
Endangered

Ecology and distribution
The plant can be found at an elevation of 10 - 1200 m in lowland to lower montane forest (common in ridges) in Sumatera, Malaysia (Peninsular Malaysia), Borneo and Brunei. Formerly found in coastal Padang formation on BRIS soil in Pak Kanchil Forest Reserve, Terengganu, but was burnt. In Borneo, it often forms pure stands in sandy heath forest over podzols.

Diagnostic characters
Coniferous tree
Large evergreen tree, up to 42 m tall
Produces cones
Bark - light reddish to reddish-brown, soft and brittle
Fruits - brown and winged

Management and maintenance
Agathis borneensis habitat is on moist soil with half-shady to exposed light. Semi-matured plant needs shaded conditions for the growth, whereas matured trees will grow well in exposed areas (full sunlight). Agathis species, however prefer moderate water consumption. The species tolerate a wide range of soil types, especially of well drained soils such as ultra-basic rock, igneous and sedimentary rocks, as well as limestone and peat-swamp.

Agathis seedlings need shade especially at their initial stage of growth. Propagation is commonly by seed. As an alternative, root suckers, stem and leaf cutting could also be used for vegetative propagation.

The leaves are opposite, narrow to broadly elliptic, sometimes narrowly ovate, glossy, young to dark green, and thick, 4-14.5 x 2-5.5 cm; petioles are about 5-15 mm long, flattened, sometimes slightly darker than their lamina when dry. The young leaves are oblanceolate, 8.5-15 x 2-4.5 cm, thinly coriaceous, with narrowly attenuate apex. Its margin is entire, slightly thickened, recurved, with narrowly attenuate to broadly acute apex, rarely rounded; veins are closely parallel, distinct above, indistinct below; intercostal veins are very faint on both surfaces; resin canals between vascular bundles frequently in pairs, one canal above the other.

Light reddish to reddish-brown, soft and brittle

“

With the current rate of lowland forest destruction, such initiatives [such as this guideline] are increasingly valuable to ensure the survival of such species.

Dato’ Henry S. Barlow,
Owner of Genting Tea Estate

Atuna racemosa Raf. ssp. *racemosa*

Local name
Merbatu

Family
Chrysobalanaceae

BOTANICAL DESCRIPTIONS

Habit
A medium sized tree, grows up to 40 m tall. The bole is up to 30 m tall and 1 m in diameter, often fluted with steep buttresses at its base. The bark is greyish-brown, inner bark is dark red, and the sapwood is pale. The twigs are glabrous or strigose (short, stiff, dense hairs) when young. Its stipules are stiff, lanceolate, up to 20 mm long, glabrous to strigose.

Inflorescences
Axillary racemes or little branched panicles with up to 3 racemose branches on a short main peduncle, 5-15 cm long; rachis tormentellous to sericeous; bracts and bracteoles ovate, acute, to 8 mm long, caducous.

Flowers
The petals are white with a bluish tinge, ovate-oblong, 10-17 mm long, receptacle 5-10 mm long, tormentellous sericeous outside; pedicels are 0.5-1 mm long; sepals are 4-7 mm long, ovate to ovate-oblong, densely tormentellous on both surfaces; petals are white with a blueish tinge, ovate-oblong, to 10 mm long, stamens pale blue to purple, 15-20, to 15 mm long; ovary is densely villous.

Fruits
The fruits are ellipsoid or sub-globose, up to 7.5 cm diameter; mesocarp to 11 mm thick; endocarp 1-3 mm.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Rare, occurs in dense rocky forests at an elevation of 170-270 m in Thailand, Malaysia (Peninsular Malaysia), Borneo (Sarawak), Brunei, Indonesia (Sumatera, Sulawesi), Philippines, Maluku (Ambon, Ceram), New Guinea, east to the Pacific Islands (Fiji, Samoa and Tonga).

Diagnostic characters
Medium size, up to 40 m tall
Steep buttressed bole
Bark - greyish-brown
Flowers - white with bluish tinge

Management and maintenance
Atuna racemosa prefers to grow in a well-drained soil with full sunlight exposure. Semi shade environment, is however still needed for seedling and sapling growth at moderate water consumption. Seed propagation technique is still used for plant production.

The leaves are alternate, varies in shape, usually elliptic to oblong, sometimes lanceolate, and rarely broadly ovate, 10-35 x 3.5-11 cm, petioles thick, 3-7 mm long, lamina usually chartaceous, more rarely stiffly coriaceous, usually base rounded to subcordate, apex acuminate with acumen 6-25 mm long, sometimes sparsely strigose beneath on lower portion when young; lateral veins 10-13 pairs, straight or arcuate; venation conspicuously papillose and often leaf a scabrous appearance.

Greyish-brown

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I believe this *'Malaysian Threatened and Rare Tree Identification and Landscape Guideline'* is timely with FRIMs' objective to raise public awareness regarding the importance of the environment and the conservation of forest biodiversity.

Dato' Dr. Abd Latif Mohmod,
Director-General,
Forest Research Institute Malaysia (FRIM)

Anisoptera laevis Ridl.

Local name
Mersawa Durian

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A very large tree, grows up to 65 m tall and 2 m girth. The bark is pale greyish buff, patchily fissured and flaky. The inner bark is pale brownish laminated and thin. Its stipules are linear-oblong or oblong-lanceolate, about 2 cm long and falling early.

Inflorescences
In slender, drooping, terminal and axillary racemes. The bracteoles are small and caducous.

Flowers
The flowers are pale yellow with a green tinge in the centre.

Fruits
The fruits are winged nuts and crowned with flattened disc-like stylopodium, about 15 x 1.5 cm, with short lobes up to about 1.5 cm long.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
The species are the most common *Anisoptera*, widespread on well-drained land, but most frequently found below 300 m altitude in Brunei, Indonesia (Sumatera), Malaysia and Singapore.

Diagnostic characters
Large trees, up to 65m tall and 2m girth
Flowers - pale yellow with a green tinge in the centre
Fruits - winged nuts

Management and maintenance
Anisoptera laevis is a large, evergreen tree with a relatively small crown, with prominent, thick, rounded, tall straight buttresses. It is a canopy tree commonly in inland lowland and hill forests.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are alternate, oblong-obovate with reddish scales on the undersurface, about 9 x 3.5 cm, about 12-nerved, venation mainly reticulate, quite glabrous, bluish-grey or green and sparsely furnished with minute reddish scales on the undersurface particularly on the midrib. The petioles are about 18 mm long and minutely scaly.

Greyish buff, patchily fissured and flaky

Anisoptera marginata Korth.

Local name
Mersawa Paya

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, up to 45 m tall, sometimes exceeding 3 m girth, and buttressed. The bark is greyish-brown, shallowly fissured and flaked. The twigs are light coloured, minutely scaly and sparsely hairy towards the end.

Inflorescences
In slender, drooping, terminal and axillary racemes. The bracteoles are small and caducous.

Flowers
Its flowers are pale yellow with broadly elliptic petals, with white stamen, about 25 mm, stylopodium ovoid-oblong

Fruits
Winged nuts, crowned with a prominent, thick, oblong stylopodium, calyx tube is about 13 mm across. The wings are about 12 x 2 cm but usually smaller, lobes up to 1.5 cm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
A species of mixed peat swamp and heath forest, occurs in Indonesia (Sumatera), Malaysia (Peninsular Malaysia) and Borneo. In Peninsular Malaysia, they usually occur in or near the coastal peat-swamp forest of Southern Perak, Selangor, Pahang and Johor. Rarely occur in well-drained soil.

Diagnostic characters

Large tree up to 45m tall, and 3m girth
Flowers - pale yellow
Fruits - winged nuts

Management and maintenance
Anisoptera marginata is cultivated in plantations at Kepong and Rantau Panjang in Selangor. It is a very large, evergreen tree with a relatively small, open crown. It has prominent, thick, rounded, tall straight buttresses. It is an emergent tree in undisturbed forests with poor soil. The tree is mostly found in alluvial sites (peat swamp, freshwater swamp), but occasionally on ridges in mixed dipterocarp or keranga forest.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are alternate and oblong-obovate, ranging from about 5 x 2.5 – 11 x 6 cm, up to 16-nerved, venation mainly reticulate, smooth or rarely sparsely minutely hairy on the veins, usually bright yellow on the undersurface. The stipules are linear-oblong, up to 8 mm long.

Greyish-brown, fissured and flaked

Anisoptera megistocarpa Sloot.

Local name
Mersawa Merah

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, up to 4 m girth, about 60 m tall, buttressed, with reddish brown and heavy crown. The bark is dull grey-brown or yellowish-grey, regularly shallowly fissured becoming irregularly fissured or scaly. Its twigs are rather coarse, and slightly flattened, also furnished with a harsh, reddish-brown and stellate tomentum towards the ends.

Inflorescences
In slender, drooping, terminal and axillary racemes. The bracteoles are small and caducous.

Flowers
The flowers are creamy white, petals ovate-lanceolate, about 12 mm long. Its stalk is about 6 mm long, and the stamens are about 60. The stylopodium is in elliptic-ovate shape and narrowing gradually to the styles.

Fruits
Winged nuts, up to 22 cm long and crowned with a short, thick apiculus. The wings are up to 22 x 3.8 cm, and its minor lobes are up to 30 mm long.

LANDSCAPE USE

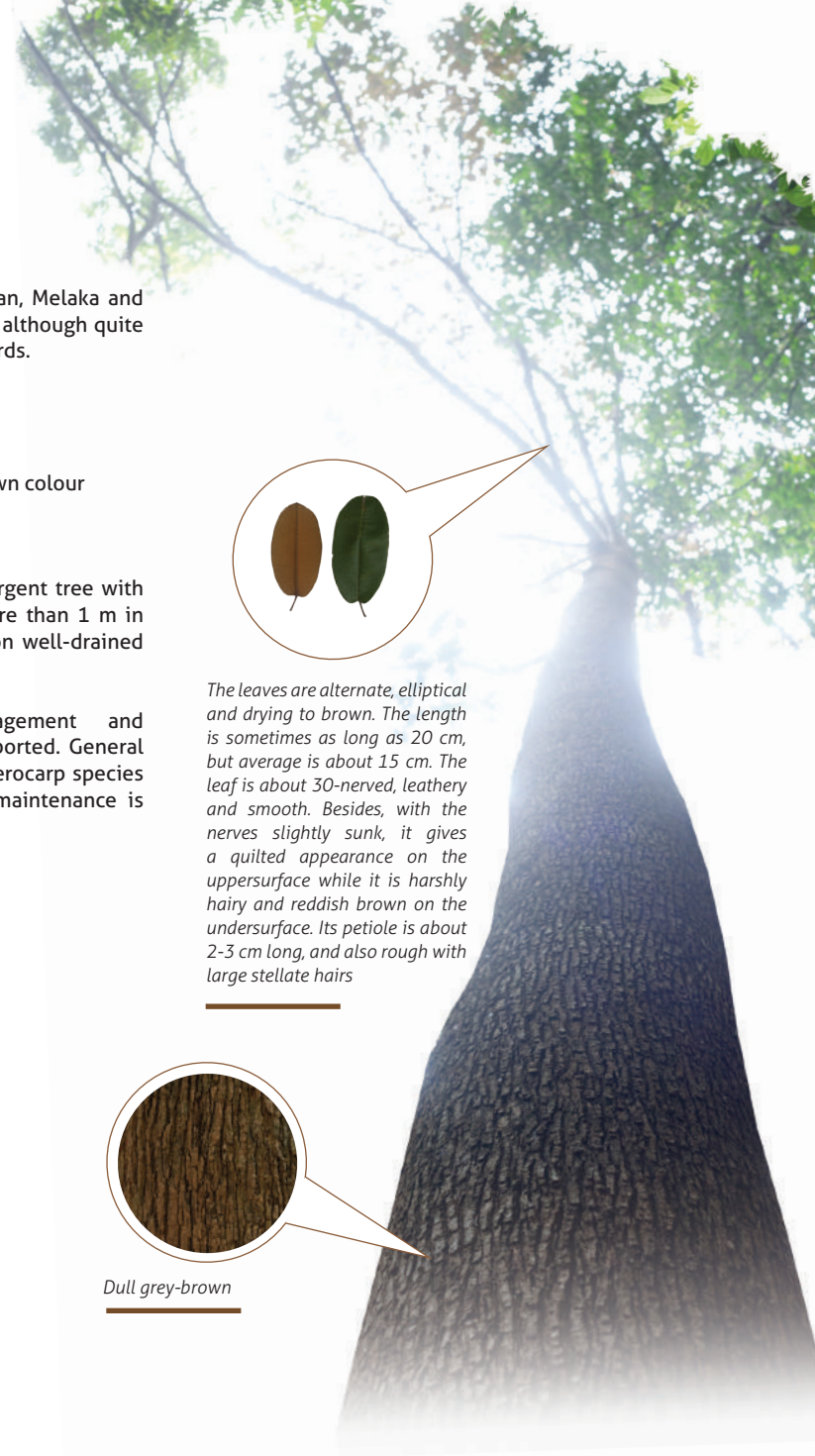
Conservation Status
Vulnerable

Ecology and Distribution
Scattered on well-drained soil in lowland and hill dipterocarp forests. The species occurs in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Thailand and Singapore. In Peninsular Malaysia, it has been found on well-drained, undulating land and low hills, in Southern Perak, Selangor, Pahang, Negeri Sembilan, Melaka and Johor. Its occurrence is rather scattered, although quite common from Negeri Sembilan southwards.

Diagnostic characters
Large tree, up to 4m girth
Buttressed roots
Crown - heavy density with reddish-brown colour
Fruits - long winged nuts

Management and maintenance
Anisoptera megistocarpa is a large emergent tree with tall buttresses that can grow up to more than 1 m in diameter. The tree is found scattered on well-drained and undulating lowland hills.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.



The leaves are alternate, elliptical and drying to brown. The length is sometimes as long as 20 cm, but average is about 15 cm. The leaf is about 30-nerved, leathery and smooth. Besides, with the nerves slightly sunk, it gives a quilted appearance on the uppersurface while it is harshly hairy and reddish brown on the undersurface. Its petiole is about 2-3 cm long, and also rough with large stellate hairs

Dull grey-brown

Anisoptera scaphula (Roxb.) Kurz

Local name
Mersawa Gajah

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 45 m tall, with a small crown. The bark is dull grey-brown or yellowish-green, more or less regularly shallowly fissured becoming irregularly fissured or scaly. The bole also has prominent, thick, rounded, tall, straight, buttresses. Its twigs are rather slender, glabrous and light coloured.

Inflorescences
In slender, drooping, terminal and axillary racemes, and with small and caducous bracteoles.

Flowers
The flowers are white with ovate-oblong, blunt petals and about 4 mm long. It is sub-globose in bud and when mature it produces fetid-sticky smell. Its stigma is slightly enlarged and with 3-lobed.

Fruits
Its calyx tube is about 15 mm across when fully mature and also slightly verrucose. Its nut is crowned with flattened disc-like stylopodium from which project the narrow and cylindrical style. The wings are up to 15 x 3 cm but sometimes smaller. It also contains minor lobes which are up to about 2.5 cm long.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
A canopy and emergent tree in semi-evergreen and evergreen dipterocarp forests. It favours low altitudes and deep valleys at elevations up to 700 m. The species occurs in Bangladesh, Malaysia, Myanmar, Thailand, and Vietnam.

Diagnostic characters
Large tree, up to 45m tall
Small crown
Straight and buttressed bole
Flowers - white, small with fetid-sticky smell
Fruits - winged nuts

Management and maintenance
Anisoptera scaphula is a very tall, evergreen tree with a relatively small crown, with tall straight buttresses. It is a canopy and emergent tree in semi-evergreen and evergreen Dipterocarp forests on undulating land and the lower parts of valleys. The tree grows best in areas where annual daytime temperatures are within the range of 20 - 33°c, but can also tolerate temperatures ranging from 15 - 38°c. It prefers a mean annual rainfall in the range of 2,000 - 3,000mm, but also tolerates 1,100 - 4,000mm.

Young *Anisoptera scaphula* grows better in the dappled shade of the forest floor, but older trees require more light. The tree can succeed in most soils of at least moderate fertility. It prefers a pH in the range of 5 - 6, also tolerating a pH in the range of 4.5 - 6.5.

The specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are alternate and oblong, averaging about 14 x 7 cm and about 17-nerved but extremely variable. As for the stipules, they are linear oblong or lanceolate shape, up to 2 cm long and known for falling early. Its venation is mainly reticulate and quite glabrous, and only sparsely furnished with minute scales that are concolorous with the light greenish-grey or yellow-brown dried leaf. Its petiole is rather slender, about 2 cm long.

Dull grey-brown or yellowish-green

Dipterocarpus caudatus Foxworthy

Local name
Keruing Gasing

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
An evergreen tree, grows up to 30 m tall. The bark of young trees are frequently light coloured, and scaly for matured trees. It has rather coarse twigs and densely furnished with golden brown hairs at the ends. The dormant buds are stout with densely golden brown hairs.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are winged and sessile. The calyx tubes are top-shaped and about 2 cm long. It is also warty and wings are up to about 14 x 3 cm. Its shorter lobes are sometimes up to 8 mm long.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
The species is an emergent tree in the semi-evergreen and evergreen tree in mixed dipterocarp forests, prefers dry ridges. The trees occur in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Singapore, Borneo and Philippines.

Diagnostic characters
Large tree, up to 50m tall
Bark - orange-red, becoming pale orange-grey when exposed
Fruits - winged and sessile

Management and maintenance
Dipterocarpus caudatus is a large emergent tree. The oleo-resin yields are used to be traded internationally, but are now only used locally. The trees can be found at moist but well-drained soils in dense, primary lowland forest.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years, the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall), the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate and elliptical, about 22 x 11 cm in length, about 18-nerved, with dense golden brown hairs on the undersurface. The leaf margins are wavy and fringed with hairs. The young leaves are pinkish red. Its stipules elongates, up to 15 cm and is usually with a red tinge and furnished with tufts of long hairs. As for the petioles, it is about 4 cm long and clothed with long and soft hairs similar to those on the twigs. Its saplings are very distinctive when the long, red-tinged, hairy, curved and stipular bud scales are developing.

Light coloured

Dipterocarpus chartaceus Symington

Local name
Keruing Kertas

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 40 m tall, with no buttresses. The older trees have a scaly, dark grey bark with a fissured appearance. The bole of young trees is lenticellate. The sapwood rapidly becomes covered with oil. Its twigs are rather slender, furnished with close golden brown hairs at the end. The dormant buds are slender and hairy.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are similar to those *Dipterocarpus gracilis*, but the wings are more prominently 3-nerved and with smaller lobes.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
An infrequent tree of lowland forest, mainly in the north and in coastal localities. The species are found in Malaysia (Peninsular Malaysia) and Thailand. It is quite common in semi-swamp forests in Tasik Gelugor Forest Reserve (Perak).

Diagnostic characters
Large tree, up to 40m tall
No buttresses
Fruits - 3-nerved winged

Management and maintenance
Dipterocarpus chartaceus is a large tree, with unbuttressed roots. It yields an oleo-resin, which is used locally. *Dipterocarpus chartaceus* is an infrequent tree of lowland forest, sometimes in areas periodically inundated, especially in seasonal areas and near the coast.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years, the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall), the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The stipules are up to 8 cm long when mature covered with yellowish stellate hairs. The leaves are alternate, 8.5-19 cm x 4-9 cm, elliptic-ovate or rarely obovate, crisply chartaceous, drying pale mauve and somewhat lustrous.

Dark grey, scaly

Dipterocarpus costatus Roxb.

Local name
Keruing Bukit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large, typical *Dipterocarpus* with a spherical crown that can grow up to 40 m tall. The bole is greenish-grey with yellowish-brown patches. The fresh bark surface is lenticellate, and later falling in scales. The cuts reveal a purple-red layer below the outer bark. Its twigs are slender and densely fulvous or golden tomentose. The buds are tapering and densely clothed with soft golden hairs.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are with golden hairs and winged, to about 11 x 2.5 cm. Calyx tube to about 2 cm long, sharply angled, sparsely furnished with golden stellate hairs.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Widely scattered in hills and upper dipterocarp forests, at 600-1100 m altitude. Found in Bangladesh, Cambodia, India (Andaman Island), Lao People's Democratic Republic, Malaysia (Peninsular Malaysia), Myanmar, Thailand and Vietnam.

Diagnostic characters
Large tree, up to 40m tall, with a spherical crown
Fruits - golden hairs and winged

Management and maintenance
Dipterocarpus costatus is a briefly deciduous tree with a rather open, spherical crown, with unbuttressed roots. A canopy tree which is scattered in hills and upper Dipterocarp forests, and in areas with year-round rain, but descending to sea level in areas with dry season.

Dipterocarpus costatus grows best in areas where annual daytime temperatures are within the range of 21 - 31°c, though it can tolerate temperatures ranging from 10 - 38°c. It is killed by temperatures of 5°c or lower. It prefers a mean annual rainfall of 2,800 - 3,500 mm, but can tolerate from 2,500 - 4,500 mm. Young trees are very shade tolerant, and can be damaged by too much exposure to the sun. As they grow older, however, they become increasingly intolerant of shade. The tree prefers a medium to heavy soil with pH in the range of 5 - 6, tolerating a pH of 4.5 - 6.5. The tree is relatively slow-growing.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The stipules are long, up to 5 cm when mature, golden-silky and hairy on the outside. The leaves are small, alternate, elliptical and hairy on the undersurface, about 10 x 7 cm, about 13-nerved, tomentose on the undersurface, with hairy petiole, about 2 cm long.

Greenish-grey with yellowish-brown patches

Dipterocarpus dyeri Pierre

Local name
Keruing Etoi

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large *Dipterocarpus* with light-coloured bark, falling in small scales. Its twigs are rough, becoming glabrous, reddish-brown, with crowded annular scars. The dormant buds are large and ovate-conical. Its stipules enlarge to 15 cm, tinged pink when fresh. The buds and stipules are covered with brown, silky hairs.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are winged, longer than 18 cm. The calyx tube is ovoid, about 4 cm long, with 5 narrow ribs running from the top to middle. The wings are about 20 x 5.5 cm, with three main nerves and short, oblong lobes, up to about 15 mm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Occurs at low levels of primary forests and in the bamboo forests in Cambodia, Malaysia (Peninsular Malaysia), Myanmar, Thailand and Vietnam.

Diagnostic characters
Large tree
Fruits - big winged with three main nerved

Management and maintenance
Dipterocarpus dyeri is a semideciduous tree, with low buttresses. It is a canopy or emergent tree in moist evergreen forests. The tree occurs at semi-evergreen forest, often in gallery forests along streams, on swamp edges or in narrow valleys at low elevations. It grows well on grey soils and stony brown soils in depressions, which may not be well drained during the rainy season.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years, the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall), the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

This species is known for its large and many-nerved leaves. The leaves are oblong and drying to reddish-brown, about 24 x 12 cm and about 25-nerved. The petioles are 3-7 cm long, slender and glabrous.

Light colour

Dipterocarpus elongatus Korth.

Local name
Keruing Latek

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large *Dipterocarpus* with grey bole and pastel pink patches on young barks. Its twigs are thick and the young tips are covered with rough and dull reddish-yellow hairs. The buds are also covered by the dull reddish-yellow hairs. The stipules enlarged to about 15 cm, covered with yellowish-brown or orange-brown hairs.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are wingless. Calyx tube is globose, up to about 5 cm across, lenticellate that may be rubbed off as a powder, and crowned with 5 large shoulders, while the calyx segments are 5-lobed.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Occurs at low levels of primary forests and in the monsoon forests in Cambodia, Malaysia (Peninsular Malaysia), Myanmar, Thailand and Vietnam.

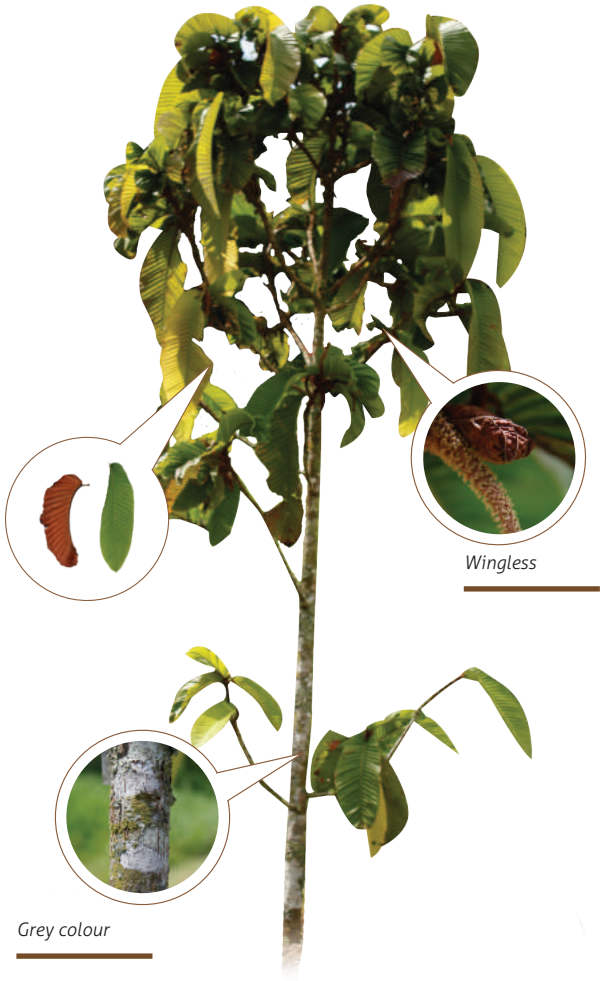
Diagnostic characters
Large tree
Bole - grey colour and pastel pink patches on young barks

Management and maintenance
Dipterocarpus elongatus is a large tree. It occurs in secondary and primary forests, as well as in freshwater swamp forest.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years, the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall), the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

This species is known for its large and many-nerved leaves. The leaves are oblong, and somehow drooping, exceeding 38 x 12 cm, about 30-nerved, with petioles less than 7 cm and with dull reddish-yellow hairs.



Dipterocarpus eurynchus Miq.

Local name
Keruing Baran

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large emergent tree, exceeding 65 m tall, short buttressed. The bark is dull grey-green, thick and tends to be fissured. The twigs are slender, covered with minute hairs towards the end, and drying to dark in colour. Its dormant buds are about 8 mm long and silky (due to minute hairs).

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The calyx tube is about 18 mm long and sharply angled. The fruits are winged to the base, up to about 10 x 2.5 cm.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
This species is scattered on high ridges of upper dipterocarp forests, at a 600-1000 m altitude in Brunei, Indonesia (Kalimantan, Sumatera) Malaysia (Peninsular Malaysia), Borneo (Sarawak) and Philippines.

Diagnostic characters
Large emergent tree, up to 65 m tall
Fruits - winged to the base

Management and maintenance
Dipterocarpus eurynchus is a medium emergent tree, with short buttresses. The tree occurs in mixed dipterocarp forest on leached clay soils.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years, the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall), the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Small and ridged leaves, about 8 x 5 cm, about 12-nerved, margins crenate and glabrous when mature. The petioles are about 16 mm long. The old leaves turn coppery red before falling, making the crown stand out from the other trees.

Dull grey-green

Dipterocarpus fagineus Vesque

Local name
Keruing Pipit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium-size emergent tree, can grow up to 45 m tall. The bole is grey, with brown patches where bark has shed. The bark is lenticellate, greyish-brown and falling in large flakes. The twigs are slender, glabrous and dark coloured. The dormant buds are small, glabrous and conical or sickle-shaped.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
Calyx tubes are elliptic, about 1.5 cm long. The ridges are prominent, from the pointed base towards the apex. The wings are about 8 cm long, glabrous, 3-nerved, with very small minor lobes.

LANDSCAPE USE

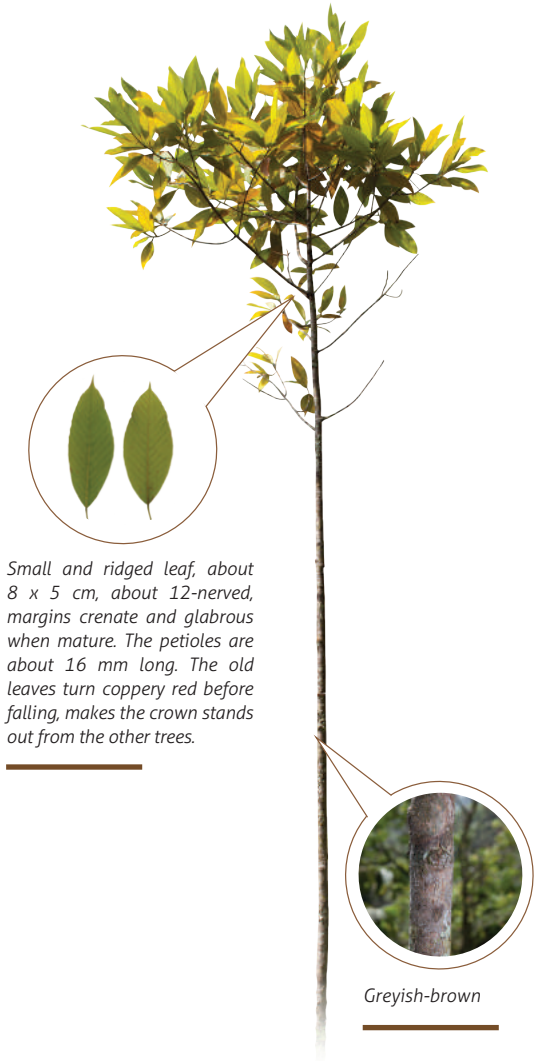
Conservation Status
Vulnerable

Ecology and Distribution
Inhabits hills and coastal hills of dipterocarp forests, 500-600 m in inland reserves and lesser altitudes near the coasts of Indonesia (Sumatera), Malaysia (Peninsular Malaysia), and Borneo (Sarawak). In Peninsular Malaysia, the tree occurs in Pulau Pinang, Perak, coastal Pahang, Terengganu and Kelantan, up to the Thai border. The species has been greatly reduced by land conversion and logging.

Diagnostic characters
Large emergent tree, up to 65 m tall
Bole - grey with brown patches and a greyish-brown
Fruits - winged 3-nerved

Management and maintenance
Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.



Small and ridged leaf, about 8 x 5 cm, about 12-nerved, margins crenate and glabrous when mature. The petioles are about 16 mm long. The old leaves turn coppery red before falling, makes the crown stands out from the other trees.

Greyish-brown

Dipterocarpus hasseltii Blume

Local name
Keruing Ropol

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree with a dense hemispherical crown and tall buttresses. The bole is usually greenish-grey. The bark is greyish-brown, smooth, and thinly flaky. The twigs are slender, smooth, and black when dry. The buds and stipules are slender, green and glabrous during all stages of development.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The calyx tube is globose, smooth, to about 3 cm across, winged to about 12-22 cm long x 3 cm, distinctly 3-nerved, short lobes rotundate and about 15 mm long.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found locally in lowland dipterocarp forests, up to 600 m in Indonesia (Bali, Java, Kalimantan, Sumatera), Malaysia (Peninsular Malaysia), Borneo (Sabah), Philippines, Thailand and Vietnam.

Diagnostic characters
Large tree with a dense hemispherical crown
Tall buttresses
Fruits - winged

Management and maintenance
Dipterocarpus hasseltii is a large and buttressed tree, with a dense hemispherical crown. It is an upper canopy tree of mainly coastal undisturbed mixed dipterocarp forests, where it is usually found on ridges. In secondary forests, it is usually present as a pre-disturbance remnant tree.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are thin, wedge-shaped at the base and have crenate margin.

Greyish-brown

Dipterocarpus rigidus Ridl.

Local name
Keruing Chogan

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree exceeding 50 m tall, with a dense and golden-brown crown from below, and not buttressed. The bole is usually light coloured, when young very similar to that of a *Vatica,* later scaly-fissured or coarsely fissured with the bark falling in thick scales. The bark is brown, vertically cracked and shallowly patchily flaked. The outer bark is sometimes fairly thin, sometimes thick, red-brown and powdery. The twigs are thick, yellowish tomentose at the ends. The buds are furry.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The calyx tube is obovate, about 3 cm across, smooth but obscurely tuberculated at the top; wings up to about 18 x 5 cm.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Locally occurs in dry forests on coastal hills in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), and Borneo (Sarawak). In Malaysia, it occurs only in the east of the peninsular, having been recorded from coastal hills in Terengganu, Pahang and Johor. It was one of the most common species of *Dipterocarpus* on hills near Kemaman in Terengganu, and in Arong Forest Reserve in north eastern Johor.

Diagnostic characters
Large tree, up to 50 m tall
No buttresses
Crown - dense and golden-brown from below
Fruits - winged

Management and maintenance
Dipterocarpus rigidus grows as a large tree. It occurs locally in dry forests on coastal hills.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are ovate, leathery, and have pale golden hairs on the undersurface, about 17 x 13 cm, about 12 to 17-nerved, very thick in texture, prominently ridged, with petioles about 5 cm long and deciduously hairy.

Red-brown and powdery

Dipterocarpus rotundifolius Foxworthy

Local name
Keruing Mengkai

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree but considered small when compared to the other *Dipterocarpus* species and grows up to 2.5 m girth. Its tree has prominent buttresses and a rough and scaly bark. The inner bark is pink and the sapwood is hard. The twigs are smooth when mature but furnished with long, dense hairs when young. The stipules are broad and boat-shaped, sometimes hairy.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are small, calyx tube about 18 mm long, narrow, pointed at the base, smooth and winged to about 9 cm long. The fruits have only one prominent main nerve, short lobes are oblong and about 14 mm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found in coastal hills, the species is endemic to Malaysia (Peninsular Malaysia). It is found in Terengganu, Pahang and north-eastern Johor. The species is critically endangered due to land conversion and logging.

Diagnostic characters
Prominent buttresses and rough and scaly bark

Management and maintenance
Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, ovate-rotundate with crenate margin, about 12 cm across but varies, about 13-nerved and slightly concave. Its petioles are up to 10 cm. The young leaves are larger and furnished with tuft long hairs.

Inner bark is pink

Dipterocarpus sarawakensis Sloot.

Local name
Keruing Layang

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree that can grow up to 55 m tall, and with a hemispherical crown. The bark is rough and scaly. Its stipules are short and hairy, and its twigs are densely hairy. The twigs are tawny tomentose. The stipules are about 1.5 cm long, narrow, obtuse, tomentose. Its buds are about 8 x 3 mm, ovoid and tomentose.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The calyx tube is oblong, about 2.5 x 1.3 cm, with prominent papery wings up to 8 mm broad in the apical half, and tapering. The larger wings are up to 9 x 2 cm, while the shorter lobes are about 10 x 5 mm.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Locally common on leached sandy soils on coastal hills. Found in Malaysia (Peninsular Malaysia's East coast) and Borneo (Sarawak).

Diagnostic characters
Large tree, up to 55 m tall
Crown - hemispherical
Fruits - papery winged

Management and maintenance
Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Alternate, ovate-rotundate with wavy margins, reddish or pinkish on the undersurface, about 7 x 4 cm, has 7 pairs of strongly ascending nerves. The petiole is short, about 9 mm. The young leaves are furnished with long hairs, turn a conspicuous coppery brown colour before falling.

Rough and scaly

Dipterocarpus semivestitus Sloot.

Local name
Keruing Padi

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree with a grey bark. The species is known for having a small-leafed crown. The bole is grey. The twigs are slender, glabrous, and drying to black. The buds are glabrous.

Inflorescences
Simple or occasionally branched, few-flowered racemes, stipular bracteoles caducous.

Flowers
Unknown.

Fruits
The fruits are small with wavy ridges and golden hairs, calyx tube is obovate and pointed, about 15 mm long, furnished with undulate ridges and sparsely golden hairs, winged, up to about 6.5 x 1.5 cm, with only one prominent main nerve. The characteristics are very close to *D.oblongifolius*, but relatively small in all parts.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found in lowland forests and almost swampy lands of Indonesia (Kalimantan) and Malaysia (Peninsular Malaysia).

Diagnostic characters
Large tree
Crown - known for having a small-leafed crown
Bole - grey bole and bark
Fruits - small with wavy ridges and golden hairs

Management and maintenance
Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Its leaves are elliptic-oblong, about 10 x 5 cm, about 7- nerved, glabrous, thin, and drying to reddish-brown. Its petioles are slender and about 14 mm long.

Bole is grey.

Dipterocarpus sublamellatus Foxworthy

Local name
Keruing Kerut

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 70 m tall, with a small-leafed crown. The buttresses are sometimes stout and rather prominent. Its bole is yellowish-red and scaly. The bark is dark orange-brown and scaly. The twigs are slender, smooth, drying to black, with conspicuous narrow annular scars. The buds are short, tawny, furry and catkin-like when freshly exposed. The species have narrow stipules, to about 8 cm long, furnished with long, reddish-brown, deciduous tufts hairs.

Inflorescences
The stipules are about 1.5 cm long, narrow, obtuse, and tomentose.

Flowers
Unknown.

Fruits
It is also known for having sub-lamellate fruits. Its calyx tube is to about 3 cm long. The long wings are about 12 x 3 cm and with 3 nerved, while the short lobes are short and auriculate.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Locally most abundant on undulating land and well-drained forests. Found in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Borneo (Sarawak) and Singapore.

Diagnostic characters
Large tree, up to 70 m
Prominent buttresses
Crown - small-leafed
Fruits - long winged

Management and maintenance
Dipterocarpus sublamellatus is a very large tree. The tree grows at undulating land and low hills, especially in moist places.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are small, alternate, ovate-elliptic, about 11 x 7cm, with ridged margins, glabrous, about 10 nerved, with long, black petioles. The saplings have pendulous branchlets, very hairy buds, and oblong, caudate-acuminate leaves.

Dark orange-brown

Dipterocarpus tempehes Sloot.

Local name
Keruing Asam, Keruing Tempayan

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large-sized tree, frequently reaches a height of over 50 m. The species has a yellowish-brown and dark greenish-brown, thinly irregular flaking bark. The twigs, leaf buds, stipules, and petioles are densely hairy. The twigs are slender and dark. The buds are about 12 x 3 mm, slender, lanceolate and acute. Its stipules are about 8 x 12 cm, lorate and acute.

Inflorescences
Raceme is very short, measuring 2.5 cm, axillary, terete, densely short hairs, unbranched, bearing up to 3 distichous flowers.

Flowers
The flower buds are 3 x 0.8 mm. The calyx and corolla are typical. The stamens are around 30, somewhat shorter than the anther, which is narrowly oblong, tapering into the acicular appendage. The appendage is as long as the anther and prominent. The ovary is ovoid and pubescent; style filiform, pubescent except in the apical 1/3.

Fruits
Fruit pedicel vestigial. The calyx is glabrous, tube measuring 4 x 4 cm, tubeinate, with prominent but unraised pale lenticels, calyx loves vestigial.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Locally abundant near freshwater swamps and streams. In undisturbed mixed dipterocarp forests, it is found at areas of up to 400 m in altitude, but commonly found on clay to sandy soils at alluvial sites and along rivers, rarely on hillsides. Found in Indonesia (Kalimantan) and Borneo (Sabah and Sarawak).

Diagnostic characters
Large tree, over 50 m
Bark - yellowish-brown and dark greenish-brown
Fruits - pedicel vestigal

Management and maintenance
Dipterocarpus tempehes is a large tree, with buttresses up to 2 m high. The species is an upper canopy tree, locally abundant and is mainly found on clay rich alluvium in fresh water swamps and on stream banks.

Specific information about propagation for this species is less reported. Generally, the *Dipterocarpus* prefers seed for its propagation method. Young trees grow best in the shade of the forest, but become increasingly light-demanding as they grow larger. Members of this genus generally only regenerate naturally in the shade of the forest. Seedlings and saplings can persist in dense forest shade for many years. In their first 2 years the young plants cannot tolerate major openings in the canopy, but after they are well established (about 120cm tall) the canopy can be opened up around them to speed up their growth.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate and broadly elliptic to obovate, about 6-12 x 3.5-8 cm, thickly leathery, with a broadly cuneate base and shortly abruptly acuminate apex. The nervation of leaves are prominent and persistently folded between the 9-12 pairs of sharply ascending nerves, nerves at 35-40 degrees; the tertiary nerves are very slender, densely scalariform. The petiole is short, about 1-2 cm, densely buff pubescent when dry.

Dryobalanops beccarii Dyer

Local name
Kapur Ranggi/Bukit, Kapur Merah

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A very large tree, sometimes exceeding 65 m in height and 10 m girth. The species is known for its purple-brown shaggy bole and the aromatic cut of the wood. Sometimes, the young parts are covered with dense, soft hairs, otherwise entirely glabrous. The twigs are to 1 mm apically, slender and smooth. The bud is 3-4 x 2 mm, narrowly lanceolate and compressed. The stipules are 5-8 mm long, linear and fugacious.

Inflorescences
The panicle is up to 10 cm long, terminal or axillary, terete, wrinkled on drying and irregularly doubly branched. The bracteoles and bracts are small, linear, and fugaceous.

Flowers
The flower buds grow up to 10 x 3.5 mm, fusiform and acute. Its sepals are glabrous, equal, narrowly deltoid and subacute. The corolla is white; petals large, broadly elliptic, obtuse and glabrous. The stamens are around 30, subequal, almost 2/3 length of style; filaments united in a tube around the base of the ovary, the tube almost half as long as the anthers; anther narrowly oblong, the cells tapering, acute; appendage to connective short, erect, slightly exceeding anther. The ovary is ovoid and glabrous; style 2-3 times as long as ovary, filiform and glabrous.

Fruits
The fruit calyx is glabrous; base is up to 8 mm diameter, shallow up to 5 mm deep cup, unconstricted at the rim, tapering gradually and cuneate at the pedicel; lobes equal, to 6.5 by 0.8 cm, glabrous, oblong-spatulate, narrow, subacute, to 2 mm broad at the base, very thin and opaque between the reticulations of the nerves. Nut to 1.4 cm long and diameter, ovoid to globose, glabrous, with acute style remnant, resting on the considerably narrower calyx cup and pushing the lobes out to a wide angle.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found in lowland dipterocarp forests, up to 700 m altitude, prefers steep slopes and ridges to flat undulating land in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Borneo (Sabah, Sarawak) and Brunei.

Diagnostic characters
Very large tree, up to 65 m tall with 10 m girth
Aromatic cut of the wood
Bole - purple-brown shaggy

Management and maintenance
Dryobalanops beccarii is a large, evergreen tree with a large, globose crown. The tree grows on shallow leached soils or sandy soils over both sandstone and shale, sometimes in periodically inundated areas or along streams. Its propagation method is mainly by seed, with the seed wings removed.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are small, about 5-8 x 1-3 cm, broadly ovate and aromatic, comparatively thin, base cuneate, acumen to 17 mm long, narrow, margin frequently undulate, with petiole 0.7-1 cm long and very slender.

Purple-brown shaggy

Hopea apiculata Symington

Local name
Resak Melukut

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
This species is a small tree with a smooth bark. It has short buttresses, up to 1 m in height, sharp and tends to become stilted. Its crown is heavy with drooping branchlets. It has a short and dark bole with light patches and a few exudations of pale dammar. The thin outer bark is dark in colour while the inner bark is about 8 mm thick and the sapwood is pale and hard.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
About 1 cm across when expanded. The petals are loosely united and pale yellow. The ovary and stylopodium are hourglass-shaped.

Fruits
Small, ovate, pointed, winged and the nut is up to 2 cm long, embraced at the base by the sepals, two of which may enlarge into wings, about as long as the nut.

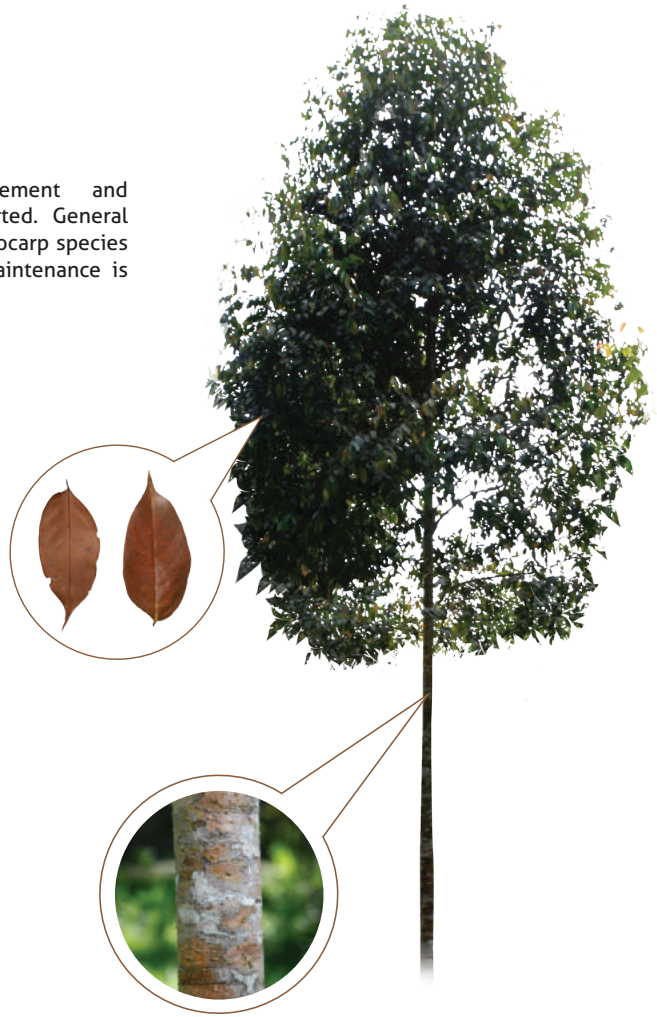
LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found endemically in lowlands to hill dipterocarp forests in Malaysia. It occurs in Kenas and Manong valleys, along the eastern boundary of Bubu Forest Reserve, and in the north of Berus Forest Reserve in Perak and on Bukit Yong, Kelantan.

Diagnostic characters
Small tree
Short buttresses
Bark - smooth
Fruits - small winged

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.



The oblong-lanceolate leaves resembles those of Neobalanocarpus heimii's, sometimes unequal sided, about 12 nerves and turn yellow-brown when dried.

Smooth bark

Hopea auriculata Foxworthy

Local name
Merawan

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree with a smooth bark. Buttresses are sharp and tend to be stilted. Its bole is tall, but not very well shaped, grey but with brown or darker patches, irregularly thin scales, and finely lenticellate. The bole also exudes whitish oleo-resin. The copious amount of whitish oleo-resin exudes from wound. The outer bark is thin, while the inner bark is thick, dull yellow tinged pink with a pellucid white line at the cambium. The sapwood is pale and slightly ripple marked. The species also has slender and smooth twigs.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
The flowers are unknown.

Fruits
The tree produces fruit with two-winged, 7 x 1.5 cm, auricled at the base, inner calyx segment developed into broad papery lobes longer than the nut.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Rare species, but commonly found in hill forests, and is endemic to Malaysia (Peninsular Malaysia). The species is found in Panti Forest Reserve, Johor, and on Gunung Tapis, Pahang.

Diagnostic characters
Small tree
Buttressed
Bark - smooth
Fruits - two-winged

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are ovate or lanceolate, few-nerved leaves with almost invisible tertiary veins. The leaves are about 8 x 5 cm with 9 nerves. The venations are of sub-dryobalanoid, with short intermediate and almost invisible reticulation.

Smooth bark

Hopea bilitonensis Ashton

Local name
Giam Belitong

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree with a smooth bark and stilt roots. Its twigs are slender, terete, and at first yellow-brown pubescent twigs.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
The flowers are 8 mm in diameter when open and stamens are 15 mm. The ovary is small, ovate with oblanceolate stylopodium and stout style, borne in long lax pendant racemes.

Fruits
The fruits are ovate nuts, about 1 cm long. The sepals are narrowly winged at base. The longer pair of wings are up to 5 x 1-2cm, while the other 3 wings are shorter than the nut.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found in sandy islands of Belitung and Banka, and one specimen found in limestone hills. Native to Indonesia (Sumatera) and Malaysia (Peninsular Malaysia).

Diagnostic characters
Small tree
Fruits - narrowly winged small ovate nut

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are elliptical with equal-based, papery, shiny, about 12 x 5 cm, 6-8-nerved, and laxly scalariform. Its acumen tapering, up to 2 cm long. Its petioles are short, about 7 mm. The leaves drying to yellow-brown.

Smooth bark

Hopea coriacea Burck

Local name
Giam Hantu

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Hopea coriacea is an emergent tree that grows up to 45 m tall, buttresses very small, bole grey, finely and shallowly or deeply fissured, probably scaly when old. The sapwood is very hard. The twigs are terete and glabrous. The tree also has a large canopy, with a dense hemispherical crown. Stilt roots few or none.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
About 6 mm across when expanded, petals pale yellow, fimbriate at the apex, ovary glabrous, and tapering into a slender.

Fruits
Two-winged, nut ovate, narrowing to the slender remnant of the style about 18 mm long, loosely embraced by the bases of the calyx lobes, 2 outer lobes up to 7 x 1.5 cm about 7-nerved, 3 inner lobes developed into rudimentary wings which may exceed nut in length.

LANDSCAPE USE

Conservation Status
Endangered

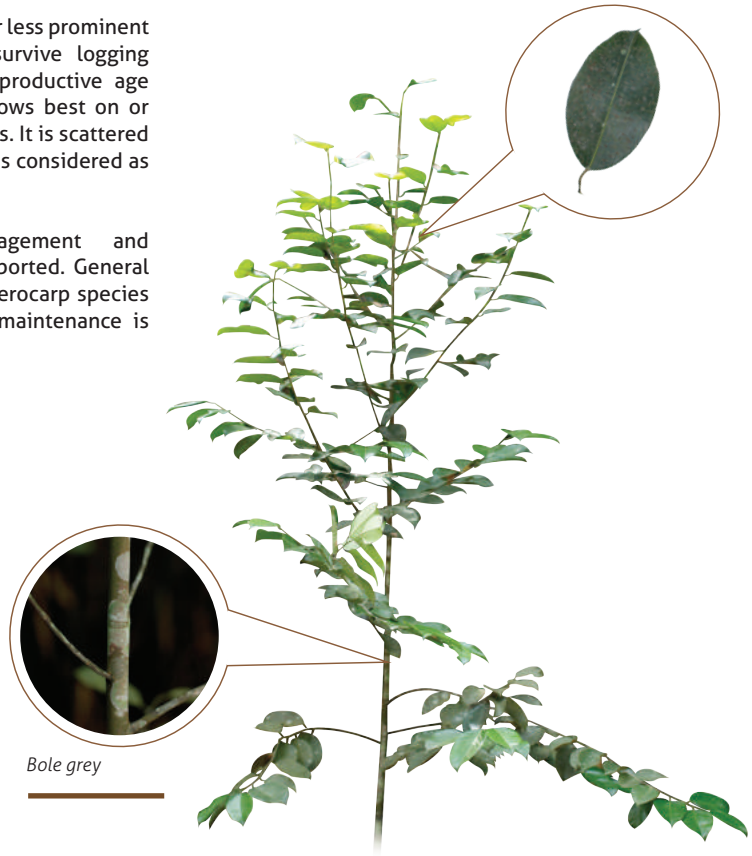
Ecology and Distribution
Scattered in hill forests and inland ridges. Native to Indonesia (Kalimantan) and Malaysia (Peninsular Malaysia). In Malaysia, it is found from southern Kelantan to southern Pahang, at low elevations. It was reported to be quite plentiful along the river bank at Sungai Nal, Kelantan. It is rare, and may now be extinct in the peninsula.

Diagnostic characters
Emergent tree up to 45 m
Small buttresses
Large canopy
Crown - dense hemispherical
Fruits - two-winged nut

Management and maintenance
Hopea coriacea is a tall tree, with more or less prominent buttresses. The tree is unlikely to survive logging activities because it doesn't reach reproductive age within a logging cycle. The species grows best on or near sandy riverbanks, and rarely on hills. It is scattered on low hills and ridges. *Hopea coriacea* is considered as slow-growing tree.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are large, broadly ovate to sub-orbicular, shortly acuminate at the apex, rounded and slightly revolute at the base, about 12 x 8 cm and 9-nerved but variable varies, glabrous but for a few hairy domatia in the axis of the nerves, drying yellowish or greenish-brown on both surfaces, venation scalariform with occasional fine intermediate nerves but nervules almost invisible to the naked eye on both surfaces, the petiole is about 2 cm long.



Bole grey

Hopea helferi (Dyer) Brandis

Local name
Lintah Bukit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree with a scaly bark. Its buttresses are sometimes large and coarse. Its crown is wide-spreading with a few large main limbs. The twigs are tomentose towards the ends. The stipules are linear, very narrow and falling early.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Petals are fimbriate at apex, pale yellow, with truncated stylopodium.

Fruits
Fruits two-winged, 6.5 x 1.8 cm, nut about 1 cm long, the lower third only embraced by the sepal bases.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found in semi-evergreen and evergreen forests in Cambodia, India (Andaman Islands), Malaysia (Peninsular Malaysia), Myanmar and Thailand. It is quite common in Langkawi Island, but also occurs throughout Kedah, Perlis, and at Sumpitan and Gerik, Perak. It is now critically endangered in the peninsula and throughout much of its range.

Diagnostic characters
Large tree
Large buttresses
Crown - wide spreading
Fruits - two-winged

Management and maintenance
Hopea helferi is a medium-sized evergreen tree, which sometimes has large and coarse buttresses. The tree occurs solitarily or in small groups on hill slopes and undulating land in semi-evergreen forests and moist evergreen forests, dry evergreen forests and riparian forests. It grows on deep and wet soils in the wild, especially on sedimentary rocks with an acid to neutral pH. It also occurs in relatively poor sites where it is distributed sporadically.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are large, alternate and oblong, about 18 × 7 cm but very variable. Its petiole is short, about 1 cm long. The undersurface is silvery white, while dry leaves are brown. Young leaves are larger, purple brown on the surface and glaucous on the undersurface, with velvety petioles.

Scaly bark

Hopea johorensis Symington

Local name
Mata Kucing Pipit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A tree with a reddish-brown powdery bole surface. Its buttresses are not very sharp and tend to be stilted, adventitious aerial roots, light reddish-brown, rough but not fissured. The bole is rough and exudates clear dammar in a stalactitic or globular form. The inner layer of the bark on the bole may often be rubbed off as reddish-brown. The outer bark is a dull purple-brown, and powdery. The inner bark is about 5 mm thick, dull with a pink tinge or light red-brown, grading to almost colourless at the cambium, sapwood is pale yellow usually with ripple marks. The twigs are slender, minutely tomentose towards the ends.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
Small, about 1 cm across when expanded and pale yellow.

Fruits
Winged nut ovoid, pale tomentose and about 2 cm long. Its three large wings are about 12 x 2.3 cm, while the two small wings are about 6.5 x 0.6 cm. The wings turn red when mature.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in inland ridges, endemic to Johor, Malaysia. It occurs in Kluang, Arong, Panti Forest Reserve and in the Endau-Rompin area.

Diagnostic characters
Bole - reddish-brown powdery surface, rough and exudates clear dammar
Bark - inner layer reddish-brown, outer bark dull purple-brown
Fruits - large, three-winged nut

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The small, ovate-acuminate, about 11 x 6 cm long, about 11-nerved, drying to dull grey-brown, and the petiole is about 1.5 cm long.

Reddish-brown, powdery

Hopea latifolia Symington

Local name
Merawan Daun Bulat

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 40 m tall. The buttresses are sharp, stilted and sometimes finely lenticellate. The species has a tall and smooth bole, but with slight cracks and fine lenticels, later becoming fissured and bleeds stalactitic dammar. The twigs are almost glabrous, light coloured and somewhat silvery when dry.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Small, cream coloured petals, and the ovary is tapering into a slender style without stylopodium.

Fruits
Ovate nuts, green when young, up to 8 mm long, with slender persistent style and are two-winged.

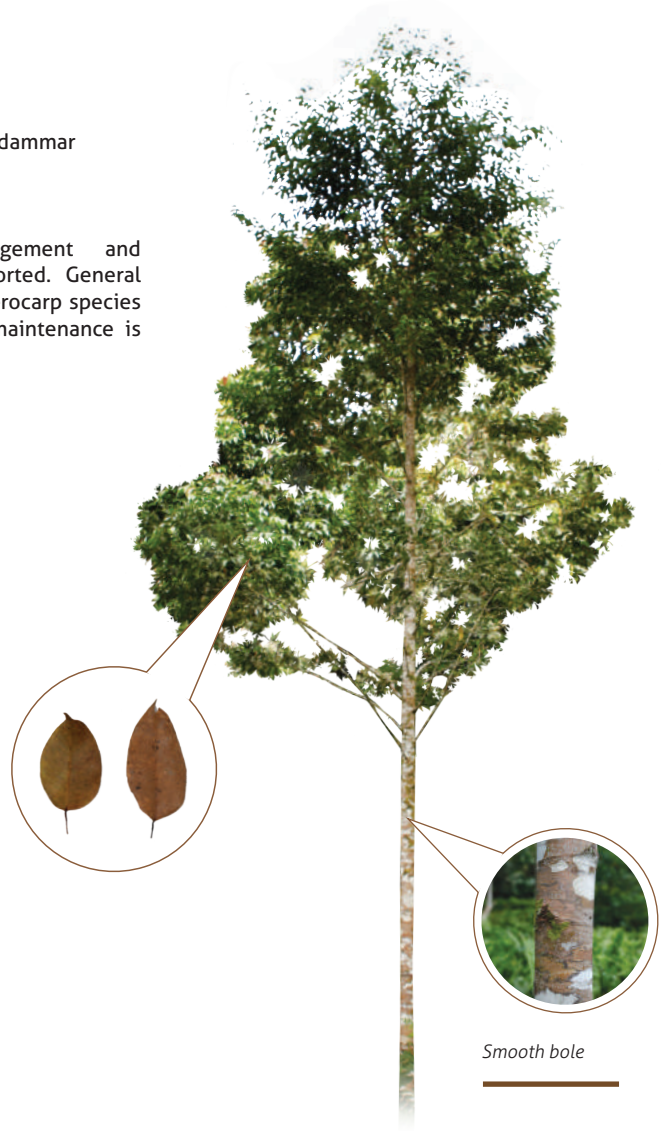
LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in lowland mixed dipterocarp forests, and is native to Brunei, Cambodia, Malaysia (Peninsular Malaysia), and Borneo (Sarawak). In Borneo, it is found in Kuching, Serian and Tatau, Sarawak. In Peninsular Malaysia, the species has been found in Perlis, Kedah, Pahang, Melaka and Johor. The species is critically endangered due to habitat conversion.

Diagnostic characters
Large tree, up to 40 m tall
Sharp buttresses
Bole - tall and smooth, bleeds stalactitic dammar
Fruits - small, two-winged nut

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.



Its leaves are alternate, ovate and shortly acuminate, about 7 x 3 cm, venation dryobalanoid, about 10-nerved.

Smooth bole

Hopea mengarawan Miq.

Local name
Merawan Penak

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 45 m tall. The bark is fissured, dark chocolate-brown with a pink tinge. The sapwood is pale and rather hard. Its stipules are small, becoming markedly recurved before they fall, caducous.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Petals are pale yellow and the stylopodium is represented by a hairy ring at the base of its long style.

Fruits
The fruits are two-winged, wings up to 7 x 1.2 cm, very narrow but markedly woody at the base, the nut is ovate-oblong, sharply apiculate, about 10 mm long and frequently resinous. Its twigs are minutely lepidote towards the ends.

LANDSCAPE USE

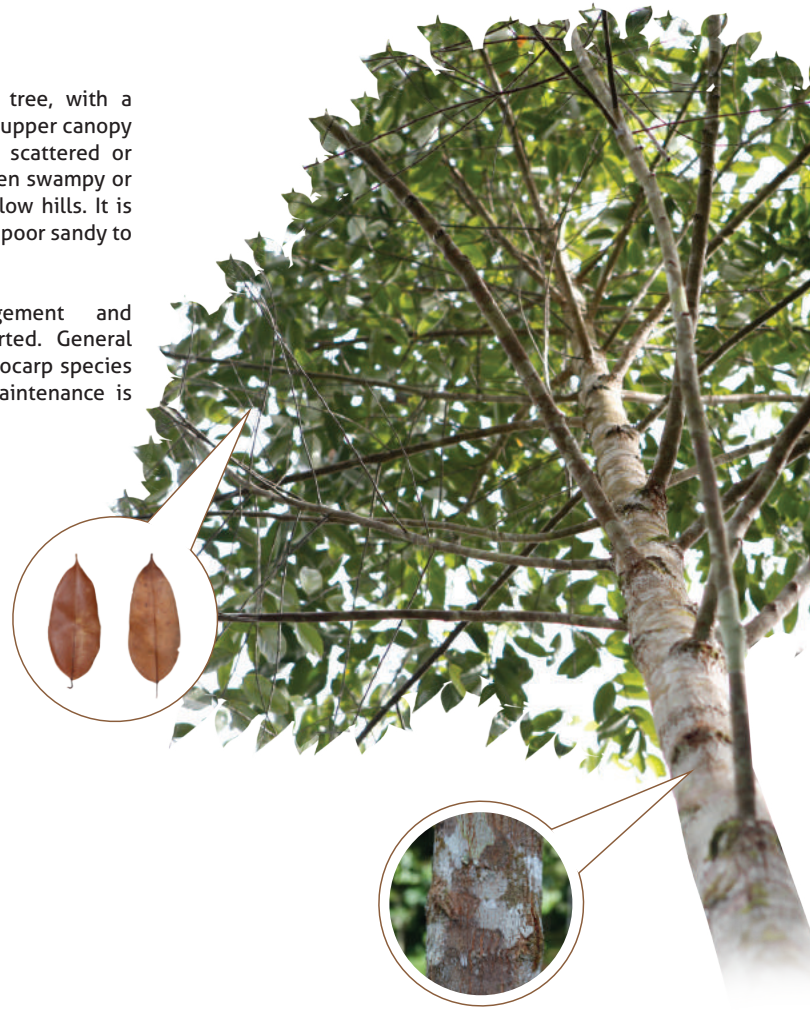
Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in lowland forests and often in swampy areas, widely distributed in Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Borneo (Sabah, Sarawak), and Singapore. In Malaysia, it occurs from Kelantan southwards down to the east coast. It is common in Temerloh, Kuantan and Pekan district of Pahang and also occurs in Kuala Pilah district of Negeri Sembilan; prefers in coastal dipterocarp swamps.

Diagnostic characters
Large tree, up to 45 m tall
Fruits - two-winged

Management and maintenance
Hopea mengarawan is a medium-sized tree, with a prominent buttressed bole. The tree is an upper canopy tree in forests, where it occurs locally, scattered or sometimes gregariously on low-lying, often swampy or periodically inundated land and also on low hills. It is usually found on ridges and hillsides with poor sandy to clayey soils in the wild, also on ultrabasic.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.



The species have oblong-lanceolate, large, leathery, about 10 x 4 cm and drying to yellowish-brown. The midrib is slightly elevated on both surfaces, venation dryobalanoid, main nerves are about 15-25 pairs and very faint. The petiole is about 11 mm long.

Fissured, dark chocolate-brown

Hopea odorata Roxb.

Local name
Cengal Pasir

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A scaly-barked tree, grows up to 45 m tall. The buttresses are medium-sized. Its bole is grey, tall, clear to certain height, or bent and rough, slightly fissured and lenticellated, later becoming scaly. A small exudation of white dammar may be present. The outer bark is dark brown, rather thick, inner bark about 16 mm thick. The crown is dense, dark green, pyramidal or conical in young trees. The twigs of this tree are slender, glabrous except the young ones. The stipules are minute and caducous.

Inflorescences
Very shortly pedicelled, in one-sided racemes.

Flowers
Small, petals are pale yellow and fimbriate at the apex, stamens 15, anthers narrowly ellipsoid, ovary avoid, punctate or glabrous. The style is as long as the ovary.

Fruits
Small, two-winged; nut ovate-conical, about 6 mm long, as the wing is about 5.5 cm long and green in colour when immature.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
A riparian species, rarely occurring far from streams. Native to Bangladesh, Cambodia, India, Lao People's Democratic Republic, Malaysia (Peninsular Malaysia), Myanmar, Thailand and Vietnam. In Malaysia, it is a popular tree in Langkawi (Kedah), Perlis, Kedah, northern Perak, Kelantan and Terengganu.

Diagnostic characters
Large tree, up to 45 m
Medium-sized buttresses
Crown - dense and dark green
Fruits - small two-winged

Management and maintenance
Hopea odorata is a medium-sized to large evergreen tree with a large crown, and buttressed bole. The species is now widely cultivated as an ornamental and shade tree in urban areas. The tree is basically a riparian species and is normally found near rivers or streams. It usually occurs on deep rich soils, most commonly along the banks of streams and in damp situations, rarely far away from a stream.

Hopea odorata grows best in areas where annual daytime temperatures are within the range of 26 - 36°c, but can tolerate temperatures within the range of 10 - 41°c. The plants are killed by temperatures of -3°c. It prefers a mean annual rainfall of 3,000 - 4,000 mm, but tolerates 2,200 - 5,100 mm. It also prefers a pH in the range 4.8 - 5.2, tolerating 4.4 – 6.

This tree has the highest increment among the dipterocarp species, with a diameter increment of 0.97cm per year and a height increment of 51 cm per year. The tree flowers and fruits almost regularly, every two years. The tree is also suitable for planting on degraded land. Experiments have shown that it is suitable for planting in degraded sites such as log yards, skid trails from logging activities, and ex-mining land.

Hopea odorata prefers seed for its propagation method. The tree usually regenerates freely, with seedlings springing up profusely round the mother tree. The seeds can be collected from the ground under the seed bearers. The seeds are recalcitrant and die within five days due to dehydration. If dried at 35°c to 33% moisture content, seeds could stay viable for 1 - 2 months at 15°c, maintaining a germination rate of over 60%. If stored at 4°c, the seeds can stay viable for about three months. Germination will takes place in 1 - 4 weeks. Germination rate has been found to be 73% in unshaded beds, 83% in shaded beds and 40% in direct field sowings. Bare root transplanting results in almost 100% survival if seedlings are root pruned first. Direct sowing is also usually successful.

The leaves are elliptical, unequal-sided, about 13 x 6 cm, drying a pale yellow-green colour. Its petioles are rather slender, about 16 mm long and drying black.

Scaly Bark

Hopea pachycarpa (Heim) Symington

Local name
Bayan

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small to medium-sized tree with a smooth bark, grows up to 40 m tall. Its twigs are pubescent.

Inflorescences
The tree produces flowers that are usually borne on the branchlets below the leaves.

Flowers
The petals are pale yellow and the stylopodium is hourglass-shaped.

Fruits
Its fruit is a wingless nut, like a small cengal fruit but covered with a thick, sticky, resinous coat when ripe and is about 1.5 cm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found in swampy forests in Malaysia (Peninsular Malaysia). Also occurs in Brunei, Indonesia (Sumatera), and Borneo (Sarawak). In Peninsular Malaysia, it is found in eastern Pahang and Johor. The species is critically endangered and perhaps extinct in the peninsula.

Diagnostic characters
Medium-sized, up to 40 m tall
Flowers - pale yellow, borne under the branchlets below the leaves
Fruits - wingless nuts

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are elliptic to lanceolate, large, pubescent, about 16 x 5 cm, about 12-20 pairs of vein, prominently nerved, more or less velvety and unequal sided.

Smooth Bark

Hopea pierrei Hance

Local name
Merawan Palung

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree with a smooth bark. The buttresses are small and stilted. The bole is mainly smooth with light patches. The outer bark is thin and the inner bark is light brown, tinged with pink. Its crown consists of small leaves. The twigs are slender and smooth.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Its petals are pale yellow in colour, the ovary and stylopodium are hourglass-shaped.

Fruits
The fruits are nuts, about 6 mm long, conical, pointed, two-winged, wings about 2.5 mm.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in lowland and hill forests in Cambodia, Indonesia (Sumatera), Lao People's Democratic Republic, Malaysia (Peninsular Malaysia), Thailand and Vietnam. In Malaysia, it has been found only in Bentong district of Pahang, in Ulu Gombak Forest Reserve in northern Selangor and in Pasoh Forest Reserve in Negeri Sembilan.

Diagnostic characters
Medium-sized, up to 40 m tall
Flowers - pale yellow
Fruits - two-winged nut

Management and maintenance
Hopea pierrei is an evergreen tree with a spherical crown, with thin buttresses. It is also the source of a resin and has local medicinal use. It is a canopy tree, mainly found in lowland evergreen rainforests on sandy soils, but also present in heath forests. The tree found in the wild is mainly in well-drained, sandy soils, and requires an acid to neutral soil. It is tolerant to strong winds. Its seed has a very short viability.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are small, ovate-acuminate, about 5 x 2.5 cm, about 18 pairs of nerves, with sunken midrib on the uppersurface of leaves.

Smooth Bark

Hopea polyalthioides Symington

Local name
Giam Rambai

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree. The bole is tall, smooth but with chocolate-brown and lighter patches. Its branches are long and slender, the leaves arranged rather like certain Myristicaceae or Annonaceae. The outer bark is thin, readily off in thin flakes which are black on the inner surface and reveal a dull red-brown layer of bark beneath, while the inner bark is light red grading to white at the cambium. The sapwood is pale yellow. It has golden velvety-tomentose twigs when young.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Unknown but probably similar to those of *H. apiculata.*

Fruits
Unknown but probably similar to those of *H. apiculata.*

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
A rare and endemic species to Johor, Malaysia. Found in well-drained lowland forest in Panti Forest Reserve, southern Johor. Its original habitat no longer exists and the species may be extinct.

Diagnostic characters
Small tree
Branches are long and slender

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are long-oblong and velvety when young, 8 x 2.5 cm to 27 x 6 cm, with 12-nerved and petiole is 8 mm long.

Smooth bole

Hopea pubescens Ridl.

Local name
Merawan Bunga

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small to medium-sized tree, grows up to 35 m tall. The buttresses are short and sharp, stilted. The bark is fissured and its twigs are downy and pubescent.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
Petals are creamy white, the ovary is conical and style is slender.

Fruits
Two-winged fruits, about 30 mm long, each with very small nuts.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
An endemic species, found in Malaysia (Peninsular Malaysia). In Kelantan and Pahang, they are widely distributed on flat and hilly well-drained land. It was also recorded to be quite abundant in parts of Lipis and Temerloh. The species is favoured for agriculture. Now they are endangered as they are, widely being cut for timber.

Diagnostic characters
Medium-sized tree, up to 35 m tall
Short buttresses
Flowers - creamy white
Fruits - two-winged small nut

Management and maintenance
Hopea pubescens is a medium-sized tree, with stilted buttresses. The tree grows frequent, sometimes abundant, on well-drained flat land and low hills.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are ovate-elliptic, small, around 5 x 2 cm, sparsely hairy on the midrib which is sunken on the uppersurface; dryobalanoid venation, 12 pairs of almost invisible main nerves

Fissured

Hopea subalata Symington

Local name
Merawan Kancing

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree, grows up to 12 m tall, and with a smooth bark. Its buttresses are stilted with adventitious stilt roots. The bole is straight but not too tall, smooth but with light patches and with a few smears of resin. The species also has a very thin outer bark, and its inner bark is 8 mm thick. Its twigs are slender, almost glabrous, with short, prominent and decurrent traces. The stipules are small and fall off very early.

Inflorescences
Terminal and axillary, dense or lax many-flowered panicles. The bracteoles are minute, caducous or persistent.

Flowers
The petals are dark purple, with truncated stylopodium.

Fruits
The fruits are small, conical, pointed nuts, about 1 cm long. Its woody sepals cover the nuts, two of which may be developed into rudimentary wings.

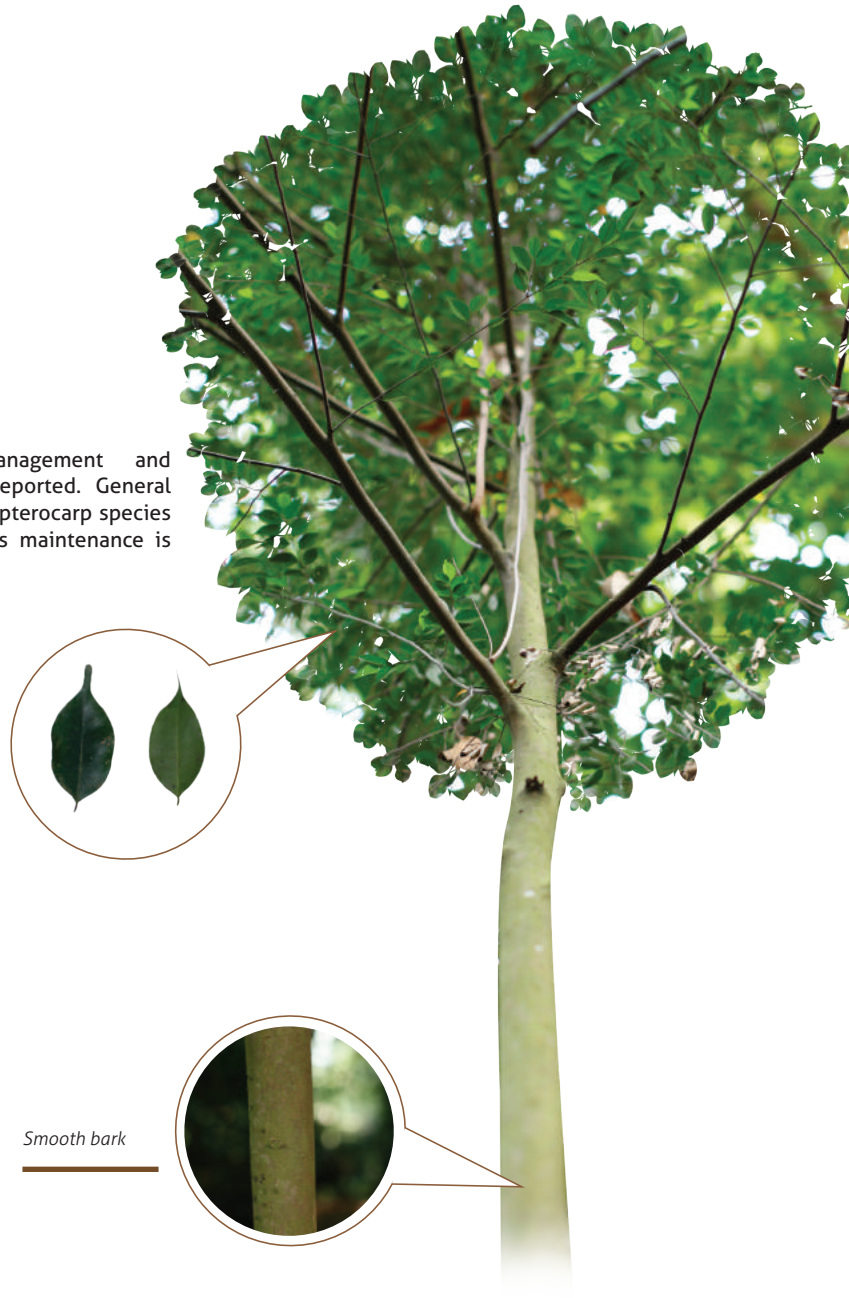
LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found only in a single location, Kancing Forest Reserve, Selangor (Malaysia), in valleys and low ridges.

Diagnostic characters
Small tree, up to 12 m tall
Buttresses stilted with roots
Flowers - dark purple
Fruits - small conical nut

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.



The leaves are elliptical and thin, with caudate acuminate apex, about 8 cm long, venation of sub-dryobalanoid, main nerves about 12 pairs.

Smooth bark

Shorea atrinervosa Symington

Local name
Balau Hitam

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, exceeding 3 m girth, with buttresses fairly large with good clear length. The bark is scaly and bleeds dark amber dammar. Its outer bark is chocolate-brown, while the inner bark is dull pale brown grading to olive in the cambium. The species has smooth twigs.

Inflorescences
Terminal or axillary panicles, bracteoles minute, caducous.

Flowers
The species produces pale yellow flowers with a bright red tinge at the base, with linear petals and elongate buds, up to 8 mm long and stamens 25-33.

Fruits
The fruit stalk is short, nut ovate-orbicular, pointed, to 2 x 1.3 cm, pale tomentose, three outer wings to 11 x 2.5 cm, two inner, narrow, to 8 x 0.9 cm.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Occur in lowland and hill forests at altitudes up to 600 m in Indonesia (Sumatera), Borneo and Malaysia (Peninsular Malaysia). In the peninsula, it is known only in the east coastal districts of Terengganu, Pahang, and northern Johor. It was reported to be one of the most common sources of Balau timber in parts of Pahang. It is endangered due to habitat conversion.

Diagnostic characters
Large tree, exceeding 3 m in girth
Large long buttresses
Fruits - three outer wings and two inner

Management and maintenance
Shorea atrinervosa derived its name from Latin (ater = dull black and nervosus = nerved) and refers to leaf venation, which is black in herbarium specimens. It is an emergent tree, up to 50 m, found in mixed dipterocarp forests on clay-rich soils.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, elliptic to ovate, about 13 x 17 cm, about 12 nerved, frequently glaucous on the undersurface with nerves and midrib drying black. The petiole is about 2 cm long and also drying black. Its stipules are reddish-brown and boat-shaped.

Scaly and bleeds dark amber dammar

Shorea bentongensis Foxworthy

Local name
Meranti Mengkai

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree with almost absent buttresses. The bole is smooth, slightly cracked, dark grey with light patches. The tree exudates clear, pale yellowish dammar. The outer bark is usually chocolate brown in colour and fairly thick, while the inner bark is characteristically laminated with bands of yellow-orange and paler tissue. The twigs are usually slender, conspicuously or sparsely furnished with a pale or ferruginous wax or scurf and really tomentose. The species also has bright red stipules that often fall off early.

Inflorescences
Lax, terminal or axillary panicles. Its branchlets are usually slender and glabrous. Its flowers are secund, bracteoles large and sometimes persistent.

Flowers
Large flowers, up to 3 cm across when expanded, sepals usually ovate-oblong, blunt or acuminate, the three outers are usually tinged red in the throat of the corolla, loosely united when they fall, stamens 15, usually oblong, sometimes up to 30, not bearded or barbate, anther cells usually oblong, the posterior pair is slightly larger than the anterior, appendage to connective a long awn which could be minute, sparsely hairy, or scabrous, towards the end.

Fruits
Short-stalked, thick, nut large, to 20 x 25 mm, almost entirely surrounded by thick sepal bases. The wings are short and narrow; three outer wings to 20 x 7 mm, and two shorter and narrower inner wings.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Commonly found in deep valleys, endemic to Malaysia (Peninsular Malaysia).

Diagnostic characters
Large tree
Prominent and stout buttresses
Exudates clear pale yellowish dammar
Flowers - large
Fruits - thick large winged nut

Management and maintenance
Shorea bentongensis is a large tree. The bole has buttresses. *Shorea bentongensis* is locally common in low-lying land in deep valleys.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

The growth of this species is extremely erratic in the early stages. There is a preliminary stage during which multiple shoots appear and die back before a proper leader is put out. This species is also easily attacked by thread-blight fungus which has been noted on seedlings. Because of that, the use of fungicide to control the fungi that attacks this species is very important. Other daily maintenance for this species is watering, pruning and getting enough sunlight.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Alternate, elliptical, usually glabrous when mature, sometimes stellate-hairy on the undersurface, and more or less glaucous-scurfy, midrib sunk on the uppersurface or prominently tomentose and the venation is scalariform.

Chocolate brown

Shorea blumutensis Foxworthy

Local name
Meranti Kelim

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium-sized tree, grows up to 30 m tall, buttresses absent to very large, rather stout, bole smooth with light and dark coloured patches when young, usually rich tawny brown. Irregularly cracked or scaly-fissured when old. The outer bark is frequently comparatively thin, inner bark dull light yellow-brown, frequently with a green tinge at the cambium, usually excluding drops of brown resin from cut surfaces. Sapwood is usually dull yellow with a greenish tinge. The species has slender and glabrescent, rarely tomentose twigs. The stipules are usually small and fall very early.

Inflorescences
In terminal or axillary panicles, usually sericeous-tomentose. The branchlets are slender, flowers secund, the bracteoles are minute and caducous.

Flowers
The flowers are pale yellow and usually very small, bud to 6 mm long, elongate, stamens 15.

Fruits
Sessile or shortly stalked fruits, nut obovate to oblong, to 3 x 1.3 cm, with a short stiff point, sericeous or fulvous-tomentose, sepals forming a cupule around the base of the nut. The wings are papery, three inner wings are about 9 x 1.8 cm, while the two inner wings are shorter, to 6.5 cm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Occurs in lowland dipterocarp forests in Indonesia (Sumatera) and Malaysia (Peninsular Malaysia). The species can easily be found throughout peninsula, except in the extreme northwest and in Langkawi Island.

Diagnostic characters
Medium-sized, up to 30 m tall
Very large buttresses
Bole - Irregularly cracked or scaly-fissured when old
Fruits - Sessile fruit

Management and maintenance
Shorea blumutensis is a large tree. Threatened directly by logging, the tree is unlikely to reach reproductive maturity within a logging cycle. Shorea blumutensis is a slow-growing species of lowland dipterocarp forests.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Its leaves are alternate, elliptic-lanceolate, about 12 x 5 cm, about 15-nerved, acuminate apex, leathery and slightly revolute margin, reddish or purple coloured when young, frequently drying greenish-yellow.

Irregularly cracked or scaly-fissured when old.

Shorea collina Ridl.

Local name
Balau Merah

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large-sized tree, with small or no buttresses and spreading crown. The bole is purple-brown and grey, smooth. The bark is falling in small scales, the outer bark is dark brown, while the inner bark is about 1 cm thick and dark purple-red, grading to dull yellow. A small exudation of dull-coloured dammar can be seen often. The twigs are smooth and turn black when dry. Its stipules are oblong, about 1 cm long and caducous.

Inflorescences
Terminal or axillary panicles, bracteoles minute, caducous.

Flowers
The buds elongate to 8 x 4 mm. The petals are linear-oblong, but unknown colour, and with about 55 stamens.

Fruits
Large, nuts broad and beaked, about 3.5 x 2.5 cm. The sepals prolonged into rudimentary wings; the outer three are about 5 x 1.3 cm. Its sepal bases are very woody.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
A lowland tree, native to Malaysia (Peninsular Malaysia) and Singapore. In Malaysia, it is only known in Pahang, eastern Terengganu and Johor. The species is now considered endangered owing to forest conversion.

Diagnostic characters
Large tree
Absent buttresses
Spreading crown
Fruits - winged, large, nuts broad and beaked.

Management and maintenance
Shorea collina is a medium-sized to large tree. The tree is a source of 'Red Balau' timber. The tree is directly threatened by logging because its slow growth prevents the tree from reaching reproductive maturity within a logging cycle.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are large, shiny, shortly acuminate, and broadly elliptic or ovate, about 12 x 8 cm, about 12-nerved, drying to slightly purple-brown. The petioles are about 3 cm long and drying to black.

Inner bark dark purple-red, grading to dull yellow

Shorea curtisii Dyer *ex* King

Local name
Seraya

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree with bluish-grey crown. Its buttresses are usually short and stout. The bole is grey or reddish-brown, coarsely fissured, and bleeds grey-brown or pale brown dammar. The twigs and branches are often brittle, littering the ground. Its stipules are linear-oblong, up to 4 cm long, and conspicuous beneath the tree at growing seasons.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
Small, about 1 cm across when expanded, petals white, turning to pale yellow, falling in rosette with 15 radiating stamens.

Fruits
Nut oblong and pointed, about 12 x 9 mm, and winged. The three large wings are about 7 x 1 cm, while other two inner wings are short, less than 4 cm.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Commonly found in hill dipterocarp forests, on inland mountain ridges, about 300-800 m above sea level. Native to Indonesia, Malaysia, Singapore and Thailand.

Diagnostic characters
Large tree
Short and stout buttresses
Crown - bluish-grey
Bole - grey or reddish-brown, coarsely fissured
Fruits - winged nut

Management and maintenance
Shorea curtisii is a tree with a huge hemispherical crown, with cylindrical bole, can be free of branches for 18 - 28 metres, with prominent buttresses up to 2.5 metres high. The leaves have ladder-like tertiary venation and are pale-waxy on the upper surface. This gives the forest canopy a blue-green sheen.

Shorea curtisii grows at deep dry soils on coastal hills, and can occur at lower elevations in lowland hill dipterocarp forests that are near the coast. The tree appears to grow more slowly than other common *Shorea* species. Mass flowering appears to occur in about 9-year intervals, after prolonged periods of drought. Flowers could be pollinated by thrips. Seeds of *Shorea curtisii* are poorly dispersed by wind, often falling near the mother tree. Foraging ants predate upon the germinating seeds.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are ovate-lanceolate, about 8 x 3 cm, about 14-nerved, silvery undersurface and drying to brown. Its petioles are about 1.5 cm long and slender.

Grey or reddish-brown, coarsely fissured

Shorea dasyphylla Foxworthy

Local name
Meranti Batu

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 45 m tall with heavy and dark crown. The bole is dark, deeply fissured, and beefy red, while the bark falling in thick flakes. The outer bark is thick, dark brown, black when damp, while the inner bark is about 12 mm thick, red like raw meat and fibrous. The sapwood is pale, narrow, soon darkening to the red heartwood. The tree also has soft twigs and tomentose at the ends. The stipules are ovate, about 6 mm long, softly hairy and persisting for a short time.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
About 1 cm across when expanded and the petals are pale yellow.

Fruits
Long wings, nut avoid-cylindrical, prominently beaked, to 18 mm long. The fruits' wings consist of three large wings up to 9 x 1.3 cm, and two small wings, linear, up to 4 cm long. The bases of sepals are woody and individually prominent.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Inhabits lowland and hills dipterocarp forest, in Indonesia (Sumatera) and Borneo (Sarawak). This species has been recorded throughout Malaysia (Peninsular Malaysia), from northern Perak and Kelantan to Johor, in eastern Sumatera, and in Sarawak.

Diagnostic characters
Large tree, up to 45 m tall
Crown - heavy and dark
Bole - dark, deeply fissured and beefy red
Fruits - long winged

Management and maintenance
Shorea dasyphylla is a tree with a dense, hemispherical crown, with stout buttresses up to 150cm high. The tree is an emergent tree in mixed dipterocarp forest on well-drained flat land and low hills.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, elliptic to ovate, with short acuminate apex, about 11 x 6 cm but varies, about 13-nerved, softly hairy on the undersurface and stipulate when young. The petioles are about 15 mm long and also tomentose.

Dark, deeply fissured and beefy red

Shorea exelliptica Meijer

Local name
Balau Tembaga

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, with a yellowish-brown crown. The bole cracked, while the bark sheds linear-oblong scales. Its outer bark is dark chocolate, while the inner bark is pink or purple-brown grading to yellow at the cambium. The sapwood is pale yellow grading to the bright, shining and brown heart-wood. Its twigs are minutely fulvous tomentose towards the ends. The stipules are ovate, up to 8 mm long and falling early.

Inflorescences
Terminal or axillary panicles, bracteoles minute, caducous.

Flowers
The buds are narrowly lanceolate, up to 10 x 3 mm. Its petals are pale yellow and tinged pink at the base.

Fruits
The fruits are sub-orbicular nuts up to 15x10 mm, with long sharp beak, pale tomentose, and winged. Its three outer wings are up to 8 x 2.4 cm, while the two inner wings are much shorter and narrower.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Inhabits lowland and hill dipterocarp forests and common in undulating and well-drained land in Malaysia (Peninsular Malaysia) and Borneo. Found in southern Kedah, being common in Bongsu Forest Reserve, and in Bruas and Tanjung Tualang forest reserves in Perak, which is now degazetted. It was also common on the east coast of Terengganu, Pahang and Johor, particularly in Kuantan and Rompin districts of Pahang.

Diagnostic characters
Large tree
Crown - yellowish-brown
Bole - cracked texture
Fruits - winged nuts

Management and maintenance
Shorea exelliptica has previously been confused with *Shorea elliptica* and the species name is derived to highlight this point (ex = excluded from). It is an emergent tree, found in mixed dipterocarp forest on yellow clay and sandy clay soils on sedimentary rock.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, elliptic, about 10 x 5 cm. About 12-nerved, glaucous and densely hairy on the undersurface and stipulate when young. The petiole is about 1.5 cm long.

Cracked texture

Shorea falcifera Dyer *ex* Brandis

Local name
Balau Kuning

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium-sized tree with a cream crown from below. The bark is flaky, yellow-brown to dark red-brown. Its inner bark is yellowish-brown, around 6 mm. The sapwood is brownish yellow, heartwood is pale brown and exudates whitish opaque dammar. The twigs are slender, densely pale yellow stellate-pubescent, appearing pale cream yellow towards the ends. Its stipules are elliptic, 6 x 4 mm and falling off very early.

Inflorescences
Terminal or axillary panicles, flowers secund (subsection of Shorea) or distichous (subsection Barbata); bracteoles minute and caducous.

Flowers
The flower buds are in panicles, all directed to the same side, petals lanceolate, 8 mm long and stamens around 33 to 44.

Fruits
Short-stalked fruits, cream-yellow, stellate-pubescent near the base. The nut is up to 25 x 15 mm, ovoid, with length of wings up to 9.5 x 1.8 cm and shorter wings up to 7 x 0.8 cm.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Commonly found in lowland to coastal hill forests. This species is native to Indonesia (Kalimantan, Sumatera) and Malaysia (Peninsular Malaysia) and Borneo (Sarawak). In Malaysia, the species is found in the east coast of Peninsular Malaysia where it is known from Terengganu and Pahang. Few of its habitats now remain in the peninsular, making the species endangered.

Diagnostic characters
Medium-sized tree
Exudates whitish opaque dammar
Crown - cream colour from below
Flowers - panicles flower buds, all directed to the same side
Fruits - winged nut

Management and maintenance
Shorea falcifera is a tree with a diffuse, hemispherical crown, with fairly thin buttresses up to 150cm high. This lowland species cannot withstand logging because of its slow growth. The tree grows on dry hill slopes near the coast on sandy and often rocky soils.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are narrowly ovate to lanceolate-falcate and have prominent nerves, with 10 pairs of nerves, slender but prominent beneath.

Flaky, yellow-brown to dark red-brown.

Shorea foxworthyi Symington

Local name
Balau Bukit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree and grows up to 60 m tall, with a dense, hemispherical, and green crown. The buttresses are large, sharp, cuneate, and sometimes up to 5 m in height. The bark is greyish, irregularly cracked to shallowly flaked and leaving scroll-marks when shed. Its outer bark is dark brown, while the inner bark is yellow. The sapwood is narrow, pale yellow-brown. The heartwood is shiny and chocolate-brown. The species also has thick and golden tomentose hairs. The stipules are oblong, up to 15 x 4 mm and falling off very early.

Leaves
The leaves are elliptic, about 11 x 5 mm and about 12-nerved. The nerves are strongly elevated on the undersurface and often wavy, drying yellow or reddish brown, petiole is 11-20 mm long.

Inflorescences
Terminal or axillary panicles, bracteoles minute and caducous.

Flowers
Its buds elongate to 10 mm long, petals are narrowly oblong, yellow and stamens are about 32-41.

Fruits
Short-stalked but large nuts, ovoid, beaked, to 25 x 14 mm, with three outer wings up to 10 x 2.5 cm, and two inner wings up to 8 x 1 cm.

LANDSCAPE USE

Conservation Status
Vulnerable

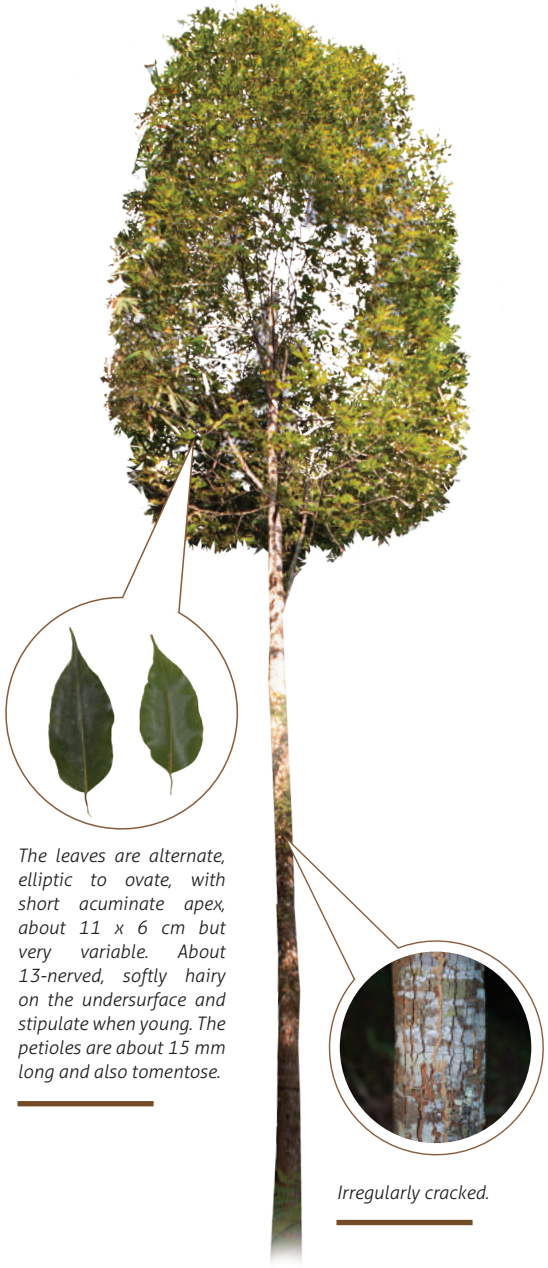
Ecology and Distribution
Commonly found in lowland and hilly forests, up to 500 m. This species is native to Indonesia (Kalimantan, Sumatera), Borneo (Sabah, Sarawak) and Thailand.

Diagnostic characters
Large tree, up to 60 m tall
Large buttresses, up to 5 m in height
Bark - irregularly cracked
Crown - dense, hemispherical green
Fruits - winged large nut

Management and maintenance
Shorea foxworthyi is a tree with a dense, irregularly hemispherical crown, with spreading buttresses up to 3 metres high. The tree scattered, sometimes common, in mixed dipterocarp forests, growing in yellow clay and sandy clay soils on undulating land or hills.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.



The leaves are alternate, elliptic to ovate, with short acuminate apex, about 11 x 6 cm but very variable. About 13-nerved, softly hairy on the undersurface and stipulate when young. The petioles are about 15 mm long and also tomentose.

Irregularly cracked.

Shorea gibbosa Brandis

Local name
Damar Hitam Gajah

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree and grows up to 70 m tall. The bole is greyish-brown, fissured, becoming scaly, shedding scales and leaving scroll-marked lenticellate bark. Sometimes the tree exudes black or yellowish dammar. Its twigs are around 1 mm apically, slender, much branched, at first frequently rugulose. The stipules are up to 3 x 1 mm, narrowly elliptic, acute and fugaceous.

Inflorescences
The panicle is up to 10 cm long, terminal or axillary, terete, densely persistently buff to pale rufous pubescent, singly branched, branchlets to 2 cm long, bearing to 6+ distichous flowers; bracteoles to 2 x 1 mm, oblong, obtuse, shortly pubescent, fugaceous.

Flowers
Pink when open, 5-13 x 2-6 cm, ovate, chartaceous, undulate, base broadly cuneate to obtuse, acumen to 1.5 cm long, nerves 7-9 pairs, slender but prominent beneath, at 50-65 degrees, tertiary nerves subreticulate. Its petioles are short, about 8-12(-16) mm. Its buds are up to 5 x 3 mm, lanceolate. Sepals are ovate, shortly densely pubescent on parts exposed in bud, the outer 3 are acute, while the inner 2 are shortly acuminate, relatively broader, shorter and thinner at the margin. Stamens are 15. The flowers also consist of ovoid and densely pubescent ovary, style columnar, pubescent in the basal 4, or otherwise glabrous.

Fruits
Fruits pedicels up to 2 mm long, and slender. Calyx shortly sparsely pubescent, 3 longer lobes to 9 x 2 cm, spatulate, obtuse, c. 4 mm broad above the to 10 x 6 mm ovate saccate thickened tuberculate base; 2 shorter lobes to 6 x 0.5 cm, narrowly spatulate, acute, similar at base. Nut to 1.8 x 1.2 cm, narrowly ellipsoid, densely buff pubescent, acute.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in lowland dipterocarp forests, this species is native to Singapore, but also found in Indonesia (Sumatera), Peninsular Malaysia (Johor) and Borneo.

Diagnostic characters
Large tree, up to 70 m tall
Exudates black or yellowish dammar
Flowers - pink

Management and maintenance
Shorea gibbosa is a tree with a vast, somewhat diffuse, cauliflower-shaped crown, with stout, spreading and sharp buttresses up to 5 metres high. The tallest measured specimen is 81.1 metres tall, in the Tawau Hills National Park in Sabah.

Shorea gibbosa is found in low-lying and flat forests. The tree is an emergent lowland tree that grows on alluvial to dry sites, usually on deep clay-rich soils. Seedlings and saplings of *Shorea gibbosa* are shade tolerant. Like the rest of the Dipterocarp species, it mass flowers only occur over long periods of interval.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, ovate and acuminate. The leaves do not roll up when dry. The saplings are reddish-brown.

Greyish-brown, fissured

Shorea gratissima Dyer

Local name
Meranti Laut

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 60 m tall, with a dense and small-leafed crown. Its buttresses are short and the bole is dark grey-brown and deeply fissured, exudes clear dammar. The bark sheds thick flakes. Its stipules are linear-lanceolate, about 15 mm long and falling off very early.

Inflorescences
Lax, terminal or axillary panicles. Its branchlets are usually slender and glabrous. Its flowers are secund, bracteoles large and sometimes persistent.

Flowers
The flowers are small, about 1 cm across, stamen 25.

Fruits
Short-stalked, ovate-oblong nut, about 15 x 8 mm, smooth and winged. The three outer wings are longer, about 7 x 1.3 cm, while the inner wings are about 5.5 x 0.6 cm.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in well-drained soil on coastal hills. A tree native to Indonesia (Sumatera), Malaysia (Peninsular Malaysia), Borneo (Sabah), Myanmar, Singapore and Thailand. In Peninsular Malaysia, it is found on Jugra Hill, at the coast of Selangor.

Diagnostic characters
Large tree, up to 60 m tall
Short buttresses
Crown - dense and small-leafed
Bole - dark grey-brown and deeply fissured

Management and maintenance
Shorea gratissima is a tree with a large, hemispherical crown comprised of a few large twisted branches. The bole can be straight or twisted, with stout buttresses up to 2 metres high. It belongs to the Meranti Pa'ang Group, a group which is characterised by timber with high silica content, thus rendering it hard to be sown and used. The tree is an emergent tree in mixed dipterocarp forests; on dry, low hills near the coast and growing in well-drained soils.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are small, ovate to elliptic, about 10 x 4 cm but varies. About 9 pairs of nerves only slightly raised beneath, usually light reddish brown above when drying and markedly glaucous on the undersurface. The petiole is slender and about 15 mm long

Dark grey-brown, deeply fissured

Shorea hemsleyana (King) King *ex* Foxworthy

Local name
Cengal Pasir Daun Besar

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small to medium tree, grows up to 20 m tall. The buttresses are medium-sized. The crown is dense with large leaves. The bole is greyish and deeply fissured. The outer bark is dark brown, thin, while the inner bark is about 12 mm thick, slightly laminate with layers of yellow-brown and lighter tissue; sapwood is pale yellow, and very resinous. The twigs are rather thick, fulvous stellate-hairy towards the ends. The stipules are large and persistent.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
The flowers are large, corolla about 2 cm across when expanded and red.

Fruits
Large, with rudimentary wings, nut ovoid or cylindrical, beaked, up to 7 cm long when mature and hairy. The calyx lobes forming rudimentary wings which are frequently broken and lobe-like on mature fruits. The bases of calyx lobes forming a thick, woody cupule.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Commonly found in lowland, semi-swampy areas. A species of Indonesia (Sumatera) and Malaysia (Peninsular Malaysia) and Borneo (Sarawak). In Peninsular Malaysia, it was quite common in Perak River, Ijok, Parit and Tanjung Tualang Forest Reserves, but now it is critically endangered by logging and land conversion.

Diagnostic characters
Medium tree, up to 20 m tall
Medium-sized buttresses
Flowers - large red
Fruits - large and rudimentary wings

Management and maintenance
Shorea hemsleyana or locally known as Meranti Daun Besar, is a species of Dipterocarpaceae from the swamp forests. It is a tree with a dense, hemispherical crown, with low, rounded buttresses. The tree is also a source of illipe nuts from its seed, which supply a fat used locally for cooking, medicine, making soap, candles, polishes and cosmetics.

Shorea hemsleyana occurs in mixed dipterocarp forests on yellow, leached, sandy clay soils and on shallow peats.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, oblong, acuminate, large, 35x15 cm, about 20-nerved, shining above, rough with hairs on the undersurface, and drying to brown. Its petiole is stout, about 18 mm long. The young leaves are very large, sometimes long-petioled and chocolate-red.

Greyish, deeply fissured

Shorea henryana Pierre

Local name
Meranti Jerit

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 40 m tall, with greyish-brown and irregularly cracked or fissured bole. The crown is yellow. The bole exudes resins. The twigs are branchless and hairy at the tip. The stipules present, interpetiolar, sheathing and leaving a circular scar, falcate, pubescent, and caducous.

Inflorescences
Subsessile, in terminal and axillary panicle, with 8-9 ramifications, peduncle angular and pubescent.

Flowers
Large, corolla about 20 mm across when expanded, the petals are marked-silky in exposed parts in buds, white, with 25-30 stamens.

Fruits
Short-stalked, nut, ovoid, about 22 x 4 mm, glabrous, and yellowish-green when young. The three outer wings are slightly narrow at base and rounded at the end, about 9.5 x 1.6 cm, while the two inner wings are smaller and acute at top, about 5.5 cm long.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Common tree in hilly forests and limestone soil. Native to Cambodia, Lao People's Democratic Republic, Malaysia (Peninsular Malaysia), Myanmar, Thailand and Vietnam. In Peninsular Malaysia, it is found in Perlis, northern Kedah and Langkawi Island.

Diagnostic characters
Large tree, up to 40 m tall
Crown - yellow
Bole - greyish-brown and irregularly fissured, exudates resins
Flowers - large white

Management and maintenance
Shorea henryana is a deciduous tree with an irregularly rounded crown; branches drooping or horizontal to the main trunk, and is buttressed. The species occurs very often in mountain dry evergreen forest, growing on well-drained soils based on granite and sandstone; and on depleted forest. The trees fruiting time is in February.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are simple, ovate-lanceolate, acute at apex, base attenuate or rounded, about 6.5-12.5 x 2.5-5 cm, pinkish on the undersurface and reddish brown when dry. Its midribs are canaliculated above, secondary veins oblique to the midrib, widely parallel, tertiary veins oblique.

Greyish-brown, irregularly fissured, exudates resin

Shorea johorensis Foxworthy

Local name
Meranti Pepijat

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 50 m tall. The bole is yellow-grey or dull purple-brown, covered with papery scales, bark falling in flakes. The outer bark is thin and dull grey-brown, while the inner bark is about 12 mm, pink and fibrous. Its sapwood is soft and almost white. The twigs are slender and glabrous when mature, and the stipules are small and yellowish brown.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
The flowers are pale yellow and about 1 cm across when expanded.

Fruits
Nut ovoid, covered with pale hairs, up to 2 cm long, and winged. Its three outer wings are large, about 12 x 2.3 cm, while the two shorter inner wings are about 6.5 x 0.6 cm. The wings turn red when matured.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found at low elevations, this species is native to Indonesia (Kalimantan, Sumatera) and Malaysia. It appears to be quite common in Panti Forest Reserve, Johor, and is critically endangered by logging.

Diagnostic characters
Large tree, up to 50 m tall
Bole - yellow-grey or dull purple-brown, covered with papery scales
Fruits - winged nuts, turn red when matured

Management and maintenance
Shorea johorensis is a tree with a large, hemispherical crown, with stout, prominent buttresses up to 3 metres high. It is usually found in the wild on riversides with clayey to sandy soils. The tree prefers fertile and well-drained soils.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, ovate, about 11 x 6 cm, about 11-nerved, shortly acuminate, drying to dull grey-brown. Its petioles are about 1.5 cm long.

Yellow-grey or dull purple-brown, covered with papery scales

Shorea lamellata Foxworthy

Local name
Meranti Lapis

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, exceeding 50 m tall, with a dark coloured crown. The bole is fissured and the bark falling in small, thin scales. Its outer and inner bark are laminated. Its twigs are reddish tomentose at the ends.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
White flowers with 15 stamens.

Fruits
Very short-stalked fruits, which are softly hairy when young, nut up to 14 x 10 mm and pointed. The two inner wings of the fruits are shorter and narrow, about 7 cm long, while the three outer wings are about 18 x 1.5 cm.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found in ridges and up to 900m altitude in valleys. Widespread in Riau Archipelago, Borneo and Malaysia (Peninsular Malaysia). In Malaysia, it is in Dindings and Kuala Kangsar, Kinta, and Batang Padang districts of Perak.

Diagnostic characters
Large tree, up to 50 m tall
Crown - dark coloured
Bole - fissured, falling in small and thin scales
Fruits - white coloured with 15 stamens

Management and maintenance
Shorea lamellata is a tree with a dense, hemispherical crown; it can grow up to 50 metres tall. The straight, cylindrical bole can be up to 175 cm in diameter with stout buttresses up to 3 metres high.

Shorea lamellata grows on alluvial as well as dry sites (hillside and ridges), on sandy to clayey soils, also on limestone.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are alternate, elliptic-oblong to ovate or occasionally obovate, about 10 x 6 cm, prominently about 24-nerved, almost leathery and hairy on the undersurface. The petioles are about 1 cm long and tomentose.

Fissured

Shorea macrantha Brandis

Local name
Kepong Hantu

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree, up to 40 m tall, with small buttresses, dense crown and drooping branchlets. The bole is dull purplish-grey and fissured. The outer bark is chocolate brown with black areas, while the inner bark is about 12 mm thick, exuding colourless sticky resin shortly after cutting. Its twigs are harshly tawny-tomentose. The stipules are ovate-oblong, broad and concave at the base, sometimes falcate and pointed, stellate-hairy, up to 16 mm long and persistent.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
The flowers are white, petals are large and narrow, about 2 cm long.

Fruits
The fruits are large and wingless, nut oblong, pointed, to 5 cm long and densely hairy. The calyx segments forming a lobed woody cup about 2 cm high, embracing the lower portion of the nut. The lobes sometimes prolong into rudimentary wings.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Inhabits swamp and semi-swamp areas and riverines. Native to Indonesia (Sumatera) and Malaysia (Peninsular Malaysia) and Borneo (Sarawak). In Peninsular Malaysia, the distribution is restricted to the lower valley of the Perak River in the west, and the eastern Pahang and Johor in the east. The species is now critically endangered due to land conversion.

Diagnostic characters
Small tree, up to 40 m tall
Small buttresses
Crown - dense
Bole - dull purplish-grey and fissured
Flowers - white with large and narrow petals

Management and maintenance
Shorea macrantha is a tree with a crown of pendent branches, with stout buttresses. It also yields an oil-rich seed, known as illipe nut, but less valued than some other species. The seed is harvested mainly for local use.

The tree grows in the inland margins of mixed peat swamp forests and on poorly drained podsols on terraces in Kerangas forests - a type of moist, heath forest found on acidic, sandy soils that are low in nutrients, especially nitrogen.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are oblong, about 13 x 7 cm, about 15-nerved, glabrous (except for midrib) and densely hairy on the undersurface. Its petioles are stout, velvety and short, about 5 mm long.

Dull purplish-grey, fissured

Shorea materialis Ridl.

Local name
Balau Pasir

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large tree, grows up to 40 m tall. The buttresses are large and sharp. The bole is usually short and frequently crooked, grey and purplish-brown, and irregularly longitudinally cracked or scaly. The crown is wide-spreading, large-leafed and light in colour. The outer bark is reddish brown, while the inner bark is about 1 cm thick, dull yellow- brown, and the sapwood is pale yellow. Twigs are smooth. Stipules are linear-oblong, about 12 mm long and falling off early.

Inflorescences
Terminal or axillary panicles, bracteoles minute, caducous.

Flowers
The buds elongate, to 10 mm long. The petals are linear, pale yellow, with stamens about 30.

Fruits
Nut rounded or ovate, beaked, about 12 mm long, wings rather narrow, the three outer are about 9 x 3 cm, while the two inner are about 6 cm long.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Common in lowland, usually in sandy or sometimes swampy habitat, near the coasts or riverine. This species is native to Brunei, Indonesia (Sumatera) and Malaysia (Peninsular Malaysia) and Borneo (Sarawak). In Peninsular Malaysia, it is limited to the east coast of Pahang, Johor, and possibly Terengganu.

Diagnostic characters
Medium tree, up to 40 m tall.
Large buttresses
Bole - irregularly longitudinally cracked
Fruits - narrow winged nut

Management and maintenance
Shorea materialis is a tree with a rather flat, diffuse crown of a few large branches, with thin buttresses up to 150cm high. The tree also furnishes a resin that is used locally. The tree has been overexploited for its timber.

Shorea materialis is an emergent tree of lowland areas in the moist tropics, in heath forest on white sand giant podsols of Quaternary marine and estuarine terraces, and sandstone cuestas.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are large, broadly ovate, unequal sided, about 12 x 8 cm, but sometimes much larger, about 12-nerved, and usually markedly glaucous on the undersurface. Its petiole is about 2 cm long and drying to black or glaucescent.

Irregularly longitudinally cracked

Shorea ochrophloia E.J. Strugnell *ex* Symington

Local name
Seraya Batu

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, buttresses usually short, and bole is typically yellowish-grey. Its crown is large, heavy and dark coloured. The bark sheds irregular and thin scales. The outer bark is thin and light brown, while the inner bark is purple-pink. Its sapwood is pale, changing rather suddenly to the rich purple-brown heartwood. The exudation of amber coloured dammar may be present. Twigs are velvety golden tomentose towards the end. The stipules are oblong, about 10 mm long and falling off early.

Inflorescences
Terminal or axillary panicles, bracteoles minute, caducous.

Flowers
The buds are elongate, up to 7 mm long. The petals are linear, creamy with red tinge or patch within the base and stamens about 30.

Fruits
The fruits are short-stalked, winged and hairy. The nut ovate-oblong, beaked, up to 2 cm long, beak densely tomentose. The three outer wings are up to about 7 x 1.5 cm, while the two inner wings are up to 6 cm long and narrow.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Common in lowland, well-drained forests or on hills under 300 m. This species is native to Indonesia (Sumatera) and Malaysia (Peninsular Malaysia).

Diagnostic characters
Large tree
Short buttresses
Crown - large with cauliflower-shaped
Fruits - short-stalked winged nut

Management and maintenance
Shorea ochrophloia is a large buttressed and evergreen tree. It is an emergent tree in evergreen lowland forests, growing in well-drained undulating low-lying ground.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are orbicular, subcordate at the base, about 7 x 5 cm but varies, about 15-nerved, margins frequently revolute, about 12 mm long, glossy and softly tomentose on the undersurface and with curled back margins.

Yellowish-grey

Shorea palembanica Miq.

Local name
Meranti Tengkawang Air

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small to very large tree, grows up to 45 m tall, with large, dark green crown. The buttresses are twisted or gnarled. The bole is greyish or dark coloured, fissured to scaly and sometimes with star-shaped lenticels. The outer bark is dark brown, while the inner bark is about 12 mm thick, fibrous, pink, grading to dull yellow at cambium. The sapwood is dull pale yellow. The twigs are drying black, lenticellate, with rather broad stipule scars, stellate- lepidote towards the ends, buds large, flattened, densely fulvous stellate-lepidote.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
About 18 mm across when expended, corolla pale yellow, the lobes narrow and falling singly or loosely attached in a rosette.

Fruits
With rudimentary wings, nut large, ovate-orbicular, pointed, to 3.5 cm long when mature, fulvous-tomentose, bases of calyx lobes thick and woody, embracing the lower portion of the nut, wings rudimentary, occasionally the outer three may be as long as the nut.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
A riparian species, found on riverbanks and in swampy areas in low altitudes. Native to Malaysia (Peninsular Malaysia), and Borneo (Sarawak). In the peninsular, it is found in the valley of the Perak River and in eastern Terengganu, Pahang and Johor.

Diagnostic characters
Large tree, up to 45 m tall
Twisted buttresses
Crown - large and dark green
Fruits - rudimentary wings and large nut

Management and maintenance
Shorea palembanica is a tree with dense, irregularly oblong to hemispherical crown, with stout buttresses. The seeds are commonly gathered from the wild as a source of local food. This large tree is a riverine and freshwater swamp species. It is a plant of lowland areas in the moist tropics, growing on river banks, silty floodplains, freshwater swamps and rarely low moist hillsides.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are ovate to oblong, with acuminate tip, 20 x 10 cm with 15 nerved, puberulous on the undersurface, drying reddish-brown. The petiole is about 25 mm long and drying black

Greyish or dark coloured, fissured to scaly

Shorea peltata Symington

Local name
Meranti Telepok

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small to medium tree, grows up to 40 m tall, without buttresses. The bole is brown and smooth, sometimes with light patches, and exudes little yellowish dammar. The outer bark is thin and brown, while the inner bark is 1 cm thick, dull light brown grading to colourless pellucid layer at the cambium. The sapwood is pale and resinous. Its twigs are slender, smooth and drying to reddish-brown.

Inflorescences
In terminal or axillary panicles, usually sericeous-tomentose. The branchlets are slender, flowers secund, and the bracteoles are minute and caducous.

Flowers
Small, bud is narrow, about 5 mm long, petals are yellow, with 15 stamens.

Fruits
The fruits are wingless. The nut is ellipsoid or obovoid, pointed, up to 30 mm long, pale fulvous tomentose, with sepals embraces the base and form a toothed cup.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found in lowland forests in Indonesia (Sumatera), Malaysia (Peninsular Malaysia) and Borneo (Sabah). In Peninsular Malaysia, the species is only found in northeastern Johor, especially at Jamaluang Forest Reserve and Mersing Forest Reserve.

Diagnostic characters
Medium tree, up to 40 m tall.
No buttresses
Bole - smooth, exudates little yellowish dammar
Fruits - wingless

Management and maintenance
Shorea peltata is a medium tree, often with small or without buttresses. It is a sub-canopy to canopy tree, locally common or even gregarious, on well-drained flat land or low hills in mixed dipterocarp forests. The tree is usually found on leached clay soils.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

Peltate and oblong leaves, about 14 x 16 cm, about 8-nerved and drying to brown to golden yellow. The petioles are rather slender, about 2.5 cm long, with joined lamina, about 12 mm from margin.

Brown, smooth

Shorea platycarpa Heim

Local name
Meranti Paya

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 50 m tall, buttresses usually large and sharp. The bole is more or less fissured, and exudes yellow or almost colourless dammar. The bark is greyish to pinky brown. Its outer bark is thick, dark chocolate brown or reddish-brown and brittle, while the inner bark is thick, dull, purple-red, with pale yellow sapwood, narrow and tinted towards the heartwood. Its stipules are oblong, about 1 cm long, tomentose and falling off early.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
About 12 mm across when expanded and the petals are pale yellow.

Fruits
Short-stalked and winged. The nut is ovate, pointed to 4 cm, long and tawny-sericeous. Its three outer wings are about 6.5 x 1.2 cm, while the two inner wings are to 4 cm long and narrow. The wings and sepal bases are sparsely furnished with soft hairs. Its sepals are woody at the base and embracing the lower third of the nut.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found in lowland forests, often in swampy areas. A species of Indonesia (Sumatera) and Malaysia. In the peninsular, it occurs on both sides from Perak and Terengganu.

Diagnostic characters
Large tree, up to 50 m tall
Large and sharp buttresses
Bole - greyish to pinky brown
Fruits - short-stalked and winged

Management and maintenance
Shorea platycarpa is a tree with a diffuse, shallowly hemispherical crown, with stout buttresses up to 4 metres high. It is an emergent tree in mixed peat swamp forest, especially near the coast; also on poorly drained podsols on former beach terraces.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings off in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are elliptic-oblong to broadly ovate, about 17-nerved, hairy on both sides of leaves and drying dull grey-brown or reddish. Its petiole is about 15-20 mm.

Greyish to pinky brown

Shorea teysmanniana Dyer *ex* Brandis

Local name
Meranti Bunga

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large tree, grows up to 45 m tall. Its buttresses are sharp and large. The bole is fissured. Its crown is small-leafed. The outer bark is thick and chocolate brown, while its inner bark is red grading to pale yellow at the cambium. Young twigs are lepidote, becoming glabrous and glaucous. The stipules are oblong, about 14 mm long, and often falling off very early.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
About 12 mm across when expanded, petals falling in a rosette, however the colour is unknown (never collected in Peninsular Malaysia).

Fruits
The fruits are ovate-conical nut, about 12 mm long, with minutely hairy wings. The two inner wings are narrow, about 3 cm long, while the three outer wings are about 8 x 1 cm.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
A tree of swamp dipterocarp forests, native to Brunei, Indonesia (Kalimantan, Sumatera) and Malaysia. In Peninsular Malaysia, it has been found only in Kelang and Langat river in Selangor.

Diagnostic characters
Large tree, up to 45 m tall
Sharp and large buttresses
Crown - small-leafed
Fruits - hairy winged ovate-conical nut

Management and maintenance
Shorea teysmanniana is a tree with a diffuse, cauliflower-shaped crown, with somewhat slender buttresses up to 150 cm high. It is an emergent tree that is very local but often frequent, growing in mixed peat swamp forest at elevations close to sea level.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are small, dark green, ovate, about 8 x 5 cm, about 11-nerved and leathery. Its petioles are about 15 mm long.

Fissured

Shorea uliginosa Foxworthy

Local name
Meranti Bakau

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A large tree, grows up to 45 m tall, with an open and spreading crown. Its buttresses are sharp and large. The bole is fissured with horizontal rings. The outer bark is thick, brittle, and dark purplish-chocolate, while the inner bark is thick and dull light purple-brown, grading to pale yellow at the cambium, and sapwood is pale. Its twigs are roughly scabrid, and ferruginous tomentose at the end. The stipules are oblong, about 14 mm long, curved and caducous.

Inflorescences
Terminal or axillary panicles, lax or dense, usually many-flowered.

Flowers
About 12 mm across when expanded, petals are pale yellow and falling in rosette.

Fruits
Similar to those of *S. platycarpa,* winged, but less densely sericeous.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Inhabits swamp forests in coastal areas. A species of Indonesia (Sumatera), Malaysia (Peninsular Malaysia) and Borneo (Sarawak). It is the most abundant tree of the large areas of swamp forests near the mouths of the Sungai Bernam in lower part of Perak, and Klang and Sungai Langat in Selangor.

Diagnostic characters
Large tree, up to 45 m tall
Sharp and large buttresses
Crown - open and spreading
Fruits - winged nut

Management and maintenance
Shorea uliginosa is a tree with a dense, irregular hemispherical crown, with stout, spreading buttresses up to 4 metres high. It is an emergent tree in mixed peat swamp forest and coastal swamp forests.

Specific information about propagation for this species is less reported. Generally, the propagation method for the *Shorea* is mainly by seed. The seed is best sown as soon as possible. It does not require pre-treatment, but it is recommended to soak the seed for 12 hours prior to sowing. The seeds are sown in seedbeds, where they are covered with a mixture of sand and soil (1:1 ratio) or with a thin layer of sawdust. Germination of fresh seeds is usually good and rapid. About two weeks after germination, or once the seedlings achieve 5 - 6 cm in height, they are potted up into individual containers (15 x 23 cm in size) with good drainage holes. It is normally recommended to use a mixture of forest soil and sand (at a ratio of 3:1) as the potting medium in order to introduce the appropriate mycorrhiza to the roots. The seedlings are placed in 50 - 60% sunlight and watered twice daily. Seedlings can be planted out when they achieve 30 - 40 cm in height. Harden the seedlings in full sunlight for one month prior to planting.

General management consideration for the dipterocarps reproduction and maintenance is described in the next chapter.

The leaves are large, elliptic-oblong, shortly acuminate, about 20 x 9 cm, about 18-nerved, drooping, hairy on the upper and undersurface, and drying to dull grey-brown. Its petioles are about 25 mm long, with roughly stellate hairs.

Fissured with horizontal rings

Vatica flavida Foxworthy

Local name
Resak Padi

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, without buttresses. The bole is minutely fissured, looks smooth from far. The old bark falling in scales and leaving scroll-marked scars. The twig are harshly reddish tomentose on the young tips.

Inflorescences
Flower borne in great profusion in dense axillary panicles.

Flowers
The petals are pale yellow and about 1 cm long.

Fruits
The fruits are ovoid nuts, to about 12 mm long, densely covered by yellowish flakes, dandruff-like. The nut is marked with 3 vertical grooves. Its calyx lobes are thinly coriaceous and bent back from the base of the nut and then curling to the front, about as long as the nut.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Inhabits lowland, swampy forests. An endemic species of Malaysia (Peninsular Malaysia). In Malaysia, this species has only been collected in southern Perak. It was nowhere abundant, and may now be extinct. It was best known in Parit Forest Reserve, but it is also found in Keroh and Cikus.

Diagnostic characters
Small or medium-sized tree
Without buttresses
Flowers - pale yellow
Fruits - ovoid nuts densely covered by yellowish flakes, dandruff-like

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are elliptical, rounded at the base, cuspidate at the apex, about 10 x 5 cm, about 9-12 nerved, and the venation is scalariform, leathery and hairy on the undersurface. Its petiole is about 10-15 mm long and coarsely stellate tomentose.

Minutely fissured

Vatica havilandii Brandis

Local name
Resak Degung

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
A small tree, grows up to 30 m tall, without buttresses. The bole is minutely fissured, looks smooth from far. The old bark falling in scales and leaving scroll-marked scars. The twigs are furnished with a pinkish-brown and hairy on the young tips. The stipules are semi-persistent, linear and up to 12 mm long.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
The petals are white and about 1cm long.

Fruits
The fruits are ovate nuts, densely ferruginous pubescent, about 12 mm across, completely hidden, but free from the calyx. Its calyx lobes are equal, to 2.5 x 1.5 cm, ovate with subcordate base, acute, and turned back on themselves along the mid-nerve.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Inhabits lowland, swampy forests and on hills. A species native to Brunei, Indonesia (Kalimantan) and Malaysia. In Peninsular Malaysia, it has been recorded in Parit Forest Reserve and Kinta in Perak, in Bukit Raka Forest Reserve in Pahang, and along Sungai Paka, Terengganu.

Diagnostic characters
Small or medium-sized tree
Without buttresses
Flowers - white petal

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are obovate-oblong, with long sharp acumen at the apex and rounded at the base, about 8-17 x 2.5-5 cm, about 15-18 pairs of nerves, with several short but prominent intermediate nerves in between. The leaves are dark purple-brown when dry and papery in texture. The petioles are about 1 cm long, and hairy when young.

Minutely fissured

Vatica lobata Foxworthy

Local name
Resak Paya

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, without buttresses. The bole is minutely fissured, looks smooth from far. The old bark falling in scales and leaving scroll-marked scars. The twigs are stellate-hairy on the very young tips.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
Unknown.

Fruits
About 15 mm across, ovate-conical nuts, crowned by thick, woody lobes at the base, that developed from calyx.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Inhabits lowland, swampy forests. An endemic species of Malaysia (Peninsular Malaysia). This species is found in Sungai Paka, Terengganu, in Temerloh, Pahang and near Mawai, Johor.

Diagnostic characters
Small or medium-sized tree
Without buttresses
Bole - minutely fissured
Fruits - ovate conical nuts

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

Ovate, about 7-24 x 2-9.5 cm, with a long, blunt acumen, and usually acute or cuneate at the base. Its petiole is about 8-12 cm long and becoming glabrous.

Minutely fissured

Vatica scortechinii (King) Brandis

Local name
Resak Langgung

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, up to 25 m tall, without buttresses. The bole is minutely fissured, looks smooth from far, with orange and white patches. The old bark falling in scales and leaving scroll-marked scars. Its twigs are covered with a minute, pale, tawny, stellate scurf at the end. The stipules are large, sometimes semi-persistent, ovate-oblong or lanceolate, subfalcate, sometimes longer than 2.5 cm and drying black.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
The flowers are pale yellow, with slight pale red patch at the tip.

Fruits
The fruits are globose nuts, about 15 mm across when ripe, pale tawny scurfy and free from the calyx. The calyx lobes are subequal, papery, ovate-oblong, blunt to about 7 mm long and reflexed from or loosely embracing the base of the nut.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
It is found in lowland and quite common on hill dipterocarp forests, up to 800 m. A species endemic to Peninsular Malaysia.

Diagnostic characters
Medium-sized tree, up to 25 m tall
Without buttresses
Bole - minutely fissured with orange and white patches
Flowers - pale yellow, with slight pale red patch

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are large, elliptic-oblong, narrow to blunt-acuminate apex, usually rounded at the base, about 2.5 x 8 cm but considerably variable, leathery, the margins tending to be revolute, nerves about 12-14 or more. Its petioles are about 13-25 mm long and with pale tawny tomentose.

Minutely fissured with orange and white patches

Vatica stapfiana (King) Sloot.

Local name
Resak Mempening

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, without buttresses. The bole is minutely fissured, looks smooth from far, with variety colour of patches, such as pink, green, orange, etc. The old bark falling in scales and leaving scroll-marked scars. The twigs are coarse, hairy on the young tips. Its stipules are lanceolate and sometimes semi-persistent.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
The petals are 12 mm long, pale yellow, with red patch at the base.

Fruits
Short-stalked and thick, elongate-ovoid nuts united at the calyx tube. The calyx lobes are equal, forming a tube to 3 cm long and covered with warts. The apex of nuts are about 25 mm across and protruding up to 18 mm beyond the calyx.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found in lowland and hill dipterocarp forests, up to 500 m, preference for valleys and vicinity of streams, from southern peninsular Thailand to Malaysia (southern Peninsular Malaysia), and Indonesia (Sumatera). In Malaysia, the species is found in parts of Perak, Pahang and Selangor.

Diagnostic characters
Medium-sized tree
Without buttresses
Bole - minutely fissured with variety colours of patches
Flowers - pale yellow, with slight pale red patch
Fruits - Short-stalked and thick

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are elliptical, blunt-acuminate, about 17 x 8 cm, about 10-nerved, leathery, smooth on the uppersurface and hairy on the undersurface, and drying to reddish brown. The petioles are about 1.7-3 cm long and usually hairy.

Minutely fissured

Vatica venulosa Blume

Local name
Resak Letup

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, up to 25 m tall, without buttresses. The bole is frequently crooked, leaning and looks smooth from far. The old bark falling in scales and leaving scroll-marked scars. The twigs are ferruginous scurfy on the young tips.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
Its petals are yellow with red tinge.

Fruits
The fruits are globose nuts, about 1 cm across, surrounded by five broad, subequal, thick and papery sepals. The sepals are about 3 x 1.3 cm.

LANDSCAPE USE

Conservation Status
Endangered

Ecology and Distribution
Found in lowland forests, favouring damp soil in the vicinity of streams. A species native to Indonesia (Sumatera) and Malaysia (Peninsular Malaysia). In Malaysia, it has been found in upper Perak, Larut and Batang Padang districts of Perak, and in the locality of Endau River in southeastern Pahang.

Diagnostic characters
Medium-sized tree, up to 25 m tall
Without buttresses
Bole - frequently crooked
Flowers - yellow with a red tinge

Management and maintenance
Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

The leaves are elliptic, ovate-lanceolate to narrowly ovate, about 8.5 x 3 cm, about 9-nerved and hairy on the undersurface. The petioles are about 8 mm long.

Frequently crooked

Vatica yeechongii L.G. Saw.

Local name
Resak Langat

Family
Dipterocarpaceae

BOTANICAL DESCRIPTIONS

Habit
Usually small or medium-sized trees, up to 15 m tall, without buttresses. The bole is minutely fissured and looks smooth from far. The old bark sheds in scales and leaving scroll-marked scars. The twigs are reddish, about 1-2 cm diameter and hairy. The stipules are about 35 x 8 mm, narrowly triangular and often twisted over.

Inflorescences
In terminal or axillary panicles, short and usually scurfy.

Flowers
Unknown.

Fruits
Broadly ovoid nuts, about 8 cm long, 18 mm diameter and glabrous. The calyx lobes are equal, about 4 x 1.5 cm, ovate, acute, ascending, recurved, hiding the nut.

LANDSCAPE USE

Conservation Status
Critically Endangered

Ecology and Distribution
Found in lowland, on gentle slopes not far from stream. A species of Malaysia (Peninsular Malaysia). Its fruit has been collected in Sungai Lalang Forest Reserve.

Diagnostic characters
Medium-sized tree, up to 15 m tall
Without buttresses
Bole - minutely fissured

Management and maintenance
Vatica yeechongii is a rare dipterocarp, adapted to growing near streamsides. It is a recent discovery to science, identified only in 2003. The tree is a medium-sized understorey tree. It is suspected that the *V. yeechongii* seeds are scattered by water. This is because the trees have been observed only near rivers and the seeds are surrounded by small petals which are not conducive for wind dispersal.

Specific information about management and maintenance for this species is less reported. General management consideration for the dipterocarp species reproduction methods and seedlings maintenance is described in the next chapter.

Large, oblanceolate, thickly coriaceous, billowed between the nerves, becoming glabrous, large, about 44-48 x 10-16.5 cm, base narrowly subcordate, acumen tapering, to 2.5 cm long, about 28-30 pairs of nerves, prominent below, elevated above, each with shorter intermediates, tertiary veins are subreticulate and elevated on both surfaces. The petiole is about 2-3 cm long, about 13 mm thick, stout, and densely woolly.

Minutely fissured

Did you know?

The estimated number of flora in Malaysia is about 15,000 species and total flora of Sabah and Sarawak is estimated at 12,000 species.

Malaysia National Strategy for Plant Conservation 2009

Lithocarpus curtisii (King *ex* Hook. f.) A. Camus

Local name
Mempening

Family
Fagaceae

BOTANICAL DESCRIPTIONS

Habit
A medium tree, with spreading buttresses. The bark is red-brown to brown colour, fibrous and sapwood is white to cream. Its twigs are smooth and occasionally striate. The stipules often fall off very early.

Inflorescences
Spikes unisexual or bisexual, stiffly erect, male terminal to 15 cm.

Flowers
The flowers are closely packed, female often mixed at either end of male spike, staminodes well developed. Cupule sessile, flat, plate-shaped, shallowly flanged and the edge is wavy and thin.

Fruits
The fruits are flattened, hemispherical, about 2 x 1.5 cm, scar concave, small and the base is covered by cupule.

LANDSCAPE USE

Conservation status
Vulnerable

Ecology and distribution
Inhabits lowland areas, endemic to Malaysia (Peninsular Malaysia). This tree can be found in Pulau Pinang, Kelantan, Pahang, Terengganu, Perak and Selangor.

Diagnostic characters
Flowers - Closely packed, bisexual
Fruits - Flattened

Management and maintenance
Specific information about management and maintenance for this species is less reported.

The leaves are oblong-elliptic, leathery, about 8-9 x 3.5-7 cm, apex long, tail like base acute running down the stalk. It has a pale green to pale fawn, on both sides, more or less glabrous on both sides, have midrib raised on both sides and striate below. The secondary nerves are prominent below, and less so above. The leaves also have 9-10 pairs of nerves, bending gentle at the margin and disappearing, while the tertiary nerves are net-like, generally inconspicuous.

Red-brown to brown

“

An informative manuscript about selected rare trees which could potentially be used in landscape design in order to help promote biodiversity. It should also prove useful for students, landscape architects, government agencies and the general public, to promote the use of threatened and rare tree species endemic to Malaysia.

Assoc. Prof. LAr. Dr. Osman Mohd Tahir,
President,
Institute of Landscape Architects Malaysia (ILAM)

Barringtonia augusta Kurz

Local name
Putat Jambu

Family
Lecythidaceae

BOTANICAL DESCRIPTIONS

Habit
A small pachycaul tree, up to 20 m tall. The twigs grow in flushes.

Inflorescences
In terminal or axillary or cauliflorous racemes or spikes, generally long and pendulous.

Flowers
The flowers are white, creamy or pink, usually with four, overlapped petals. The ovary is inferior, with 2 or 4 chambers, each with 2-6 ovules attached apically and axillary.

Fruits
The fruits are ellipsoid, often winged or angled at least when young, fleshy and fibrous.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found along rivers in primary lowland forests, up to 300 m altitude, though recorded up to 1200 m, in Myanmar, Thailand and Malaysia (Peninsular Malaysia).

Diagnostic characters
Small tree, up to 20 m tall
Flowers - white or pink, with four overlapped petals
Fruits - ellipsoid and winged

Management and maintenance
Specific information about management and maintenance for this species is less reported.

The leaves are clustered, obovate-oblong or obovate-lanceolate, often with intercoastal nerves between the secondaries. Its stipules are tiny and falling off early.

“

Finding appropriate species from this list for use of urban parks can play a key role in increasing its population while raising the awareness of the general public.

Dr. Dzaeman Dzulkifli,
Executive Director,
Tropical Rainforest Conservation & Research Centre (TRCRC)

Magnolia champaca (L.) Baill. *ex* Pierre

Local name
Cempaka

Family
Magnoliaceae

BOTANICAL DESCRIPTIONS

Habit
A large, evergreen tree that grows up to 50 m tall. The crown is cylindrical or conical. The bark is grey-brown and smooth.

Inflorescences
Solitary, bisexual and axillary.

Flowers
The stalk is stout and erect, about 1-2 cm long, perianth lobes around 12-15, linear-oblanceolate, about 4-4.5 cm long, orange or yellow and fragrant.

Fruits
The fruits are in a bunch (grapes-like) and cylindrical. The fruits contain 2-5 seeds per fruitlet, each splitting open at maturity so that the hard, angular seeds hang out on slender white strings.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found in primary forests, up to 800 m altitude. Found in India, Myanmar, Thailand, Laos, Cambodia, Vietnam, China, Indonesia (Sumatera, Java and Lesser Sunda Island) and Malaysia (Peninsular Malaysia).

Diagnostic characters
Large tree, up to 50 m tall
Bark - reddish grey-brown
Crown - cylindrical or conical
Flowers - orange or yellow and fragrant
Fruits - bunch (grapes-like) and cylindrical

Management and maintenance
The *Magnolia* seeds are oily. It can lose their viability in a short period of time. Therefore, the seeds should be sown as soon as possible after harvesting in conventional practice. Seed viability could be increased between 4-7 months by keeping them at 5°C or in pits at 13°C.

It is best practice to sow the seed in a shady condition. Gradually increase the light intensity as the seeds germinate. Germination period takes between 5 weeks to 4 months. The germination rate is generally poor. The seedlings can be transferred to containers when they reach the height of 2–4 cm and left to grow in the nursery for at least 1 year. They can be transferred or planted at the field when they achieve the height of 30–40 cm. As an alternative reproduction, vegetative propagation can also be practiced such as grafting and root cuttings.

The leaves are elliptic to oblong-lanceolate or ovate, 10-20 x 10-18 cm, thinly leathery, spirally arranged, apex acuminate or acute, base acute or rounded, nerved with 16-22 and reticulations inconspicuous.

Reddish grey-brown

Did you know?

Under The National Policy on Biological Diversity 2015-2025, Goal No.3 and Target 9 mentioned that, by 2025, the extinction of known threatened species has been prevented and their conservation status has been improved and sustained.

National Policy on Biological Diversity 2016-2025, Ministry of Natural Resources and Environment publication

Pternandra coerulescens Jack

Local name
Nipis Kulit

Family
Melastomataceae

BOTANICAL DESCRIPTIONS

Habit
A small tree not exceeding 20 m tall.

Inflorescences
Inflorescences are shorter than the leaves.

Flowers
Calyx is covered with a tuberculate pattern of scales. Calyx lobes are small. Petals are about 2-6 x 2-4 mm. Staminal filaments flattened, about 2-4 mm long. Style slender, straight and about 4-7 mm long.

Fruits
Infructescences are shorter than the leaves. Fruits are globular, about 10 x 10 mm. Calyx lobes and style persistent at the apex. Seeds are numerous with about 1 x 0.5 mm.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Commonly found in lowland and hill forest in Peninsular Malaysia.

Diagnostic characters
Medium-sized tree
Bole - Smooth bark
Flower - Purplish

Management and maintenance
Specific information about management and maintenance for this species is less reported.

Stipules are absent but scars resemble. The stipular scars present on the twigs between the petioles. Leaf blades 3-nerved, about 7-10 x 3.5-5 cm, glabrous. The minor lateral veins form an intramarginal vein which are very close to the margin of the leaf blade. Young leaves are purplish in colour. Petioles are narrowly grooved on the uppersurface. Leaf blades are brittle and cracking transversely when folded.

Smooth bark

“

As Malaysia is one of the mega biodiversity countries, many native plant species should be used within urban landscape design. The important aspect of this guideline is to provide recommendations regarding a particular threatened tree species suitable for landscape uses, which include the botanical characteristics, growth's environmental factors and management consideration.

LAr. Abd Aziz bin Othman,
Head, Department of Landscape Architecture,
Faculty of Design and Architecture, Universiti Putra Malaysia (UPM)

Knema hookeriana (Wall. *ex* Hook. f. & Thomson) Warb.

Local name
Penarahan Arang

Family
Myristicaceae

BOTANICAL DESCRIPTIONS

Habit
A slender tree, with deep, dense, conical crown, grows up to 2 m tall. Its bark is blackish or greyish-brown, often tinged greenish, scaly. Its outer bark is dull brown. The branches are drooping and arranged in alternate and spiral position. Its young twigs are stout, densely woolly and hairy at the tip.

Inflorescences
Clustered on short, woody, sometimes branched knobs to around 1.3 cm long.

Flowers
Very large and woolly. The pedicel suntended by a sessile, caducous bract and with an apical or median persistent bracteole. The ovary is hairy, stigma disc-like and variously lobed, sessile or on a style.

Fruits
The fruits are ellipsoid, large, about 4.5 x 3 cm, and also woolly.

LANDSCAPE USE

Conservation Status
Vulnerable

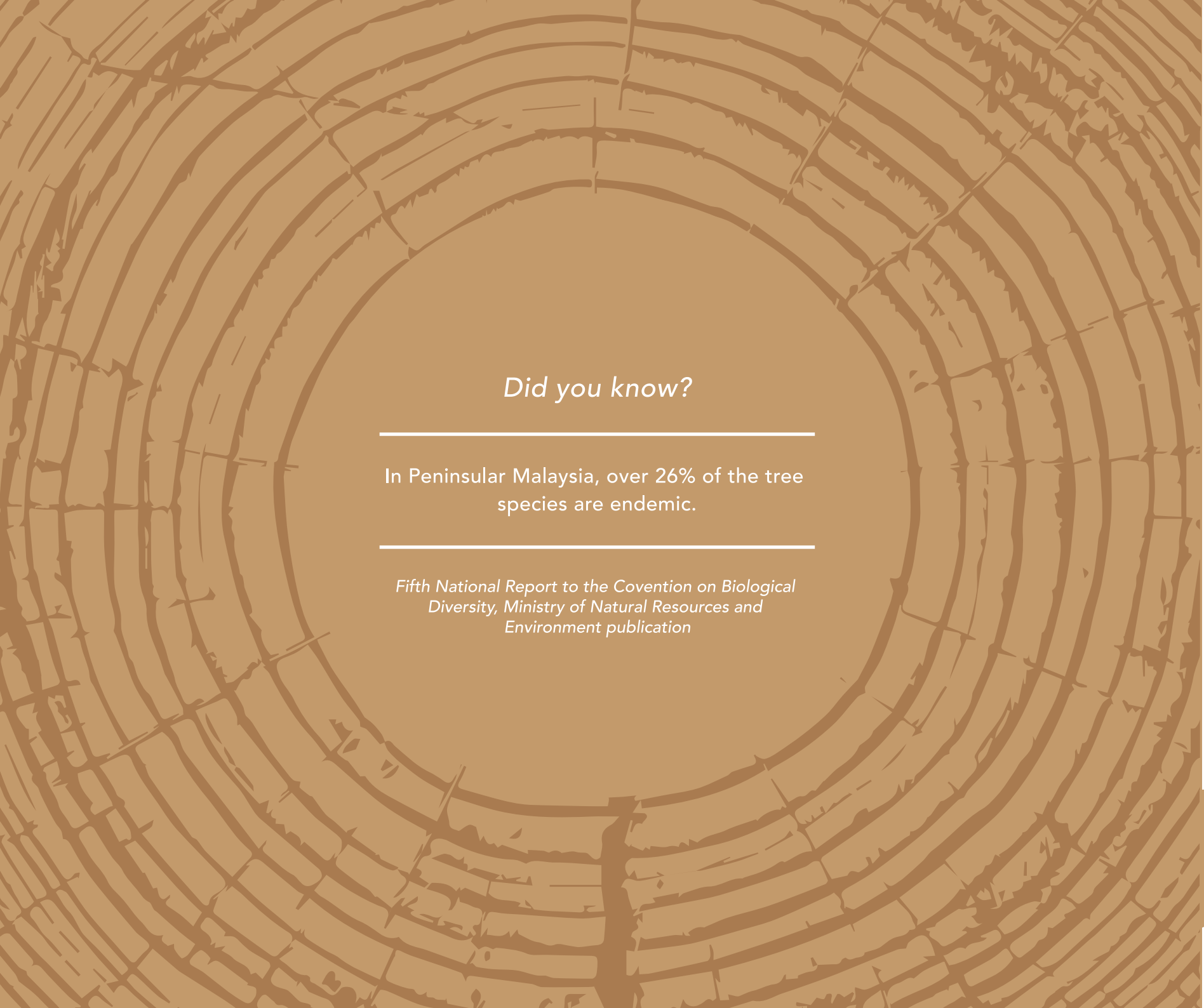
Ecology and Distribution
Found in lowland and hill forests, in Indonesia, Malaysia, Singapore and Thailand.

Diagnostic characters
Slender tree, up to 2 m tall
Crown - deep dense conical crown
Flowers - very large and woolly
Fruits - large and woolly

Management and maintenance
The *Knema* species seeds are contained in capsules. The capsule disseminates the seeds with a dehiscent action and the vacant capsules remain on the twigs. The seed has a thin seed coat which is permeable that can absorb water for them to germinate in a short period of time. As the moisture content of *Knema* seeds is lower than 10%, they can be stored for a long time at normal room temperature.

The species has a very long, lanceolate leaves, about 30-66 x 10-13 cm and about 20-30-nerved, reticulations are ladder-like, with one short nerve parallel to secondaries near midrib.

Blackish or greyish-brown, scaly



Did you know?

In Peninsular Malaysia, over 26% of the tree species are endemic.

Fifth National Report to the Covention on Biological Diversity, Ministry of Natural Resources and Environment publication

Glenniea Penangensis (Ridl.) Leenh.

Local name
Unknown

Family
Sapindaceae

BOTANICAL DESCRIPTIONS

Habit
A medium tree, grows up to 30 m tall. The bark is smooth to slightly fissured. The indument is velutinous, hairs are solitary or sometimes in two, restricted to the terminal buds, young twigs, inflorescences, and the flowers.

Inflorescences
The inflorescences are axillary, up to 25 cm long and pedicels are about 2 mm long.

Flowers
The flowers are without petals, only four sepals, and with woolly hairs. The calyx lobes are slightly imbricate in bud, nearly equal and the free lobes are 2 x 1.5-2 mm. Its petals are broadly deltoid to shortly and widely funnel-shaped, around 1 x 1.3-2 mm. Stamens 5-8, filament is 3 mm long, and anther is 0.6 mm long, laterally dehiscent and the ovary is 1.2 mm high.

Fruits
The fruits are yellow, thick and globular.

LANDSCAPE USE

Conservation Status
Vulnerable

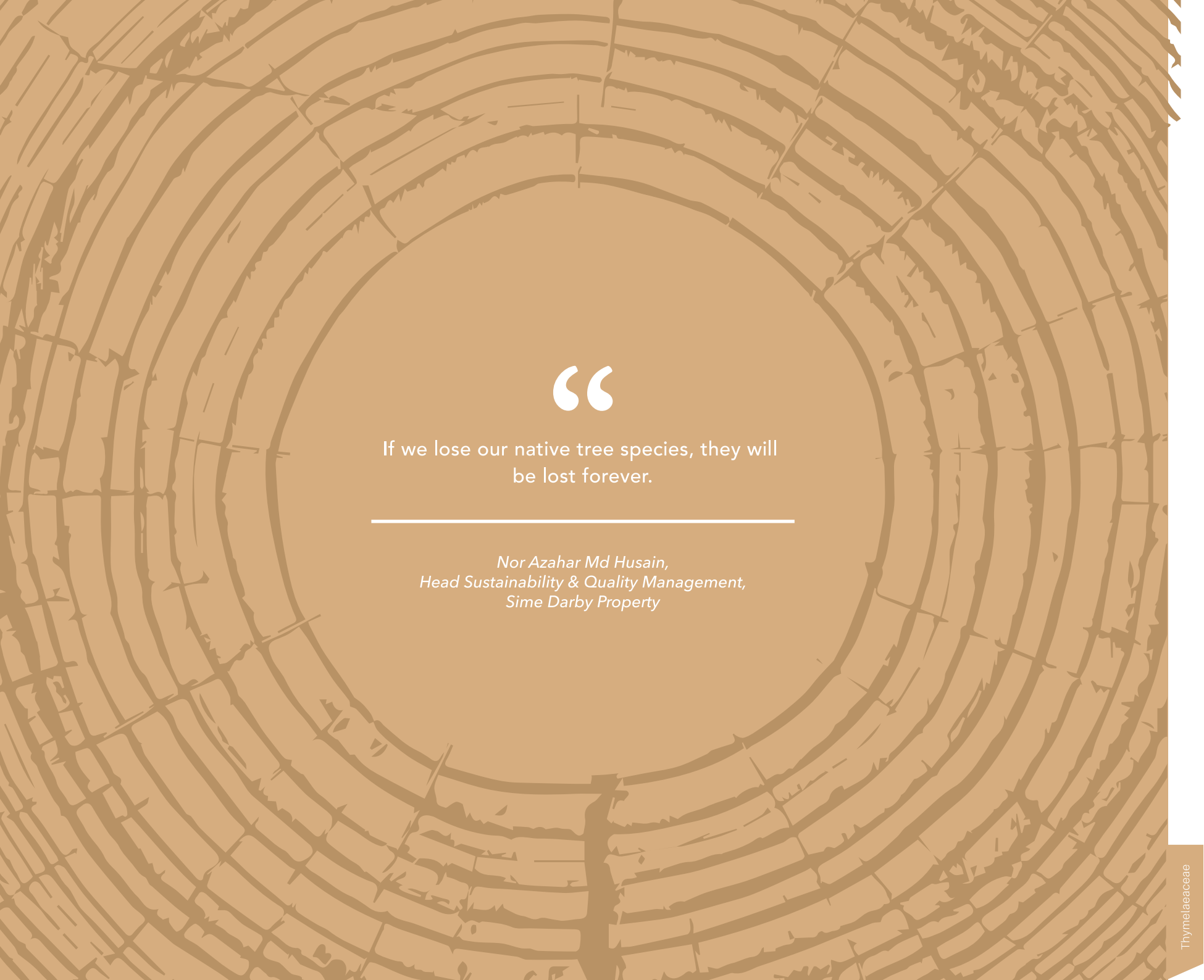
Ecology and Distribution
Found in lowland and hill forests, up to 900 m. Native to Malaysia (Peninsular Malaysia).

Diagnostic characters
Medium tree, up to 30 m tall
Flowers - without petals, only four sepals
Fruits - yellow, thick and globular

Management and maintenance
Specific information about management and maintenance for this species is less reported.

The leaves are unifoliate, obovate, petiole semi-terete to dorsiventrally flattened, 0.7-6.5 cm long; petiolules are flat above, up to 5 mm long; leaflets are opposite to alternate, pergamentaceous to coriaceous, base equal sided or sometimes oblique, apex often slightly emarginate, midrib above flat to prominulous and rounded, beneath angular, nerves 1-2 cm distant, angle to midrib 60-70°, curved to nearly straight, intercalated veins many, variably developed.

Smooth to slightly fissured



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If we lose our native tree species, they will be lost forever.

Nor Azahar Md Husain,
Head Sustainability & Quality Management,
Sime Darby Property

Aquilaria malaccensis Lam.

Local name
Gaharu/Karas

Family
Thymelaeaceae

BOTANICAL DESCRIPTIONS

Habit
A medium to large tree, grows up to 40 m tall. Straight bole, sometime fluted with small buttresses; bark is smooth, and whitish.

Inflorescences
Terminal, axillary or supra-axillary, but sometimes intermodal umbel, usually branched into 2-3 umbels, each with about 10 flowers.

Flowers
The flowers are in panicles, white or yellow, and fragrant.

Fruits
A loculicidal capsule, pear-shaped.

LANDSCAPE USE

Conservation Status
Vulnerable

Ecology and Distribution
Found in primary and secondary forests, mainly in plains but also on hillside and ridges up to 1500 m altitude. Native to Peninsular Malaysia and north-eastern India, Indonesia (Kalimantan, Sumatera), Myanmar, Philippines, Singapore and Thailand.

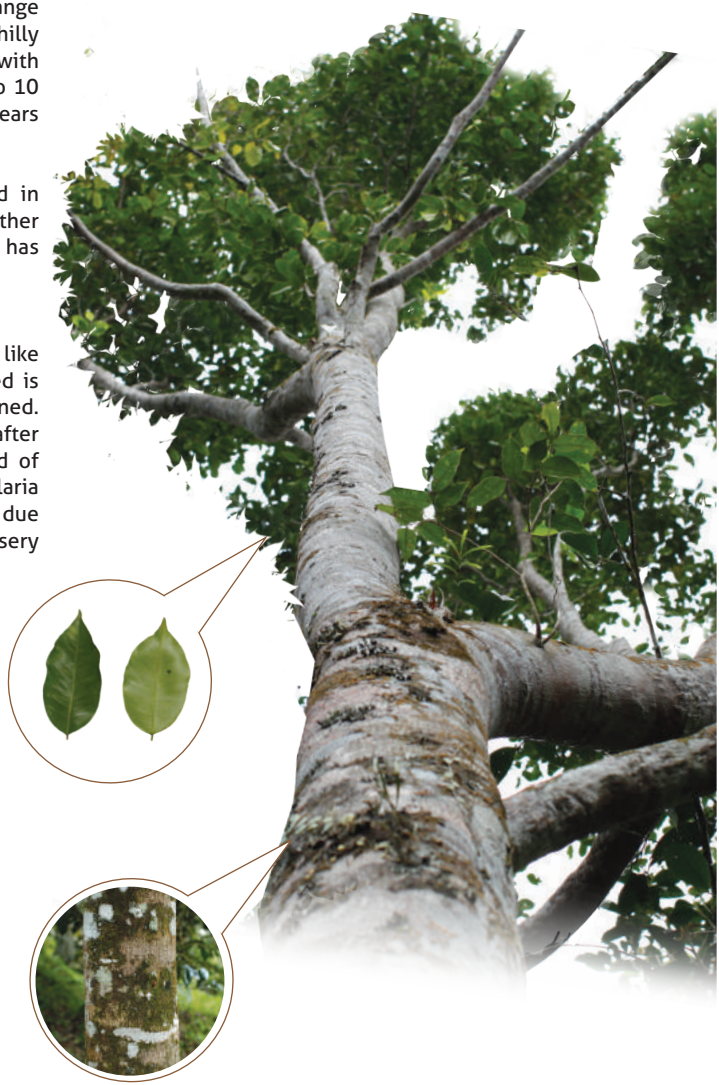
Diagnostic characters
Medium to large tree, up to 40m tall
Fragrant wood and resin
Flowers - white or yellow and fragrant

Management and maintenance
Aquilaria malaccensis is commonly found in wide range of conditions especially on forest edges and hilly ecosystem. They are fast growing trees. In the areas with adequate moisture, the plants would achieve up to 10 cm diameter at breast height (DBH) within 4 to 6 years of age.

Aquilaria species have been successfully planted in plantations. They are also intercropped with other forest trees. In Southeast Asia, Aquilaria species has been grown with rubber, teak, banana and oil palm.

Aquilaria seed is hardly found in natural forest like dipterocarp species. However, propagation by seed is still practiced. The seeds mature as the fruit opened. The seeds should be sown as soon as possible after harvesting as the seeds have a very short period of viability. Although the viability period is short, Aquilaria seedlings can still be produced in a large number due to the current best management practices in nursery production.

Leaves are simple, alternate; petiole is 4-6 mm long; blade is elliptical to oblong to oblong-lanceolate, 7.7 – 12 cm x 2.5 – 5.5 cm, chartaceous to subcoriaceus, glabrous, sometimes pubescens and glabrescent beneath, greenish, shiny on both surfaces; base is acute, attenuate or obtuse; apex is acuminate; vein in 12-16 pairs, often branched, elevated and distinct beneath, curving upward to the margin, plane and obscure above.



Smooth and whitish

Management Considerations

This management consideration section is divided into three categories, which consist of management considerations for:

a. Dipterocarp species;
b. Non-Dipterocarp species; and
c. Protection from the sun (applies to all species)

a. Dipterocarp Species

Dipterocarp species are among the tallest and largest forest trees species. They often emerge above the main canopy to spread their tufted crowns (also known as emergent species). More than 50% of the emergent layer in lowland forests in Malaysia consists of dipterocarp species. They are, however by nature, generally slow growing and take time to build their great girth and height. Furthermore, Dipterocarp species are the most important hard timber trees and 'dammar' production trees. There are about 500 dipterocarp species in Malaysia, of which 156 species (of 9 families) are found in the Peninsular Malaysia.

This guide, however, focuses on the 63 species of dipterocarp which includes

i. Shorea – 23 species
ii. Dipterocarpus – 14 species
iii. Hopea – 14 species
iv. Vatica – 7 species
v. Anisoptera – 4 species
vi. Dryobalanops – 1 species

Dipterocarp species are extraordinarily prolific in producing seeds, with some matured trees producing up to 20 million flowers at one time. In natural forests, dipterocarp seeds are dispersed by gravity, and often aided by wind as well as territorial animals such as rodents. The dipterocarp seeds generally possess seed wings, which assist in dispersion by helping the seed spin as they drift away and fall from the parent tree.

The seeds germinate rapidly (2 to 13 days) under warm and moist conditions. The optimum temperature is between 26°C and 31°C. Studies showed that germination will reduce or fail at temperatures below 16°C due to chilling damage. Most of the dipterocarp seeds are observed to have a short viability period (i.e., between 3 to 5 days) with no classical dormancy period. Therefore, the seeds must be sown as soon as possible.

For landscape nursery production, dipterocarp seeds are generally collected after falling on the ground. This is because of the difficulty to climb the trees. Seed wings are removed prior to sowing in order to provide good contact with the soil medium. The seeds, however require partial shade protection and temperature control for germination and early survival. As the seedlings grow, the light intensity will be increased to provide a similar forest environment. The environment is vital for satisfactory establishment and growth of the seedlings. The seedlings tend to form multiple leaders if over-exposed to light. The growth rate comparatively increases as it grows under a controlled environment and suitable light intensity. Seedling survival and establishment usually depend on site specifics according to the particular biotic, microclimatic and edaphic characteristics.

As seed germination is the most common practice for propagating tree species, tissue culture is an alternative technique for dipterocarp reproduction. It has been suggested as a means of storage of gene resources under slow growth and controlled conditions. This micropropagation technique, however, is not easy for dipterocarp species because of the high rates of cell necrosis which have been observed for some species. The high resin content in dipterocarp's tissue may be one of the reasons for failure.

For field plantations, a planting distance of 2–4m x 3–4m is recommended for optimum space to attain straight boles. For strip planting, 2–3m spacing within the strip and 6–10m between strips. In the first 2–3 years of field planting, existing shade trees are normally used to control the light intensity. Weeding is necessary during the first three years. Thinning should be carried out after 5, 10, 15 and 25 years.

b. Non-Dipterocarp Species

Out of 74 threatened forest tree species in this guide, 11 species are non-dipterocarp. They are *Agathis borneensis, Aquilaria malaccensis, Atuna racemosa, Barringtonia augusta, Glenniea penangensis, Knema hookeriana, Lithocarpus curtisii, Magnolia champaca, Mangifera macrocarpa, Popowia velutina* and *Pternandra coerulescens.* As these species are from various families, the management considerations of the plants are discussed separately.

i. *Agathis borneensis*

The habitat is on moist soil with half-shady to exposed light. Semi-matured plants need shaded conditions for growth whereas matured trees will grow well in exposed area (full sunlight). Agathis species prefer moderate water consumption. The species tolerates a wide range of soil types especially well-drained soils such as ultra-basic rock, igneous and sedimentary rock as well as limestone and peatlands.

Agathis seedlings need shade especially at their initial stage of growth. Propagation is commonly by seed. As an alternative, root suckers, stem and leaf cuttings could also be used for vegetative propagation.

ii. *Aquilaria malaccensis*

Aquilaria species are commonly found in a wide range of conditions especially on forest edges and hilly ecosystems. They are fast growing trees. In areas with adequate moisture, the plants would achieve up to 10 cm diameter at breast height (DBH) within 4 to 6 years of age.

Aquilaria species have been successfully planted in plantations. They have also been intercropped with other forest trees. In Southeast Asia, *Aquilaria* species have been grown with rubber, teak, banana and oil palm.

Propagation by seed is still practiced. The seeds mature as the fruit opens. The seeds should be sown as soon as possible after harvesting as the seeds have a very short period of viability. Although the viability period is short, Aquilaria seedlings can still be produced in a large number due to the current best management practices in nursery production.

iii. *Atuna racemosa*

Atuna species prefers to grow in well-drained soil with full sunlight exposure. However, a semi shade environment is still needed for seedling and sapling growth. The seed propagation technique is still used for plant production.

iv. *Knema hookeriana*

The *Knema* species seeds are contained in capsules. The capsule disseminates the seeds with a dehiscent action and the vacant capsules remain on the twigs. The seed has a thin seed coat, which is permeable that can absorb water for them to germinate in a short period of time. As the moisture content of *Knema* seeds is lower than 10%, they can be stored for a long time at normal room temperature.

v. *Magnolia champaca*

Magnolia seeds are oily. It can lose their viability in a short period of time. Therefore, the seeds should be sown as soon as possible after harvesting in a conventional method. Seed viability could be increased between 4-7 months by keeping them at 5°C or in pits at 13°C.

Seed should be sown in a shady location. Gradually increase the light intensity as the seeds germinate. The germination period takes between 5 weeks to 4 months. The germination rate is generally poor. The seedlings can be transferred to containers when they reach the height of 2–4 cm and left to grow in the nursery for at least 1 year. They can be transferred or planted at the field when they achieve the height of 30–40 cm. As an alternative reproduction, vegetative propagation can also be practiced such as by grafting and root cuttings.

vi. Other species

For the other 6 species, which are *Barringtonia augusta, Glenniea penangensis, Lithocarpus curtisii, Mangifera macrocarpa, Popowia velutina* and *Pternandra coerulescens*, there is little research on the management aspects of plant reproduction. It is believe that the conventional practices of seed propagation applied.

c. Protection from the sun (applies to all species)

When seedlings are first planted out, it is important that they be shaded, ideally a green oil palm frond, cut into two and placed over the planted seedling. As the frond withers, the light will become stronger, thus acclimatising the seedling slowly.

Glossary

Deciduous
Losing/falling off at maturity. In other parts of the world, including tropical, subtropical, and arid regions, plants lose their leaves during the dry season or other seasons, depending on variations in rainfall.

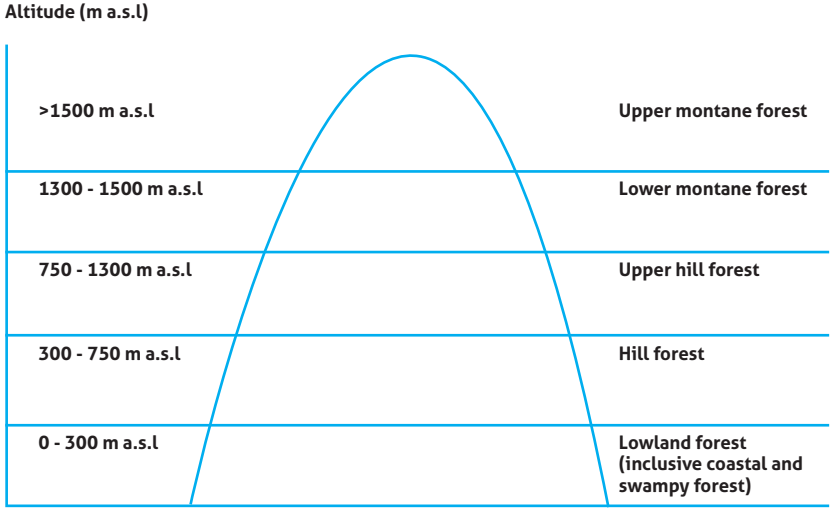
Evergreen
A tree that has leaves throughout the year, always green. In tropical forests, flowering seasons start mid-year, which is then followed by the fruiting season until the end of the year. However, some trees do not have a specific season.

Forest types
Malaysian forest types are classified based on differences in altitude. These include; coastal forest, peat forest, lowland forest (0-300 m above sea level), hill forest (300-750 m above sea level), upper hill forest (750-1300 m above sea level), lower montane forest (1300-1500 m above sea level) and upper montane forest (>1500 m above sea level).

Conservation status
The conservation status of threatened species is based on the IUCN RED List Categories and Criteria version 3.1 (2001). There are eight categories and the definition of each category is described below. The species were also crosschecked against the FRIM 'Malaysia Plant RED List'.

Extinct (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW) - A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.



Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR) - A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. Conservation Dependent (cd). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. Near Threatened (nt). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. Least Concern (lc). Taxa which do not qualify for Conservation Dependent or Near Threatened.

Data Deficient (DD) - A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data is available. In many cases, great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may be well justified.

Not Evaluated (NE) - A taxon is Not Evaluated when it has not yet been assessed against the criteria.

In this report, only three categories are included; Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

Tree height
The height of the tree is divided into small trees (≤15m), medium trees (15m – 45m) and big trees (≥45m).

Tree form
Cone
Cone-shaped trees have triangular canopy, wider at the base and narrower toward the top

Oblong
A shape like columns or cylinders, with branches of uniform length from top to bottom.

Pagoda
Pyramidal shapes are wider at the bottom, with a main centre trunk and horizontal branches.

Spread
With strong horizontal branches, even at the top of the canopy, these trees seem very wide.

Round
An upright tree, with a central strong trunk that branches into a dense round or oval-shaped crown.

Types of bark

Smooth

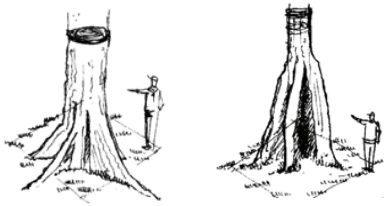
Fissured

Scaly

Papery

Lenticel

Types of buttress



Plank

Steep

Spreading

Absent
(No buttress)

Leaves type
Simple
A leaf blade is not divided into parts.

Compound
A leaf of a plant consisting of several or many distinct parts (leaflets) joined to a single stem.

Leaves colour

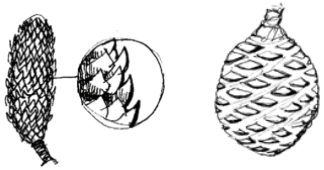
- Green
- Light Green
- Dark Green
- Reddish
- Yellowish
- Bluish
- Brownish
- Grey/Silver

Fruit type
Capsule
Develops from single-carpel ovary; splits open along both sides.

Drupe
Usually only one-carpel ovary and with only one seed developing; endocarp is hard and stony, fitting closely around seed; mesocarp is fleshy, and fruit is thin skinned.

Wing
One or two-seeded achene-like fruit; wing(s) form from outgrowth of ovary wall.

Cone
Plants have no flower or fruit especially members of Gymnospermae (Pine tree).



Nut
One seeded fruit with hard pericarp (shell).

References

Ahmad Azaruddin, M. N. et al. 2002. The Use of Hopea odorata as an Ornamental and Shade Tree in Urban Areas. In Aminah, H. et al. (eds). *Proceedings of the Seventh RoundbTable Conference on Dipterocarps.* Kuala Lumpur : Mouse Studio Sdn. Bhd.

Appanah, S., Turnbull, J.M. (eds.). 1998. *A Review of Dipterocarps: Taxonomy, Ecology and Silviculture.* Bogor : Centre for International Forestry Research.

Ashton, P. 1998. *The IUCN RED List of Threatened Species 1998*: e.T33010A9748011. http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T33010A974801.en

Chua, L. S. L., Suhaida, M., Hamidah, M. & Saw, L. G. 2010. *Malaysia Plant Red List Peninsular Malaysia Dipterocarpaceae.* Research Pamphlet No. 129. Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Chua, L.S.L. 1998. *The IUCN RED List of Threatened Species 1998*: e.T36398A9994842. http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T36398A9994842.en.

Farjon, A. 2013. *The IUCN RED List of Threatened Species 2013*: e.T202905A2757743. http://dx.doi.org/10.2305/IUCN.UK.2013G1.RLTS.T202905A27

Fern, K. 2014. *Useful Tropical Plant Database.* http://tropical.theferns.info New York : Van Nostrand Reinhold.

Foxworthy, F.W. 1927. *Commercial Timber Trees of the Malay Peninsula.* Malayan Forest Records No. 3. Kuala Lumpur : Caxton Press Limited.

Foxworthy, F.W. 1932. *Dipterocarpaceae of Malay Peninsula. Malayan Forest Records* No. 10. Kuala Lumpur : Caxton Press Limited.

GBIF Secretariat. 2013. GBIF Backbone Taxonomy. http://www.gbif.org species/7335183 *International Union for Conservation of Nature and Natural Resources. The IUCN Red List of Threatened Species.* http://www.iucnredlist.org

Keng, H. 1969. *Orders and Families of Malayan Seed Plants. Singapore* : University Malaya Press.

Kiew, R., Chung, R.C.K., Saw, L.G., Soepadmo, E. & Boyce, P.C. (Eds.). 2010. *Flora of Peninsular Malaysia, Series II : Seed Plant, Volume 1.* Malayan Forest Records No. 49. Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kiew, R., Chung, R.C.K., Saw, L.G., Soepadmo, E. & Boyce, P.C. (Eds.). 2011. *Flora of Peninsular Malaysia, Series II: Seed Plants, Volume 2.* Malayan Forest Records No. 49. Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (Eds.). 2012. Flora of Peninsular Malaysia, Series II: Seed Plants, Volume 3. *Malayan Forest Records No. 49.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (Eds.). 2013. *Flora of Peninsular Malaysia, Series II*: Seed Plants, Volume 4. Malayan Forest Records No. 49. Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (Eds.). 2015. *Flora of Peninsular Malaysia, Series II: Seed Plants, Volume 5.* Malayan Forest Records No. 49. Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kochummen, K.M. 1997. *Tree Flora of Pasoh Forest. Malayan Forest Record No. 44.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Kochummen, K.M. 1998. The IUCN Red List of Threatened Species 1998: e.T31370A9629697. http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T31370A9629697.en

Kostermansia, A.J.G.H. & Bombard, J.M. 1993. *The Mangoes: Their Botany, Nomenclature, Horticulture and Utilization.* London : Academic Press.

Lim, T.W. 2007. *The IUCN RED List of Threatened Species 2007*: e.T31427A9633976. http://dx.doi.org/10.2305/IUCN.UK.2007.RLTS.T31427A9633976.en

Ng, F.S.P. (Ed.). 1978. *Tree Flora of Malaya : A Manual for Foresters, Volume Three.* Kuala Lumpur : Longman Malaysia Sdn. Bhd.

Ng, F.S.P. (Ed.). 1989. *Tree Flora of Malaya : A Manual for Foresters, Volume Four.* Kuala Lumpur : Longman Malaysia Sdn. Bhd.

Oldfield, S., Lusty, C. & MacKinven, A. 1998. *The World List of Threatened Trees.* Cambridge : World Conservation Press.

Ong, K.H. et al. 2002. *Growth and Photosynthesis Rate of Open Planted Hopea odorata Saplings.* In Aminah, H. et al. (eds). *Proceedings of the Seventh Roundbtable Conference on Dipterocarps.* Kuala Lumpur: Mouse Studio Sdn Bhd. Orwa, C., Mutua, A., Kindt, R. , Jamnadass, R. & Anthony, S. 2009. Agroforestree Database : A Tree Reference and Selection Guide Version 4.0. http://www.worldagroforestry.org/treedb/AFTPDFS/

Pieter, B., Kalkman, K. & Geesink, R. 1990. *The Plant Diversity of Malaysia.* London : Kluwek Academic Publisher.

Ridley, H.N. 1922. *Flora of the Malay Peninsula.* London : L. Reeve. Robinette G. & Nehring R. 1983. Planting Details. New York : Van Nostrand Reinhold Co. Inc.

Slooten, D.F. van. 1926. *The Dipterocarpaceae of the Dutch East Indies 1*: *The Genus Anisoptera. Bulletin du Jardin Botanique de Buitenzorg*, 3 (8.

Soepadmo, E. & Wong, K.M. (Eds.). 2006. *Tree Flora of Sabah and Sarawak, Volume One. Kuala Lumpur* : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Wong, K.M. & Saw, L.G. (Eds.). 2009. *Tree Flora of Sabah and Sarawak, Volume Two.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E. & Saw, L.G. (Eds.). 2006. *Tree Flora of Sabah and Sarawak, Volume Three.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Saw, L.G. & Chung, R.C.K. (Eds.). 2007. *Tree Flora of Sabah and Sarawak, Volume Four.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Saw, L.G. & Chung, R.C.K. (Eds.). 2004. *Tree Flora of Sabah and Sarawak, Volume Five.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Saw, L.G., Chung, R.C.K. & Kiew, R. (Eds.). 2007. *Tree Flora of Sabah and Sarawak, Volume Six.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Saw, L.G., Chung, R.C.K. & Kiew, R. (Eds.). 2011. *Tree Flora of Sabah and Sarawak, Volume Seven.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Soepadmo, E., Saw, L.G., Chung, R.C.K. & Kiew, R. (Eds.). 2014. *Tree Flora of Sabah and Sarawak, Volume Eight.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM), Sabah Forestry Department & Sarawak Forestry Department.

Staples, G. W. & Herbst, D. R. 2005. *A Tropical Garden Flora: Plants Cultivated in the Hawaiian Islands and Other Tropical Places.* Hawaii : Bishop Museum Press.

Symington, C. F. 1934. *Notes on Malayan Dipterocarpaceae 2.* The Gardens' Bulletin Vol. 8 Singapore : National Park Board.

Symington, C. F., Ashton, P. S., Appanah, S. & Barlow, H. S. 2013. *Foresters' Manual of Dipterocarps. Malayan Forest Records No.16.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

Turner, I.M. 1995. A Catalogue of the Vascular Plants of Malaya. In The Gardens' Bulletin Vol. 47. Singapore : National Park Board.

Whitmore, T.C. (Ed.). 1972. *Tree Flora of Malaya : A Manual for Foresters, Volume One.* Kuala Lumpur : Longman Malaysia Sdn. Bhd.

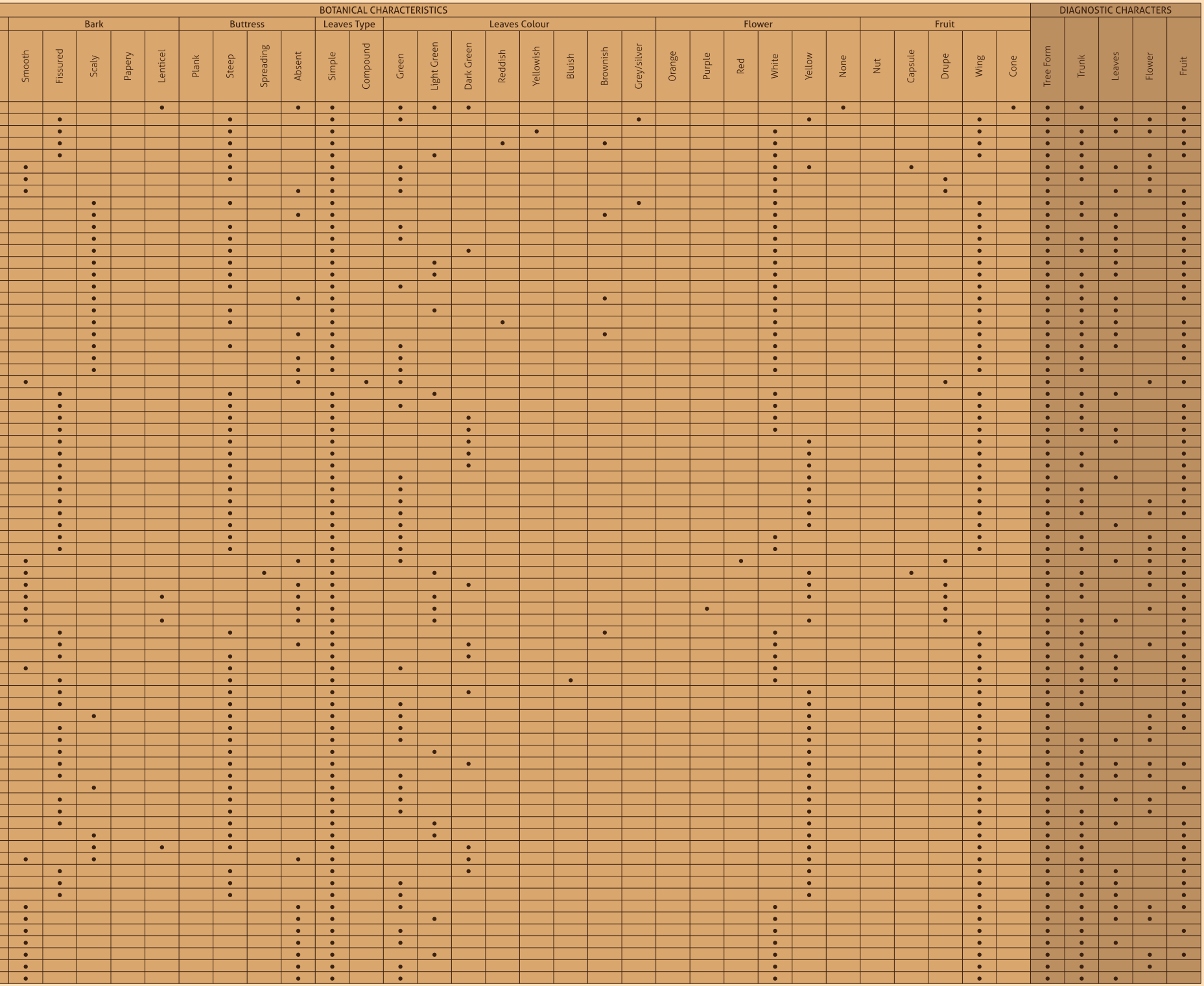
Whitmore, T.C. (Ed.). 1973. *Tree Flora of Malaya : A Manual for Foresters, Volume Two.* Kuala Lumpur : Longman Malaysia Sdn Bhd.

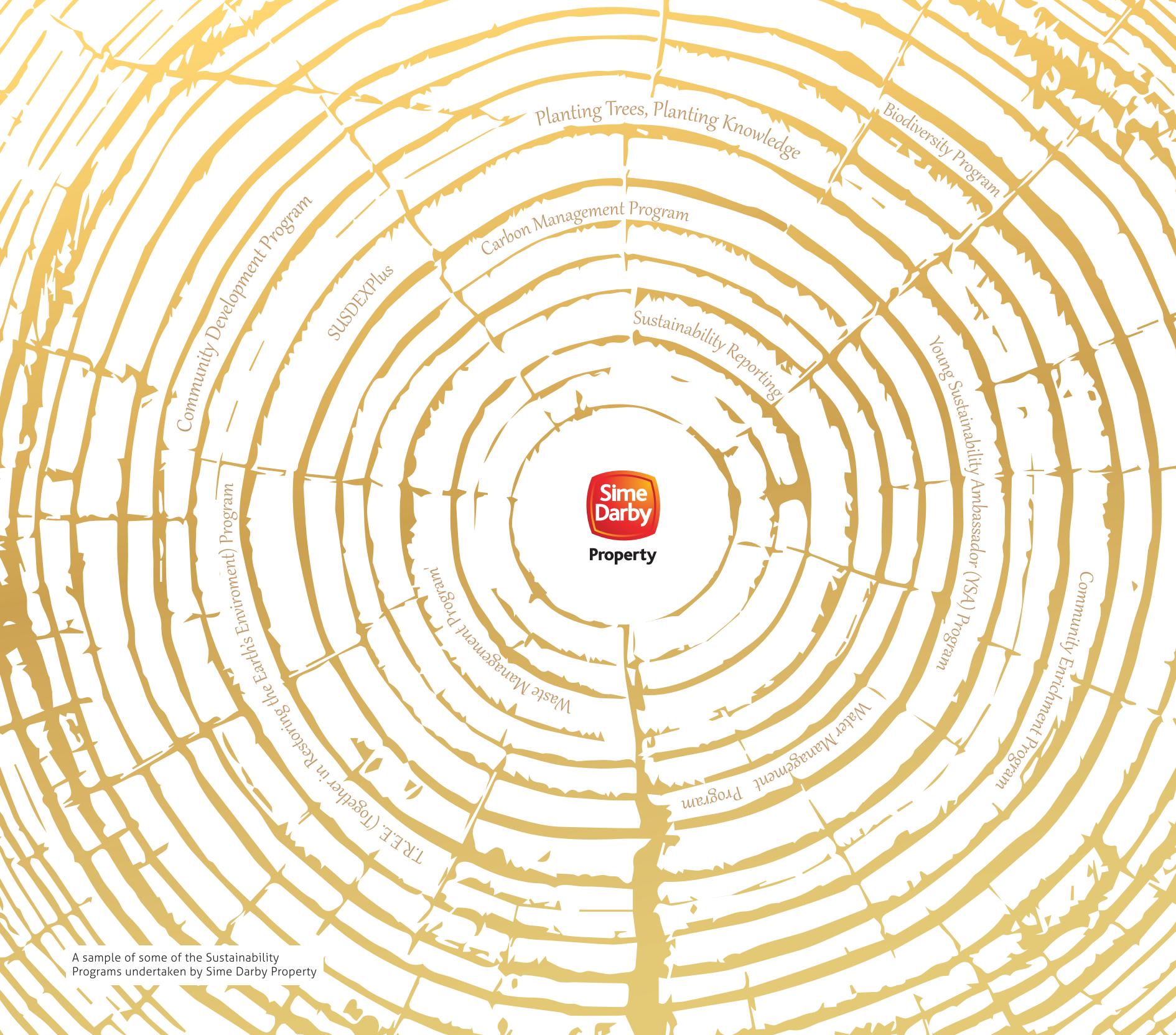
World Conservation Monitoring Centre. 1998. *The IUCN RED List of Threatened Species 1998*:e. T31393A9625403. http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T31393A9625403.en

WyattGSmith, J. & Kochummen, K.M. 1999. *Pocket Checklist of Timber Trees. Malayan Forest Records No. 17.* Kuala Lumpur : Forest Research Institute Malaysia (FRIM).

SPECIES SUITABILITY QUICK FINDER

No.	Species	Family	ENVIRONMENTAL FACTORS																										
			Seasonal		Flowering & Fruiting			Forest Types									Distribution			Conservation Status			Tree Height			Tree Form				
			Deciduous	Evergreen	Throughout the year	April-July	July-November	Coastal	Swampy (peat)	Riparian	Lowland forest (0-300m asl)	Hill forest (300-750m asl)	Upper Hill Forest (750-1300 m asl)	Lower Montane Forest (1300-1500 m asl)	Upper Montane Forest (> 1500 m asl)		Peninsular Malaysia	Sabah	Sarawak	Critically Endangered	Endangered	Vulnerable	Small Tree (≤ 15m)	Medium Tree (15m – 45m)	Big Tree (≥ 45m)	Cone	Oblong	Pagoda	Spread	Round
1	*Agathis borneensis*	Araucariaceae		●	●			●			●	●	●				●	●	●		●				●					
2	*Anisoptera laevis*	Dipterocarpaceae		●		●	●				●						●	●	●		●				●					●
3	*Anisoptera marginata*	Dipterocarpaceae		●		●	●		●		●						●	●	●		●				●					●
4	*Anisoptera megistocarpa*	Dipterocarpaceae		●		●	●				●	●					●		●	●					●					●
5	*Anisoptera scaphula*	Dipterocarpaceae		●		●	●				●	●					●	●		●					●					●
6	*Aquilaria malaccensis*	Thymelaeaceae		●		●	●				●	●	●				●		●			●		●						●
7	*Atuna racemosa subsp. racemosa*	Chrysobalanaceae		●		●	●				●						●	●	●			●		●					●	
8	*Barringtonia augusta*	Lecythidaceae		●	●					●	●						●					●		●					●	
9	*Dipterocarpus caudatus*	Dipterocarpaceae		●		●	●				●	●					●					●			●					●
10	*Dipterocarpus chartaceus*	Dipterocarpaceae		●		●	●	●									●			●				●						●
11	*Dipterocarpus costatus*	Dipterocarpaceae		●		●	●					●	●				●					●		●						●
12	*Dipterocarpus dyeri*	Dipterocarpaceae		●		●	●				●						●			●					●					●
13	*Dipterocarpus elongatus*	Dipterocarpaceae		●		●	●				●						●			●					●					●
14	*Dipterocarpus eurynchus*	Dipterocarpaceae		●		●	●					●	●				●		●	●					●					●
15	*Dipterocarpus fagineus*	Dipterocarpaceae		●		●	●	●				●					●		●	●				●						●
16	*Dipterocarpus hasseltii*	Dipterocarpaceae		●		●	●				●	●					●	●		●				●					●	
17	*Dipterocarpus rigidus*	Dipterocarpaceae		●		●	●	●					●				●		●	●					●				●	
18	*Dipterocarpus rotundifollus*	Dipterocarpaceae		●		●	●	●									●			●				●					●	
19	*Dipterocarpus sarawakensis*	Dipterocarpaceae		●		●	●	●									●		●	●					●				●	
20	*Dipterocarpus semivestitus*	Dipterocarpaceae		●		●	●				●						●							●					●	
21	*Dipterocarpus sublamellatus*	Dipterocarpaceae		●		●	●				●						●		●		●				●					●
22	*Dipterocarpus tempehes*	Dipterocarpaceae		●		●	●				●	●						●	●	●					●					●
23	*Dryobalanops beccarii*	Dipterocarpaceae		●		●	●				●	●					●	●	●		●				●					●
24	*Glenniea penangensis*	Sapindaceae		●		●	●				●	●					●					●		●					●	
25	*Hopea apiculata*	Dipterocarpaceae		●		●	●				●	●					●			●				●					●	
26	*Hopea auriculata*	Dipterocarpaceae		●		●	●					●					●				●			●					●	
27	*Hopea bilitonensis*	Dipterocarpaceae		●		●	●	●			●						●			●				●					●	
28	*Hopea coriacea*	Dipterocarpaceae		●		●	●					●					●			●				●					●	
29	*Hopea helferi*	Dipterocarpaceae		●		●	●				●						●			●				●					●	
30	*Hopea johorensis*	Dipterocarpaceae		●		●	●				●	●					●			●				●					●	
31	*Hopea latifolia*	Dipterocarpaceae		●		●	●				●						●			●				●					●	
32	*Hopea mengarawan*	Dipterocarpaceae		●		●	●		●		●						●	●	●			●		●					●	
33	*Hopea odorata*	Dipterocarpaceae		●		●	●			●							●					●		●					●	
34	*Hopea pachycarpa*	Dipterocarpaceae		●		●	●		●								●		●			●		●					●	
35	*Hopea pierrei*	Dipterocarpaceae		●		●	●				●	●					●				●			●					●	
36	*Hopea polyalthioides*	Dipterocarpaceae		●		●	●				●						●			●				●					●	
37	*Hopea pubescens*	Dipterocarpaceae		●		●	●				●	●					●			●				●					●	
38	*Hopea subalata*	Dipterocarpaceae		●		●	●				●						●			●				●					●	
39	*Knema hookeriana*	Myristicaceae		●		●	●				●	●					●	●	●			●		●			●			
40	*Lithocarpus curtisii*	Fagaceae		●		●	●				●						●					●		●					●	
41	*Magnolia champaca*	Magnoliaceae		●	●						●	●					●					●			●	●				
42	*Mangifera marcrocarpa*	Anacardiaceae		●		●	●				●						●	●				●		●					●	
43	*Pternandra coerulescens*	Melastomataceae		●	●						●						●					●	●				●			
44	*Popowia velutina*	Annonaceae		●	●						●						●			●			●						●	
45	*Shorea atrinervosa*	Dipterocarpaceae		●		●	●				●	●					●				●				●				●	
46	*Shorea bentongensis*	Dipterocarpaceae		●		●	●				●	●					●				●			●					●	
47	*Shorea blumutensis*	Dipterocarpaceae		●		●	●				●						●				●			●					●	
48	*Shorea collina*	Dipterocarpaceae		●		●	●				●						●			●					●				●	
49	*Shorea curtisii*	Dipterocarpaceae		●		●	●					●										●			●				●	
50	*Shorea dasyphylla*	Dipterocarpaceae		●		●	●				●	●					●		●		●				●				●	
51	*Shorea exelliptica*	Dipterocarpaceae		●		●	●				●	●					●	●	●			●			●				●	
52	*Shorea falcifera*	Dipterocarpaceae		●		●	●	●			●										●			●					●	
53	*Shorea foxworthyi*	Dipterocarpaceae		●		●	●				●	●					●	●	●	●					●				●	
54	*Shorea gibbosa*	Dipterocarpaceae		●		●	●				●						●	●	●	●					●				●	
55	*Shorea gratissima*	Dipterocarpaceae		●		●	●	●			●						●	●			●				●				●	
56	*Shorea hemsleyana*	Dipterocarpaceae		●		●	●		●		●						●		●	●				●					●	
57	*Shorea henryana*	Dipterocarpaceae		●		●	●					●					●				●			●					●	
58	*Shorea johorensis*	Dipterocarpaceae		●		●	●				●						●	●	●	●					●				●	
59	*Shorea lamellata*	Dipterocarpaceae		●		●	●					●					●			●					●				●	
60	*Shorea macrantha*	Dipterocarpaceae		●		●	●			●	●						●		●	●				●					●	
61	*Shorea materialis*	Dipterocarpaceae		●		●	●	●			●						●		●	●				●					●	
62	*Shorea ochrophloia*	Dipterocarpaceae		●		●	●				●						●			●					●				●	
63	*Shorea palembanica*	Dipterocarpaceae		●		●	●		●	●	●						●		●	●					●				●	
64	*Shorea peltata*	Dipterocarpaceae		●		●	●				●						●	●						●					●	
65	*Shorea platycarpa*	Dipterocarpaceae		●		●	●		●		●						●			●					●				●	
66	*Shorea teysmanniana*	Dipterocarpaceae		●		●	●		●								●				●				●				●	
67	*Shorea uliginosa*	Dipterocarpaceae		●		●	●	●	●								●					●		●					●	
68	*Vatica flavida*	Dipterocarpaceae		●		●	●		●		●						●			●				●					●	
69	*Vatica havilandii*	Dipterocarpaceae		●		●	●		●		●	●					●	●	●	●				●					●	
70	*Vatica lobata*	Dipterocarpaceae		●		●	●		●		●						●			●				●					●	
71	*Vatica scotechinii*	Dipterocarpaceae		●		●	●				●	●					●			●				●					●	
72	*Vatica stapfiana*	Dipterocarpaceae		●		●	●				●	●					●				●			●					●	
73	*Vatica venulosa*	Dipterocarpaceae		●		●	●		●		●						●			●				●					●	
74	*Vatica yeechongii*	Dipterocarpaceae		●		●	●				●						●			●				●					●	


BOTANICAL CHARACTERISTICS
DIAGNOSTIC CHARACTERS
Bark
Buttress
Leaves Type
Leaves Colour
Flower
Fruit
Smooth
Fissured
Scaly
Papery
Lenticel
Plank
Steep
Spreading
Absent
Simple
Compound
Green
Light Green
Dark Green
Reddish
Yellowish
Bluish
Brownish
Grey/silver
Orange
Purple
Red
White
Yellow
None
Nut
Capsule
Drupe
Wing
Cone
Tree Form
Trunk
Leaves
Flower
Fruit



A sample of some of the Sustainability Programs undertaken by Sime Darby Property