

TREE FLORA of SABAH AND SARAWAK

Volume One

edited by
E. Soepadmo and K.M. Wong



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TREE FLORA
of
SABAH AND SARAWAK

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ARAUCARIACEAE

P.C. Yii

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Kuching, Malaysia

Hooker *f.*, Fl. Br. Ind. 5 (1890) 650; Merrill, EB (1921) 32; Ridley, FMP 5 (1925) 277; Masamune, EPB (1940) 2; Backer & Bakhuizen *f.*, FJ 1 (1963) 87; Keng, OFMSP (1969) 12, TFM 1 (1972) 39; de Laubenfels, Philip. J. Biol. 7, 2 (1978) 143, FM 1, 10 (1988) 419; Kochummen, Mal. For. Rec. 17 (1979) 54; Cockburn, TS 2 (1980) 2; Anderson, CLTS (1980) 347; Corner, WSTM 2 (1988) 762; Whitmore, Tantra & Sutisna, CLK 1 (1989) 27.

Monoecious trees or rarely shrubs. Exudate resinous, colourless or slightly whitish. **Leaves** simple, spiral, opposite, sub-opposite or in whorls, scale- or needle-like or broad leathery blades with many faint closed longitudinal veins. Male and female cones on separate branches. **Male cones** solitary, lateral or rarely terminal, cylindrical, consisting of numerous spirally arranged microsporophylls, each bearing a few to numerous microsporangia at the abaxial or lower side of an enlarged shield-like apex. **Female cones** solitary, terminal on robust shoots or pedunculate with bracts at the base, ovoid or round, consisting of an axis with numerous spirally arranged seed-scales (megasporephylls), each bearing a solitary seed (ovule) on the adaxial (upper) surface; mature female cones large, woody; cone-scales wedge-shaped. **Seed** winged or not; cotyledons either in 2 fused pairs or of 4 independent units.

Distribution. 2 genera (*Agathis* and *Araucaria*) and 40 species, chiefly in countries bordering the South Pacific Ocean (Indo-China, Malesia, New Caledonia, Australia, New Zealand, Melanesia, and South America). In Sabah and Sarawak represented by a single genus (*Agathis*) with 5 species.

AGATHIS Salisb.

(Greek, *agathis* = a clew; the shape of the cone)

Trans Linn. Soc. London 8 (1807) 311; Hooker *f. l.c.* 650; Merrill *l.c.* 32; Ridley *l.c.* 277; Meijer Drees, Bull. Jard. Bot. Btzg. 3, 16 (1940) 455; Backer & Bakhuizen *f. l.c.* 87; Keng *l.c.* (1969) 12, *l.c.* (1972) 39; Cockburn *l.c.* 2; Anderson *l.c.* 347; Whitmore, Pl. Syst. Evol. 41 (1980) 46, New Phytol. 84 (1980) 407; de Laubenfels, Blumea 24 (1978) 499, Blumea 25 (1979) 531, *l.c.* (1988) 419; Whitmore, Tantra & Sutisna *l.c.* 27. **Synonym:** *Dammara* Link, Enum. Hort. Berol. Alt. 2 (1822) 411.

Usually large trees. *Bole straight and cylindrical, often swollen at the base or with large superficial roots.* **Bark** light-grey to greyish brown, usually smooth and lenticellate when young, gradually peeling off into thin irregular flakes, leaving behind irregular pock-marks on larger trees; inner bark granular, reddish brown. Twigs glabrous, greenish. *Terminal buds globular, usually covered with several pairs of overlapping scales. Petioles usually very short, hardly distinguishable from the blades, slightly channelled above.* **Leaves** entire,

spirally arranged on the older branches and decussate on the young twigs, size and shape extremely variable, lanceolate, ovate, to elliptic, without distinct midrib; juvenile leaves distinctly larger than the adult leaves and often have more acuminate apices. Male cones subtended by several pairs of bracts, sessile or shortly pedunculate. Female cones with numerous closely appressed more or less triangular seed-scales. Seed flattened ovoid, with 2 unequal lateral wings; cotyledon 2, opposite and leaf-like.

Distribution. About 21 species; Indo-China, Malesia, Australia, New Zealand and Melanesia (except Solomon Islands). 5 species occur in Sabah and Sarawak.

Ecology. Large and emergent trees with 2 species, *Agathis borneensis* and *A. endertii*, widely distributed from lowland peat swamp, *kerangas* (heath), mixed dipterocarp and montane forest to about 2400 m. Young trees often produce female cones several years ahead of males.

Uses. *Agathis* produces a beautiful softwood which fetches a very good price. Its pleasing yellow timber has a natural sheen which is very suitable for furniture and cabinet making, wall and ceiling panelling. It is not durable for outdoor use. The white crystalline resin is also collected for sale as copal. For more information, see Whitmore, Econ. Bot. 34 (1980) 1.

Taxonomy. The species of *Agathis* occurring in Sabah and Sarawak are characterised by the decussate leaves with close faint longitudinal veins without prominent midrib, and by the male and female cones which are borne on separate branches. For a detailed account of the systematy of the genus see papers by de Laubenfels, Blumea 24 (1979) 531 and Whitmore, New Phytol. 84 (1980) 407 and Pl. Syst. Evol. 41 (1980) 41.

Key to *Agathis* species

1. Leaf lower surface glaucous.....2
 Leaf lower surface not glaucous.....4
2. Adult leaves distinctly convex-lens-shaped, asymmetric; apex and base sharply acute
 **4. A. lenticula**
 Adult leaves not so.....3
3. Adult leaves ovate or orbicular, apex obtuse or rounded, usually less than 4 cm. Male cone usually less than 6 mm in diameter, shortly pedunculate. Seed-scales without distinct lip.....**5. A. orbicula**
 Adult leaves elliptic, apex acute or rarely blunt, usually longer than 5 cm. Male cones about 10 mm in diameter, sessile. Seed-scales with distinct protruding lips at the apical margin.....**2. A. endertii**
4. Adult leaves elliptic, usually longer than 5 cm, apex acute. Male cones oblong, pedunculate, usually larger than 20 mm in diameter.....**1. A. borneensis**
 Adult leaves ovate, usually less than 5 cm long, apex usually acuminate or round and blunt with a distinct tip. Male cones about 10 mm in diameter.....**3. A. kinabaluensis**

1. **Agathis borneensis** Warb.
(of Borneo)

Fig. 1.

Monsunia 1 (1900) 184; Merrill *l.c.* 32; Masamune *l.c.* 2; Meijer Drees *l.c.* 459; de Laubenfels *l.c.* (1979) 532, *l.c.* (1988) 433; Whitmore *l.c.* (1980) 54. **Type:** *Beccari* 491 (B) & 596 (B, K), Sarawak (syntypes). **Synonyms:** *Pinus dammara* Lamb., Descr. Pinus 1 (1803) 61; *A. dammara* (Lamb.) Richard, Comm. Bot. Conif. & Cycad. (1826) 83; *A. loranthiifolia* Salisb. *l.c.* 312; *Dammara loranthiifolia* (Salisb.) Link *l.c.* 411; *A. beccarii* Warb. *l.c.* 184; *A. macrostachys* Warb. *l.c.* 183; *A. rhomboidalis* Warb. *l.c.* 184; *A. alba* Foxw., Philip. J. Sc. 4 (1909) 442; *A. latifolia* Meijer Drees *l.c.* 459.

Emergent tree to 55 m tall and 100 cm diameter. **Bark** warty lenticellate, papery scaly or flaky, maurish grey; inner bark granular, pale brown. **Leaves** when juvenile ovate to lanceolate, up to 14 x 4 cm; when adult *elliptic to ovate*, 6–12 x 2–3.5 cm, *leathery, glabrous*; base cuneate rounded, *apex acute*. **Male cones** *oblong*, 4–7 cm long, 20–25 mm across, on short peduncles, 2–10 mm long; *microsporophylls* 6–7 x 4.5–5 mm, with broad, rounded apex. **Female cones** ovoid, 6–8.5 x 5.5–6.5 cm; seed-scales 30–40 x 25–28 mm, *roughly triangular in shape with well rounded apical margin*. **Seeds** flattened ovoid, *c.* 12 x 9 mm, with one well-developed wing, *c.* 20 x 16 mm.

Vernacular names. Sabah—*manggilan* (Dusun), *salang* (Kedayan). Sarawak—*bindang* (Malay), *bulu* (Iban), *kayu jadi* (Malay, Iban). Brunei—*tulong* (Brunei, Malay, Dusun).

Distribution. Sumatra, Peninsular Malaysia and throughout Borneo. In Sabah and Sarawak widespread; also in Brunei and Kalimantan.

Ecology. Infrequent in the lowlands, although found in sandy margins of some peat swamps and *kerangas*, and lower montane forests to 1200 m. Generally prefers more acidic soils; often forming dense, nearly pure stands on certain areas of low-lying wet *kerangas* forest and dry *kerangas* forest on sandstone formations at higher altitude, elsewhere uncommon and scattered.

2. **Agathis endertii** Meijer Drees

(F.H. Ender, 1891–1953, forester at the Forest Research Institute, Bogor, Indonesia)

l.c. 470; Masamune *l.c.* 3; de Laubenfels *l.c.* (1979) 534, *l.c.* (1988) 439. **Type:** *bb.* 21694, Southern Borneo (holotype BO).

Emergent tree to 60 m and 100 cm diameter. **Bark** smooth with shallow pock-marks and scales, grey-purplish brown; inner bark granular, straw-brown. Exudate whitish, opaque. **Leaves** when juvenile lanceolate, with blunt or acute apex; when adult *elliptic*, 5–9 x 1.8–3.5 cm, *leathery and slightly glaucous on undersurface*; base cuneate rounded, *apex broadly acute or rarely blunt*. **Male cones** *cylindrical*, 2.6–3.8 cm long, 7–10 mm across, *sessile*; *microsporophylls* *spoon-shaped*, *c.* 25 x 20 mm, with spreading and slightly angled apical margin. **Female cones** shortly ovoid, *c.* 4.5 x 7 cm; seed-scales *c.* 32 x 42 mm, *more or less triangular with well rounded apical margin, and a distinct protruding lip (c. 8 x 3 mm) at the apical margin*. **Seed** flattened ovoid, *c.* 11 x 8 mm; wing one, *c.* 18 x 14 mm.

Vernacular names. Sarawak—*bulok* (Iban).

Distribution. Endemic to Borneo. In Sabah and Sarawak scattered.

Ecology. Scattered throughout lowland rain forests from sea-level to sandstone *kerangas* forest at 1600 m.

3. *Agathis kinabaluensis* de Laub. (of Mt. Kinabalu)

l.c. (1979) 535, *l.c.* (1988) 439. **Type:** *de Laubenfels P625*, Sabah, Mt. Kinabalu (holotype L; isotypes A, K, SAN).

Tree up to 36 m tall, becoming relatively stunted on exposed ridges and summits. **Bark** dark brown, with numerous lenticels, peeling off into irregular flakes; inner bark granular, reddish brown. Exudate white. **Leaves** when juvenile ovate, up to 9 x 4.4 cm, apex strongly acuminate; when adult *ovate*, 3.5–7 x 1.8–3.2 cm; *base cuneate rounded, apex slightly acuminate or more or less round and blunt with distinct tips on smaller leaves*. **Male cones** cylindrical, 1.8–3 cm long, 8–10 mm across, nearly sessile or on very short peduncles; *microsporophylls spoon-shaped, c. 1.7 x 1.4 mm, with very slightly angled apical margin*. **Female cones** ovoid, *c. 8 x 11 cm*; seed-scales 28–32 x 40–45 mm, *with distinct narrow ridges along apical margin and broadly rounded at the upper end*. **Seed** *c. 11 x 7 mm, distinctly acute at one end and with a broad wing c. 20 x 12 mm at the other*.

Vernacular name. Sarawak—*tumu* (Kelabit, Murut).

Distribution. Only known from Mt. Kinabalu, Sabah, and Mt. Murut in Sarawak.

Ecology. Upper mossy montane forest at 1500–2400 m.

4. *Agathis lenticula* de Laub. (Latin, *lenticularis* = a double convex lens; the leaf shape)

l.c. (1979) 537, *l.c.* (1988) 436. **Type:** *de Laubenfels P619*, Sabah, Mt. Kinabalu, Park HQ (holotype L; isotypes A, K, SAN).

Tree to 45 m tall. **Bark** greyish brown, with numerous small lenticels; young bark distinctly covered with thin exfoliating flakes, gradually breaking into irregular plates; inner bark granular, reddish brown. *Exudate whitish, gradually turning yellow*. **Leaves** when juvenile lenticular, up to 11 x 4.7 cm, tapering toward both ends; when adult lenticular, 5–7 x 1.7–2.4 cm, *leathery, glaucous on the undersurface, apex and base more or less acute*. **Male cones** cylindrical, 3–4 cm long, 9–10 mm in diameter, on short peduncles,

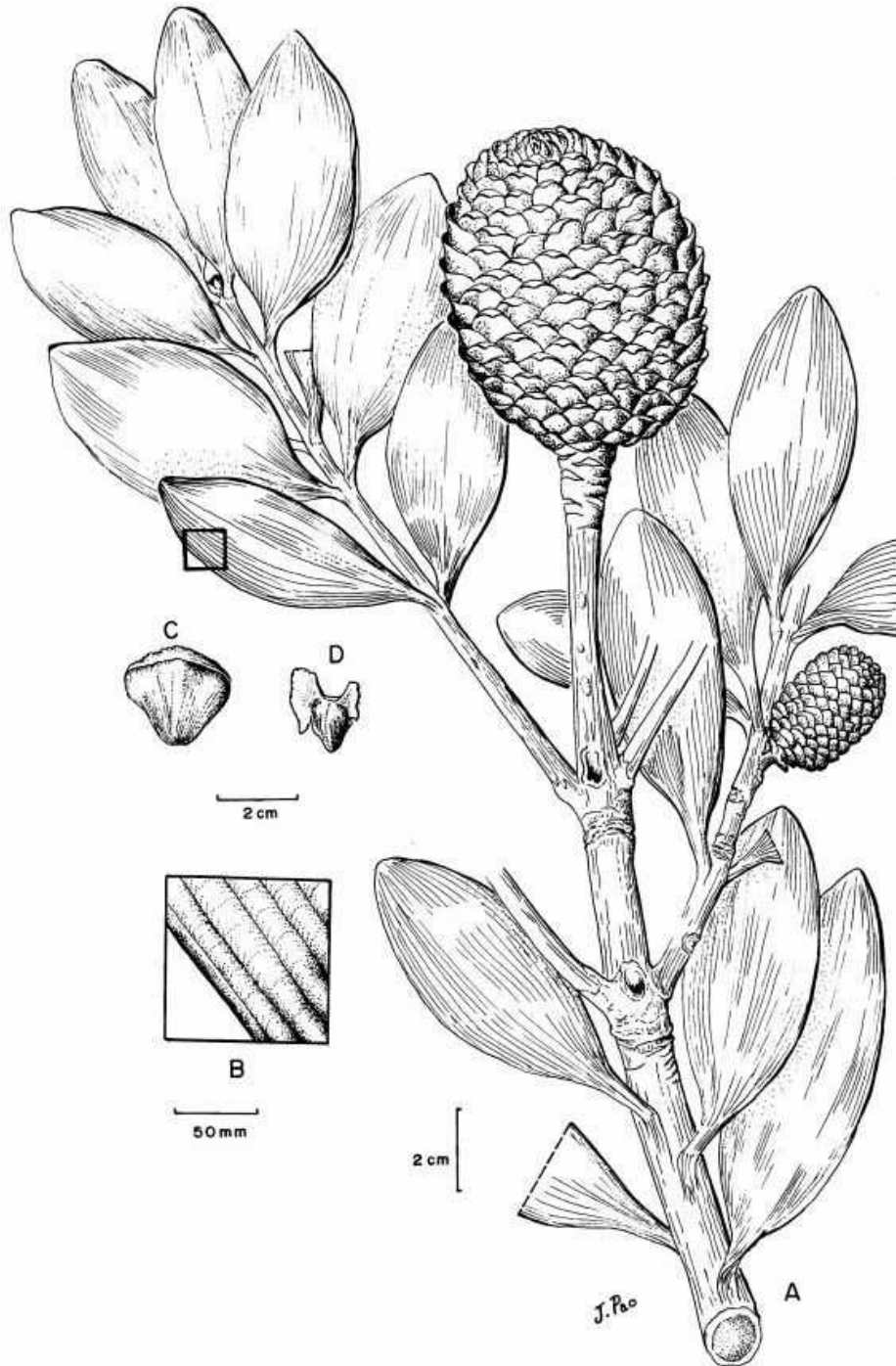


Fig. 1. *Agathis borneensis*. A, leafy branch with lateral male cone and terminal female cone; B, detail of leaf venation; C, seed-scale; D, winged seed. (All from S. 9633.)

2–6 mm long; *microsporophylls* spoon-shaped, 2–2.5 x 1.5–2 mm, with blunt spreading apical margin. **Female cones** spherical, c. 7 x 6 cm; seed-scales c. 40 x 27 mm. **Seeds** c. 11 x 7 mm, with a broadly rounded wing, c. 8 x 14 mm at one end.

Vernacular names. Sabah—*tangilan, tungilan* (Dusun).

Distribution. So far only known from the Crocker Range, including Mt. Kinabalu in Sabah.

Ecology. Emergent trees in mossy montane rain forest, at 1140–1680 m.

5. *Agathis orbicula* de Laub.

(Latin, *orbicularis* = circular; the leaf shape)

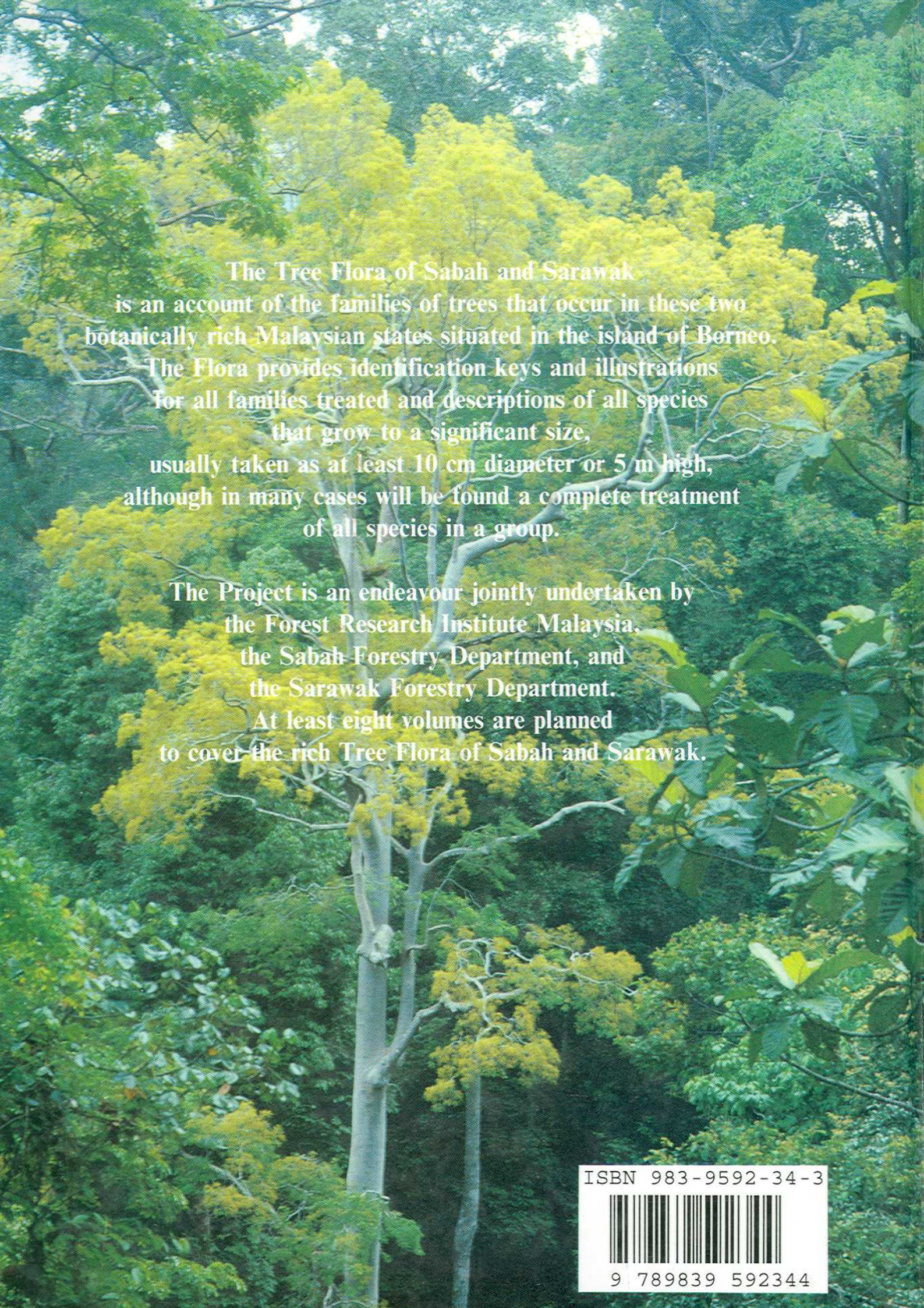
l.c. (1979) 540, *l.c.* (1988) 437. **Type:** *de Laubenfels P614*, Sarawak, Lawas (holotype L; isotypes A, K, SAN, SAR).

Tree to 40 m tall. **Bark** dark brown, peeling off into irregular flakes, exposing scattered lenticels; inner bark granular, reddish brown. *Exudate* resinous, light yellow and produced in abundance. **Leaves** when juvenile ovate, up to 6.5 x 2.8 cm; apex bluntly acute; when adult ovate to orbicular, 2.4–4 x 1.2–2.4 cm, broadly rounded to slightly angled at the apex, tapering toward the base. **Male cones** minute, cylindrical, 0.8–1.4 cm long, 4–6 mm through; *microsporophylls* helmet-shaped, 1.2–1.5 x 1–1.2 mm, with blunt apex. **Female cones** ovoid, c. 7 x 4.5 cm; seed-scales ovate, c. 20 x 33 mm. **Seeds** similar to that of *A. lenticula*.

Vernacular names. Sarawak—*bulok* (Iban), *tubu* (Kenyah & Kayan), *tumuh* (Murut).

Distribution. Endemic to Borneo; known from southern parts of Sabah to Central Sarawak.

Ecology. Scattered in sandstone *kerangas* forest at 450–1050 m.



The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
The Flora provides identification keys and illustrations
for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

The Project is an endeavour jointly undertaken by
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the Sarawak Forestry Department.
At least eight volumes are planned
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