

New Species and New Record of *Lithocarpus* Blume (Fagaceae) from Sabah and Sarawak, Malaysia

S. JULIA AND E. SOEPADMO

Forest Research Institute Malaysia
Kepong, 52100 Kuala Lumpur, Malaysia

Abstract

Eleven new species and one new record of *Lithocarpus* are described from Sabah and Sarawak. The new species are *L. brochidodromus*, *L. corneri*, *L. kalkmanii*, *L. keningauensis*, *L. kochummenii*, *L. melataiensis*, *L. muluensis*, *L. oblancifolius*, *L. sandakanensis*, *L. stonei*, and *L. tawaiensis*, and the new record is *L. hystrix*. Descriptions of the new taxa are provided.

Introduction

In his account of the Malesian Fagaceae, Soepadmo (1972) recognised 49 species of *Lithocarpus* in Sabah and Sarawak. Upon revision of the genus for the *Tree Flora of Sabah and Sarawak*, eleven new species and one new record are to be added, making the number of known species from the two eastern states of Malaysia 61. Of the eleven described new taxa, six occur in Sabah only, two in Sarawak only, two both in Sabah and Sarawak, and one in Sarawak and Brunei.

Description of the New Species

1. *Lithocarpus brochidodromus* S. Julia & Soepadmo, **sp. nov.** Fig.1
(Latin, *brochidodromus*=loop-veined; referring to the leaves)

Lithocarpus cooperto simillimus, sed foliis multo maioribus crassioribusque, venis lateralibus valide brochidodromis, glande ovoideo-globosa differt.
Typus: Dewol & Lideh SAN 105591, Borneo, Sabah, Pensiangan, Sapulut, Sg. Saburan (*holotypus* SAN!).

Tree up to 20 m tall, 15–55 cm in diameter. Bark flaky, greyish or brownish; inner bark reddish or greyish or greenish. Sapwood brownish or whitish. Twig densely tomentose with appressed stellate and simple hairs, later subglabrescent, smooth or sparsely large-lenticellate, sometimes scaly. Stipules linear or ovate, 5–15 x 2–5 mm. Leaves coriaceous, rigid, sparsely appressed yellowish tomentose with simple and stellate hairs or rarely

glabrous above, densely appressed yellowish tomentose below; blades broadly elliptic-oblong or ovate, 14–22(–32) x 5–9(–11) cm, base rounded or broadly acute, margin strongly recurved, apex acuminate, acumen 15–20 mm long; midrib broad, slightly raised above, strongly raised below, densely stellate-tomentose above, sparsely appressed, stellate-tomentose below; lateral veins thick, 7–12 pairs, lax, strongly impressed above, strongly raised below, clearly and strongly joining near the margin, forming an angle of 20°–30° with the midrib; intercostal veins scalariform or subscalariform, lax, prominent and impressed above, clearly prominent below; petioles 4–12 x 2–5 mm. *Inflorescences* male and female. *Male inflorescences* solitary in the axils of distal leaves or in subterminal, lax paniculate clusters on the new shoot, 6–10 cm long; bracts linear to acute, 1.5–3.5 x 1–2 mm; bracteoles linear, c. 1.7 x 0.6 mm. *Male flowers* solitary along the rachis; perianth 6-lobed, thick coriaceous, elliptic, 2.5–3 x 1–1.5 mm; stamens 12, filaments c. 2 mm long; pistillode subglobose, 1.5–2 mm in diameter. *Female inflorescences* in subterminal, lax paniculate clusters on the new shoot or solitary in the axils of distal leaves, 14–18 cm long; bracts acute, 2–2.5 x 1–1.7 mm; bracteoles linear-elliptic, c. 2 x 0.5 mm. *Female flowers* solitary along the rachis; perianth 6-lobed, thick coriaceous, acute-rounded, 0.4–0.7 mm across; staminodes 12; styles 3, conical, slightly recurved, 1.5–2.5 mm long. *Cupules* solitary along the rachis, c. 5-mm-stalked, deeply cup-shaped, 1.5–2.5 x 2–2.5 cm, densely appressed stellate-tomentose, scaly or set with spine-like appendages; wall bony, thick, enclosing the acorn completely or more than half of the acorn; scales distinct, sturdy, hook-like, set irregularly. *Acorn* ovoid-globose, 1.5–2 cm across, sparsely tomentose with simple hairs, brown, base flat, top rounded-acute; scar convex, c. 1 cm in diameter; wall woody, thin, greater parts free from the cupule.

Vernacular names: Sabah: *tikalod* (Dusun Ranau); Sarawak: *tekalat* (Murut).

Distribution: Endemic to Borneo. In Sabah, recorded from Sapulut in Keningau, Ulu Tungud in Beluran, and Sg. Timbulanan in Labuk Sugut area. In Sarawak, collected from Sg. Plieran, Belaga and Lambir NP in Miri.

Ecology: In primary to secondary forests, including riparian forest. Usually grow on hill slopes, up to 465 m.

Notes: A species closely allied to *Lithocarpus coopertus* but differs by its much bigger and thicker leaves with strongly looped lateral veins, and its ovoid-globose acorn.



Figure 1. *Lithocarpus brochidodromus* S. Julia & Soepadmo, *sp. nov.* A, flowering (female) leafy twig; B, female flower; C, longitudinal section of female flower; D, part of male inflorescence; E, longitudinal section of male flower; F, infructescence (A–C from SAN 103647, D–E from S 24089, F from SAN 106929).

Specimens Examined: BORNEO. SABAH: Labuk Sugut, Sg. Timbulanan, *Aban SAN 90489* (K, KEP!, L, SAN!, SAR!); Beluran, Ulu Tungud, Sg. Dual, *Joseph et al. SAN 96531* (K, KEP!, KLU!, L, SAN!, SAR!); Keningau, Sapulut FR, Sg. Tibou, *Sumbing & Soludi SAN 103647* (K, KEP!, L, SAN!); Nabawan, Sapulut, Sg. Saburan, RP. 474, *Dewol & Lideh SAN 105591* (SAN!); Sapulut, Sg. Saburan, *Fidilis & Omar SAN 106929* (SAN!); Keningau, Sapulut, East of Sg. Saburan RP. 474, *Leopold Madani SAN 119228* (K, KEP!, SAN!). SARAWAK: Miri, Lambir NP, *Chai S 24089* (KEP!, SAN!, SAR!); 7th Division, Belaga, Plieran Rapids, Sg. Pleieran, Murum, *Lai et al. S 67948* (SAR!); 7th Division, Belaga, Plieran Rapids, Sg. Pleieran, Murum, *Lai et al. S 67949* (SAR!).

2. *Lithocarpus corneri* S. Julia & Soepadmo, **sp. nov.** Fig. 2
(E. J. H. Corner, 1906–1996, prominent former Professor of Tropical Botany, University of Cambridge, United Kingdom)

In folii characteris Lithocarpo ruminato simillimus, sed cupula glandeque obconica, foliis venis intercostalibus densis facile distinguendus. Typus: *Berhaman SAN 132620*, Borneo, Sabah, Tenom District, Lumaku FR (*holotypus:* SAN!; *isotypi* KEP!, L, SAR!).

Tree 10–15 m tall, 20–30 cm in diameter. Bark rough, brown. Twig sparsely tomentose, glabrescent, greyish brown, sparsely lenticellate, sometimes smooth. Stipules linear, 3–4 x 1 mm, persistent. Leaves thin coriaceous, sparsely appressed yellowish tomentose above, densely appressed yellowish tomentose below; blades elliptic, (6–)8–12 x 3–4.5 cm, base acute to broadly acute, margin recurved, apex acuminate, acumen 5–10 mm long; midrib raised on both surfaces, stronger above, sparsely appressed tomentose on both surfaces; lateral veins thin, 5–8 pairs, lax, flat above, slightly raised below, disappearing towards the leaf margin, forming an angle of 45°–60° with the midrib; intercostal veins scalariform or subscalariform, dense, obscure on both surfaces or slightly prominent below; petioles 5–10 x 2 mm. Inflorescences and flowers unknown. Cupules solitary along the rachis, sessile, obconical, 2.5–4.5 x 3.5–5.5 cm, base rounded-acute, top flat, densely appressed tomentose, lamellate; wall woody, 2–3 mm thick, completely enclosing the acorn except for an opening of 1–2 cm in diameter; lamellae distinct, entire, set in 12–15 regular lines, denser towards the top. Acorn obconical, 2–4 x 3–5 cm, densely tomentose with simple and stellate hairs, brown; wall woody, thick, greater parts adnate to the cupule.

Distribution: Endemic to Sabah, Borneo. So far collected from Lumaku FR, Tenom and Mark Pang logging area, Ranau.

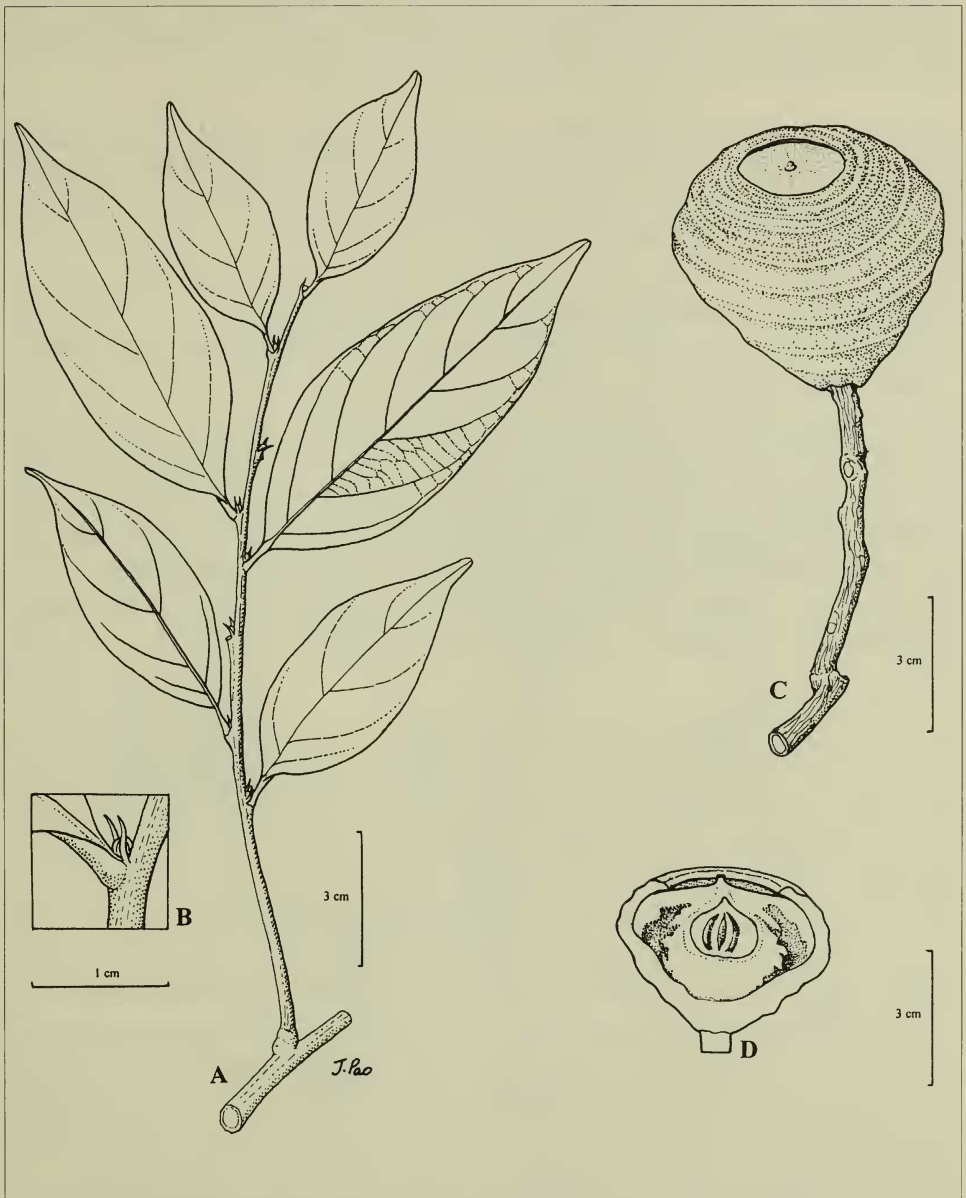


Figure 2. *Lithocarpus corneri* S. Julia & Soepadmo, *sp. nov.* A, leafy twig; B, stipules; C, mature cupule; D, longitudinal section of the cupule showing the acorn (A–C from SAN 132620, D from SAN 110435).

Ecology: In primary to disturbed forests on hillsides.

Notes: A species closely related to *Lithocarpus ruminatus* in leaf characters but can be easily distinguished by its obconical cupule and acorn, densely lamellate cupule, and leaves with dense intercostal veins.

Specimens Examined: BORNEO. SABAH: Ranau, Mark Pang Logging area, Amin & Lideh SAN 110435 (SAN!); Tenom, Lumaku FR, Berhaman et al. SAN 132620 (KEP, L, SAN!, SAR!); Tenom, Lumaku FR, Maikin et al. SAN 132937 (K, KEP!, L, SAN!).

3. *Lithocarpus kalkmanii* S. Julia & Soepadmo, sp. nov. Fig.3
(C. Kalkman, 1928 - 1998, former Director of the Rijksherbarium, Leiden, the Netherlands)

In characteris cupulae Lithocarpo halleri simillimus et in folii Lithocarpo pulchro, sed ab Lithocarpo halleri foliis crassis coriaceis rigidis, venis lateralibus densis costa angulis 30°–40° abeuntibus, venis intercostalibus dense scalariformibus differt. Ab Lithocarpo pulchro cupula obovoideo-globosa lamellata glandem praeter aperturam c. 0.5 cm in parte apicali omnino tegenti distinguendus. Typus: Meijer & Hendry SAN 42460, Borneo, Sabah, Ranau, Kinabalu NP, W border, N of Sosopodon (*holotypus* SAN!; *isotypi*: AA, K, L).

Tree up to 30 m tall, 45–60 cm in diameter. Bark large-lenticellate or cracky, brownish or greyish; inner bark reddish brown. Sapwood yellowish. Twig sparsely brownish tomentose, later glabrescent, smooth or sparsely large-lenticellate. Leaves thick coriaceous, sometimes rigid, densely appressed yellowish tomentose above, densely appressed greyish brown tomentose below; blades broadly elliptic, 11–15.5 x 5–8 cm, base broadly acute, margin recurved, apex acuminate, acumen 5–12 mm long; midrib slightly raised above, strongly raised below, sparsely appressed tomentose on both surfaces; lateral veins thick, 12–14 pairs, dense, flat above, strongly raised below, disappearing near the margin, forming an angle of 30°–40° with the midrib; intercostal veins scalariform, dense, obscure above, slightly prominent below; petioles 15–20 x 2–3 mm. Inflorescences and flowers unknown. Cupules solitary along the rachis, sessile, obovoid-globose, 5–7 x 4–5.5 cm, base rounded, top flat, glabrous, lamellate; wall woody, thick, completely enclosing the acorn or with an opening of c. 0.5 cm in diameter; lamellae distinct, entire or minutely denticulate, especially the upper-most ones, set in 6–7 regular lines. Acorn obovoid-globose, 4.5–6 x 3–5 cm, densely tomentose, dark brown; scar deeply concave, c. 1 cm in diameter; wall woody, thick, greater parts adnate to the cupule.

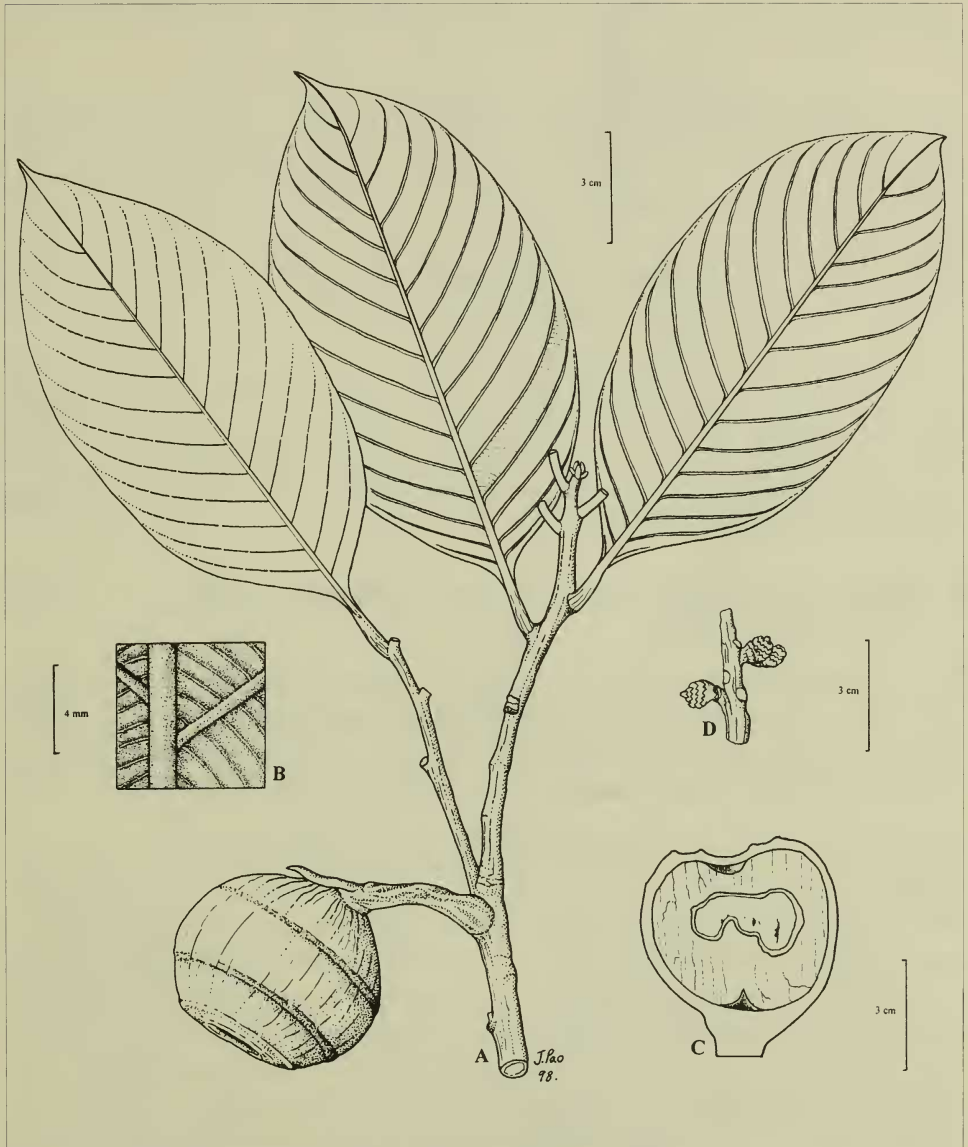


Figure 3. *Lithocarpus kalkmanii* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, detailed of lower leaf surface; C, longitudinal section of cupule; D, young infructescence (A–B from SAN 42460, C–D from SAN 56714).

Distribution: Endemic to Sabah, Borneo. So far only found in the Kinabalu NP and Sosopodon FR in Ranau area and one collection from Nabawan.

Ecology: In primary upper hill mixed dipterocarp to submontane oak-laurel forests at altitude 1080–1500 m.

Notes: A species closely related to *Lithocarpus halleri* in cupule characters and to *Lithocarpus pulcher* in leaf characters but differs from *Lithocarpus halleri* by its thick coriaceous and rigid leaves, its dense lateral veins forming an angle of 30°–40° with the midrib and densely scalariform intercostal veins. From *Lithocarpus pulcher* it can be distinguished by its obovoid-globose, lamellate cupule, which completely encloses the acorn except for an opening of c. 0.5 cm on the apical part.

Specimens Examined: BORNEO. SABAH: Ranau, Kinabalu NP, W. border N. of Sosopodon, *Meijer & Henry SAN 42460* (AA, K, L, SAN!); Ranau, Kinabalu, Jalan Liwagu, *Francis Sadau SAN 42825* (SAN!); Ranau, Sosopodon FR, *Aban Gibot SAN 56714* (KEP!, K, L, SAN!); Nabawan, *Ignasius SAN 139147* (SAN!).

4. *Lithocarpus keningauensis* S. Julia & Soepadmo, sp. nov. Fig.4
(Of Keningau, Sabah)

In foliis characteris Lithocarpis meijeri luteo sericobalanoque simillimus, ab his cupula magna lignosa glandem omnino tegenti, lamellis etiam in iuventu arcte distinctis facile distinguendus. Typus: Amin SAN 95311, Borneo, Sabah, Keningau, Bukit Kitau (holotypus SAN!; isotypi K!, KEP!, L, SAR!).

Tree 15–20 m tall, 25–60 cm in diameter. Bark fissured or scaly, brown or reddish; inner bark brown or reddish. Sapwood yellowish to brownish. Twig densely appressed tomentose, later glabrescent, slightly fissured or sparsely large-lenticellate or smooth. Leaves thick coriaceous, rigid, glabrous or densely appressed yellowish tomentose above, densely appressed yellowish or brownish tomentose below; blades elliptic or broadly elliptic, 12.5–16.5(–29) x 4.5–7(–12.5) cm, base acute, margin recurved, apex acuminate, acumen c. 10 mm long; midrib broad, slightly raised above, strongly raised below, densely appressed tomentose on both surfaces; lateral veins thick, 12–14 pairs, lax, slightly raised or flat above, raised below, disappearing near the margin, forming an angle of 35°–45° with the midrib; intercostal veins scalariform, dense, obscure above, slightly prominent below; petioles 10–15 x 3–5 mm. Inflorescences and flowers unknown. Cupules solitary along the rachis, sessile, obovoid, 7–11 x 5–6.5 cm, base acute, top flat, glabrescent, lamellate; wall woody, thick, completely

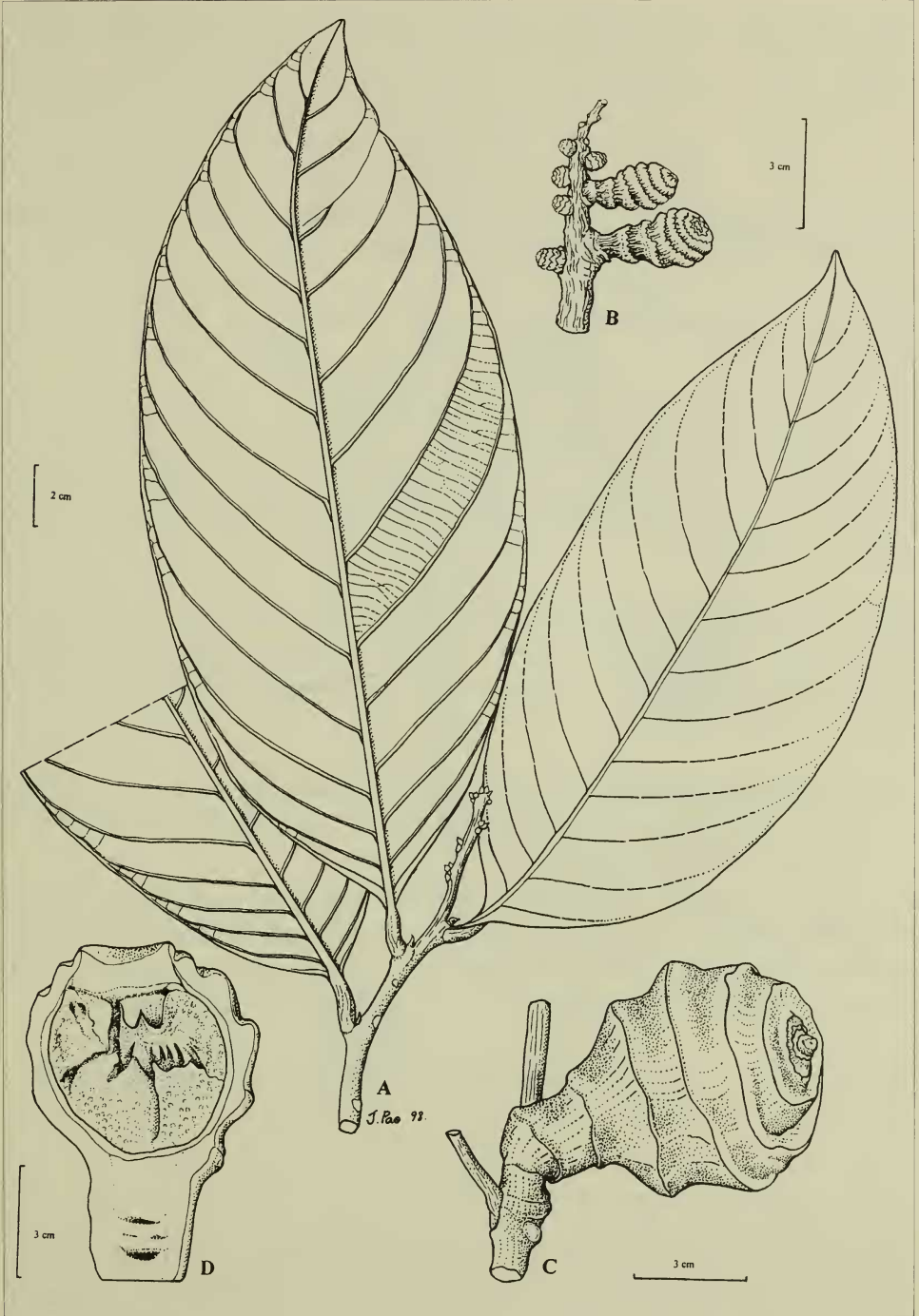


Figure 4. *Lithocarpus keningauensis* S. Julia & Soepadmo, *sp. nov.* A, leafy twig; B, young infructescence; C, mature cupule; D, longitudinal section of mature cupule (A & D from SAN 50208, B from SAN 92174, C from SAN 95311).

enclosing the acorn; lamellae strongly distinct even in the young cupule, folded inwardly, longitudinal groove entire or wavy at the top, set in 6–10 regular lines, protruding from the cupule surface. *Acorn* obovoid globose, 4.5–6 x 3–5 cm, densely tomentose, dark brown; scar deeply concave, c. 1 cm in diameter; wall woody, thick, greater parts adnate to the cupule.

Distribution: Endemic to Sabah, Borneo. Known only from Ulu Biah, Bukit Kitau and Keningau trail in Keningau, Sabah.

Ecology: In primary to disturbed forests on hill slopes, up to 300 m, on dark brown soils.

Notes: A species closely related to *Lithocarpus meijeri*, *Lithocarpus luteus* and *Lithocarpus sericobalanus* in leaf characters but can be easily distinguished from the three by its big and woody cupule, which is completely enclosing the acorn and by its strongly distinct lamellae even in the young cupule.

Specimens Examined: BORNEO. SABAH: Papar, Keningau trail, *Francis Sadau* SAN 50208 (KEP!, SAN!, SAR!); Keningau, Ulu Biah, *Oikawa* SAN 92174 (K!, KLU!, L, SAN!, SAR!); Keningau, Bukit Kitau, *Amin* SAN 95311 (K!, KEP!, L, SAN!, SAR!).

5. *Lithocarpus kochummenii* S. Julia & Soepadmo, sp. nov. Fig.5
(K. M. Kochummen, senior forest botanist at the Forest Research Institute Malaysia, Kepong)

Lithocarpo cooperto simillimus, sed foliis maioribus crassioribus, venis lateralibus distincte brochidodromis, cupula maiore appendiculis validioribus spiniformibus differt. Typus: Bernard Lee S 38884, Borneo, Sarawak, Miri, Gunung Mulu NP (holotypus SAR!; isotypi K!, KEP!, SAN!).

Tree 15–30 m tall, 10–60 cm in diameter; stilt root up to 2 m high. Bark fissured or lenticellate, reddish brown. *Twig* densely tomentose, later glabrescent, sparsely to densely large-lenticellate. Stipules linear, 6–10 x 1 mm. *Leaves* thick coriaceous, rigid, sparsely appressed tomentose or glabrescent above, densely appressed brownish or yellowish tomentose below; blades broadly or rarely narrowly lanceolate or oblanceolate, (10–)14–18(–22) x (4–)5–7(–8.5) cm, base cordate or rounded, margin strongly recurved, apex sharply acute or acuminate, acumen 15–20 mm long; midrib broad, raised on both surfaces, stronger below, glabrescent or sparsely tomentose on both surfaces; lateral veins thick, (11–)14–18(–20) pairs, dense, strongly impressed or rarely flat above, strongly raised below, clearly joining



Figure 5. *Lithocarpus kochummenii* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, part of female inflorescence; C, longitudinal section of female flower; D, longitudinal section of male flower; E, top view of cupule; F, side view of cupule; G, longitudinal section of cupule showing the free acorn (A from S 4557, B–D from DK 964, E–G from S 38884).

near the margin, forming an angle of 30°–40° with the midrib; intercostal veins thin, scalariform, rarely subscalariform, lax, obscure above, thinly prominent below; petioles 5–10 mm long. *Inflorescences* male, female or androgynous. *Male inflorescences* in lateral or subterminal, dense paniculate clusters on the new shoot or solitary in the axils of distal leaves, 5–13 cm long; bracts acute-linear, 1.5–1.7 x 0.8 mm; bracteoles oblong, c. 0.5 x 0.2 mm. *Male flowers* solitary along the rachis; perianth 6-lobed, thin coriaceous, elliptic, c. 1.2 x 1 mm; stamens 12, filaments 2–2.5 mm long; pistillode c. 1 mm in diameter. *Female or androgynous inflorescences* solitary in the axils of distal leaves or in terminal, lax paniculate clusters on the new shoots, 7–15 cm long; bracts acute, c. 1.2 x 0.6–1 mm; bracteoles acute, c. 1 x 0.8 mm. *Female flowers* solitary along the rachis; perianth 6-lobed, thick coriaceous, ovate-acute, c. 1.1 x 0.8 mm; staminodes 10–12; styles 3, conical, recurved, c. 2 mm long. *Cupules* solitary along the rachis, sessile, conical-ovoid, 2–2.5 cm across, densely tomentose with simple and stellate hairs, scaly or with spine-like appendages; wall woody, thin, enclosing the acorn completely; spine-like appendages distinct, broad and sturdy, straight or slightly recurved, set irregularly. *Acorn* conical, 1.5–2 cm across, densely tomentose with simple hairs, rarely glabrous, brown, base flat, top acute; scar deeply concave, 1.3–1.5 cm in diameter; wall woody, thin, greater parts free from the cupule.

Vernacular name: Sarawak: *salad* (Murut).

Distribution: Endemic to Borneo. Recorded from Gunung Mulu, Ulu Sg. Kayan in Belaga, Batu Lawi in Bario and Ulu Sg. Masia, Kota FR in Lawas, Sarawak. Also known from Bukit Tudal, Temburong, Brunei.

Ecology: In submontane, *kerangas* and riparian forests, at 900–1280 m.

Notes: Closely related to *Lithocarpus coopertus* but differs by its much larger and thicker leaves with clearly looped lateral veins, and larger cupule with sturdier spine-like appendages.

Specimens Examined: BORNEO. SARAWAK: Kalabit Highland, foot of Batu Lawi, a tributary of Sg. Tabun, *Nooteboom & Chai 2314* (K!, KEP!, SAR!). Baram, Gunung Mulu, path from Sg. Melinau Paku, *Anderson S 4557* (K!, SAN!, SAR!); Limbang, Lawas, along Sg. Masia at Maligan Range, *Ilias Paie S 32852* (KEP!, SAR!); Limbang, Lawas, Ulu Sg. Masia in Kota FR, *Tong & Jugah S 32911* (KEP!, SAR!); Miri, Gunung Mulu NP, *Martin S 38182* (K!, KEP!, SAN!, SAR!); Miri, Gunung Mulu NP, *Bernard Lee S 38884* (K!, KEP!, SAN!, SAR!); Kapit, Belaga, Dulit Range,

Ulu Sg. Kayan, *Dayang Awa & Yii S 46836* (K!, KEP!, SAR!); BRUNEI: Temburong subdistrict Amo, Bukit Tudal, *Kirkup 964* (BRUN, K!, KEP!).

6. *Lithocarpus melataiensis* S. Julia & Soepadmo, **sp. nov.**

Fig.6

(Of Bukit Melatai, Sarawak)

In folii characteris Lithocarpo pusillo simillimus, petiolo longiore, cupula maiore, glande piloso differt. Typus: Yii S 48455, Borneo, Sarawak, Kapit, Batang Balleh, Bukit Melatai (holotypus SAR; isotypi: BKF, K, KEP!, KLU!, L).

Tree 12–27 m tall, 25–70 cm in diameter. Twig sparsely tomentose, smooth or fissured. Stipules linear, *c.* 10 x 1 mm. *Leaves* thin coriaceous, sparsely appressed brownish tomentose above, densely yellowish brown tomentose, sometimes with simple hairs below; blades narrowly elliptic, 9–13.5 x 2–3 cm, base sharply acute or cuneate, margin recurved, apex caudate or long acuminate, acumen 15–22 mm long; midrib slightly raised on both surfaces, glabrous above, sparsely appressed tomentose with simple hairs below; lateral veins thin, (8–)9–12 pairs, dense, flat above, raised below, faintly joining towards the margin, forming an angle of 30°–40° with the midrib; intercostal veins (sub)scalariform, lax, obscure on both surfaces or slightly prominent below; petioles 6–12 mm long. *Inflorescences* male and female. *Male inflorescences* in lateral or subterminal, lax to dense paniculate clusters on the new shoot or solitary in the axils of distal leaves, 5–11 cm long; bracts linear-triangular, 1–1.3 x 0.3 mm; bracteoles acute, 0.4–0.6 x 0.3–0.5 mm. *Male flowers* solitary along the rachis; perianth 6-lobed, coriaceous, ovate-rounded, 1–1.2 x 0.5–1 mm; stamens 12, filaments 2–2.5 mm long; pistillode globose, *c.* 1 mm in diameter. *Female inflorescences* in terminal, lax paniculate clusters on the new shoot, 9.5–12.5 cm long; bracts linear-triangular, *c.* 1.2 x 0.3–0.5 mm; bracteoles acute-rounded, 0.2–0.3 mm across. *Female flowers* solitary along the rachis; perianth 6-lobed, thick coriaceous, ovate-acute, 0.4–0.6 x 0.2–0.3 mm; staminodes 10; styles 3, conical, straight, *c.* 1 mm long. *Cupules* solitary along the rachis, sessile, deeply saucer-shaped, 0.4–0.7 x 1.2–1.7 cm, densely tomentose with stellate and simple hairs, lamellate; wall bony, thin, enclosing less than half of the acorn; lamellae distinct, minutely denticulate, set in 6–8 regular lines. *Acorn* conical, 1.7–2 x 1.1–1.5 cm, densely simple hairy, brown; scar concave, 0.7–1 cm in diameter, base flat, top sharply acute; wall bony, thin, greater parts free from the cupule.

Distribution: Endemic to Sarawak, Borneo. So far only collected from Bukit Melatai and Ulu Balleh in Kapit division.



Figure 6. *Lithocarpus melataiensis* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, male inflorescence; C, longitudinal section of male flower; D, female inflorescence; E, longitudinal section of female flower (A, D & E from S 48455, B–C from S 48454).

Ecology: Mixed dipterocarp forests at altitude 300–880 m.

Notes: A species closely related to *Lithocarpus pusillus* in leaf characters but differs by its bigger cupule, hairy acorn and longer petiole.

Specimens Examined: BORNEO. SARAWAK: Kapit, Ulu Balleh, above Sg. Mengiong, *Othman Haron S 29203* (AA, BO, K, KLU!, L, MEL, SAN!, SAR!); Kapit, Batang Balleh, Bukit Melatai, Camp. 2, *Yii & Jegong S 48440* (BKF, K, KEP!, KLU!, L, SAR!); Kapit, Batang Balleh, Bukit Melatai, Camp. 2, *Yii S 48454* (BKF, K, KEP!, KLU!, L, SAN!, SAR!); Kapit, Batang Balleh, Sg. Melatai, Bukit Melatai, above camp 2, *Yii S 48455* (BKF, K, KEP!, KLU!, L, SAR!), *S 48463* (BKF, K, KEP!, KLU!, L, SAR!).

7. *Lithocarpus muluensis* S. Julia & Soepadmo, sp. nov.
(Of Gunung Mulu, Sarawak)

Fig.7

Folii textura Lithocarpo rigido simillimus, folii basi late acuto ad rotundato, petiolo plerumque longiore, venis lateralibus angustioribus, glandis apice rotundato differt. Typus: Illias Paie S 15082, Borneo, Sarawak, Gunung Mulu (holotypus SAR!).

Tree 12–24 m tall, 15–75 cm in diameter. Bark flaky. *Twig* glabrescent, fissured or sparsely lenticellate. *Leaves* thick coriaceous, rigid, glabrous above, sparsely appressed yellowish tomentose below; blades elliptic to broadly elliptic, (8–)11–17 x (4.5–)5.5–8.5(–9) cm, base broadly acute, margin strongly recurved, apex acute to acuminate, acumen (5–)13–23 mm long; midrib raised on both surfaces, stronger above, glabrescent; lateral veins thin, 9–15 pairs, dense or lax, slightly raised on both surfaces, faintly joining towards the margin, forming an angle of 40°–50° with the midrib; intercostal veins (sub)scalariform, lax, obscure on both surfaces; petioles (8–)10–13(–15) mm long. Inflorescences and flowers unknown. *Cupules* in clusters of 2 along the rachis when young, later solitary along the rachis, sessile, saucer-shaped, 1.8–2.4 x 2–2.5 cm, sparsely stellate-tomentose, scaly; wall woody, thick, enclosing less than half of the acorn; scales distinct, broad and rigid, set irregularly. *Acorn* depressed subglobose, 1.8–2.4 x 2–2.5 cm, glabrous and shiny, dark brown, base flat, top rounded; scar deeply concave, 1.5–1.7 cm in diameter; wall woody, thick, greater parts free from the cupule.

Distribution: Endemic to Sarawak, Borneo. So far only collected from Gunung Mulu in Miri division.

Ecology: In primary hill and submontane forests, 1350–1500 m.

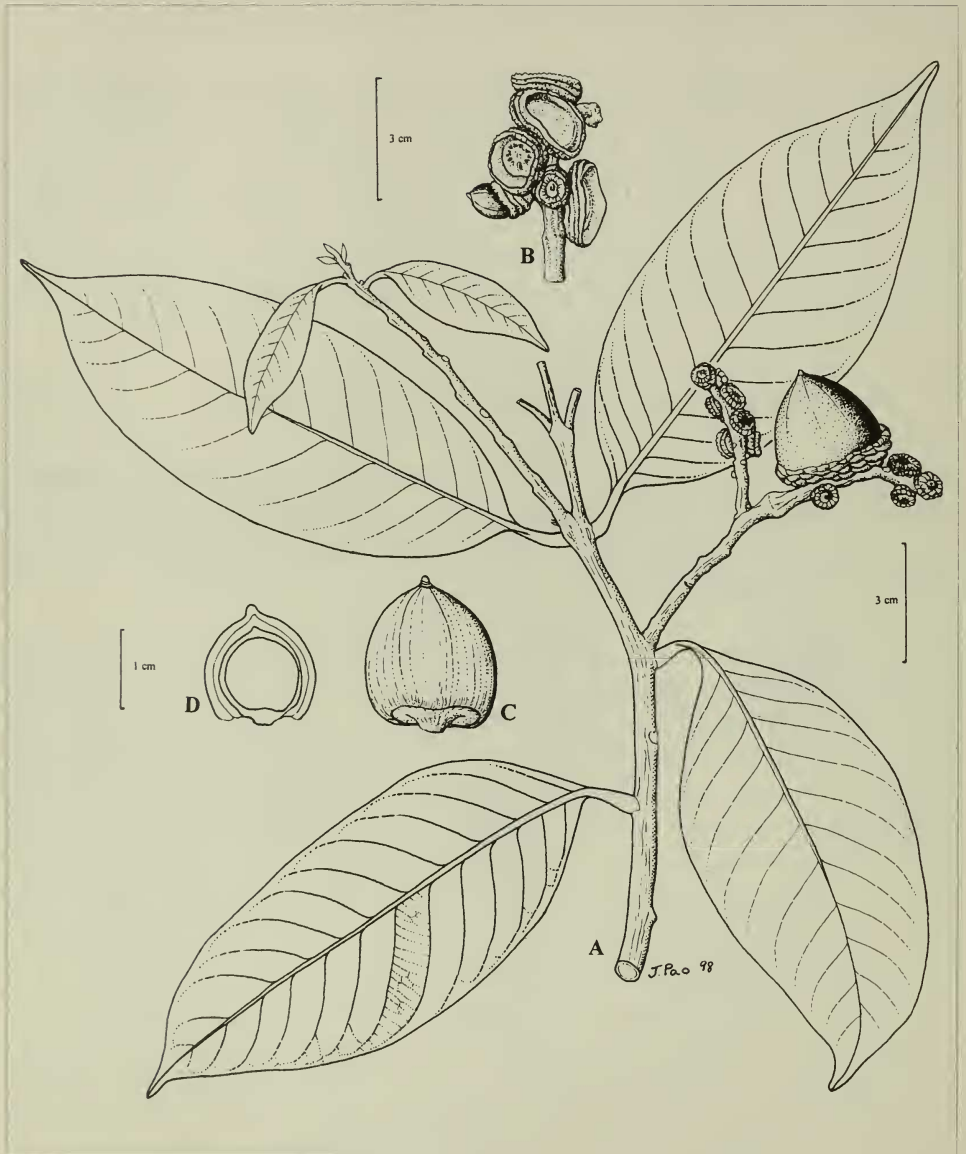


Figure 7. *Lithocarpus muluensis* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, infructescence showing cup-shaped cupules; C, acorn; D, longitudinal section of acorn (A–B from *S 15082*, C–D from *S 15081*).

Notes: A species closely related to *Lithocarpus rigidus* in leaf texture but differs by its broadly acute or rounded leaf base, usually longer petiole, thinner lateral veins, and acorn with rounded apex.

Specimens Examined: BORNEO. SARAWAK: Gunung Mulu, path from Sg. Melinau Paku, *Anderson S 4506* (AA, K, L, SAN!, SAR!, SING), *S 4598* (AA, K, L, SAN!, SAR!, SING); Gunung Mulu, *Ilias Paie S 15077* (SAR!), *S 15081* (BO, K, L, SAN!, SAR!, SING), *S 15082* (SAR!); Miri, Mulu NP, Gunung Mulu, Camp. 3, *Yii & Abu Talib S 58283* (K, KEP!, KLU!, L, SAN!, SAR!).

8. *Lithocarpus oblancifolius* S. Julia & Soepadmo, **sp. nov.**

Fig.8

(Latin, *oblancifolius*=with reversed spear-shaped leaves)

In foliis characteris Lithocarpo lucido simillimus, sed cupula minore tenuiore, glande conico, venarum lateralium numero minoribus, venis intercostalibus minus prominentibus differt. Cupula cupulae Lithocarpi papilliferi similis sed folia differunt. Typus: Leopold Madani SAN 133942, Borneo, Sabah, Tawau, Tawau Hill Park (holotypus SAN!).

Tree up to 24 m tall, 20–45 cm in diameter. Bark lenticellate or smooth, brown or greyish; inner bark greyish to yellowish. Sapwood whitish to yellowish. Twig sparsely tomentose, later subglabrescent, smooth or sparsely large-lenticellate. Stipules linear, *c.* 2 x 1 mm. Leaves thin coriaceous, glabrous above, sparsely appressed greyish tomentose below; blades oblanceolate, (6–)8–13.5 x (2.5–)3–4.5 cm, base cuneate, margin recurved, apex rounded or shortly acute; midrib raised on both surfaces, stronger below, glabrescent; lateral veins thin, 8–13 pairs, lax, flat or impressed above, raised below, joining near the margin, forming an angle of 30°–50° with the midrib; intercostal veins reticulate or subscalariform, dense, obscure above, prominent below; petioles 3–5 x 2 mm. Inflorescences male, female, androgynous or mixed. Male inflorescences in lateral, lax to dense paniculate clusters on the new shoot, 3–11 cm long; bracts linear, *c.* 1 x 0.3 mm; bracteoles linear, *c.* 5 x 0.1 mm. Male flowers solitary along the rachis; perianth 6-lobed, thin coriaceous, ovate or elliptic, 0.8–1 x 0.6–0.8 mm; stamens 10–12, filaments *c.* 2 mm long; pistillode globose, 0.7–0.8 mm in diameter. Female or androgynous inflorescences in subterminal, lax paniculate clusters on the new shoot or solitary in the axils of distal leaves, 4–12 cm long; bracts linear-acute, 1–1.2 x 0.2–0.4 mm; bracteoles acute, *c.* 0.5 x 0.2 mm. Female flowers solitary along the rachis; perianth 6-lobed, coriaceous, broadly acute or rounded, 0.5–0.9 x 0.5–0.7 mm; staminodes 12; styles 3, conical, recurved, 1–1.2 mm long. Cupules solitary along the rachis, sessile, saucer-shaped, 1–1.2 x 1.6–2 cm, densely appressed tomentose

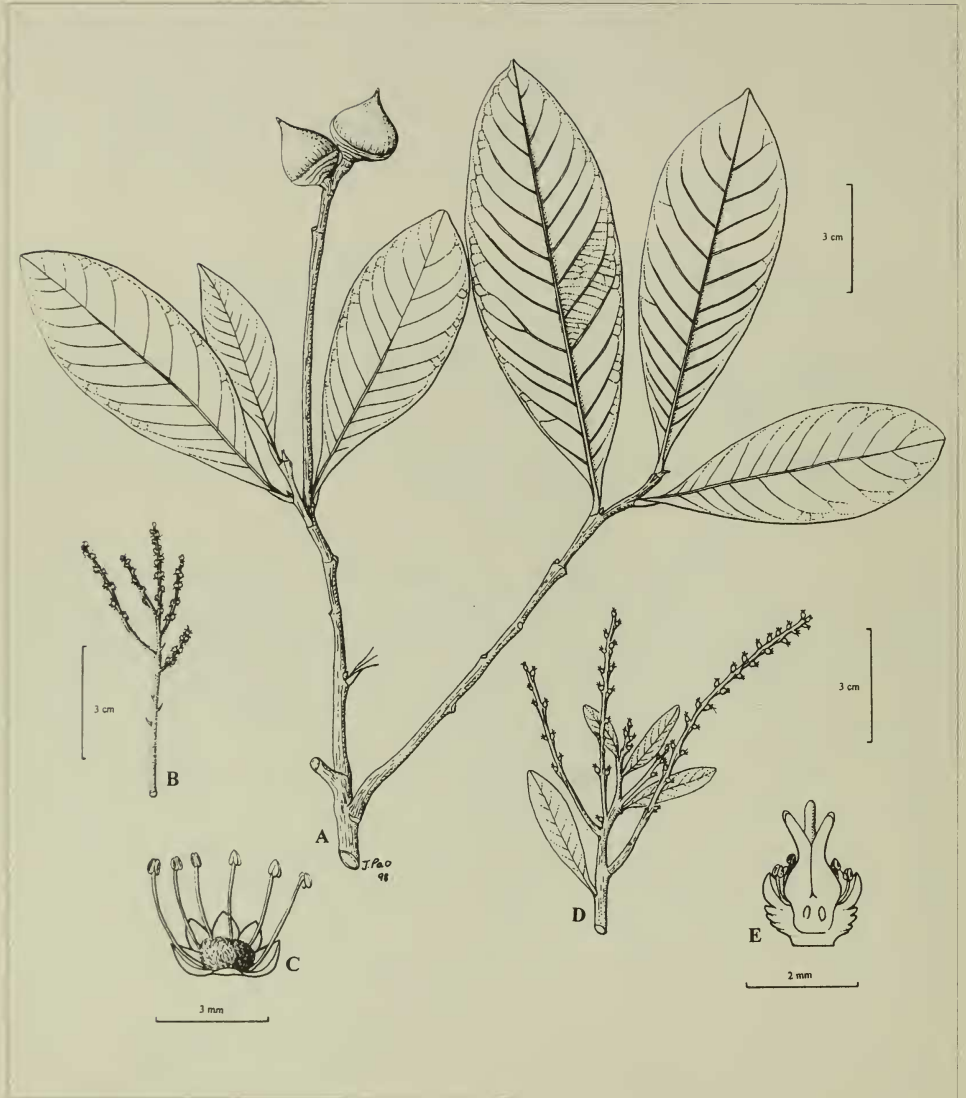


Figure 8. *Lithocarpus oblancifolius* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, male inflorescence; C, longitudinal section of male flower; D, female inflorescence; E, longitudinal section of female flower (A from SAN 132942, B–C from SAN 91636, D–E from SAN 111174).

with stellate and simple hairs, lamellate; wall woody, thin, enclosing less than half of the acorn; lamellae distinct, entire, set in 6–8 regular lines. *Acorn* ovoid-conical, 1.6–1.8 x 1.6–2 cm, glabrous, brown, base flat, top acute; scar concave, c. 1.5 cm in diameter; wall bony, thick, greater parts free from the cupule.

Distribution: Endemic to Sabah, Borneo. Collected from Tawau Hill Park in Tawau and Sg. Piso in Labuk Sugut area.

Ecology: Near the riverbank, rather open area at altitude c. 90 m.

Notes: A species closely allied to *Lithocarpus lucidus* in leaf characters but differs by its smaller and thinner cupule, conical acorn, less number of lateral veins and by its less prominent intercostal veins. The cupule is similar to that of *Lithocarpus papilifer* but the leaves are different.

Specimens Examined: BORNEO. SABAH: Labuk Sugut, Sg. Piso, *Aban Gibot & Dewol* SAN 91636 (K, SAN!); Tawau, Tawau Hill Park, Water Pump, *Leopold Madani & Sigin* SAN 111174 (K, L, SAN!, SAR!); Tawau, Tawau Hill Park, *Leopold Madani et al.* SAN 133942 (SAN!).

9. *Lithocarpus sandakanensis* S. Julia & Soepadmo, sp. nov. Fig.9
(Of Sandakan, Sabah)

Lithocarpus stonei simillimus, foliis tenuioribus, cupula parum minore, glande piloso distinguendus. Typus: Wood SAN A 4697, Borneo, Sabah, Sandakan, Sepilok FR, Compartment 17 (*holotypus* KEP!; *isotypi* AA, L, MEL, SING).

Tree 10–45 m tall, 15–90 cm in diameter; buttresses small. Bark smooth, greyish or brownish; inner bark yellowish. Sapwood whitish or purplish. *Twig* glabrescent, sparsely lenticellate. *Leaves* coriaceous, sparsely appressed yellowish tomentose or glabrescent above, densely appressed brownish tomentose below; blades broadly elliptic-oblong, 26–39(–46) x 7.5–11.5 cm, base acute-rounded, margin recurved, apex sharply acute to acuminate, acumen c. 15 mm long; midrib flat or slightly raised above, strongly raised below, glabrous on both surfaces; lateral veins thick, 11–14 pairs, dense, flat or impressed above, strongly raised below, disappearing towards the margin, forming an angle of 30°–45° with the midrib; intercostal veins subscalariform or reticulate, lax, thinly prominent on both surfaces, stronger below; petioles 8–18 x 3–6 mm. *Male inflorescences* c. 10 cm long; bracts linear-acute, 1–1.1 x 0.4 mm; bracteoles linear-acute, c. 0.6 x 0.2 mm. *Male flowers* solitary along the rachis; perianth 6-lobed, coriaceous, elliptic, 1.1–



Figure 9. *Lithocarpus sandakanensis* S. Julia & Soepadmo, *sp. nov.* A, leafy twig; B, part of infructescence; C, longitudinal section of cupule and acorn (All from SAN A 4697).

1.3 x 0.6–0.8 mm; stamens 10, filaments *c.* 2 mm long; pistillode subglobose, 0.6–1 mm in diameter. Female inflorescences and flowers unknown. *Cupules* solitary along the rachis, 0.5–0.7-cm-stalked, cup-shaped, 1.5–2 x 3–3.5 cm, densely tomentose, lamellate; wall woody, thick, enclosing up to half of the acorn; lamellae distinct, minutely denticulate or wavy, set in 7–8 regular lines. *Acorn* depressed ovoid, 3.5–4 cm across, densely tomentose with simple hairs, dark brown, base flat, top acute; scar deeply concave, *c.* 2 cm in diameter; wall woody, thick, greater parts free from the cupule.

Distribution: Endemic to Sabah, Borneo. All known specimens were collected from Sepilok FR, Sandakan.

Ecology: Primary lowland mixed dipterocarp forest, on yellow soil, up to 15 m altitude.

Notes: A species closely related to *Lithocarpus stonei* but can be distinguished by its much thinner leaves, slightly smaller cupule and by its hairy acorn.

Specimens Examined: BORNEO. SABAH: Sandakan, 15 miles W of Sandakan, Sepilok FR, Compartment 17, *Wood SAN A 4697* (AA, KEP!, L, MEL, SING); Sandakan, Sepilok FR, Jalan Batu 15, *Patrick SAN 19698* (KEP!, SAN!); Sandakan, Sepilok FR, Batu 15, *Meijer SAN 34286* (K, L, SAN!); Sandakan, Sepilok FR, Jalan Kantor Pos, *Patrick SAN 62061* (SAN!); Sandakan, Arboretum, Mile 14, *Aban Gibot, Kumin & Rakim SAN 73710* (SAN!).

10. *Lithocarpus stonei* S. Julia & Soepadmo, **sp. nov.** Fig.10
(B. C. Stone, 1933 – 1994, former Reader in Botany, Department of Botany, University of Malaya, Kuala Lumpur, Malaysia)

Species cupula magna lignosa cupuliformi, glande magno glabro apice nitido rotundato, foliis crassis rigidis notata. Cupulae Lithocarpi revoluti satis similis sed folii characteri differunt. Typus: Yap & Khairuddin SAN 106051, Borneo, Sabah, Tambunan road (*holotypus* SAN!; *isotypus* KEP!).

Tree 10–25 m tall, 60–100 cm in diameter. Bark fissured or smooth or lenticellate, dark grey; inner bark fibrous, yellowish brown or whitish. Sapwood whitish. *Twig* densely tomentose, sparsely to densely large-lenticellate. *Leaves* thick coriaceous, rigid, densely appressed yellowish tomentose above, sparsely yellowish tomentose below; blades broadly elliptic-oblong, 28–36(–40) x 9–14 cm, base rounded to broadly acute, margin recurved, apex acuminate, acumen *c.* 15 mm long; midrib strongly raised

on both surfaces, stronger below, sparsely appressed tomentose on both surfaces, denser above; lateral veins thick, (9–)10–12 pairs, lax, flat or impressed above, strongly raised below, disappearing towards the margin, forming an angle of 30°–45° with the midrib; intercostal veins reticulate, lax, obscure above, prominent below; petioles 10–15 x 5–7 mm, kneed. Male inflorescences and flowers unknown. *Female inflorescences* solitary in the axils of distal leaves, much branched and sturdy, c. 20 cm long; bracts linear-acute, 2–2.5 x 0.2–0.5 mm; bracteoles broadly acute, c. 0.5 x 0.7 mm. *Female flowers* in clusters of 2–3 along the rachis; perianth 6-lobed, coriaceous, acute, c. 1 x 0.5 mm; staminodes 12; styles 3, conical, straight, c. 1.5 mm long. *Cupules* in clusters of 2–3 or rarely solitary along the rachis, sessile, deeply cup-shaped, 2–3 x 4–5 cm, densely tomentose, lamellate; wall woody, 3–5 mm thick, enclosing half or more than half of the acorn; lamellae strongly distinct, folded inward, wavy, set in 7–9 regular or irregular lines. *Acorn* depressed ovoid globose, 3–4 x 3–5 cm, glabrous and shiny, brownish, base flat, top rounded; scar deeply concave, 2–2.5 cm in diameter; wall woody, thick, greater parts free from the cupule.

Vernacular name: Sarawak: *saled urong* (Kelabit).

Distribution: Endemic to Borneo. In Sabah, collected from Crocker Range in Tenom, Gunung Alab and Tambunan road in Tambunan. In Sarawak, collected only from Sg. Marariro in Bario area.

Ecology: In lower montane forest, on recent alluvium, clay soils, at 960–1050 m.

Notes: A species characterised by its big, woody and cup-shaped cupule, big, glabrous acorn with shiny and rounded apex, and by its thick and rigid leaves. The cupule is rather similar to that of *Lithocarpus revolutus* but the leaf characters are different.

Specimens Examined: BORNEO. SABAH: Tambunan District, Crocker Range, Kota Kinabalu to Sunsuron Road, *Andrews 851* (K!); Tambunan, Crocker Range, along Tambunan-Penampang road, *Sugau et al. JBS 66* (AA, AAU, EDH, HAST, K, KEP!, L, PNH, SAN!, SAR!, SING); Kota Kinabalu, Tambunan Road, *Yap & Khairuddin SAN 106051* (KEP!, SAN!); Tambunan, Gunung Alab, km 56, Jalan Kota Kinabalu-Tambunan, *Fidilis & Sumbing SAN 121701* (K!, KEP!, L, SAN!); Tenom, Crocker Range, *Meijer SAN 136522* (CHI, KY, SAN!). SARAWAK: Bario, Ulu Baram, path to Pa'Main, near Sg. Marariro, *Anderson S 20067* (SAN!, SAR!).

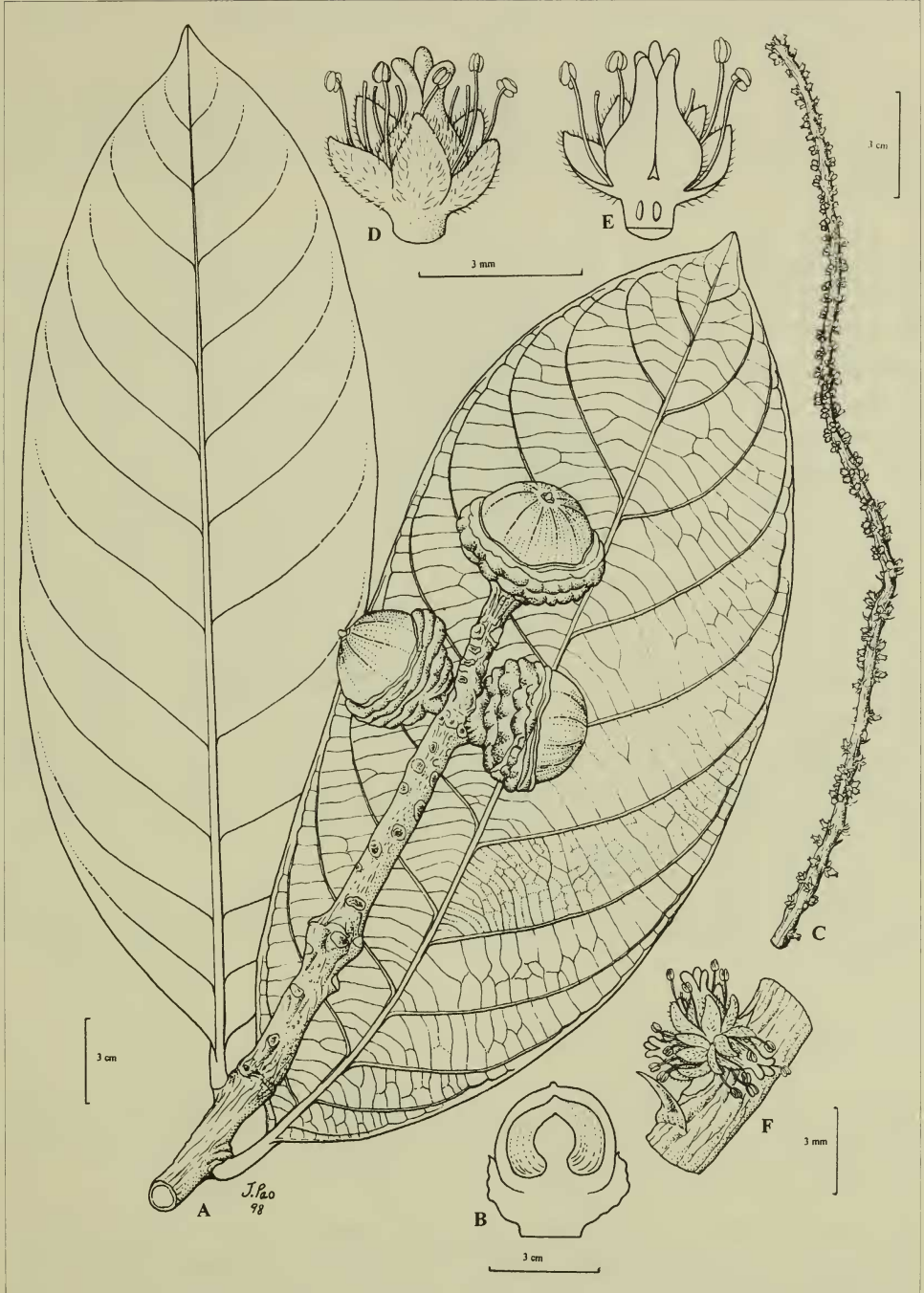


Figure 10. *Lithocarpus stonei* S. Julia & Soepadmo, *sp. nov.* A, fruiting leafy twig; B, longitudinal section of cupule; C, female inflorescence; D, female flower; E, longitudinal section of female flower; F, part of female inflorescence (A–B from SAN 106051, C–F from SAN 136522).

11. *Lithocarpus tawaiensis* S. Julia & Soepadmo, sp. nov.
(Of Bukit Tawai, Sabah)

Fig.11

Ab generis speciebus omnibus foliis sessilibus crasse coriaceis rigidis, basi cordato, venis lateralibus fere invisibilis, inflorescentiis masculis validis differt.

Typus: Berhaman et al. SAN 134267, Borneo, Sabah, Bukit Tawai (holotypus KEP!).

Stunted treelet of about 1–1.5 m tall and c. 5 cm in diameter. Bark pale brown. Twig sparsely appressed tomentose, smooth. Stipules ovate-rounded, 10–13 x 10–18 mm. Leaves sessile, thick coriaceous, rigid, glabrous above, sparsely appressed yellowish tomentose or glabrescent below; blades ovate-rounded, 6.5–10.5 x 6–9 cm, base cordate, margin recurved, broadly acute; midrib raised on both surfaces, slightly stronger below; lateral veins thin, 10–12 pairs, dense, flat and almost invisible on both surfaces, faintly joining near the margin, forming an angle of 20–30° with the midrib; intercostal veins reticulate, dense, obscure above, slightly prominent below. Male inflorescences in lateral or terminal, lax paniculate clusters on new shoots or solitary in the axils of distal leaves, 6–15 cm long; bracts and bracteoles ovate-acute, 0.6–0.8 x 0.4–0.6 mm. Male flowers solitary or in clusters of 2–3 along the rachis; perianth 6-lobed, thick coriaceous, elliptic, c. 1.2 x 0.7 mm; stamens 12, filaments c. 2 mm long; pistillode globose, c. 0.5 mm in diameter. Female inflorescences and flowers unknown. Young cupule solitary along the rachis, sessile, saucer-shaped, 1–1.3 x 0.3–0.4 cm, scaly, enclosing less than half of the acorn; scales distinct, set irregularly. Acorn for the greater parts free from the cupule.

Distribution: Endemic to Borneo. Twice collected from Bukit Tawai, Telupid, Sabah.

Ecology: Primary hill forest on ultrabasic soil.

Notes: A species differs from any other known species of the genus by its sessile, thick coriaceous and rigid leaves with cordate base and almost invisible lateral veins, and its sturdy male inflorescences.

Specimens Examined: BORNEO. SABAH: Telupid, summit of Bukit Tawai, Berhaman et al. SAN 134267 (KEP!); Telupid, Bukit Tawai, Sugau et al. SAN 138832 (KEP!, SAN!).



Figure 11. *Lithocarpus tawaiensis* S. Julia & Soepadmo, *sp. nov.* A and B, flowering (male) leafy branches; C, distal twig with axillary, branched male inflorescence; D, distal part of male inflorescences with flower buds; E, cluster of 3 male flowers; F, proximal twig with young infructescence; G, cluster of 3 developing cupules and acorns; H, very young developing cupule; I, young infructescence; J, mature cupules; K, detailed venation on the leaf undersurface (A–H from SAN 134267; I–K from SAN 138832).

New record

Lithocarpus hystrix (Korth.) Rehder

The species is previously known from Sumatra, Peninsular Malaysia and Kalimantan in Borneo (Soepadmo 1972). Recent collections extend the distribution to Sarawak and Brunei.

Specimens Examined: SARAWAK: Bintulu division, Bukit Lumut, *Abg. Mohtar & Yii S 65896* (BKF, K, KEP!, L, SAN!, SAR!); 7th Division, Belaga, Dulit Range, Ulu Sg. Kayan, *Dayang Awa & Yii S 46731* (BKF, K, KEP!, KLU!, L, SAR!); Lundu, Pasir Tengah/Biawak, *Othman Ismawi et al. S 63890* (BKF, K, KEP!, KLU!, L, SAR!); 1st division, Lundu, Sampadi FR, Syarikat Woodworking Salmas, *Othman Ismawi S 37824* (K, KEP!, KLU!, L, SAR!); Kapit District, Bukit Raya, *Soepadmo & Chai S 28198* (AA, BO, K, KLU!, L, SAN!, SAR!, SING); Simanggang, Ulu Skrang, path to Bukit Sadok, *Ilias Paie, Banyeng & Manggi S 44907* (BKF, K, KLU!, L, SAR!); 4th division, Gunung Mulu NP, *Martin S 38902* (K, KEP!, KLU!, L, SAN!, SAR!); 1st and 2nd division boundary, Ulu Simunjan, Gunung Angkong, *Martin S 36953* (K, KEP!, KLU!, L, MO, SAR!); 1st division, Padawan, Bukit Woen, *Yii S 61453* (BKF, K, KEP!, KLU!, L, SAR!). BRUNEI: Temburong River Valley, *Johns 7325* (BRUN, KEP!).

Acknowledgements

We wish to extend our gratitude for the support and encouragement extended by the Director-General of FRIM, Kepong and to the Curators of K, L, SAN and SAR herbaria for the loan of specimens. We are also deeply indebted to Dr. J.F. Veldkamp of the Rijksherbarium, Leiden, the Netherlands for providing the Latin diagnoses of the new species, and to Ms. Rosemary Wise (OFI) and Mr. Joseph Pao (SAR) for preparing the illustrations. The research was part of the Tree Flora of Sabah and Sarawak Project, funded by the International Tropical Timber Organization (ITTO), the Malaysian Government, and the Overseas Development Administration of the United Kingdom (ODA-UK).

References

Soepadmo, E. 1972. Fagaceae. *Flora Malesiana* **7**, **2**: 318–385.