

## *Lithocarpus pulongtauensis* (Fagaceae), a new species from Borneo

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We describe a new species of *Lithocarpus* from the central Kelabit Highlands of Sarawak, Malaysia with a distribution extending north to Mt. Kinabalu, Sabah. This species was included in a previous morphometric and phylogenetic study of the section *Synaedrys*, mistakenly identified as *L. rotundatus*. Several individuals were observed on the western slopes of Mt. Kinabalu between the elevation of 1200–1500 meters. The species has a distinctive cupule, which usually completely encloses the nut and is very dark in color, almost black with a brittle texture similar to charcoal. The fruit is semi-hemispheric in shape and the bracts on the cupule are entirely fused, relatively sparse, stiff, brittle, and prominent.

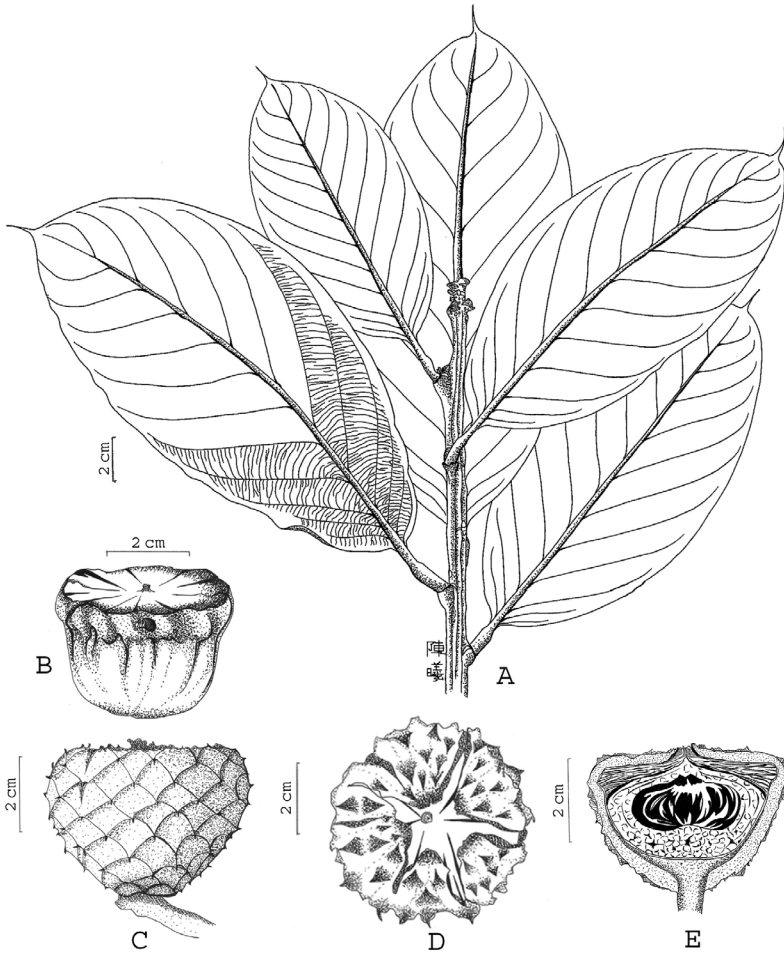
After carefully examining an excellent example of *Lithocarpus rotundatus* (L.), the authors were able to determine that several specimens had been previously misidentified as *L. rotundatus*. These specimens actually represent a new species. Data from these specimens have been used in several previous analyses (Cannon & Manos 2000, 2001, 2003). Detailed photographs and morphological descriptions were provided of these misidentified specimens (Cannon & Manos 2000). The new species described in that paper, *L. palungensis*, is still valid. The confusion involves *L. rotundatus* and the new taxon described here. The confusion could have been avoided if careful attention had been paid to the description of *L. rotundatus* (Soepadmo 1970, 1972). The specimens of the new species described here clearly have a different cupule but the authors had previously not been able to

locate adequate material of *L. rotundatus* for a conclusive identification. Very few specimens of the taxon exist and most of these do not include mature fruit, which are critical for the identification of *Lithocarpus* species.

***Lithocarpus pulongtauensis*** C.H. Cannon & Chen, *sp. nova* (Fig. 1)

*Arbores celsae raro inclinatae cortice laevi. Cupula nigricans manifeste diagonaliter porcata crasse lignea appendicibus brevibus erectis ligneis. Semen in receptaculo ligneo inclusum obconicum ad subhemisphaericum.*

TYPE: Malaysia. Sarawak, Bario, Pa Dappur, Ulu Sg. Menalio, Route to Tama Abu Range. 1050 m a.s.l. 4.IX.1985 *Dayang Awa S51088* (holotype L, *carpologica* 20181).



**Fig. 1.** *Lithocarpus pulongtauensis* (all specimens in L). — **A:** Branch tip with leaves (*Ilias bin Pais S.28579*). — **B:** Nut removed from cupule (*Sidiyasa & Arifin 2567*). — **C:** Fruit lateral view (*Dayang Awa S.51088*). — **D:** Fruit top view (*Dayang Awa S.51088*). — **E:** Radial dissection of fruit (*Cannon 97.548*).

**TREES:** large, 20–35 m tall, the bole dark and rather smooth.

**BRANCHLETS:** glabrous, becoming deeply ridged at tips upon drying, usually a rufous-brown color. Young expanding leaves drying blackish and lustrous, slightly resinous.

**STIPULES:** caducous, small, absent from most specimens, leaving a small lacunar scar.

**PETIOLE:** 1.5–2.5 cm long, 0.2–0.6 cm across, terete, broadly thickened to 3/4 length, straight, slightly grooved above, glabrous, dark reddish-brown to black.

**LEAVES:** evergreen, stiffly chartaceous to slightly coriaceous, 16–23 cm long, 7–16 cm across, broadly elliptical to slightly obovate. Lamina above glabrous, greenish-brownish, occasionally slightly waxy in appearance. Lamina below lightly reddish brown to yellow-

ish green, slightly glaucous, densely covered with minute appressed hairs (*see Cannon & Manos 2000: fig. 4*), erect hairs absent. Margins entire, occasionally very slightly undulate. Base acute to obtuse, attached to adaxial side of petiole. Apex roundly obtuse with a short board driptip, occasionally slightly folded. Midrib raised below and slightly above, glabrous with a central groove on both sides. Secondary veins (9–11 pairs), visible above, clearly visible below and slightly raised, evenly spaced down the midrib, arising at 40–50 to midrib, veins curving smoothly near margins and gradually disappearing without anastomosing, sharply bent near their origin on midrib. Tertiary veins absent to slightly visible above, visible below, largely percurrent without much branching.

**STAMINATE INFLORESCENCE:** not seen.

**PISTILLATE INFLORESCENCE:** one flower per cymule, no immature fruits seen.

**INFRACTESCENCE:** a spike, up to 19 cm long and 1 cm thick, heavily covered in pale lenticels, round in cross-section.

**MATURE CUPULE:** shortly and thickly pedicellate, obconical to rounded hemispherical, 4–6 cm across, 3–4 cm tall, and up to 0.5 cm thick, woody and hard, completely enclosing nut except for a small 0.3–0.4 cm opening above a persistent stigma, occasionally dehiscing irregularly along a few major lines, fused to nut except for distal end where exocarp has become flattened and oriented perpendicularly to central axis of fruit. Abscission scar deeply concave and glabrous. Exterior of cupule always quite dark, brown to blackish, sometimes slightly glaucous in appearance near base. Appendages of cupule forming thick and woody ridges that form diamond-shaped patterns. A tiny free bract occasionally present at intersection of ridges. Ridges arranged in a broadly spiral pattern.

**MATURE NUT:** 3–4.5 cm across, 1.5–2.5 cm tall, subhemispherical, abscission scar from cupule broadly convex, very hard, central axis with seed cavity poorly developed. Ovary wall quite flat and not extended beyond receptacle, entirely glabrous, lustrous, embryos seldom found inside developed fruit. Cotyledons free.

*Lithocarpus pulongtauensis* possesses the same fruit type as *L. rotundatus* and belongs in the section *Synaedrys* (Cannon & Manos 2000). Taxa in this section produce seeds that are enclosed in a heavily lignified receptacle. The ‘enclosed receptacle’ or ER nut does not ‘abscise’ from the cupule as a typical acorn nut does. Instead, the seed falls from the tree with the fruit still inside its cupule. The ER fruit type appears to be associated with a shift in seed chemistry, towards producing larger seeds with higher concentrations of non-structural carbohydrates and lower concentrations of indigestible fibers than the stereotypical ‘acorn’ fruit, in which the thin exocarp encloses the seed (Chen 2010). This shift appears to be correlated with the development of strong mechanical protection, releasing the seed from investment in anti-feedants. These ER nuts can also be dormant for up to a year before germination (Ng 1991), which is an unusual strategy among tropical

trees in the Southeast Asian rainforests.

The new species has close affinities with *Lithocarpus echinifer*. The vegetative material of both species is similar and the density and prominence of the cupular appendages are similar. The fruit of the new species are much larger than *L. echinifer* and the cupule has a slightly brittle and corky texture with regular diamond-shaped ridges. One specimen is difficult to confidently place into one of these two groups and clearly illustrates the connection between the two taxa (*L. Ilias bin Paie S.28579*). This specimen also represents the southernmost collection of the new taxon, found in the upper Rajang in central Sarawak, Malaysia. This taxon is largely confined to the north central mountain range of the island of Borneo and has a similar biogeographic distribution to *L. echinifer*. The two taxa also have quite different ecological distribution, as *L. echinifer* is found in the lowlands, often near the coasts, while the new taxon is an upland species. The first author found a grove of these trees on the western slopes of Mt. Kinabalu, along the path from the village of Kiau to the ultrabasic savannah at roughly 1700 m a.s.l. These trees had recently fruited and good samples were collected from the ground.

The species name serves to highlight the region where the type specimen was collected. Pulong Tau National Park, in the Kelabit Highlands of Sarawak, was initially proposed in 1984 by the National Parks & Wildlife Office and supported with a petition from the local community (National Parks & Wildlife Office Sarawak 1984). The proposed park covered 164 500 ha and included Gunung Murud (Sarawak’s highest peak), the spectacular twin peaks of Batu Lawi and the Tamu Abu mountain range (Anon. 1998). The largely undisturbed uplands are a fantastically interesting region on the island of Borneo and possess several endemic species (Sang & Soepadmo 1998) and unique genetic diversity (Kamiya *et al.* 2002, Cannon & Manos 2003).

The national park was officially recognized by the Sarawak government as a national park in 2005. The park is currently part of the ITTO sponsored Tranboundary Biodiversity Conservation project (<http://www.itto-pulongtau.com/>). The park possesses a rich and relatively unexplored flora (Pearce 2006).

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