

Reinstatement of *Lithocarpus longispinus* (Fagaceae): a species confined to the Malay Peninsula (southern Thailand and Peninsular Malaysia)

WEI HARN TAN¹, SUKONTIP SIRIMONGKOL², FAIZAH METALI¹ & JOERI SERGEJ STRIJK^{3,*}

ABSTRACT

Lithocarpus is a major Asian endemic genus of (sub)tropical trees found throughout the region. The nearly 350 species can be difficult to identify in the absence of good fruiting material, often leading to confusion and misidentification. Once recognized as a distinct species, *Lithocarpus longispinus* is currently a heterotypic synonym of *Lithocarpus wrayi*. Following careful examinations and comparisons of herbarium specimens throughout the distribution range, along with in situ collections, we find distinct morphological differences between the two species. Here we define the diagnostic morphological traits, provide a complete description of the species along with an initial conservation assessment and propose the reinstatement of *L. longispinus*.

KEYWORDS: Indochina, Malesia, nomenclature, Stone oak, Sundaland, taxonomy.

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INTRODUCTION

After *Quercus* L. (Oaks), *Lithocarpus* Blume (Stone oaks) is the second largest genus in Fagaceae with currently 347 recorded species. Stone oaks have a wide geographic distribution, ranging from northeast India to south China, southern Japan and Taiwan, and extending throughout South-East Asia to New Guinea (Cannon & Manos, 2003). These ubiquitous evergreen trees are ecologically important in both tropical and subtropical rainforests of Asia as the acorns are an important fallback source of food for animals and insects in times of famine (e.g., Wong *et al.*, 2002; Luskin & Ke, 2017; Harapan *et al.*, 2023; Payne & Zainudin, 2023). Stone oaks can be found in a wide range of different habitats, from lowlands and swamps to montane forests. Much of the diversity of *Lithocarpus* is centred around SE Asia, encompassing the biogeographic regions of Indochina, Sundaland and Wallacea (Cannon & Manos, 2003; Strijk *et al.*, 2020; Strijk, 2025).

The Dipterocarp-dominated tropical rainforest of the Malay Peninsula (i.e., southern Thailand, Peninsular Malaysia, and Singapore) is part of the megadiverse Sundaic region (Myers *et al.*, 2000). Peninsular Malaysia has an estimated 9,030 vascular plant taxa comprising 248 families and 1,651 genera (Yong *et al.*, 2021). This includes a diverse assemblage of *Lithocarpus* with over 43 species, and at least four of these are endemic to Peninsular Malaysia (Cockburn, 1972). The remainder of the species have either a distinct Indo-Burmese (8 spp.), Sundaland (23 spp.) or regionally localised to widespread distribution (8 spp.). Substantial work on SE Asian Fagaceae was done in the past decades in Flora Malesiana (Soepadmo, 1972b) and the Tree Flora of Malaya project (Cockburn, 1972). New treatments for the family in the Flora of Peninsular Malaysia, CLV (Cambodia, Laos and Vietnam) and a revision for Flora Malesiana are currently being prepared.

¹ Faculty of Science, Universiti Brunei Darussalam, Jalan Tungku Link BE1410, Brunei Darussalam.

² Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Bangkok 10900, Thailand.

³ Alliance for Conservation Tree Genomics, Kuala Lumpur 51000, Malaysia.

* Corresponding author: jsstrijk@actg.science

Following fieldwork and reviewing specimens from herbaria, we came across a peculiar *Lithocarpus* acorn that was enclosed in a cupule, covered with soft pseudo-spines, resembling those of the rambutan fruit (*Nephelium lappaceum* L.). Based on the literature (Cockburn, 1972; Soepadmo, 1972b), the traits of these were later found to match those of *L. longispinus* Barnett. However, *L. longispinus* is currently treated as a heterotypic synonym of *L. wrayi* (King) A. Camus (synonymised in Phengklai's (2008) treatment of Fagaceae for the Flora of Thailand without justification). Based on the distinct morphological differences observed, *L. longispinus* should be recognised as a separate species from *L. wrayi*. Here we re-establish *L. longispinus* and identify the diagnostic characters that distinguish it from *L. wrayi* and other similar species in the range.

MATERIALS AND METHODS

Comparative traits were examined through careful analysis of specimens from herbaria, both online (A, ABD, BM, CAL, E, K, L, P) and in person (BK, BKF, HN, KEP, QSBG, UM). For *Lithocarpus wrayi*, we supplemented our observations with fresh specimens collected from Royal Belum State Park.

We examined a total of 39 specimens:

a) *Lithocarpus longispinus* (five from herbaria and one collected during fieldwork). Of the herbarium specimens, 40% have flowers, and 60% have fruits. No specimens have both.

b) *Lithocarpus wrayi* (32 from herbaria and one collected during fieldwork). Of the herbarium specimens, 23% have flowers, and 54% have fruits. No specimens have both and 23% of the specimens were sterile.

TAXONOMIC TREATMENT

Lithocarpus longispinus Barnett, Bull. Misc. Inform. Kew 1938: 100. 1938.— Type: [Thailand], Pattani, Kao Kalakiri, alt. 300 m, 9 Sept. 1923, A.F.G. Kerr 7755 (lectotype **K** (K000832434!), designated here, Fig. 1A; isolectotypes **ABD** (ABDUH2/937!), **BM** (BM015153409!), **K** (K000832435!)).

Tree, bark smooth, greyish. Twigs thin, lightly covered in lenticels, glabrous, young twigs covered

in very fine adpressed hairs, 0.3 cm thick. *Petiole* relatively short and thin, 0.9×0.1 cm, blackish brown. *Leaves* simple, thin-papery, 20.5–22.2 $\times$ 5.5–6.7 cm, elliptic, apex acute or apiculate, base cuneate, margin entire, both surfaces glabrous, midrib raised on both sides, more prominent on the underside, secondary veins 12–14 pairs, raised below, flat above, tertiary veins subscalariform, obscure above, faintly visible on the underside of leaf. *Inflorescences* male, female or androgynous, axis sparsely covered in fine adpressed hairs, bracts narrowly ovate, sparsely tomentose. *Male axis* flowers in clusters of 3, perianth deeply incised, lobes 5–6, stamens 10–12, filaments 4–5 mm long, anthers 0.35 mm long, pistillode subglobose, 1–1.5 mm long; androgynous axis 10–15 cm long, 1–2 mm thick. *Female axis* up to 15 cm long, flowers solitary or in clusters of 2, styles 3, terete, 0.1 cm to 0.5 cm. *Peduncle* glabrous, immature, 15–20 cm long, 0.2 cm thick, young acorns widely spread throughout, up to 21 fruits around 1 cm apart; mature peduncle shorter, around 8 cm in length, 0.2 cm thick, with very few acorns, solitary. *Acorn* 1.8–2 $\times$ 1.7–2.1 cm. *Cupule* sessile, green when fresh, fully enclosing the nut or up to 20% of the nut exposed, densely covered in soft pseudo spine scales, flayed outwards when fresh like rambutan, recurving towards the base when dried. *Pseudo-spines* densely tomentose, on average 0.8 cm long and can be up to 1.2 cm long, base distinct, irregularly arranged. *Nut* ovoid, free except for the scar, concave, wall thin, 0.1 cm thick, outer wall densely tomentose, silver when fresh and tawny when dried. (Fig. 1A–F).

Phenology.— No clear pattern observed, with flowering occurring in January–March and fruiting in September–November.

Distribution and habitat.— Southern Thailand and Peninsular Malaysia. Found in lowland to hill dipterocarp forest; 300–600 m alt.

Specimens examined.— Peninsular Malaysia. — Selangor [Ulu Gombak, alt. 450 m, 3 Nov. 1961, Poore 987 (**KLU!**); Genting Sempah, alt. 600 m, 19 Mar. 1963, bin Rajab 2167 (**KLU!**); 16 May 1963, bin Rajab 1505 (**KLU!**); 6 Sept. 1963, bin Rajab 1548 (**KLU!**); 9 Sept. 1964, bin Rajab 1585 (**KLU!**)]. Thailand.— PENINSULAR: Yala [Bang Lang National Park, alt. 80 m, 8 Feb. 2004, Middleton *et al.* 2789 (**BKF!**)].

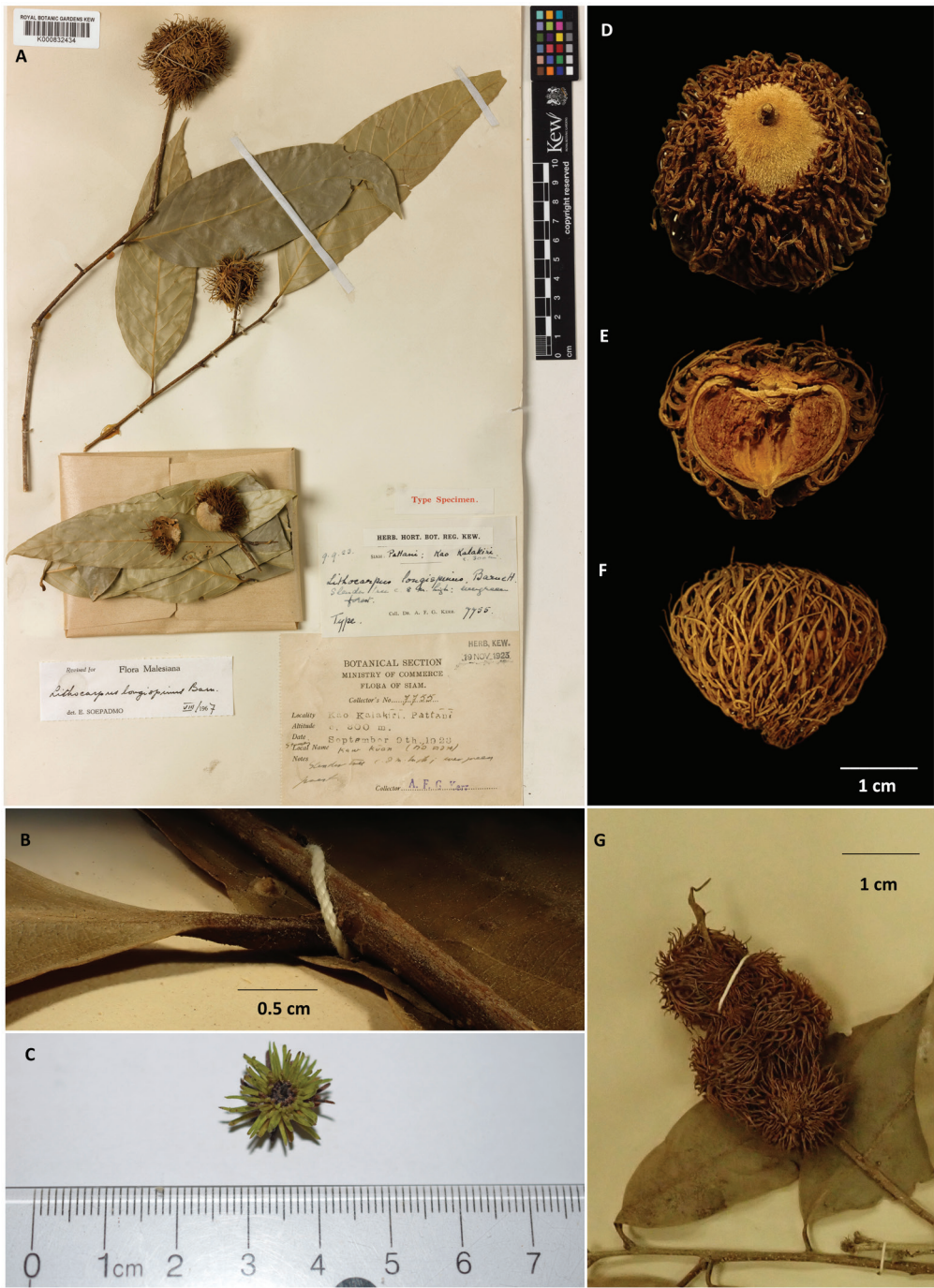


Figure 1. *Lithocarpus longispinus* Barnett. A. Lectotype specimen, reproduced with permission © The Board of Trustees of the RBG, Kew; B. Close-up of petiole; C. Immature acorn from the field; D–F. Close-up and cross section of matured acorn; G. Matured acorn bunch (photos B–G by W.H. Tan).

Lithocarpus wrayi (King) A.Camus, *Riviera Sci.* 18: 42. 1931.— *Quercus wrayi* King, *Ann. Roy. Bot. Gard. (Calcutta)* 2: 77. 1889.— *Pasania wrayi* (King) Gamble, *J. Asiat. Soc. Bengal*, Pt. 2, Nat. Hist. 75: 446. 1915.— *Synaedrys wrayi* (King) Koidz., *Bot. Mag. (Tokyo)* 30: 187. 1916.— Type: [Peninsular Malaysia], Perak, *L. Wray Jr. 2854* (lectotype **K** (K000832425!)), designated by Soepadmo (1972a: 288), Fig. 2A; isolectotypes **A** (A00033996!), **BM** (BM000951958!), **CAL** (CAL0000014777!), **SING** (SING0045392!, SING0045393!)].

Tree, bark smooth, greyish. *Twigs* fulvous, sparsely lenticellate. *Petiole* fulvous. *Leaves* simple, thin-coriaceous, 16.5–19 × 4.6–5.4 cm, elliptic, apex aristate by 2 cm, base cuneate, margin entire and pubescent, slightly recurved downwards, pubescent on both sides, midrib raised on both surfaces, secondary nerves 14–15 pairs, flat on top and prominently raised on the bottom, fulvous, tertiary nerves subscalariform, visible on both sides. *Inflorescences* male or androgynous, densely yellowish-brown pubescent with erect simple hairs; bracts narrowly ovate-acute, 2–3 by 0.7–1 mm, bracteoles 0.7–1 by 0.3–0.5 mm. *Male axis* 10–20 cm long; male flowers solitary or in clusters of 3, perianth 5–7-lobed, stamens 10–12, filaments 3–4 mm, anthers 0.25–0.30 mm long, pistillode subglobose. *Androgynous axis* 10–15 cm long; female flowers solitary, perianth 6-lobed, staminodes 12, rather well-developed but not exceeding the perianth, styles 3, conical, 1–2 mm, male flowers clustered at the tip. *Peduncle* pubescent, covered in yellow tomentose, fruits clustered with up to 8 acorns. *Acorn* 1–1.5 × 2–2.5 cm. *Cupule* sessile, green when fresh, wall thin, fully enclosing the nut or with the apex exposed, surface densely covered in imbricated soft pseudo-spines scales that curve towards the apex. *Pseudo-spines* subulate, sparsely covered in erect hairs. *Nut* ovoid, free except for the scar, concave, wall thin 0.1 cm thick, outer wall densely tomentose, silver when fresh and tawny when dried. (Fig. 2A–F).

Phenology.— No clear pattern observed, with flowering occurring in January–March and fruiting in July–September.

Distribution and habitat.— Indochina (unconfirmed), Peninsular Malaysia, Thailand and Sumatra. Found in lowland to hill dipterocarp forest; 30–1,200 m alt.

Specimens examined.— Peninsular Malaysia. — Terengganu [Dungun, 12 Sept. 1996, *Anonymous s.n. KL4624* (**KEP!**); Kuala Terengganu, Bukit Lanjut, 20 Sept. 1969, *Suppiah FRI11834* (**KEP!**); Selangor [Hulu Selangor, Semangkok, alt. 850 m, Aug. 1968, *Ando AKK394* (**KEP!**), *Ando AKK27* (**KEP!**); Perak [Hulu Perak, Piah Forest Reserve, 18 Feb. 1976, *Sidek SK480* (**KEP!**); Bintang Hijau Forest Reserve, alt. 450 m, 30 July 1970, *Everett FRI14525* (**KEP!**); Kuala Kangsar, Bubu Forest Reserve, 15 Feb. 1967, *Whitmore FRI1967* (**KEP!**); Batang Padang, Bukit Tapah Forest Reserve, 3 Apr. 1971, *Loh FRI17372* (**KEP!**); Pahang [Jerantut, Taman Negara, Sungai Riul, 12 Sept. 1976, *Everett FRI14433* (**KEP!**), 14 Sept. 1976, *Everett FRI14457* (**KEP!**); Temerloh, Krau Wildlife Reserve, Gunung Benom, 14 Mar. 1967, *Whitmore. FRI3159* (**KEP!**), Ulu Krau, 22 Apr. 1967, *Zahir KEP99126* (**KEP!**); Cameron Highlands, Sungai Parang, 8 Apr. 1934, *Jaamat FMS36154* (**KEP!**); Fraser's Hill, alt. 1,219 m, 15 Oct. 1966, *Kochummen FRI2154* (**KEP!**); 15 Nov. 1937, *Symington FMS45479* (**KEP!**); Negeri Sembilan [Jelebu, Pasoh Forest Reserve, 6 Feb. 1937, *Browne FMS46063* (**KEP!**); Kuala Pilah, Angsi Forest Reserve, 9 Dec. 1930, *Tachun FMS23740* (**KEP!**), 20 Feb. 1971, *Loh FRI17342* (**KEP!**); Senaling Inas Forest Reserve, 18 Sept. 1916, *Awang 707* (**KEP!**); Kelantan [Gua Musang, Sg. Nenggiri, 18 July 1967, *Whitmore FRI4096* (**KEP!**); Pasir Puteh, Chabang Tongkat Forest Reserve, 19 June 1968, *Suppiah KEP108870* (**KEP!**); Kedah [Pendang, 15 Nov. 1951, *Pendang FRI17184* (**KEP!**); Padang Terap, Koh Mai Forest Reserve, 20 July 1938, *Hassan FMS42434* (**KEP!**); Baling, Gunung Inas Forest Reserve, 7 Feb. 1968, *Burgess FRI4960* (**KEP!**); Kubang Pasu, Changlun, 9 July 1929, *Leh FMS17593* (**KEP!**); Kota Setar, July 1929, *Sidek FMS17590* (**KEP!**); Johor [Mersing, Jalan Mersing-Endau, alt. 15 m, 27 Oct. 1963, *Burkill HMB3221* (**KEP!**); Kota Tinggi, Panti Forest Reserve, alt. 30 m, 5 Mar. 1968, *Cockburn FRI7826* (**KEP!**)]. Thailand.— NORTH-EASTERN: Loei [Phu Kading, alt. 300 m, 18 Oct. 1968, *Anonymous s.n. BKF51830* (**BKF!**)].

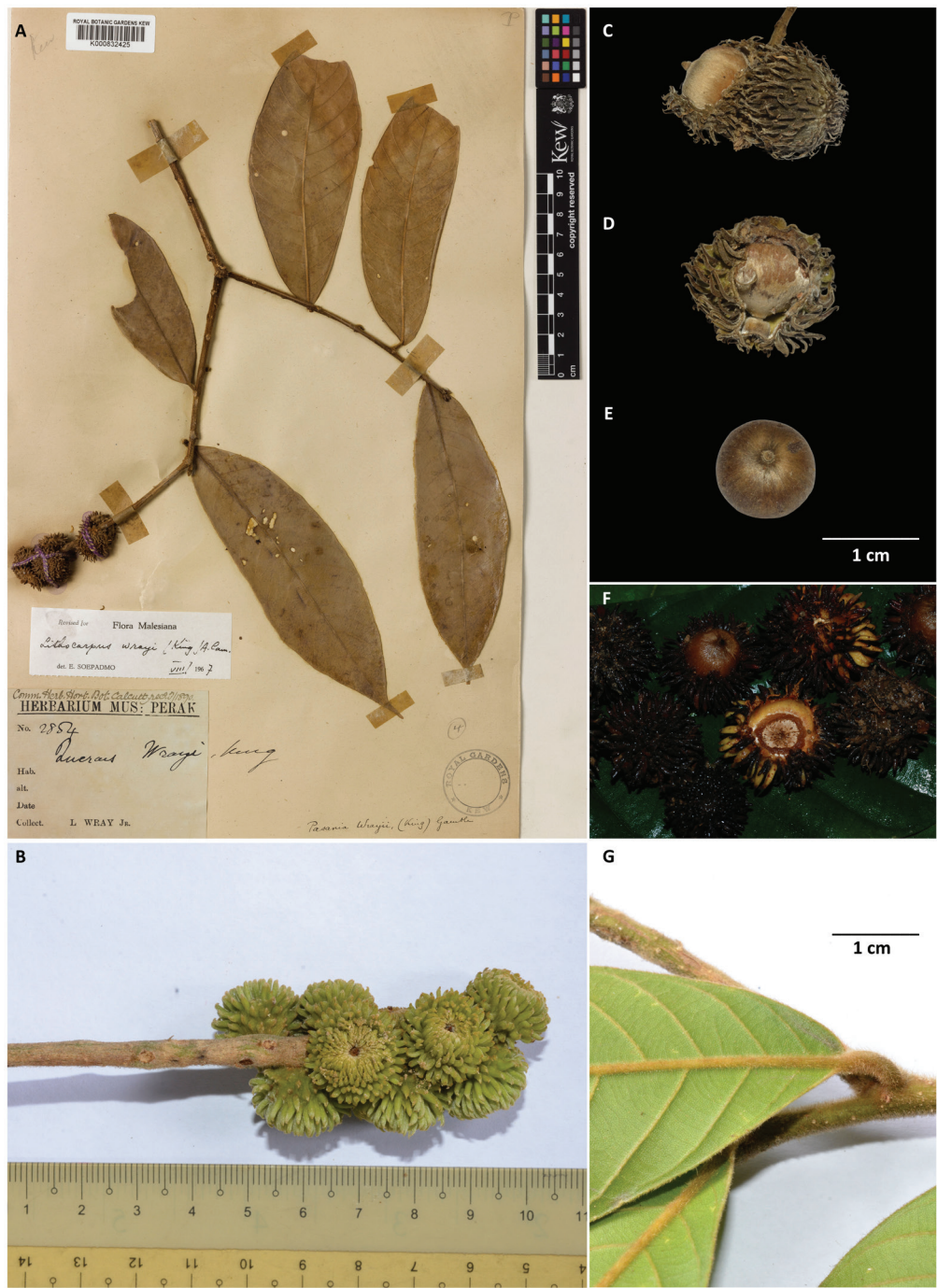


Figure 2. *Lithocarpus wrayi* (King) A.Camus. A. Lectotype specimen, reproduced with permission © The Board of Trustees of the RBG, Kew; B. Developing fruit bunch; C. Matured acorns; D. Acorn with nut exposed; E. Nut; F. Acorns collected in the field; G. Close-up of petiole (photos B–E and G by W.H. Tan and, F by J.S. Strijk).

Morphological differences between species

Both species are morphologically distinct and differ in several vegetative and reproductive characteristics, including leaf morphology, venation patterns, petiole structure, twig morphology, and cupule characteristics (Table 1).

Conservation status

Using the IUCN Red List guidelines (IUCN, 2024), we provide here an initial conservation assessment of the species as Data Deficient (DD), based on the limited number of records described here. We expect that additional historical collections are awaiting rediscovery in herbaria elsewhere and may have been erroneously identified as *Lithocarpus wrayi*. Not all collections of *L. longispinus* were made in protected areas, and we anticipate that more individuals exist in large, protected areas that straddle the Thai–Malay border zone (Hala-Bala Wildlife Sanctuary, Royal Belum State Park, Hutan Lipur Sungai Hitam). Additional survey work in these areas is recommended to expand our knowledge of population sizes and distribution. More information and images are available on the species webpages (www.asianfagaceae.com/lithocarpus_longispinus/ and www.asianfagaceae.com/lithocarpus_wrayi/) and GBIF (www.gbif.org).

DISCUSSION

Lithocarpus longispinus has hitherto been treated as a synonym of *L. wrayi* but clear morphological differences (Table 1) provide sufficient evidence to distinguish them as two distinct species. The leaves of *L. longispinus* are completely glabrous, thin and papery while the leaves of *L. wrayi* are pubescent, coriaceous with margins recurved downwards. Moreover, the obscure venation of *L. longispinus* is also different from the prominently tomentose venation of *L. wrayi*. Branchlets and petioles of *L. longispinus* are completely glabrous in contrast to the tomentose branchlets and petioles of *L. wrayi*. The fulvous nuts of both species are typically fully enclosed within a cupule covered with pseudo-spine like scales. The pseudo-spines are morphologically different between species, with the pseudo-spines of *L. longispinus* being thin, longer, glabrous and flayed out when fresh like those of *Nephelium lappaceum*, while the pseudo-spines of *L. wrayi* are short, subulate, sparsely hairy and curved towards the apex of the nut. Based on these distinct morphological differences, we recommend reviving *L. longispinus* as a separate species.

Little is known about the present distribution of *L. longispinus* other than from a few historical records in herbarium collections. These collections were concentrated in the two neighbouring districts

Table 1. Morphological diagnostic comparison between *L. longispinus* Barnett and *L. wrayi* (King) A.Camus.

Characteristics	<i>L. longispinus</i>	<i>L. wrayi</i>
Leaves	Completely glabrous	Pubescent on both sides and margin
Venation	Midrib and secondary venation obscure on both sides, glabrous	Midrib and secondary venation prominently raised on the abaxial surface, yellowish tomentose.
Twig	Completely glabrous	Densely fulvous
Petiole	Completely glabrous	Tomentose
Cupule	Pseudo-spines long (on average 0.8 cm, up to 1.2 cm long), thin like that in rambutan (<i>Nephelium lappaceum</i> L.).	Pseudo-spines short (c. 0.7 cm long), subulate and curved towards the apex like that of a lotus flower.

of Gombak and Genting Sempah, Northern Selangor. The most recent encounter was in the Berembun Forest Reserve, Negeri Sembilan where several eaten fragments of acorns were recovered. From these records, *L. longispinus* appears to be confined to the Malay Peninsula, with Pattani being its northernmost point. Further fieldwork is needed to confirm if *L. longispinus* continues to persist in previous collection sites which will help in expanding its known range with new records, followed by assigning its conservation status.

The reinstatement of *L. longispinus* as a species, along with the recent description of *Castanopsis corallocarpus* W.H.Tan & Strijk (Tan *et al.*, 2023) highlights the need for renewed efforts into the study of Fagaceae from Peninsular Malaysia. This is in line with the revision of the family as part of the Flora of Peninsular Malaysia project.

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