

## *Lithocarpus gigantophyllus* (Fagaceae), a new record from Loei province (Thailand)

JOERI S. STRIJK<sup>1,2,3,\*</sup> & HOANG THANH SON<sup>4</sup>

### ABSTRACT

A new record for the Flora of Thailand is reported, *Lithocarpus gigantophyllus*. The new record was discovered among Thai herbarium specimens during the Fagaceae Identification and Red Listing workshop, organised by BGCI and Pha Tad Ke Botanical Garden in Luang Prabang, Laos. For this species we provide colour images and a description of the collecting locality together with a morphological analysis and an updated key for the *Lithocarpus* species found in Thailand. The species is unique for Thailand in having a combination of large leaves, infructescences with variably developed cupules arranged in clumps, depressed, turbinate acorns with broad scars and golden silky hairs inside the cupules.

KEYWORDS: conservation assessment, Flora of Thailand, *Lithocarpus*, new record, taxonomy.

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### INTRODUCTION

The genus *Lithocarpus* Blume is the second largest genus in Fagaceae with over 330 species currently recognized (Strijk, 2019). Species occur in broad-leaf evergreen forests near sea level, to mixed forests at over 3,200 m elevation. The distribution range of *Lithocarpus* varies from warm-temperate, subtropical and tropical regions in eastern India to the southern islands of Japan, and east- and southward to include the Philippines and New Guinea. Since the first treatment of *Lithocarpus* in Thailand (Barnett, 1942) (30 spp.), intensified field surveys have revealed many new populations, records and several endemic species for Thailand (Phengklae, 2004; Strijk *et al.*, 2014a; Strijk *et al.*, 2014b). The most recent systematic treatment of *Lithocarpus* for the Flora of Thailand (Phengklae, 2008) describes 56 species, bringing the updated total to 58, the largest genus in the family in Thailand. While attending a Botanic Gardens Conservation International (BGCI) field workshop aimed at

teaching tropical Fagaceae identification and IUCN Red Listing skills at Pha Tad Ke Botanical Garden in Luang Prabang (Laos), herbarium specimens were brought by participants from herbaria in Thailand (Queen Sirikit Botanical Garden) and Vientiane (National University of Laos - FOF). Upon closer examination, these specimens revealed an erroneously identified specimen to hold a new record of *Lithocarpus* for Thailand.

### DESCRIPTION

***Lithocarpus gigantophyllus*** (Hickel & A. Camus) A. Camus, *Riviera Sci.* 18: 40. 1931; *Les Chênes*, T. 3 (2e partie), p. 1086–1088 (1952–1954); *Monogr. genre Lithoc.*, Atl., Pl. 495. (1948).— *Pasania gigantophylla* Hickel & A. Camus, *Chênes d'Indo-Chine* in *Ann. Sc. Nat.*: ser. 10, 3: 398, f. 4. 1921; in *Fl. Indo-Chine* 9: 986, f. 114. 1929. Type: Vietnam, Quảng Yên, *de Beauchaine 126* (lectotype P [P00744456!], designated here). Fig. 1.

<sup>1</sup> State Key Laboratory for Conservation and Utilization of Subtropical Agro-bioresources, College of Forestry, Guangxi University, Nanning, Guangxi 530005, China.

<sup>2</sup> Biodiversity Genomics Team, Plant Ecophysiology & Evolution Group, Guangxi Key Laboratory of Forest Ecology and Conservation (under state evaluation status), College of Forestry, Nanning, Guangxi 530005, China.

<sup>3</sup> Alliance for Conservation Tree Genomics, Daxuedonglu 100, Nanning, Guangxi 530005, China.

<sup>4</sup> Department of Forest Plant Resources, Silviculture Research Institute (SRI), Vietnamese Academy of Forest Sciences, 46 Duc Thang, Bac Tu Liem, Ha Noi, Vietnam.

\* Corresponding author: [jsstrijk@gmail.com](mailto:jsstrijk@gmail.com)

Small-medium sized tree, up to 16 m tall; bark grey-brown, dull, with deep furrows; sapwood white to orange-yellow, with inner bark ridges forming longitudinal slits in sapwood surface; young branches ashy-coloured, scaly, covered by short-velvety hairs. *Stipules* elongated, acuminate, somewhat persistent. *Leaves* lanceolate to ovate-lanceolate, up to 17–37 cm long, to 8–11 cm wide, apex acuminate, base long attenuate; margin entire, glabrous above, dull green, more brownish tinged, appearing glabrous below but with thin-walled hairs scattered on the thickened midrib which is prominent on both sides but especially on underside of the leaf, brown, thickened; lateral veins 15–16 pairs, nearly parallel in orientation, brown, slightly recurving towards the edge, secondary veins occasionally appearing near-opposite; petiole 1.5–2.5 cm long, thickened, glabrous. *Inflorescences* erect, with female (below) and male (above) flowers on the same rachis; male flowers maturing first; pedicel very short, covered mostly by the cup. *Infructescence* long, up to 16–20 cm long on thickened stalk, up to 1 cm in diameter and free of cupules at the base, glabrescent, with few fully developed acorns, maturing bi-annually. *Cupules* clustered in groups of three, (partially) fused at the base, tightly wrapping up to half of the height of the nut, deepened and narrowing cupshaped, up to 2–2.6 cm in diameter and up to 1 cm high, covered with white-yellow-grey hairs on the outside, and with golden silky hairs inside; outer surface of cup covered with numerous distinct scales, oval-lanceolate, pubescent, the top ones narrower but all long acuminate, erect (very distinct in young cupules). *Acorns* spread out along the rachis, more densely clustered towards the top but smaller in size. Nut half exposed, but occasionally nearly entirely enveloped (especially in young acorns); depressed, turbinate, truncate at the base, overall very rounded and mucronate at the top, diameter 2.2–2.4 cm, height 1.3–1.6 cm. *Nut* with blunt stylopodium and umbilical perianth, glabrous in the adult state, cracked, brown and with somewhat typical striated divisions, scar of nut flat or slightly convex, up to 1–1.2 cm across.

Thailand.— NORTH-EASTERN: Pha Som Dej – Pha Ta Lern trail, Phu Luang Wildlife Sanctuary, Phu Luang, Loei Province. 14 Oct. 2000, *Norsaengsri 1046* (QBG [no. 18274!]; BKF [SN142000]).

Distribution.— Cambodia (Thepong Province, Mt. Knang Repoeu), Vietnam (Quang Ninh and

Quảng Yên Provinces). An uncommon species in South-East Asia.

Ecology.—Deciduous to semi-evergreen forest, in open patches. Generally, found at medium elevations, in Thailand on table plateau mountain, around 1,500 m; in Cambodia reported from 700 m.

Vernacular.— Ko dum (ក្រៃជុំ)(Thailand); Dè cau, Dè lá-to, Gic-can (Vietnam).

Conservation assessment.— Known from only three locations in Vietnam, Cambodia and Thailand, the species is here classified under the Red List Assessment criteria as Endangered C1, as the current estimated number of species is fewer than 2,500 mature individuals and there has been a decline of more than 20% in 2 generations. Only three populations are known and in at least one of these regions (Vietnam: Quang Ninh and Quảng Yên Provinces) there has been extensive urban development over the past 20 years.

Notes.—The characters that distinguish *Lithocarpus gigantophyllus* from similar species in the region are: 1 – half exposed nuts, but occasionally nearly entirely enveloped (especially when young), and cupule wall covered with distinct pubescent erect scales, 2 – inner surface of cup covered in silky golden hairs, 3 – nut shape depressed, turbinate, truncate at the base, overall very rounded and mucronate at the top and 4 – distinctly spaced acorn placement and variable fruit development along a thickened rachis. *Lithocarpus gigantophyllus* is unique in having a combination of large leaves, infructescences with cupules arranged in clumps, depressed, turbinate acorns with broad scars and golden silky hairs inside the cupules. Other species with similar-sized leaves, lack this indumentum and fruit development characteristics, and have different scale types or fruits with scales arranged in rings or lamellae. Morphologically similar species have much broader continuous geographic ranges, while *L. gigantophyllus* is only known from three populations and has not been recorded in the intervening areas.

The collection *de Beauchaine 126* (P00744456) is chosen as lectotype for the presence of a complete infructescence structure and nuts. Presence of these features in collections of Asian Fagaceae greatly facilitate identification as the family is poor in diagnostic characters at the species-level. The other

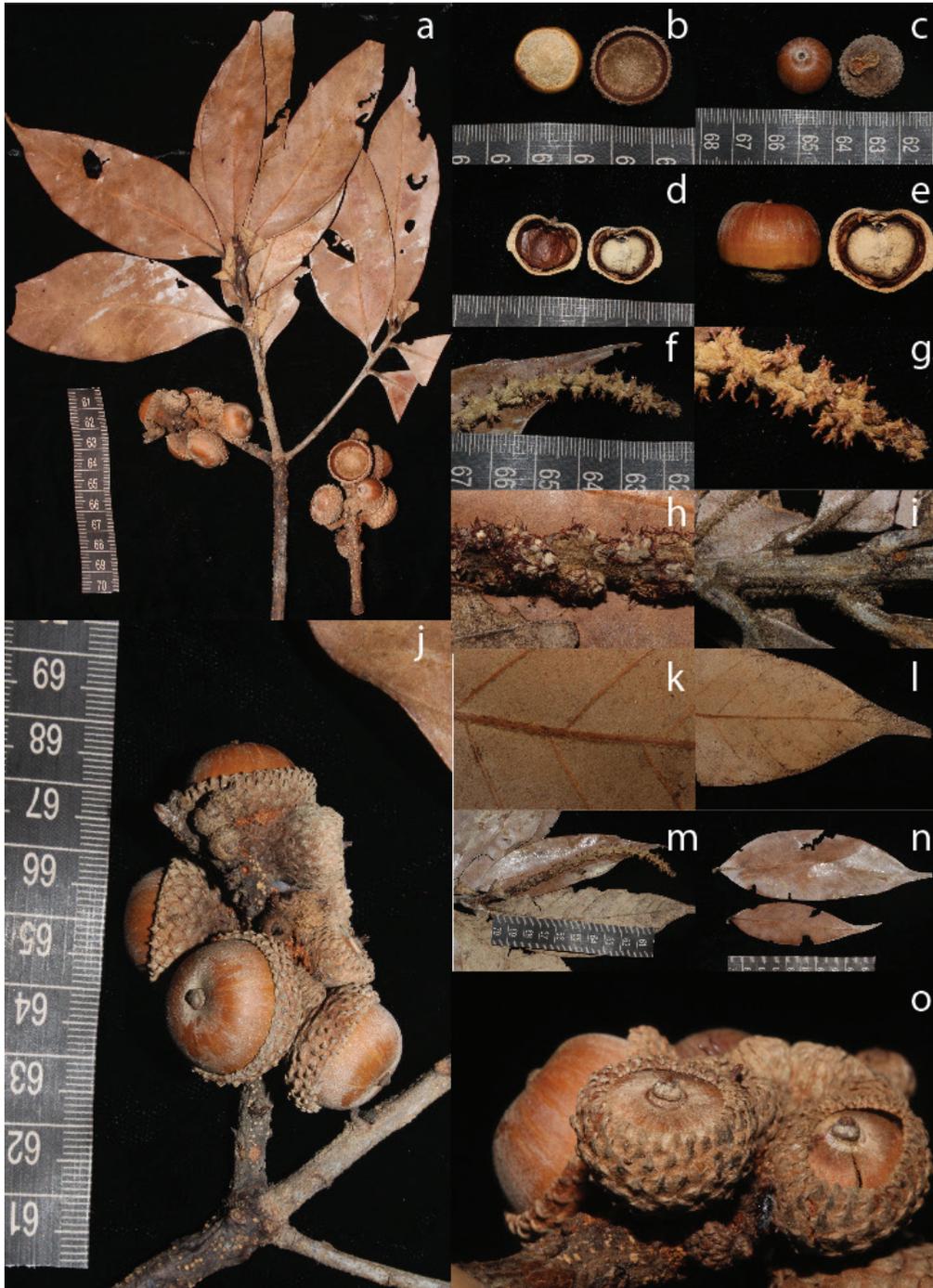


Figure 1. *Lithocarpus gigantophyllus* (Hickel & A.Camus) A.Camus., *Norsaengsri 1046*. (QBG no. 18274). a. Habit with infructescence. b. Under-surface of nut and inner surface of cupule. c. Top view of nut and under-surface of cupule plus stalk. d. Cross-section of cupule. e. Side view of nut and cross-section of cupule. f. Leaf apex and female flowers close up. g. Female flowers. h. Male flowers. i. Indumentum on twigs and petioles. j. Close up side view of mature infructescence. k. Primary venation on under-surface of leaf with indumentum. l. Leaf under-surface with dense hairs. m. Full view of mixed inflorescence and leaf upper and lower surface. n. Leaf shape. o. Close up of partial acorn envelopment in young acorns. Pictures by Hoang Thanh Son.

syntype collection for this species are sterile (*Pierre* 667, P00744474!, P00744476!, P00744475!, K000832470!; Cambodia: mont Knang Repoeu, Thepong).

Online resources.— More information, images and specimen data can be found online at: [http://www.asianfagaceae.com/lithocarpus/Lithocarpus\\_gigantophyllus/](http://www.asianfagaceae.com/lithocarpus/Lithocarpus_gigantophyllus/)

Table 1. Morphological differences between *Lithocarpus gigantophyllus*, *L. echinophorus* (Hickel & A.Camus) A.Camus, *L. echinops* Hjelmq., and *L. trachycarpus* (Hickel & A.Camus) A.Camus.

Characters	<i>L. gigantophyllus</i>	<i>L. echinophorus</i>	<i>L. echinops</i>	<i>L. trachycarpus</i>
Nut wall	Free from the cup	Free from the cup	Free from the cup	Free from the cup
Nut enclosure	Nut half exposed, but occasionally nearly entirely enveloped (especially in young acorns)	Nut enveloped by the cupule up to ½ to ⅔ of the nut	Nut nearly completely enclosed by cupule	Nut completely enclosed by cupule except the umbo
Nut shape	Depressed, turbinate, truncate at the base, overall very rounded and mucronate at the top, diameter 2.2–2.4 cm, height 1.3–1.6 cm	Ovoid to broadly ovoid, 1–1.5 by 2–2.5 cm, apex broadly conical, flattened at base	Broadly ovoid, 2.5–3 cm high, depressed at both ends	Broadly conical, 1.2–1.5 cm high
Cupule surface	Exterior of cupule covered with distinct scales, oval-lanceolate, pubescent, the top ones more narrow but all long acuminate and erect. Inner surface of cup covered in silky golden hairs	Cupule wall with alternate scales, fused at the base, free at apex, spreading there and more or less recurved	Cupule wall covered with alternate pseudo-spines and free scales, upper scales erect and the lower ones decurved	Cupule wall with alternate, grey pubescent scales, fused internally, except at apex where erect
Cupule shape	Deeply cup-shaped	Cupules nearly entirely fused, shape indistinct	Broadly cup-shaped	Broadly cup-shaped or ovoid
Leaf margin	Entire throughout	Entire throughout	Entire throughout	Entire throughout
Scar position, shape and size	Scar basal, flat or slightly convex and bulging, 1–1.2 cm in diameter	Scar basal, flattened (or somewhat concave), up to 2 cm in diameter	Scar extending up to half of the nut height	Scar basal, flattened or slightly concave, up to 1 cm in diameter
Nut indumentum	Young nut with white-yellowish indumentum	No hairs present	Sometimes with few silvery hairs	No hairs present

### Updated key for the species of *Lithocarpus* occurring in Thailand

Following the treatment of Fagaceae for the Flora of Thailand (Phengklai, 2008), no further comprehensive treatments have been published. In the updated key we include here, we incorporate the identification of *L. gigantophyllus* and add several additional corrections.

#### KEY TO THE THAI SPECIES OF *LITHOCARPUS*

(based on vegetative characters and acorns)

1. Outer surface of cupules with annular or lamellate markings or markings lacking
  2. Cupules without lamellae, chartaceous or subcoriaceous, enclosing nearly all of the nut, more or less dehiscent when mature
  3. Cupules weakly dehiscent from the apex, cupule surface distinctly undulate with vertical and horizontal lines
  4. Cupule urn-shaped
  5. Cupule base broadly conical, much broader than apex, skin distinct with many vertical filiform lines or without. Nut conical
- 5. *L. blumeanus***

5. Cupule base obconic, much narrower than apex, surface distinct with 3–4 horizontal filiform lines. Nut obconical  
**33. *L. maingayi***
4. Cupule top- or globe-shaped
6. Cupule top-shaped, enclosing  $\frac{4}{5}$  of nut, surface with 2–6 distinct horizontal, filiform lines  
**30. *L. macphailii***
6. Cupule globe-shaped, enclosing nut completely, except for a tiny section at the apex, surface with distinct irregularly placed scales along 5–9 horizontal and vertical lines  
**36. *L. orbicarpus***
3. Cupules readily dehiscent into irregular parts from the top, surface with 2–5 filiform, undulate, horizontal lines
7. Cupules with 2 or 3 such lines  
**18. *L. encleisacarpus***
7. Cupules with 4 or 5 such lines  
**37. *L. pattaniensis***
2. Cupules with distinct lamellae, coriaceous, enclosing a variable amount of the nut, indehiscent
8. Cupule enclosing not less than  $\frac{1}{2}$  of the nut
9. Cupule enclosing about  $\frac{1}{2}$  of the nut
10. Nuts ovoid to conical at apex, scar shallowly concave or flattened  
**24. *L. gracilis***
10. Nuts subhemispheric or depressed at apex, scar deeply concave  
**8. *L. clementianus***
9. Cupule enclosing not less than  $\frac{3}{4}$  of the nut
11. Cupules obconic, enclosing nut almost completely except around the umbonate apex
12. Nut longer than broad, ca 1 by 0.7 cm  
**26. *L. hendersonianus***
12. Nut shorter than broad, 1–2.7 by 2–3 cm  
**32. *L. magnificus***
11. Cupules saucer-shaped, enclosing ca  $\frac{3}{4}$  of the nut  
**1. *L. aggregatus***
8. Cupule enclosing not more than  $\frac{1}{4}$  of the nut
13. Nuts hemispheric or depressed on both sides
14. Cupule enclosing  $\frac{1}{5}$  to  $\frac{1}{4}$  of the nut  
**39. *L. platycarpus***
14. Cupule enclosed only the base of the nut
15. Acorns sessile. Scar deeply concave  
**15. *L. eichleri***
15. Acorns with stalk up to 0.5 cm long. Scar slightly concave  
**6. *L. cantleyanus***
13. Nuts conical to broadly ovoid, or with a dome-shaped apex
16. Cupule enclosing only the base of the nut
17. Acorns sessile. Leaves oblanceolate  
**29. *L. lucidus***
17. Acorns with fruit-stalk up to 0.5 cm long. Leaves oblong  
**43. *L. reinwardtii***
16. Cupule enclosing ca  $\frac{1}{4}$  of the nut
18. Nut with one horizontal ring around equator. Leaves ensiform to linear-lanceolate  
**28. *L. loratifolius***
18. Nut without horizontal ring. Leaves ovate, ovate-oblong or narrowly elliptic
19. Nut ovoid or conical. Cupules cup- or saucer-shaped. Leaves ovate or ovate-oblong, apex caudate  
**3. *L. bancanus***
19. Nut broadly ovoid. Cupules slightly obconical to saucer-shaped. Leaves narrowly elliptic  
**41. *L. rassa***
1. Outer surface of cupules with alternate lamellae (resembling fish scales) or pseudospines
20. Mature cupules of one infructescence more or less fused together
21. Acorns broader than long, depressed both on top and at base. Cupules saucer- or cup-shaped or obconic, some hardly distinct from each other through fusion
22. Infructescences with densely arranged cupules
23. Cupules barely distinct, resembling a large gall  
**13. *L. echinophorus***
23. Cupules distinct, saucer-shaped
24. Nut flattened or apiculate at apex, to 2.2 cm diam. Leaves cuneate at base  
**16. *L. elegans***
24. Nut retuse at apex, not less than 3 cm diam. Leaves auriculate at base  
**2. *L. auriculatus***
22. Infructescences with spaces between cupules
25. Rachis of infructescence always with sub-branches. Acorns stalked  
**34. *L. mekongensis***
25. Rachis of infructescence without sub-branches
26. Acorns sessile  
**24. *L. finetii***
26. Acorns stalked  
**50. *L. tenuinervis*\***
21. Acorns longer than broad, conical, ovoid or turbinate. Cupules cup-shaped or cylindrical
27. Rachis of infructescence always with sub-branches. Acorns stalked, nuts shining
28. Acorn up to 1 cm high. Rachis up to 4 mm in diam.  
**7. *L. ceriferus***
28. Acorn not less than 1 cm high (to 2.5 cm). Rachis not less than 4 mm in diam.  
**40. *L. polystachyus***
27. Rachis of infructescence without sub-branches. Acorns sessile, nuts more or less shining
29. Twigs glabrous or sparsely pubescent, glabrescent
30. Cupules cup-shaped, enclosing up to  $\frac{1}{2}$  of the nut  
**12. *L. dealbatus***
30. Cupules turbinate, enclosing the whole nut, open only around umbo  
**53. *L. truncatus***
29. Twigs ferruginous or tomentose
31. Leaves glabrous except along midrib. Cupules enclosing up to  $\frac{1}{3}$  of the nut  
**25. *L. harmandianus***
31. Leaves densely tomentose especially on lower surface. Cupules enclosing  $\frac{1}{2}$  of the nut  
**27. *L. lindleyanus***
20. Mature cupules of one infructescence, free, not fused
32. Acorn longer than broad, conical, ovoid or obconical. Cupules cup- or saucer-shaped or obconic
33. Cupules enclosing nut completely or  $\frac{2}{3}$  of the nut
34. Cupules enclosing ca  $\frac{2}{3}$  of the nut

35. Cupules slightly obconical-shaped, nuts hairy at style apex (if persistent) **45. *L. rufescens***  
 35. Cupules cup or saucer-shaped **16. *L. elegans***
34. Cupules enclosing nut completely, or up to the apex of the nut
36. Cupules dehiscent, obconic or ovoid
37. Cupules obovoid, sessile, surface with dense, long and narrow recurved pseudospines **42. *L. recurvatus***  
 37. Cupules ovoid, fruit stalk 2–3 mm long, surface finely ornamented with thin, triangular lamellae throughout **35. *L. neo-robinsonii***
36. Cupules indehiscent, ovoid, surface clothed with dense, triangular lamellae
38. Infructescences up to 18 cm long. Leaves less than 18 cm long **9. *L. craibianus***  
 38. Infructescences not less than 20 cm long. Leaves more than 18 cm long **19. *L. erythrocarpus***
33. Cupules enclosing up to ½ of the nut
39. Acorns stalked
40. Cupules slightly obconic. Leaves ovate, ovate-oblong or obovate **48. *L. sootepensis***  
 40. Cupules cup-shaped or saucer-shaped
41. Cupules cup-shaped. Leaves lanceolate to lanceolate oblong **47. *L. siamensis***  
 41. Cupules saucer-shaped to flattened. Leaves oblong to oblong-lanceolate **10. *L. curtissii***
39. Acorns sessile
42. Acorns (mature) not less than 3.5 by 2.2 cm
43. Cupule lamellae bearing pseudo-spines reflexed towards the base. Leaf apex acute to obtuse **46. *L. scortechinii***  
 43. Lamellae curved towards the cupule apex. Leaf apex acuminate **20. *L. eucalyptifolius***
42. Acorns (mature) up to 3 by 2.2 cm
44. Infructescence with acorns in clusters, but not fused
45. Nuts ovoid. Leaves usually curved to one side **54. *L. wallichianus***  
 45. Nuts strongly apically depressed, occasionally conic. Leaves not curved **51. *L. thomsonii***
44. Infructescence with acorns solitary, with spaces between them
46. Cupules saucer- or cup-shaped, limb recurved. Leaves not less than 12 cm long **21. *L. falconeri***  
 46. Cupules obconical, limb not recurved. Leaves up to 11 cm long **4. *L. bennettii***
32. Acorns broader than long, hemisphaeric-depressed
47. Cupules enclosing more than half of the nut up to the apex, or enclosing the nut completely
48. Cupules enclosing more than half of the nut up to the apex, lamellae with erect or reflexed pseudo-spines, not fused
49. Pseudo-spines erect or spreading. Leaves oblanceolate to ovate-lanceolate
50. Infructescence with acorns packed close together, but not fused. Leaves oblanceolate to elliptic-oblong, slightly cuneate at base **14. *L. echinops***  
 50. Infructescence with acorns spread out along the rachis, occasionally in clusters, with only a small number fully developed. Leaves lanceolate to ovate-lanceolate, base long attenuate **59. *L. gigantophyllus***
49. Pseudo-spines reflexed. Leaves oblong or oblanceolate
51. Infructescence with acorns packed close together, but not fused. Leaves base slightly cuneate **23. *L. garrettianus***  
 51. Infructescence with acorns solitary, with spaces between them. Leaves base obtuse **54. *L. tubulosus***
48. Cupules enclosing the nut completely, except the umbo
52. Lamellae pointed, with narrowly pseudo-spines. Infructescence with acorns packed close together, but not fused **57. *L. wrayi***
52. Lamellae flattened and imbricate. Infructescence with acorns solitary, with spaces between them
53. Lamellae fused on lower half, the upper half free and adaxially curved **22. *L. fenestratus***  
 53. Lamellae fused almost to apex, only a short free lobe adaxially curved **52. *L. trachycarpus***
47. Cupules enclosing up to ½ of the nut
54. Acorns stalked, cupules enclosing only base of the nut
55. Stalk up to 1 cm long. Leaves glaucous on lower surface, petiole up to 1 cm long **49. *L. sundaicus***  
 55. Stalk not less than 1 cm long. Leaves not glaucous on lower surface, petiole not less than 1 cm long **31. *L. magneinii***
54. Acorns sessile, cupules enclosing up to ½ of the nut
56. Acorns not less than 2 by 2.5 cm
57. Cupules slightly obconical. Leaves oblong, acute to caudate at apex, margin not revolute, petiole not less than 1 cm **11. *L. cyclophorus***  
 57. Cupules saucer-shaped. Leaves obovate, obtuse at apex, margin revolute, petiole up to 0.6 cm long **44. *L. revolutus***
56. Acorns up to 1.5 by 2 cm
58. Nuts convex at the apex
59. Cupules saucer-shaped to flattened and discoid. Leaves not whorled
60. Lamellae usually fused throughout. Leaves less than 17 cm long **38. *L. pierrei***  
 60. Lamellae fused at base only, apices free. Leaves more than 18 cm long **17. *L. elephantum***
59. Cupules cup-shaped. Leaves usually whorled at the twig tips **58. *L. xylocarpus***  
 58. Nuts flattened at the apex. Cupule cup-shaped, enclosing ⅓ to ½ of the nut. Leaves oblong to elliptic-oblong, not less than 10 by 3.5 cm, 14–20 pairs of lateral nerves with unequal sides, usually curved to one side **55. *L. vestitus***

\* According to (Phengkai, 2008), this species is unconfirmed for Thailand.

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