
Lectotypification and New Synonymy in *Quercus* subg. *Cyclobalanopsis* (Fagaceae)

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ABSTRACT. The name *Quercus cambodiensis* Hickel & A. Camus (Fagaceae) is lectotypified herein. Based on morphological comparison and wild population observation, seven names within *Quercus* subg. *Cyclobalanopsis* (Oerst.) C. K. Schneid. (Fagaceae) are synonymized: *Q. patelliformis* Chun to *Q. asymetrica* Hickel & A. Camus; *Cyclobalanopsis yingjiangensis* Y. C. Hsu & Q. Z. Dong to *Q. brevicalyx* A. Camus; *Q. cambodiensis* Hickel & A. Camus, *Q. camusiae* Hickel & A. Camus, and *C. pachyloma* (Seemen) Schottky var. *mubianensis* Y. C. Hsu & H. W. Jen to *Q. langbianensis* Hickel & A. Camus; and *Q. subhinoidea* Chun & W. C. Ko and *Q. chingsiensis* Y. T. Chang to *Q. thorelii* Hickel & A. Camus.

Key words: Fagaceae, *Quercus*, subgenus *Cyclobalanopsis*.

Subgenus *Cyclobalanopsis* (Oerst.) C. K. Schneid. in *Quercus* L. (Fagaceae) consists of about 150 species (Huang et al., 1999). Their distribution is restricted to East and Southeast Asia, with 69 species (43 endemic) in China. Most are important components of Southeast Asia's broad-leaved evergreen forests (Huang et al., 1999). The rank status of *Cyclobalanopsis* is an arguable issue in the taxonomy of Fagaceae. Most taxonomists treat the name as a subgenus of *Quercus*, based on the homologous origin of imbricate scales and concentric lamellae on the fruit cupules (Camus, 1938; Barnett, 1944; Soepadmo, 1968; Menitsky, 1984; Govaerts & Frodin, 1998). *Cyclobalanopsis* has been recognized at generic rank by other taxonomists (Schottky, 1912; Brett, 1964;

Huang et al., 1998, 1999). Both the *Flora Reipublicae Popularis Sinicae* (vol. 22) and the *Flora of China* (vol. 4) recognized *Cyclobalanopsis* at the generic level. Molecular phylogenetic studies support two main clades in the genus *Quercus*: one broader clade composed of the largely New World section *Lobatae* Loudon, *Quercus* s. str., and section *Protobalanus* (Trel.) A. Camus, and a second monophyletic clade of the two strictly Old World groups, subgenus *Cyclobalanopsis* and section *Cerris* Loudon, which lies sister to the New World clade (Manos et al., 1999, 2001; Oh & Manos, 2008). Herein, we adopt the subgeneric placement of *Cyclobalanopsis* and interpret *Quercus* at the generic level.

- 1. *Quercus asymetrica*** Hickel & A. Camus, Bull. Mus. Natl. Hist. Nat. 29: 601. 1923. TYPE: Vietnam. Tonkin: Khe-va, Hai-ninh, 27 Sep. 1919, *Casabianca* s.n. (holotype, P; isotype, P).

Quercus patelliformis Chun, J. Arnold Arbor. 28: 241. 1947, syn. nov. *Cyclobalanopsis patelliformis* (Chun) Y. C. Hsu & H. W. Jen, J. Beijing Forest. Univ. 15(4): 45. 1993. TYPE: China. Guangxi: Nan-Lin, Kuei-Kai Shan, 16 Oct. 1933, C. Wang 34658 (holotype, SYS not seen; isotype, A).

Distribution and habitat. *Quercus asymetrica* occurs in evergreen forests of Guangxi and Hainan provinces in China and also extends into Tonkin (Bac Ky), Vietnam.

Discussion. In the original description (Chun, 1947), *Quercus patelliformis* was characterized by highly connate, columnar styles and a somewhat

Table 1. Key diagnostic features for *Quercus asymetrica* and *Q. patelliformis*.

Characters	<i>Q. asymetrica</i> ^{1,2}	<i>Q. patelliformis</i> ^{1,2,3}
Leaf shape	ovate-lanceolate, base slightly asymmetrically rotundate	ovate-lanceolate, base asymmetrically rotundate
Leaf size (cm)	15–20 × 5–8	7–18 × 2.5–7
Leaf lateral venation	10 to 11 pairs	9 to 11 pairs
Teeth of the margin	serrate in the apical half	serrate in the apical half
Fruit cupule shape and size (length × diam., mm)	saucer-shaped, 8–9 × ca. 25	saucer-shaped, 6–10 × 20–30
Cupule coverage of acorn	1/3	1/3
Trichomes on external cupule surface	short gray sericeous	gray sericeous
Trichomes inside cupule wall	densely gray sericeous	densely gray sericeous
Number of concentric lamellae	8	8 or 9
Dentition of concentric lamellae on cupule	lobed tooth at basal 2 to 4 rings, upper ring entire	lobed tooth at basal 2 to 4(5) rings, upper ring entire
Acorn shape and size (length × diam., cm)	oblate, 2.2–2.4 × 2.5–2.6	oblate, (1.9–)2.1–2.5 × 2.4–2.8
Trichomes on external acorn surface	densely sericeous	densely sericeous
Style base	convex, densely pubescent	obvious convex, with dense pubescence
Seed scar	concave, ca. 2 cm diam.	concave, 1.8–2.2 cm diam.

¹ Observations from type materials.
² Observations from herbaria collections.
³ Observations from living populations in the wild.

depressed hemispheric acorn borne in a shallow cup with a narrow rim, which differed from *Q. asymetrica* in the coriaceous leaves and the nonturbinate acorns. The original publication of *Q. asymetrica* (Hickel & Camus, 1923: 601) stated “Folia ovato-lanceolata, asymetrica, basi oblique rotundata, apice attenuate, coriacea, crassa,” which seems otherwise consistent with *Q. patelliformis*.

We measured and compared key diagnostic features for accessible specimens of *Quercus patelliformis* and *Q. asymetrica* (Table 1). The results indicated both the sterile and fruiting features of the two species show no essential differences. The diagnostic features of the two species listed by Chun (1947) appear arbitrary. The leaves from the type of *Q. patelliformis* appear smaller (7–18 × 2.5–7 cm), but leaf size varies dramatically even on the same tree of *Q. patelliformis*. Considering the uniform characters of the sterile and fruiting material of *Q. asymetrica* and *Q. patelliformis*, we reduce *Q. patelliformis* to synonymy under *Q. asymetrica*.

Specimens examined. CHINA. **Guangxi:** Shangshi, M. Deng 477 (KUN). **Hainan:** Baoting, G. M. Lou 60170 (IBSC). VIETNAM. **Tonkin [Bac Ky]:** s. loc., Chevalier 39634 (P).

2. *Quercus brevicalyx* A. Camus, Chênes Atlas 3: t. 347, f. 31–38. 1948. TYPE: Laos. Pu Bia, 2300 m, 13 Sep. 1932, A. F. G. Kerr 21017 (holotype, P not seen; isotype, P).

Cyclobalanopsis yingjiangensis Y. C. Hsu & Q. Z. Dong, Acta Bot. Yunnan. 5: 341. 1983, syn. nov. *Quercus yingjiangensis* (Y. C. Hsu & Q. Z. Dong) Govaerts, World Checkl. Bibliogr. Fagales: 322. 1998. TYPE:

China. Yunnan: Yingjiang, Su-Dian, Mo-Ion-ho, 2500 m, 24 May 1980, S. R. Yang 9 (holotype, SWFC; isotype, SWFC).

Distribution and habitat. *Quercus brevicalyx* is endemic to southwestern Yunnan Province, China, and Laos; it is found in mixed forests, at 1800–2500 m altitude.

Discussion. The original publication of *Cyclobalanopsis yingjiangensis* (Hsu & Sun, 1983) stated that this species is allied to *Quercus chrysocalyx* Hickel & A. Camus, but differed in its thinner and smaller leaves with rounded or broadly cuneate bases, deciduous and sparsely stellate pubescent abaxially, as well as in the subflattened cup. When we checked the type material, we found that the cupules of *C. yingjiangensis* and *Q. brevicalyx* are both saucer-shaped, with a flat base, 2–4 × 30–31 mm diam., with seven lamellae on the cupule wall and irregular teeth. Their acorns are subhemispheric to ovate-conical, with a flat base, glabrous, 25–30 × 20–25 mm diam., with a convex stylar base. Leaves in the two species are ovate-lanceolate, with the base slightly asymmetric and rounded, serrate, viridescent adaxially, but sparsely stellate-tomentose abaxially and later glabrate. In *Q. brevicalyx*, leaves range from 8–9 × 4–4.1 cm, with lateral veins in nine to 11 pairs; in *C. yingjiangensis*, leaves are 8–12 × 3–4 cm, with lateral veins in nine to 12 pairs. All key diagnostic features of the two species appear identical, and we therefore assign *C. yingjiangensis* to synonymy under *Q. brevicalyx*.

Specimens examined. CHINA. **Yunnan:** Xishuangbanna Nat. Reserve, Hui-yin-he, Anonymous 2408 (SWFC).

3. *Quercus langbianensis* Hickel & A. Camus, Ann. Sci. Nat., Bot., ser. 10, 3: 382. 1921. TYPE: Vietnam. Annam [Trung Ky]: “massif dulangbian, Grand Piton, pres du village de Beneur,” 1500–2000 m, 15 Feb. 1914, A. Chevalier 30029 (holotype, P; isotypes, AAU, P).

Quercus cambodiensis Hickel & A. Camus, Bull. Mus. Natl. Hist. Nat. 29: 600. 1923, syn. nov. *Quercus langbianensis* Hickel & A. Camus subsp. *cambodiensis* (Hickel & A. Camus) Menitsky, Novosti Sist. Vyssh. Rast. 13: 56. 1976. TYPE: Cambodia. “Mont. De Elephant, sol argileux tourbeu,” 1000 m, E. Poilane 215 (lectotype, designated here, P; isotypes, NY, P).

Quercus camusiae Trel. ex Hickel & A. Camus, Fl. Indo-Chine 5: 957. 1929, syn. nov. Replaced name: *Quercus geminata* Hickel & A. Camus, Bull. Mus. Natl. Hist. Nat.: 599. 1923. *Cyclobalanopsis camusiae* (Trel. ex Hickel & A. Camus) Y. C. Hsu & H. W. Jen, J. Beijing Forest. Univ. 15(4): 44. 1993. TYPE: Vietnam. Annam [Trung Ky]: “Pres de Nha-trang, massif de Honba,” 1000–1500 m, 18–20 Sep. 1918, A. Chevalier 38650 (holotype, P; isotype, P).

Cyclobalanopsis pachyloma (Seemen) Schottky var. *mubianensis* Y. C. Hsu & H. W. Jen, Acta Phytotax. Sin. 14: 84. 1976, syn. nov. *Quercus pachyloma* Seemen var. *mubianensis* (Y. C. Hsu & H. W. Jen) C. C. Huang, Guihaia 12: 303. 1992. TYPE: China. Guangxi: Mubian, 1000 m, 3 Dec. 1958, Z. Q. Zhang 14033 (holotype, PE).

Distribution and habitat. *Quercus langbianensis* has a wide distribution on the Indochinese peninsula, from southeastern Yunnan and western Guangxi provinces in China into Vietnam and Cambodia. It is one of the dominant species in the broad-leaved evergreen forests in this area.

Discussion. In their original publication of *Quercus cambodiensis*, Hickel and Camus (1923) cited two specimens, E. Poilane 215 and E. Poilane 270. Both were collected from the same location in Vietnam. Poilane’s collections were mainly deposited in P, but E. Poilane 270 was not found there. We also searched the other herbaria (A, B, BR, E, F, G, K, L, NY, P, PC, US) where E. Poilane’s collections were possibly deposited, but we were unable to locate E. Poilane 270. E. Poilane 215 consists of three specimens distributed in P and NY. All three had acorns attached to the specimens and their morphology is consistent with the description of Hickel and Camus (1923). Given these circumstances, we selected E. Poilane 215 as lectotype for *Q. cambodiensis*.

Hickel and Camus (1923) established *Quercus geminata* [\equiv *Q. camusiae* Trel. ex Hickel & A. Camus] based on an unnumbered collection by A. Chevalier from Vietnam (“Annam: pres de Nha-trang, massif de Honba, alt 1.000–1.500 metres”), but this name was a later homonym to *Q. geminata* Small (published in 1897). Hickel and Camus (1929) later

published the replacement name *Q. camusiae* Hickel & A. Camus. This was followed with an italicized citation (Hickel & Camus, 1929: 957) as “*Q. geminata* Hickel & A. Camus in Bull. Mus. Paris (1923), p. 599 (non Small)” citing a specimen of A. Chevalier without a collection number, but with the same collection information as given for *Q. geminata* in 1923. Although Hickel and Camus (1929) did not clearly state the relationship of *Q. camusiae* and *Q. geminata*, this evidence supports the name *Q. camusiae* as a replacement name for *Q. geminata* Hickel & A. Camus. In Camus’s (1938: 236) monograph, she cited the type specimen of *Q. camusiae* as A. Chevalier 38650 from Vietnam and the detail of the collection information corresponded to that for *Q. geminata* and *Q. camusiae*. This suggests her effective lectotypification of the name *Q. camusiae* and that *Q. camusiae* and *Q. geminata* were published based on the same type, with *Q. camusiae* the replacement name for *Q. geminata*.

Menitsky (1984) placed *Quercus camusiae* as a synonym of *Q. langbianensis* subsp. *cambodiensis*. Xu and Ren (1993), however, regarded *Q. camusiae* as a distinct species, transferring it to the genus *Cyclobalanopsis* Oerst. Later, Hsu and Jen (1976) described a new variety, *Cyclobalanopsis pachyloma* var. *mubianensis*, distinguishing it by the shallower cupule that covered only one third of the acorn.

After detailed examination of the accessible specimens, including types, we found the leaves, cupules, and acorns of the synonymized three species to be closely similar to *Quercus langbianensis* (Table 2).

The key characters that Camus (1938) applied to subgrouping the taxon in *Quercus* subg. *Cyclobalanopsis* included the length of the styles and the percentage of the cupule covering the acorns. In her key to the species, Camus used styles either rather long or very long and weak to separate *Quercus* ser. *Semiserrata* A. Camus, which included *Q. langbianensis* and *Q. cambodiensis*, and *Quercus* ser. *Pachylomae* A. Camus, which included *Q. camusiae*. She noted that the cupules of *Q. langbianensis* covered half or less than half of the acorn body, differing from *Q. cambodiensis*, in which the cupule only covered one fourth to one fifth of the acorns. Our results revealed an inaccuracy in the series key to the species given by Camus (1938). In the type material, the fruits of *Q. camusiae* are immature, but the type materials of our synonymized species are mature, which would weakly support Camus’s recognition of the species. From our field observations in Pinbian, in southeastern Yunnan Province in China, at altitudes from 1980 to 2000 m, we also found the length of the unripe and ripe acorns to gradually change. The young

Table 2. Comparison of key taxonomical characters of *Quercus langbianensis*, *Q. cambodiensis*, *Q. camusiae*, and *Cyclobalanopsis pachyloma* var. *mubianensis*.

Characters	<i>Q. langbianensis</i> ^{1,2}	<i>Q. cambodiensis</i> ^{1,2}	<i>Q. camusiae</i> ^{1,2,3}	<i>C. pachyloma</i> var. <i>mubianensis</i> ^{1,2,3}
Leaf size (length × width, cm)	5.8–15.5 × 2.3–5.2	6–14.5 × 2.5–5	8–15 × 3–5.5	9–12 × 2.5–4
Leaf lateral veins	11 to 14 pairs	8 to 11 pairs	12 to 14 pairs	12 to 15 pairs
Fruit cupule lamellae	8 or 9	8 or 9	7 or 8	8
Toothing of the concentric lamellae on cupule	lobed, toothed or irregularly denticulate	upper lamellae entire, the lower lamellae irregularly denticulate	upper lamellae entire, the lower lamellae irregularly denticulate	irregularly denticulate
Cupule size (length × diam., cm)	1.1–1.4 × 1.7–2.2	0.9–1.2 × ca. 1.8	1–1.5 × 1.5–2.2	1.3–1.5 × 1.4–1.7
Acorn shape	obovoid to oblong	subovoid to oblong	obovoid	obovoid
Acorn size (length × diam., cm)	2.1–3.1 × 1.5–1.7	1.2–3 × 1.3–1.8	ca. 2.2 × 1.2–1.7	ca. 2.1 × 1.5
Cupule coverage of acorn	1/4–1/3	1/3	1/3–1/2	1/3
Acorn scar diam. (cm)	1–1.1	0.8–0.9	ca. 0.8	ca. 0.9
Acorn base	flat, subconvex, or convex	flat	flat or subconvex	subconvex

¹ Observations from type materials.
² Observations from herbaria collections.
³ Observations from living populations in the wild.

immature acorns are completely enclosed by the cupule; during later fruit development, however, the acorns are elongate, and at maturity the cupule covers from one fourth to one half of the acorn bodies. This cupule coverage is a developmental difference rather than a diagnostic feature.

Specimens examined. CHINA. **Guangxi:** Shangsi, W. T. Tsang 24793 (SYS). **Yunnan:** Hekou, Y. M. Shui 11296 (KUN). CAMBODIA. s. loc., E. Poilane 2296h (L). INDO-CHINA. s. loc., A. Petelot 4848 (IBSC). VIETNAM. **Tonkin [Bac Ky]:** Sai-Wong-Mo-Shan, W. T. Tsang 30338 (L). **Annam [Trung Ky]:** Mont Bani, J. Clemens 3455 (P).

4. *Quercus thorelii* Hickel & A. Camus, Bull. Mus. Natl. Hist. Nat. 29: 599. 1923. *Cyclobalanopsis thorelii* (Hickel & A. Camus) Hu, Bull. Fan Men. Inst. Biol. Bot. 10: 106. 1940. TYPE: Laos. “Maong-pun, from de Sam. Neua,” 17 Sep. 1920, E. Poilane 1902 (holotype, P; isotypes, IBSC, NY, P).

Quercus subhinoidea Chun & W. C. Ko, Acta Phytotax. Sin. 7: 39. 1958, syn. nov. *Cyclobalanopsis subhinoidea* (Chun & W. C. Ko) Y. C. Hsu & H. W. Jen ex Y. T. Chang, Acta Phytotax. Sin. 34: 339. 1996. TYPE: China. Hainan: Dongfang, Qichai village, 380–500 m, 26 Nov. 1956, S. H. Chun 11329 (holotype, IBSC; isotype, IBSC). Figure 1.

Quercus chingsiensis Y. T. Chang, Acta Phytotax. Sin. 11: 258. 1966, syn. nov. *Cyclobalanopsis chingsiensis* (Y. T. Chang) Y. T. Chang, Acta Phytotax. Sin. 34: 339. 1996. TYPE: China. Guangxi: Jing-si, Biao-lin, 1 Sep. 1935, S. P. Ko 55677 (holotype, IBSC; isotype, KUN).

Distribution and habitat. *Quercus thorelii* is found in dense forests in mountain valleys, to 500 m altitude in southwestern Yunnan, southwestern Guangxi, and Hainan provinces in China, and in Laos.

Discussion. The cupules and acorns of *Quercus thorelii*, *Q. subhinoidea*, and *Q. chingsiensis* are morphologically similar and share a bowl-shaped, apically incurved cupule that encloses most of the oblate acorn. Only the top of the acorn and style emerge from the cupule. The external cupule wall is covered with grayish yellow, shortly tomentulose trichomes, and the concentric rings of the basal half are mostly fused to the cupule wall, with only the rims free. Vegetatively, the young twigs and young leaves were densely grayish yellow tomentose, later glabrate. However, a gradual series of finer differences was reported in the literature among these species. The original publication of *Q. subhinoidea* (Chun & How, 1958: 39) noted this species was close to *Q. thorelii*, but differed in the young twigs covered with a yellow tomentum, the leaves with 16 to 22 pairs of lateral veins, and the shallower fruit cupule with eight concentric lamellae. This differed from *Q. thorelii* (Chun & How, 1958), which was observed to have glabrous young twigs, leaves with 15 to 16 lateral veins, and a longer cupule with additional lamellae (Chun & How, 1958). The original description of *Q. chingsiensis* (Chang, 1966) indicated the thin cupule wall and upper incurved concentric lamellae differed from *Q. thorelii*. Subsequently, in the *Flora of China*,



Figure 1. *Quercus subhinoidea* Chun & W. C. Ko collected from Changjiang, Hainan Province, China (voucher *M. Deng* 556, KUN), showing the infructescences attached to a current-year branch. Scale bar = 2 cm.

the fruit was indicated as maturing during the current year in *Q. thorelii* versus maturing on one-year-old branchlets in *Q. chingsiensis* as a diagnostic feature of the two species (Huang et al., 1999). However, these aspects confused rather than resolved the species boundaries. In order to clarify this, we examined all accessible materials of *Q. thorelii*, *Q. subhinoidea*, and *Q. chingsiensis*, and further studied the morphological variation of the populations of *Q. thorelii* and *Q. subhinoidea* in the wild.

Our first study site was in Yunnan, China, at an altitude of 560 m. We collected four specimens from different parts of a branch and 50 mature fruits (*M. Deng* 559, KUN) of *Quercus thorelii* to discriminate key characters. Our second field site was in Hainan Province, China, at 500 m (*M. Deng* 555, 556, 776, 777, KUN), corresponding to the type locality for *Q. subhinoidea*. Key taxonomic features are compared in Table 3, which shows that most attributes did not

essentially differ among the three species. The acorn size of *Q. chingsiensis* seems smaller and flatter than *Q. thorelii* and *Q. subhinoidea*, but the type material of *Q. chingsiensis* was collected in September, while *Q. thorelii* and *Q. subhinoidea* mostly fruit from October to November. It is postulated that the flat acorns in *Q. chingsiensis* represent an immature stage and that these acorns correspond with those seen in *Q. thorelii* and *Q. subhinoidea*. Both morphology and phenology of the three species are similar, and therefore *Q. subhinoidea* and *Q. chingsiensis* synonymize under *Q. thorelii*.

Specimens examined. CHINA. **Guangxi:** Shang-si, *C. C. Chang* 12455 (IBSC). **Hainan:** Changjiang, *M. Deng* 555, 556, 776, 777 (KUN). **Yunnan:** Mengyan, *M. Deng* 559 (KUN).

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Table 3. Morphological comparison of *Quercus subhinoidea*, *Q. thorelii*, and *Q. chingsiensis*.

Characters	<i>Q. subhinoidea</i> ^{1,2,3}	<i>Q. thorelii</i> ^{1,2,3}	<i>Q. chingsiensis</i> ^{1,2}
Young twig and leaf	grayish yellow tomentose	golden woolly vestiture	NA
Mature leaf, adaxial surface	glabrous and shiny	glabrous and shiny	glabrous and shiny
Leaf size (length × width, cm)	6–15 × 3–6	9–17 × 3–6	8–10 × 3–5
Leaf lateral vein	15 to 21(22) pairs	(11)12 to 19(20) pairs	11 to 13(14) pairs
Venation type	semicraspedodromous	semicraspedodromous	semicraspedodromous
Fruit cupule size (length × diam., cm)	1.1–1.4 × 2.4–2.9	1.2–1.8 × 2–3.1(–3.3)	ca. 1 × 2.2
Cupule coverage of acorn	3/4 to entire acorn	3/4 to entire acorn	entire acorn
Cupule wall thickness (mm)	1.1–3(–3.5)	1.5–3(–5)	2.2–3
Acorn size (length × diam., cm)	1.4–1.7 × 1.8–2.4	1–1.5 × 2.1–2.8	ca. 0.7 × 2.5
Style base	concave or flat	concave or flat	concave
Acorn scar diameter and shape	1.3–1.8 cm, flat or subconvex	1.3–1.8(–2) cm, flat or subconvex	1.8–2 cm
Fruiting habit	fruit matures in current year; late Sep.–Nov.	fruit matures in current year; early Oct. to late Nov.	fruit matures in current year

NA, not available.
¹ Observations from type materials.
² Observations from herbaria collections.
³ Observations from living populations in the wild.

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