

Taxonomic notes on the genus *Cyclobalanopsis* (Fagaceae)

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Three new combinations in the genus *Cyclobalanopsis* are proposed based on examination of type materials and other specimens. *Quercus fleuryi* Hickel & A. Camus and *Q. macrocalyx* Hickel & A. Camus var. *tomentosa* Metcalf are treated as synonyms of *C. macrocalyx* and *C. kouangsiensis* (A. Camus) Y.C. Hsu & H.W. Jen, respectively. The taxonomic treatment of several species in this genus is discussed.

Key words: *Cyclobalanopsis*, Fagaceae, *Quercus*, taxonomy

The generic status of *Cyclobalanopsis* is an arguable issue in delimitation of *Quercus*. *Cyclobalanopsis* is treated as a subgenus of *Quercus* by most taxonomists (Camus 1934–1954, Barnett 1944, Soepadmo 1968, Axelrod 1983, Menitsky 1984, Nixon 1985, 1989, Govaerts & Frodin 1998: 201–394), but as a separate genus by others (Oersted 1866, Schottky 1912, Brett 1964, Hjelmqvist 1968, Hsu & Jen 1976, Zheng 1979, Chang & Cheng 1996, Huang *et al.* 1998, 1999). *Flora Reipublicae Popularis Sinicae* and *Flora of China* recognize *Cyclobalanopsis* as a genus (Huang *et al.* 1998, 1999). The current revision follows the *Flora of China* (Huang *et al.* 1999).

Cyclobalanopsis macrocalyx (Hickel & A. Camus) M. Deng & Z.K. Zhou, *comb. nova*

Quercus macrocalyx Hickel & A. Camus, *Ann. Sci. Nat.*

Bot. 3: 383–384. 1921. — TYPE: Laos. “Tranninh”, alt. 1000–1500 m, *Magnein s.n.* (holotype P!).

Quercus fleuryi Hickel & A. Camus, *Bull. Mus. Natl. Hist. Nat.* 29: 600. 1923, *syn. nov.* — *Cyclobalanopsis fleuryi* (Hickel & A. Camus) Chun *ex* Q.F. Zheng, *Fl. Fujian*. 1: 404. 1982. — TYPE: Vietnam. “Tonkin, pr. De Sontay, mont Bavi”, alt. 800–1200 m, *Fleury 37.831* (holotype P!).

Quercus tsoi Chun *ex* Menitsky, *Novosti Sist. Vyssh. Rast.* 13: 58. 1976. — TYPE: China. “Kweichow, Pana, Chengfeng”, 1930 Y. Tsiang 4409 (holotype LE, not seen; isotype SYS!).

Cyclobalanopsis austroyunnanensis Hu, *Acta Phytotax. Sin.* 1(2): 149. 1951. — TYPE: China. Yunnan, “Si-chour, Ting-mann”, 12.X.1947 K. M. Feng 12387 (holotype PE!; isotypes PE!, KUN! A not seen).

Cyclobalanopsis nengpulaensis H. Li & Y.C. Hsu, *Acta Bot. Yunnanica Suppl.* 5: 23. 1992. — TYPE: China. Yunnan, Gongshan Xian, Du-long-jiang, Nengpula, alt. 1400 m, in broad-leaved forest, 8.XII.1990 *Dulongjiang Bot. Expedition* 923 (holotype KUN!).

DISTRIBUTION: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Jiangxi, Tibet and

Yunnan), Laos, and Vietnam.

HABITAT ECOLOGY: In evergreen forest and limestone evergreen forest, alt. 500–1800 m.

PHENOLOGY: Flowering from March to April, acorn maturation biennial; fruiting from October to December.

Quercus fleuryi is a common species in SE Asia. The name or its combination *Cyclobalanopsis fleuryi* has been used in numerous national, regional and local floristic works. The species goes by the common name of Fleury oak. It is also richly represented in three major Chinese herbaria PE, KUN and IBSC. Its identity has long been determined with certainty.

Quercus macrocalyx was described by Hickel and Camus (1921) two years before they described *Q. fleuryi*. Camus (1934–1954) considered it to be different from all others in the subgenus (translated) “by huge, oblong cupule which is as high as the acorn”. She also recorded that it is distributed in Guangxi. However, our observations of wild populations and herbarium specimens of the two species reveal continuous variation in the cupule and the acorn. We found that the percentage of the cupule covering the acorn varies considerably at different stages of fruit ripening and at different localities. The name *Q. macrocalyx* has been applied to specimens with smaller, unripe fruits. *Quercus fleuryi* is characterized by its longer acorn and can be considered to represent specimens with large, ripe fruits. The type specimen of *Q. macrocalyx* is only one fruit, which gives no information on vegetative characters for discrimination. Fortunately, we found two other specimens of *Q. macrocalyx* that Camus (1934–1954) cited. One is from China, Koungsi, distr. “Shang-sze” (Tsang), another is *Poilane 7094*, from Annam, Vietnam. Both of these have entire glabrous oblong-elliptic leaves. We also found several specimens (*Y. W. Taam 809*, *W. T. Tsang 22380*, *20373*, *22605*, *24366*, *W. T. Tsang 25117*, *S. H. Chun 3130*, *Poilane 15975*, *29626*) identified as *Q. macrocalyx*. All the specimens of the two species only represent one taxon.

ADDITIONAL SPECIMENS EXAMINED: — **China.** Fujian: Nanjing, *Z. H. Wu 150209* (IBSC). Guangdong: Conghua, *L. Teng 7707* (IBSC); Fengchuan, *C. Huang 164495* (KUN); Fengkai, *K. L. Lin 4742* (IBSC); Huaiji, *Y. G. Lui 2955* (IBSC,

PE); Lechang, *S. H. Chun 3130* (IBSC, KUN, PE); Liannan, *P. C. Tam 59128* (KUN, PE); Lianshan, *P. C. Tam 58696* (IBSC, KUN, PE); Longmen, *S. C. Lee 200436* (IBSC, PE); Maoming, *L. Teng 2417* (PE); Renhua, *L. Teng 7707* (KUN, PE); Ruyuan, *Guangdong Woody Plants Survey Exped. 161* (IBSC); Wengyuan, *S. K. Leu 5334* (IBSC, KUN, PE); Xinfeng, *Y. W. Taam 809* (P); Xinyi, *C. Wang 31846* (IBSC, SYS KUN, PE); Yangchun, *Rongjiang Region Vegetation Exped. 3368* (IBSC); Zhaoqing, *K. L. Shi & S. D. Huang 2194* (IBSC); Guangxi: Cangwu, *S. H. Chun 10188* (IBSC, KUN); Da-miao-shan, *H. C. How 867* (IBSC, KUN); Jinxiu, *Q. H. Lu 4652* (IBSC, KUN); Fangcheng, *W. T. Tsang 25117* (SYS); Jingxi, *C. C. Chang 15154* (IBSC); Longsheng, *Longsheng Exped. 50281* (IBSC); Pingnan, *C. Wang 39957* (IBSC); Shangsi, *W. T. Tsang 22380* (P), *22605* (IBSC, P, SYS), *24366* (SYS); Zengcheng, “*Nan-kun-shan*”, *W. T. Tsang. 20373* (IBSC, KUN, PE, SYS). Guizhou: Huishui, *Agricultural & Forestry Exped. 760228* (SYS, PE); Kaili, *S. Guizhou Exped. 2289* (KUN, PE). Hainan: Baoting, *Diao-lou-shan Exped. 3168* (PE); Dongfang, *H. Y. Liang 63574* (IBSC, KUN); Ledong, *Q. Wang 820398* (IBSC); Qiongzong, *Wu-zhi-shan, S. H. Chun 10922* (IBSC, KUN). Jiangxi: Jing-gang-shan, *J. Xiong & D. W. Liu 7569* (P, E). Tibet: Gelin, *ETM. 2720* (KUN). Yunnan: Gongshan, *K. M. Feng 24354* (KUN); Puwen, *P. I. Mao 6655* (IBSC). — **Vietnam.** Annam, *Poilane 7094* (P), *29626* (IBSC). — **Laos.** *Poilane 15975* (P).

Cyclobalanopsis macrocalyx* var. *litoralis (Y.C. Hsu & H.W. Jen) M. Deng & Z.K. Zhou, *comb. & stat. nov.*

Cyclobalanopsis litoralis Y.C. Hsu & H.W. Jen, *Acta Bot. Yunnan.* 1: 147. 1979. — *Quercus hainanica* C.C. Huang & Y.T. Chang, *Guihaia* 12: 302. 1992, *nom. inval.* — *Quercus obconica* Y.C. Hsu ex Z.K. Zhou, *Acta Bot. Yunnan.* 20(1): 43. 1998. — TYPE: China. Hainan, Ledong, Jian-feng-lin, *H. W. Jen & N. D. Zhu 77100* (holotype SFC!; isotype IBSC!).

Leaf thick leathery, leaf blade ovate to obovate, tomentose beneath when young, later glabrous, apex obtuse or acute, margin entire or with 3–5 undulate serrate apically, base cuneate, 7–15 cm long, 4–9 cm wide, secondary veins 5–9 pairs, secondary veins arciform, curved to the margin; cupule 2–3 cm long, 2.5–3 cm diam, densely tawny tomentose outside, densely sericeous inside, wall 3–5 mm thick; concentric lamellae 9–12, margin of basal ones entire, others entire, denticulate or obviously dentate; acorn ovoid to cylindrical, 3–4.5 cm long, 2.2–2.8 cm diam., densely sericeous at first, later glabrous, the ripe acorn 1/3–1/2 enclosed in cupule, apex rounded or depressed, base subconvex, convex or conically convex.

DISTRIBUTION: China (Hainan).

HABITAT ECOLOGY: In evergreen forest, alt. 700–900 m.

PHENOLOGY: Flowering from March to May, acorn maturation biennial; fruiting from October to December.

The distinctive large grayish-brown tomentose cupules and ellipsoid acorns of *C. litoralis* show identity to *C. macrocalyx*. From our study, *C. macrocalyx* has a wide distribution in SE Asia and is variable in morphology. Its leaf blade varies from obovate or ovate to lanceolate, entire or serrate at the apex, remotely serrate and undulate. However, specimens with obovate or ovate leaves and relatively few lateral veins are only found on Hainan island. Considering its distribution and morphological characters, we reduce *C. litoralis* to a variety of *C. macrocalyx*.

This variety is easy to distinguish from *C. macrocalyx* by having fewer secondary veins (5–9 pairs) and thick, leathery, ovate or obovate leaves.

ADDITIONAL SPECIMENS EXAMINED: — **China**. Hainan: Baoting, *H. C. How* 72891 (IBSC); Lingshui, *C. L. Tso & N. K. Chun* 44293 (IBSC); Dongfang, *H. Y. Liang* 63381 (IBSC); Ledong, *Q. Wang* 2739 (IBSC).

***Cyclobalanopsis kouangsiensis* (A. Camus) Y.C. Hsu & H.W. Jen**

Acta Phytotax. Sin. 14(2): 78. 1976. — *Quercus kouangsiensis* A. Camus, Bull. Soc. Bot. France. 84: 176. 1937. — TYPE: China. “*Kouang-si, San Kiang Hsien*”, Steward & Cheo 966 (holotype P!; isotypes A!, IBSC!, CAS!).

Quercus macrocalyx var. *tomentosa* Metcalf, Lingnan Sci. J. 20(2–4): 218. 1942, *syn. nov.* — TYPE: China. Hainan, Baoting, 27.VIII.1935 *H. C. How* 73518 (holotype IBSC!; isotype PE!).

Quercus nemoralis Chun, J. Arnold Arbor. 28: 241. 1947. — TYPE: China. Hainan, “*Ting-an Hsien, Lung-wan, tree 15 m tall, with gray bark, in mixed wood*”, 23.I.1934 *C. Wang* 36843 (holotype IBSC!; isotype PE!).

Leaf leathery, leaf blade ovate or oblong-elliptic, densely pale grayish brown tomentose beneath, margin apical 1/2 undulate or remotely serrate, with 4–6 acuminations apically, base cuneate, 12–10 cm long, 3–6 cm wide, secondary veins straightly reach margin; cupule 2–3 cm long, 2–2.8 cm diam., densely tawny tomentose

outside, densely sericeous inside, wall 1.6–3 mm thick; concentric lamellae 7–9, margin entire or of basal ones dentate, denticulate, upper ones denticulate or entire; acorn ovoid to cylindrical, 3–4.5 cm long, 2–2.8 cm diam, densely sericeous, later glabrous, ripe acorn 1/2–3/5 enclosed in cupule, apex rounded, base subconvex or convex.

DISTRIBUTION: China (Guangxi, Hainan).

HABITAT ECOLOGY: In evergreen forest, alt. 700–900 m.

PHENOLOGY: Flowering from March to May; acorn maturation biennial; fruiting from October to December.

The diagnosis of *Quercus macrocalyx* var. *tomentosa* (Metcalf 1942) was only one sentence: “*A specie foliis subtus distinctis tomentosis differt.*” We checked its type specimen *H. C. How* 73518 (from China, Hainan, Po-ting) demonstrating that *C. kouangsiensis* and *Q. macrocalyx* var. *tomentosa* are identical, and that the latter should be reduced to a synonym.

Cyclobalanopsis kouangsiensis is close to *C. macrocalyx*. The characters such as marginal serration of leaves, leaf apex, thickness of cupule, number and serration of cup scale whorls were considered to distinguish *C. kouangsiensis* and *C. fleuryi* (Huang *et al.* 1999). The cupule and acorn of *C. kouangsiensis* differ from *C. fleuryi* since the former has a much thinner cupule (1.5 mm thick), less lamellae (8–9 rings) and a bigger nut scar (1.5 cm diam.) in contrast to 6 mm thick cupule, 10–13 rings and a smaller nut scar (1.2 cm diam.) in *C. fleuryi*.

Cyclobalanopsis macrocalyx (*C. fleuryi*) has a wide distribution. Its acorn and cupule are greatly varied in different environments. From measurements on specimens and natural habit observations on the two species, we found that the number of the lamellae, the teeth of the lamellae margin and diameter of nut scar differ greatly between the two species. All the fruit characters Huang *et al.* (1999) employed to distinguish the two species are overlapping and invalid at species level. We found that stable differences between the two species are the adult leaves distinctly tomentose beneath, and margin apical 1/2 undulate or remotely serrate in *C. kouangsiensis*, but glabrous, entire or apex

acuminate in *C. macrocalyx*. Foliar trichomes are one of the most significant characters in distinguishing taxa or groups and for interpreting evolutionary relationships in *Quercus* (including *Cyclobalanopsis*) (Jones 1986, Manos 1993, Llamas et al. 1995, Zhou et al. 1995, Bussotti & Grossoni 1997, Lou 2000). Thus we still treat *C. kouangsiensis* as a distinct species.

ADDITIONAL SPECIMENS EXAMINED: — **China**. Guangxi: Fangcheng, *W. T. Tsang 26677* (SYS); Xiangxian, *C. Wang 40304* (IBSC, PE); Shangsi, *H. Y. Liang 69623* (IBSC, PE, SZ). Hainan: Baoting, *H. C. How 73501* (IBSC, KUN, PE); Yaxian, *C. Wang 33334* (SZ).

Cupules and acorns are important characters in the taxonomy of Fagaceae. *Cyclobalanopsis macrocalyx* and closely related species share the distinct characters of ripe cupule covered with dense tawny tomentum outside; acorn densely covered with tawny hair, stylobate strongly convex with 5–9 small concentric rings, styles 4–6(7); leaves leathery. All these characters make this group of plants distinct from other plants in *Cyclobalanopsis*.

Key to Chinese species of *Cyclobalanopsis* with distinct dense tawny tomentum on the cupule and acorn densely covered with tawny hair.

1. Ripe cupule less than 1.6 cm long 2
2. Ripe cupule more than 2 cm diam., acorn oblate to global, leaves less than 10(12) cm long, 3.5 cm wide
..... *C. hui*
2. Ripe cupule less than 1.8 cm diam., acorn obovate to oblong, leaves 8–18 cm long, 4–7 cm wide
..... *Q. langbianensis*
1. Ripe cupule more than 1.8 cm long 3
3. Adult leaves abaxially densely pale grayish-brown stellate-tomentose *C. kouangsiensis*
3. Adult leaves beneath glabrescent 4
4. Adult leaves margin apical 1/3–1/2 distinctly acuminate, usually less than 10 cm long, 3.8 cm wide, leaf blade obovate or obovate-lanceolate *C. pachyloma*
4. Adult leaves margin entire, apex remotely serrate or undulate, usually more than (8)10 cm long, 4 cm wide, leaf blade oblong or elliptic 5
5. Leaf secondary veins 5–9 pairs, leaf blade obovate, ovate to elliptic, tertiary veins abaxially inconspicuous, ripe cupule covering 1/3–1/2 of acorn
..... *C. macrocalyx* var. *litoralis*
5. Leaf secondary veins 10–12(15) pairs, leaf blade oblong-elliptic to ovate-elliptic, tertiary veins abaxially conspicuous, ripe fruit cupule covering 3/5–4/5 of acorn
..... *C. macrocalyx* var. *macrocalyx*

Cyclobalanopsis augustinii* (Skan) Schottky var. *nigrinux* (Hu) M. Deng & Z.K. Zhou, *comb. & stat. nov.

Cyclobalanopsis nigrinux Hu, Acta Phytotax. Sin. 1(2): 154. 1951. — TYPE: China. Xichou, Fadou, alt. 1500–1600 m, 19.IX.1947 *K. M. Feng 11904* (holotype PE!; isotypes PE!, KUN!).

Quercus chevalieri auct., non Hickel & A. Camus, J. Beijing Forest. Univ. 15(4): 45. 1993. — *Cyclobalanopsis chevalieri* (Hickel & A. Camus) Y.C. Hsu & H.W. Jen, J. Beijing Forest. Univ. 15(4): 45. 1993. — TYPE: Vietnam. “Tonkin, pres de Lao kay, Cha pa, altitude 1400–1500 m”, A. *Chevalier 29488* (isotypes P!, AAU!).

DISTRIBUTION: China (Guangxi, Hainan and Yunnan) and Vietnam.

HABITAT ECOLOGY: In evergreen forest, alt. 890–2000 m.

PHENOLOGY: Flowering from April to May, acorn maturation annual, fruiting October to December.

ADDITIONAL SPECIMENS EXAMINED: — **China**. Guangxi: Debao, *C.T. Li 602025* (IBK); Jingxi, “*Tong-fa-jie, Lao-hwai-da-shan*”, *S.P. Ko 55546* (IBK); Hainan: Ledong, Jiang-fong-ling, *W. J. Jen & N. D. Zhu 77189* (SFC); Lingshui, Diao-luo-shan, *Diao-luo-shan Exped. 3204* (IBK); Yunnan: Pinbian, Da-wei-shan, *C. J. Wang 900* (SFC); Xichou, Fadou, back hill of To-pi-shu village, in dense woods, alt. 1560 m, *M. Deng 49* (KUN). — **Vietnam**. Tonkin, “*Phan-si-pan, prov. Lao-kay*”, *Poilane 25062* (PE).

Xu and Ren (1993) reduced *Cyclobalanopsis nigrinux* to a synonym of *C. chevalieri*. We checked the type materials of *C. chevalieri* and *C. nigrinux*. The leaf blade of *C. nigrinux* is ovate-lanceolate, apex remotely spiculate serrate, acuminate; adaxial secondary veins 6–10 pairs, slender, inconspicuous, irregularly curved to the margin; tertiary veins obscure to very slender on both sides. These characters show that this taxon is by no means similar to *C. chevalieri* (leaf blade elliptic; apex acute or caudate; adaxial secondary veins 9–13, conspicuous; tertiary veins conspicuous).

From our observations, *C. nigrinux* is very close to *C. augustinii*. We also checked the type material of *C. augustinii* (*A. Henry 11430*, from China, Yunnan, “Mengtse”, alt. 1500 m) in A and IBSC and other specimens of this species, finding the only differences between the two species are that *C. nigrinux* has thinner leaves, glossy

brown beneath, which are neither farinose nor glaucescent, while typical leaves of *C. augustinii* are farinose or glaucescent beneath. We therefore reduce *C. nigrinix* to a variety of *C. augustinii*.

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