The Genus *Calophyllum* (Guttiferae) in Thailand

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ABSTRACT

This work finished since 1999 but has never been technically published. It was conducted by a comparative morphological study. Both specimens collected from fieldwork in several regions and herbarium specimens deposited in several herbaria in Thailand were examined.

Seventeen species of *Calophyllum* in Thailand were found namely: *C. calaba* L., *C. canum* Hook. f., *C. depressinervosum* M. R. Hend. & Wyatt-Sm., C. *dryobalanoides* Pierre, *C. inophyllum* L., *C. macrocarpum* Hook. f., *C. molle* King, *C. pisiferum* Planch. & Triana, *C. polyanthum* Wall. ex Choisy, *C. rupicola* Ridl., *C. sclerophyllum* Vesque, *C. soulattri* Burman f., *C. symingtonianum* M. R. Hend. & Wyatt-Sm., *C.tetrapterum* Miq., *C. teysmannii* Miq., *C. thorelii* Pierre and *C. touranense* Gagnep. ex P. F. Stevens, of which, three species, *C. canum, C. sclerophyllum* and *C. teysmannii,* were regarded to be the new records for Thailand at that time.

A key to species based on flowering and fruiting materials of Thai *Calophyllum* is presented. Full species descriptions of the three new records are provided.

Key Words: *Calophyllum,* Guttiferae, Clusiaceae, Taxonomy, Thailand

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INTRODUCTION

Tropical forest accommodates the highest plant species diversity compared to other habitats in the globe. Approximately ten thousand species of vascular plants have been estimated to present naturally in Thailand (Santisuk *et al*., 1991). Until now, hundreds of species are still under documented because the Flora of Thailand project has not finished yet (Parnell, 2000; Middleton, 2003). However, it is looking promising as we now have both easterners and westerners come to work together on the project.

The genus *Calophyllum* is one of the large genera, with many identification problems, of the mangosteen family (Guttiferae). Earlier studies of this genus in Thailand reported taxonomic confusion in the number and delimitation of species (*e.g.* Craib, 1931; Smitinand, 1980; Stevens, 1980; Phengklai & Niyomdham, 1991). Many species in this genus are economically important, in particular for timber (especially for housing, shipbuilding, furnituring *etc.*). Their non-timber products are also important *e.g.* for medicinal uses (Henderson & Wyatt-Smith, 1956; Perry, 1980; Stevens, 1980). Therefore taxonomic study of the genus *Calophyllum* is strongly needed for Thailand.

This study aimed to 1) study morphological characters of the genus *Calophyllum* in Thailand. 2) construct the key to species of Thai *Calophyllum*. 3) To record their geographical and ecological distributions.

MATERIALS AND METHODS

Materials used in this study are as follows:

1. Plant presses 30 by 45 cm., used newspapers, cardboards, pruning knife, plastic bags and field books. Materials for mounting herbarium specimens are:
   - herbarium sheet 300 gram, 26.5 by 42 cm.
   - White paper covers, 27 by 42 cm.
   - Needles and thread
   - Labels 10 by 13.5 cm.
2. Handlens and dissecting microscope
3. 70% ethyl alcohol
4. Altimeter
5. Tree climbing spurs
6. SLR 35 mm. camera, negative films and colors slides

The methods performed by this study are listed below:

1. Surveying and collecting specimens were carried out in all regions of Thailand. The geographical and ecological distributions of individual plants were systematically recorded.

2. The herbarium specimens were prepared and studied, and then deposited at the Herbarium of Faculty of Forestry, Kasetsart University (KUFFH, abbreviation only used in this study). Materials from the following herbaria; The Forest Herbarium, National Park, Wildlife and Plant Conservation Department (BKF); The Bangkok Herbarium, Department of Agriculture (BK) and Prince of Songkla University Herbarium (PSU) were also investigated.

3. The species identification was based on a comparative morphological study. Information about the type specimens of accepted species and synonyms obtained from Stevens (1980). The types have been seen (by first author) are indicated by "!".

4. Vernacular names used in this study obtained from Smitinand (1980), otherwise stated.

5. Utilization of each species was based primarily on Henderson & Wyatt-Smith (1956); Perry (1980) and Stevens (1980). The information from the fieldwork was also used.

RESULTS AND DISCUSSION

Synopsis and description of the genus

***Calophyllum* L.** Sp. Pl. 1: 513. 1753; Planchon & Triana, Ann. Sci. Nat. Bot. IV. 15: 241. 1862; Bentham in Bentham ษ Hook. f. Gen. Pl. 1: 175. 1862; T. Anderson in Hook. f. Fl. Brit. India 1: 271. 1874; King, Jour. Asiatic Soc. Bengal, II. 59: 172. 1890; Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 316. 1910; Ridl., Fl. Malay Penin. 1: 181. 1922; Gagnep. Fl. Gen. Indo-Chine Suppl. 1(3): 268. 1943; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 285. 1956; Backer & Bakh. f. Fl. Java 1: 384. 1963; P. F., Jour. Arnold Arb. 61: 167. 1980. Type: *Calophyllum inophyllum* L.

____*Ponna* Rheede ex Ludwig, Defin. Gen. ed. 3. 239. 1760, *nomen superfluum.*

____*Calaba* Plum. ex Adanson, Familles 2: 446. 1763, *nomen superfluum.*

____*Apoterium* Blume, Bijd. Nerderl. Indie 1(5): 218. 1825. Type: *Apoterium sulatri* Blume.

Small to large evergreen trees. ***Trunk*** usually without buttresses, occassionally with stilt roots and pneumatophores (*C. sclerophyllum*). ***Bark*** yellowish-brown to grayish-brown; usually smooth with diamond- or boat-shaped lenticellate fissures in immature trees thereafter changed into longitudinally fissured in mature trees, occassionally smooth with hoop-marked

(*C. canum*); pink to redish slash-marked bark, laminated; exudate clear honey or opaque whitish, sticky or not (see Figure 1). ***Youngest twigs*** characteristically quadrangular, and with terminal buds. ***Leaves*** simple and petiolate, opposite and decussate; lamina coriaceous, usually glabrous and shining, occassionally dorsally pubescent (*C. molle*); lateral nerves numerous, slender, close together and paralleled from midrib towards margin, occassionally sub-marginal vein distinct (*C. teysmannii*); exstipulate. ***Inflorescences*** cymose, rarely pseudo-umbellate (*C. soulattri*); terminal and/or upper leaf axils or axillary only; flowers usually numerous, bisexual; tepals 4-8, imbricate or decussate; stamens numerous, usually glabrous, occasionally puberulent (*C. molle*); filaments slender, basifixed, more or less joined at base into 4-6 bundles; anther oblong or oblique, 2-celled, apex retuse or apiculate, dehiscence vertically. Ovary superior, ocassionally pubescent (*C. molle*), 1-locular, 1 ovule, anatropous, basal placentation; style slender, stigma peltate. ***Fruit*** a drupe, ovoid to globose with crustose endocarp; yellowish-green, pale brown, orange or blackish when ripen; seed exalbuminous, single, erect; ovoid to globose; not arillate; testa thin or thick and spongy; embryo slender, straight, with distinct large cotyledons.

A large genus of about 120 species worldwide, they are mostly distributed in the tropical Asia, to the Pacific Islands, a few species were reported to occur in tropical America and Madagascar. So far, 17 species are naturally found in Thailand, of which, three species, *C. canum, C. sclerophyllum and C. teysmannii,* are regarded as the new records for Thailand. The species descriptions of all Thai *Calophyllum* can be seen in Sangkaew (1999).

Keys to the species of the genus *Calophyllum* L. in Thailand

1. Inflorescences terminals and/or from upper leaf axils.
   2. Outer pair of tepals dorsally pubescent.
      3. Fruit mesocarp fibrous.----------1. ***C. thorelii***
      3. Fruit mesocarp soft or sclerenchymatous, not fibrous.
         4. Outer pair of tepals equal to the inner one. Terminal buds usually 0.5-0.7 cm long. Fruits subglobose to globose, apexrounded.----------2. ***C.touranense***
         4. Outer pair of tepals shorter than or about half the length of the inner one. Terminal buds usually 1-2 cm long. Fruits ovoid to subglobose, more or less pointed at apex.----------3. ***C.polyanthum***

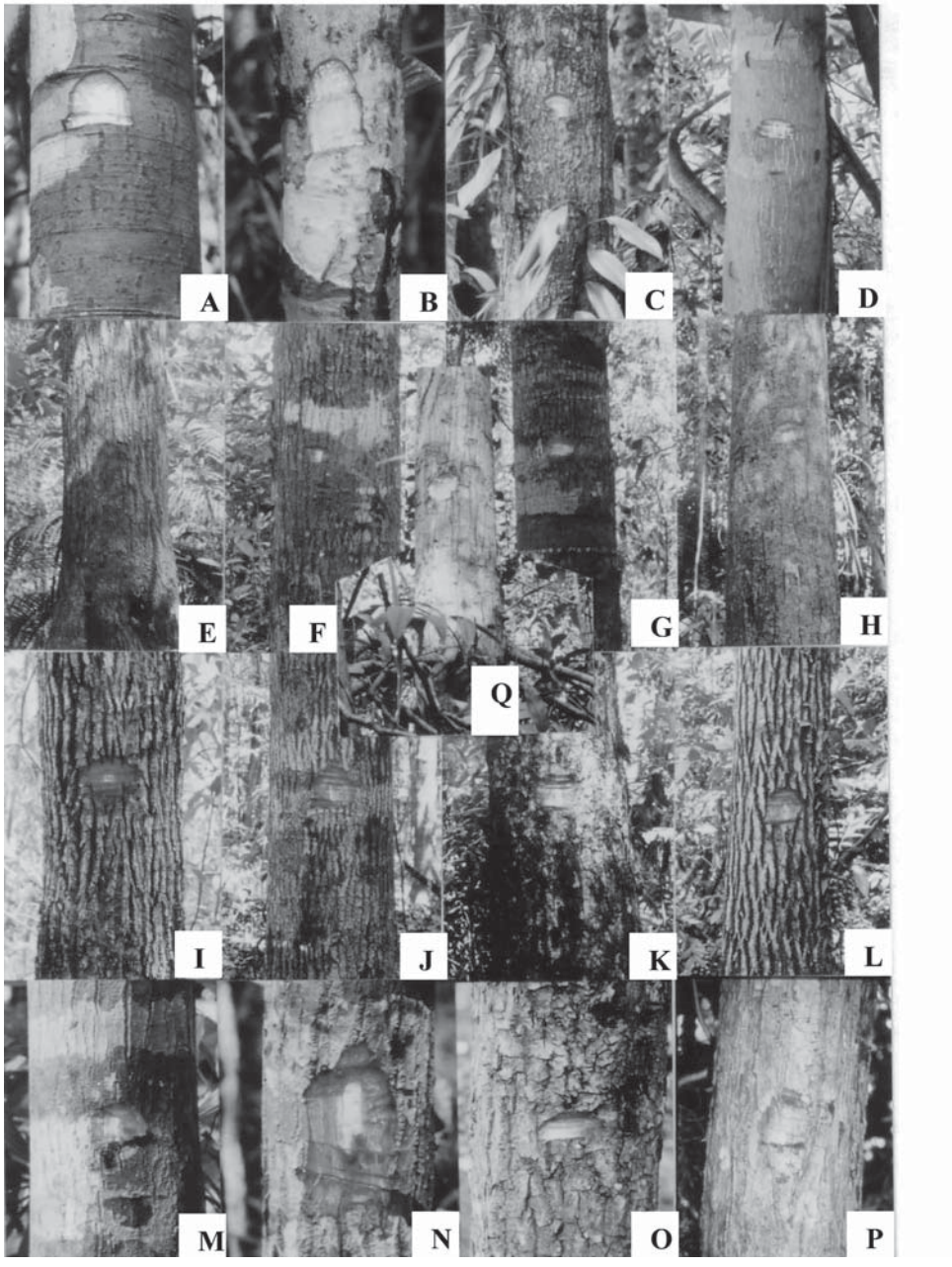

Figure 1 The barks of Thai *Calophyllum*. **A.** *C. canum*; **B.** *C. rupicola*; **C.** *C. soulattri*; **D.** *C. pisiferum*; **E.** *C. macrocarpum*; **F.** *C. depressinervosum*; **G.** *C. symingtonianum*; **H.** *C. molle*; **I.** *C. thorelii*; **J.** *C. calaba*; **K.** *C. touranense*; **L.** *C. polyanthum*; **M.** *C. teysmannii*; **N.** *C. tetrapterum*; **O.** *C. inophyllum*; **P.** *C. dryobalanoides*; **Q.** *C. sclerophyllum*. Based primarily on the bark, Thai *Calophyllum* can be characteristically classified into two groups: 1) Bark with opaque whitish exudate; **A-D.** 2) Bark with clear honey exudate; **E-Q.**

2. Outer pair of tepals dorsally glabrous or slightly pubescent towards base.
5. Stamens more than 140/flower. Fruits broadly ovoid, 1-1.5 x 0.7-1 cm; acute to acuminate at apex. Ratio of leaf length/width is 2/1. ----------4. *C.dryobalanoianum*
5. Stamens less than 80/flower. Fruits ellipsoid or ovoid, 1.7-2 x 1.5-1.7 cm; acute to rounded at apex. Ratio of leaf length/width is 3/1. ----------5. *C.symingtonianum*

1. Inflorescences axillary only.
6. Tepals 8 [except C. tetrapterum, tepals (4)-8].
7. Outer pair of tepals dorsally pubescent.
8. Lamina coriaceous; apex acute to acuminate. Fruits ellipsoid, 6.5- 8x 4.5-5.5 cm. Tree without stilt roots. ----------6. *C.macrocarpum*
8. Lamina strongly coriaceous; apex retuse to round. Fruits ovoid, ellipsoid to subglobose, 2.5-3.5 x 2-3 cm. Tree with stilt roots.----------***7. sclerophyllum***
7. Outer pair of tepals dorsally glabrous.
9. Leaf with intra-marginal vein. Youngest twigs with transvers lines at nodes.----------8. ***C. teysmannii***
9. Leaf without intra-marinal vein. Youngest twigs without transvers lines at nodes.
10. Leaf apex rounded to retuse (rarely acute). Stamens 120-260/flower. Fruits more than 1.5 cm across. Tree withoutstill roots.----------***9. C. inophyllum***
10. Leaf apex acute to acuminate. Stamens 20-100/flower. Fruits less than 1.5 cm across. Tree occassionally with short still roots or spurs. ----------***10. C. tetrapterum***

6. Tepals 4 [except *C. tetrapterum*, tepals (4)-8].
11. Outer pair of tepals dorsally pubescent.
12. Lower surface of leaves pubescent. Ovary and fruit pubescent.---------***11. C. molle***
12. Lower surface of leaves glabrous, or slightly pubescent only along midrib. Ovary and fruit glabrous.
13. Outer pair of tepals dorsally generally pubescent.
14. Stamens usually more than 300/ flower. Exudate opaque whitish. ----------***12. C. canum***
14. Stamens usually less than 200/flower. Exudate clear honey.----------***13. C. calaba***

13. Outer pair of tepals dorsally pubescent along midrib.
15. Youngest twigs glabrous. Buds and inflorescences usually supra-axillary. ----------***14. C. rupicola***
15. Youngest twigs pubescent. Buds and inflorescences firmly axillary. ----------***15. C. pisiferum***

11. Outer pair of tepals dorsally glabrous.
16. Veins on lower surface of leaves obscure. Midrib on lower surface depressed or flattened. Ripening fruits pale brown.----------***16. C. depressinervosum***
16. Veins on lower surface of leaves distinct. Midrib on lower surface raised. Ripening fruits dark green or blackish.
17. Youngest twigs glabrous; internode 1-3 cm long. Fruits dark green when ripen.----------***10. C. tetrapterum***
17. Youngest twigs reddish-brown pubescent; internode 3-7(-10) cm long. Fruits blackish when ripen. ----------***17. C. soulattri***

1. ***Calophyllum thorelii* Pierre,** Fl. Forest. Cochinch. 1: *pl.* 103. 1885; Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 322. 1910; Craib, Fl. Siam. Enum. 1: 122. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. 1: 269. 1943; P. F. Stevens, Jour. Arnold Arb. 61: 218. 1980. Type: Cochinchine [Vietnam], in montibus Dinh ad Baria Galliae, 300 m., March? 1867, *Pierre* 34 (lectotype, P; isolectotypes, BM, K). Figure 2.

— *C. thorelii* Pierre var. *oxycarpum* Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. 1: 270. 1943, *nomen invalidum.*

Thailand. — NORTH-EASTERN: Mukdahan; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat.

Distribution.— Vietnam.

Ecology.— In semi-evergreen forest, at *ca.* 50-300 m. altitude. Flowering November-January. Fruiting December-May.

Vernacular.— Kathanghan (กะทังหัน), Kanghan (กังหัน) (Chanthaburi).

Uses.— The wood is generally useful in construction, including that of boats and masts, apparently being resistant to the attacks of borers. The flowers are very fragrant. Fruit is edible.

2. *Calophyllum touranense* Gagnep. ex P. F. Stevens, Jour. Arnold Arb. 61: 226. *fig.* 8, b-d. 1980. Type: Indochina [Vietnam], Annam, Hoi Mit, 40 km. N. of Tourane, 10 July 1927, *J. & M. S. Clemens 4162* (holotype, A; isotypes, K, NY, P). Figure 3.

—*C. touranense* Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. 1: 271. 1943, *nomen invalidum.*

Thailand.— NORTH-EASTERN: Phetchabun; EASTERN: Chaiyaphum, Nakhon Ratchasima; SOUTH-WESTERN: Phetchaburi.

Distribution.— Vietnam.

Ecology.— Usually present in hill evergreen forest, at *ca.* 700-1200 m. altitude. Flowering January-March. Fruiting February-June and September-October.

Vernacular.— Tanghon khao (ตังหนเขา) (by first author).

Uses.— The wood is used for house construction.

3. ***Calophyllum polyanthum* Wall. ex Choisy,** Descr. Guttif. Inde, 43. 1849; T. Anderson in Hook. f. Fl. Brit. India 1: 274. 1874; Kurz, Jour. Asiatic Soc. Bengal, II. 43: 88. 1874, Forest Fl. Brit. Burma 1: 95. 1877; Gamble, List Trees Darjeeling Distr. 7. 1878; Brandis, Indian Trees, 54. 1907; Craib, Fl. Siam. Enum. 1: 121. 1931; P. F. Stevens, Jour. Arnold Arb. 61: 220. 1980. Type: India, Assam, Sillet, 1832, *Wallich dist. 4844* (holotype, G; isotypes, BM, FI, G, GH, K, P). Figure 4.

—*C. smilesianum* Craib, Kew Bull. 1924: 85. 1924. Type: Siam [Thailand], Kao Keo Kang, Dan Sui , *ca.* 1300 m., April 1922, *Kerr 5792* (holotype, K; isotypes, E, P).

—*C. smilesianum* Craib var. lutea Craib, Kew Bull. 1924: 86. 1924. Type: Siam [Thailand], Doi Pahom Pok, Mg. Fang, ca. 1600 m., 1 April 1921, *Kerr 5180* (holotype, K).

—*C. williamsianum* Craib, Kew Bull. 1924: 86. 1924. Type: Siam [Thailand], Nan, Doi Tiu, *ca.* 1100 m., 8 March 1921, *Kerr 5038* (holotype, K; isotypes, E, P).

Thailand.— NORTH: Mae Hong Son, Chiang Mai, Nan; NORTH-EASTERN: Loei; SOUTH-WESTERN: Uthai Thani, Prachuap Khiri Khan; PENINSULAR: Nakhon Si Thammarat, Trang.

Distribution.— India (Western Ghats and northeastern India) to southwestern China.

Ecology.— Evergreen forest in Peninsular, at *ca.* 100-200 m. altitude and in hill evergreen forest in North and North-Eastern, at *ca.* 950-1500 m. altitude. Flowering March-May. Fruiting May-November and October-February.

Vernacular.— Pha ong (พะอง) (Loei); Kho-mai-do (คอไหม้ดอ) (Karen-Kamphaeng Phet); Saa-chum-mun (ซ้าจุ้มมุ่น) (Karen-Mae Hong Son); Tanghon (ตังหน) (Nakhon Si Thammarat; Ma haen doi (มะแหนดอย) (Chiang Mai).

Uses.— The wood is used for general construction and furniture.

4. ***Calophyllum dryobalanoides* Pierre,** Fl. Forest. Cochinch. 1: *pl.* 106. 1885; Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 319. 1910; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. 1: 274. 1943, *pro minore parte;* P. F. Stevens,

Jour. Arnold Arb. 61: 232. 1980. Type: Cochinchine [Vietnam], in montibus Dinh ad Baria Galliae, Oct. 1866, *Pierre 83* (lectotype, P; isolectotypes, A, K! (photograph), L, P, SING). Figure 5.

Thailand.— SOUTH-EASTERN: Chanthaburi, Trat.

Distribution.— Vietnam, Cambodia.

Ecology.— In semi-evergreen forest, at *ca.* 900-1000 m. altitude. Flowering November-December. Fruiting January-March.

Vernacular.— Pha ong (พะอง) (Chaiyaphum).

Uses.— The wood is used for general construction. Fragrant oil used in hair dressing.

5. ***Calophyllum symingtonianum* M. R. Henderson & Wyatt-Smith,** Gard. Bull. Singapore 15: 338. pl. 18. 1956, *pro majore parte;* T. C. Whitmore, Tree Fl. Malaya 2: 192. 1973, *pro parte*; P. F. Stevens, Jour. Arnold Arb. 61: 229. 1980. Type: Malaya, Pahang, Cameron Highlands, Boh Plantation, 4000 feet [1219 m.], 12 April 1937, *SFN 32633 coll. Nur* (holotype, SING; isotypes, A, K! (photograph), KEP, L, MO, P, UC, US). Figure 6.

Thailand.— PENINSULAR: Trang, Songkhla, Yala.

Distribution.— Malaya.

Ecology.— In evergreen Forest, at ca. 100-150 m. altitude. Flowering unknown. Fruiting February-April.

Vernacular.— Tanghon (ตังหน) (Trang).

Uses.— The wood is used for house construction.

6. ***Calophyllum macrocarpum* Hook. f.,** Fl. Brit. India 1: 273. 1874; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 317. 1956; T. C. Whitmore, Tree Fl. Malaya 2: 187. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 52. *fig.* 28, g, h. 1980. Type: Malaya, Malacca, 30 July 1867, *Maingay 1728* (Kew dist. 174) (lectotype, K! (photograph)). Figure 7.

Thailand.— PENINSULAR: Chumphon, Ranong, Krabi, Nakhon Si Thammarat, Trang, Songkhla, Narathiwat.

Distribution.— Malaya to Borneo, excluding Java.

Ecology.— In evergreen forest, at *ca.* 100-220 m. altitude. Flowering May-July. Fruiting August-April.

Vernacular.— Chuat (ชวด), Tanghon (ตังหน) (Trang).

Uses.— The wood is used for construction and furniture.

7. ***Calophyllum sclerophyllum* Vesque,** Epharmosis 2: *t.* 33. 1889; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 324. 1956; Smythies, Common Sarawak Trees, 64. *pl.* 22. 1965; T. C. Whitmore, Tree Fl. Malaya 2: 191. 1973; J. Anderson, Trees Peat

Swamp Sarawak, 88. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 447. 1980. Type: Sarawak, Kuching, Nov. 1886, *Beccari PB 2705* (holotype, P; isotypes, FI, K, M). Figure 8.

—*C. rhizophorum* Boerl. & Koord. in Koord.-Schum. Syst. Verzeich. 2: 39. 1910. Type: Sumatra, bei Biwak Soengei Gati, 25 m., 11 March 1891, *Koorders 10333* (holotype, BO).

—*C. teysmannii* Miq. var. inophylloide (King) P. F. Stevens, *sensu.* C. Phengklai & C. Niyomdham, Flora in Peat Swamp Areas of Narathiwat, 196. *fig.* 108. 1991.

Large tree up to 40 m tall; trunk straight, with many branched stilt roots up to 5 m tall, knee roots present. ***Outer bark*** reddish-brown to dark brown, narrowly and shallowly fissured, sometimes with papery. Slash-marked pink to dark red, exudate clear honey. ***Youngest twigs*** flattened to rectangular, slightly brown pubescent, waxy or glabrous; internode 1-3 cm long. Uppermost pair of axillary bud 1-2 mm long. ***Terminal buds*** 0.8-1 cm long, with brown pubescent. *Leaves* petiolate, 1.5-2 cm long, broadly concave above and convex below, waxy or slightly pubescent to glabrous. Lamina obovate, oblong-obovate to oblong, 10.5-18.5 by 6-9.5 cm; apex usually retuse to round, base cuneate, margin entire to slightly repand; strongly coriaceous, drying brownish-yellow to reddish-brown above and light brown below; midrib on upper surface depressed in channel about 1/3-2/3 of lamina length, under one strongly raised, lateral veins on the both surface distinct, 5-9 veins/0.5 cm. ***Inflorescences*** axillary, covered by brown pubescent, 3.5-15 cm long, 9-11 flowers/inflorescence, pedicels 1-4 cm long. Tepals 8, the outer pair ovate to suborbicular, 6.5-7.5 by 6.5-7 mm, dorsally densely brown pubescent; inner one ovate to suborbicular, 10-13 by 9-9.5 mm, dorsally pubescent in band; the next two ones with same shape and size, obovate, 10-14 by 5-7(-10) mm, slightly pubescent only margin. Stamens about 199-356 per flower, filament 4-6 mm long, anther 1.3-1.8 mm long. Ovary 4-4.5 mm long, style 4.5-6.5 mm long. ***Fruits*** ovoid, ellipsoid to subglobose, 2.5-3.5 by 2-3 cm; apiculate, acute to rounded at apex; yellowish-green when ripen. Exocarp plus mesocarp 0.3-0.5 cm thick. Endocarp 1-2 mm thick, ovoid, ellipsoid to subglobose, 2.3-2.8 by 1.8-2.5 cm.

Figure 2 *C. thorelii*. **A.** Fruiting branch, one fruit showing part of exocarp plus mesocarp removed and another fruit in cross section; **B.** Fruits, showing fiber-like mesocarp.

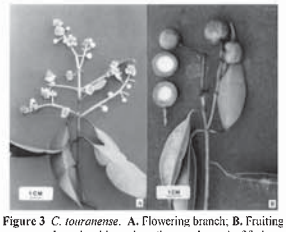

Figure 3 *C. touranense*. **A.** Flowering branch; **B.** Fruiting branch with sections (long and cross) of fruits.

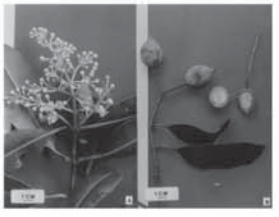

Figure 4 *C. polyanthum*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

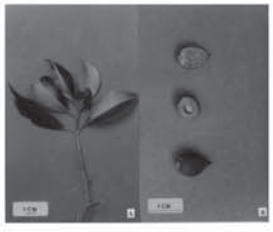

Figure 5 *C. dryobalanoides*. **A.** Fruiting branch; **B.** Fruit and sections of fruits.

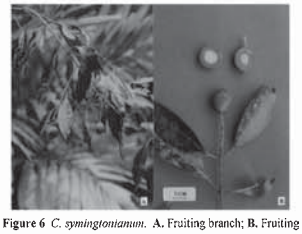

Figure 6 *C. symingtonianum*. **A.** Fruiting branch; **B.** Fruiting branch with sections of fruits.

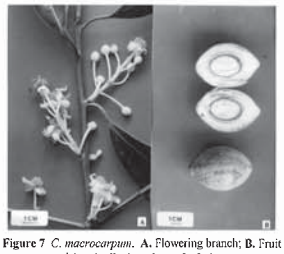

Figure 7 *C. macrocarpum*. **A.** Flowering branch; **B.** Fruit and longitudinal sections of a fruit.

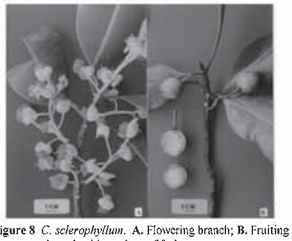

Figure 8 *C. sclerophyllum*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

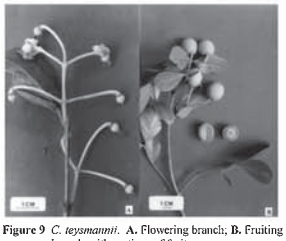

Figure 9 *C. teysmannii*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

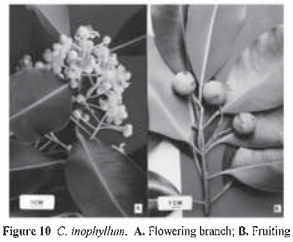

Figure 10 *C. inophyllum*. **A.** Flowering branch; **B.** Fruiting branch.

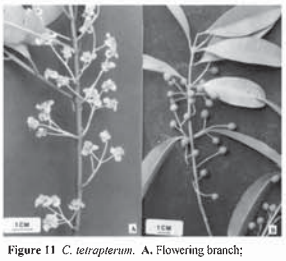

Figure 11 *C. tetrapterum*. **A.** Flowering branch; **B.** Fruiting branch.

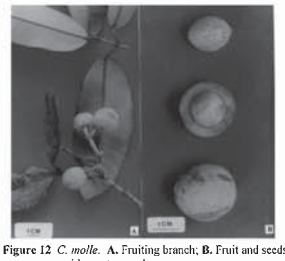

Figure 12 *C. molle*. **A.** Fruiting branch; **B.** Fruit and seeds with crustose endocarp.

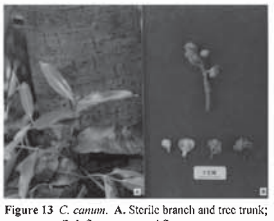

Figure 13 *C. canum*. **A.** Sterile branch and tree trunk; **B.** Inflorescence and flowers.

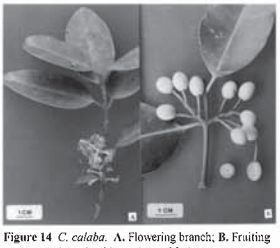

Figure 14 *C. calaba*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

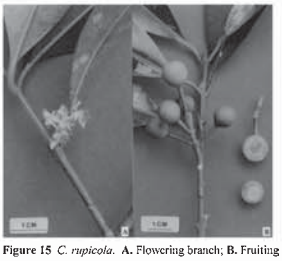

Figure 15 *C. rupicola*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

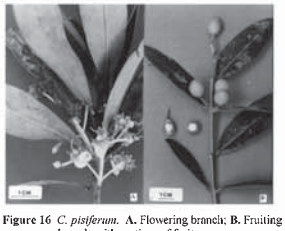

Figure 16 *C. pisiferum*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits.

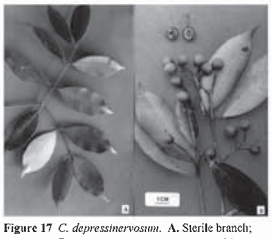

Figure 17 *C. depressinervosum*. **A.** Sterile branch; **B.** Fruiting branch with sections of fruits.

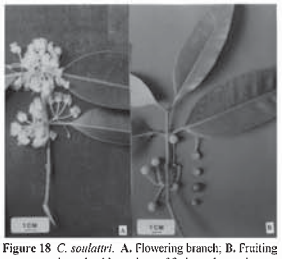

Figure 18 *C. soulattri*. **A.** Flowering branch; **B.** Fruiting branch with sections of fruits and a seed.

Thailand.— PENINSULAR: Narathiwat.

Distribution.— Malay Peninsular (mostly on the eastern coast) to Borneo excluding Java.

Ecology.— In Peat Swamp Forest, at *ca.* sea level -10 m. altitude. Flowering July-August. Fruiting August-December.

Vernacular.— Ya-Kang (ยะกัง) (Malay-Narathiwaat); Kra thing phru (กระทิงพร) (by first author).

Uses.— The wood is hard and heavy and used in general construction; since it is not attacked by insects, it is durable.

8. ***Calophyllum teysmannii*** **Miq.,** Fl. Indiae Batavae Suppl. 1(3):499. Dec. 1861; P. F. Stevens, Jour. Arnold Arb. 61: 431. 1980. Type: Sumatra, prope Paja-kombo, *Teysmann, HB 650* (holotype, U; isotypes, BO, L, P). Figure 9.

—*C. inophylloide* King var. *singapurense* M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 316. pl. 9. 1956. Type: Singapore, MacRitchie Reservoir, 10 Nov. 1936, *SFN 32518 coll. Corner* (holotype, SING; isotypes, K, KEP).

—*C. intramarginale* M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 342. *pl.* 22. 1956. Type: Malaya, Trengganu, Gunong Padang, 4000 feet [1218 m.], June 1937, *SFN 31900 coll. Moysey & Kiah* (holotype, SING; isotypes, A, K, KEP).

Medium to large tree up to 25 m tall; trunk bole and straight, sometimes with small buttresses or spurs. ***Outer bark*** grayish-brown to dark brown, shallowly and narrowly fissured. Slash-marked pink to dark red; exudate clear honey. ***Youngest twigs*** flattened, more or less slender, slightly brown pubescent, waxy or glabrous; internode 1.5-3.5 cm long. Uppermost pair of axillary bud 0.05-0.2 mm long, usually attached by petoles. ***Terminal buds*** 0.3-0.45 cm long, with brown pubescent. ***Leaves*** petiolate, 0.3-0.7 cm long, concave above and convex below, slightly pubescent to glabrous. Lamina obovate, elliptic-obovate to elliptic, 3.5-7.5 by 1.5-3.5 cm; apex acute, rounded to retuse, base cuneate, margin entire, submarginal vein distinct; coriaceous, drying reddish-brown to grayish-brown above and reddish-brown below; midrib on upper surface depressed in channel about 1/3 of lamina length, under one raised, lateral veins on the both surface distinct, 6-10 veins/0.5 cm. ***Inflorescences*** axillary, covered by brown pubescent, 2.5-5 cm long, 3-7 flowers/inflorescence, pedicels 1.3-2.3 cm long. Tepals 8, the outer pair oval to suborbicular, 4-5 by 4-4.5 mm, glabrous or slightly pubescent at margin; inner one ovate to suborbicular, 5-8 by 5.5-7 mm, glabrous or slightly pubescent at margin; the next two ones with same shape and size, obovate to spathulate, 6-9 by 2-5 mm,

glabrous or slightly pubescent at margin. Stamens about 81-212 per flower, filament 3-3.5(-5) mm long, anther 1-1.5 mm long. Ovary 2-2.5 mm long, style 4.5-5 mm long. ***Fruits*** ellipsoid to subglobose, 2-2.5 by 1.8-2 cm; acute to rounded at apex; yellowish-green to pale brown when ripen. Exocarp plus mesocarp 0.2-0.3 cm thick. Endocarp 0.5-0.8 mm thick, ellipsoid to subglobose, 1.8-2 by 1.4-1.7 cm.

Thailand.— PENINSULAR: Narathiwat.

Distribution.— Northeastern and southeastern Malay Peninsular to Borneo.

Ecology.— In evergreen forest, at *ca.* 230-315 m. altitude. Flowering May-June. Fruiting July-August.

Vernacular.— Tanghon bai neep (ตังหนใบหนีบ) (by first author).

9. ***Calophyllum inophyllum* L.,** Sp. Pl. 513. 1753; T. Anderson in Hook. f. Fl. Brit. India 1: 273. 1874; Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 324. 1910; Craib, Fl. Siam. Enum. 1: 120. 1931; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15:314. *pl.* 1C. 1956; H.-L. Li, Woody Fl. Taiwan, 601. *fig.* 235. 1963; Baker & Bakh. f. Fl. Java 1: 386. 1965; P. F. Stevens, Jour. Arnold Arb. 61: 324. 1980. Type: Ceylon, *Hermann s.n.* (lectotype, BM, herb. Hermann 2.82). Figure 10.

—*C. bintagor* Roxb. Hortus Bengal. 41. 1814. Type: based on Rumph. Herb. Amboin. 2: *t.* 71. 1741.

—*C. inophyllum* L. β [forma] *obovata* Miq. Pl. Jungh. 291. 1854. Type: Java, ad sinum maris Wijnkoopersbaai [*Junghuhn s.n.*] (lectotype, L, sheet no. 903,343-103).

—*C. inophyllum* L. γ [forma] *oblongata* Miq. Pl. Jungh. 291. 1854. Type: Java, sine loco, *Junghuhn s.n.* (lectotype, L, sheet no. 903,343-55).

—*C. inophyllum* L. var. *takamaka* Fosberg, Kew Bull. 29: 255. 1974. Type: Aldabra Atoll, South Island, Takamaka Grove, 9 Feb. 1968, *Fosberg 49272* (holotype, US; isotype, K).

Thailand.— SOUTH-EASTERN: Chon Buri, Trat; SOUTH-WESTERN: Prachuap Khiri Khan; PENINSULAR: Chumphon, Ranong, Surat Thani, Phatthalung, Trang, Satun, Songkhla, Narathiwat.

Distribution.— Eastern Africa to Taiwan, the Ryukyu and Line islands and New Caledonia; often planted both within its range and in West Africa and the tropics of the New World.

Ecology.— Usually in beach forest or coastal area and commonly planted for ornamental trees. Flowering and fruiting all year.

Vernacular.— Krathing (กระทิง) (Central); Thing

(ทิง) (Krabi); Saaraphee thale (สารภีทะเล) (Prachuap Khiri Khan).

Uses.— The wood is moderately heavy and fairly strong and has a closely grain; it is especially durable under water and used in various other aspects of construction. Oil can be extracted from seeds by heating them either cut and with water or finely crushed. It is used in soap making. It is also used against rheumatism and skin infection when applied externally. The round stones are used as marbles. *Calophyllum inophyllum* contains saponins, hydrocyanic acid and also poisonous coumarin derivatives. There are numerous other medicinal and quasi-medicinal uses of the plant. *Calophyllum inophyllum* is widely planted as an ornamental tree and is known as "Alexandrian Laurel".

10. ***Calophyllum tetrapterum* Miq.,** Pl. Jungh. 291. 1854; P. F. Stevens, Jour. Arnold Arb. 61: 505. 1980. Type: Sumatra, Angkola superior, 1000-3000 pedes [310-925 m.], *Junghuhn s.n.* (holotype, U; isotypes, BO, L). Figure 11.

—*C. dryobalanoides* auct., non Pierre; Craib, Fl. Siam. Enum. 1: 120. 1931, *pro parte.*

—*C. floribundum* Hook. f. Fl. Brit. India 1: 272. 1874, *pro parte.* Type: Malaya, Malacca, 1 Jan. 1867, *Maingay 1660* (Kew dist. 170) (lectotype, K).

—*C. praineanum* King, Jour. Asiatic Soc. Bengal, II. 59: 175. 1890. Syntypes: Malaya, Perak, Larut, less than 100 feet [30 m.], Dec. 1883, King's collector [*Kunstler] 5366* (BM, FI, G, K, P, UC), 800-1000 feet [240-305 m.], Feb. 1885, King's collector [*Kunstler]* 7243 (BM, FI, K, P).

—*C. pulcherrimum* auct., non Wall. ex Choisy; T. Anderson in Hook. f. Fl. Brit. India 1: 271. 1874, *pro parte.*

—*C. rupicola* Ridl. var. *elatum* T. C. Whitmore, Gard. Bull. Singapore 26: 270. 1970, *pro minore parte.* Type: Malaya, Kelantan, Ulu Sat F. R., 180 m., 2 Feb. 1970, *FRI 2538 coll. Kochummen* (holotype, KEP; isotypes, K, L, SING).

Thailand.— SOUTH-EASTERN: Trat; PENINSULAR: Chumphon, Ranong, Krabi, Trang, Satun, Songkhla, Narathiwat.

Distribution.— Cambodia to Borneo, excluding mainland Java.

Ecology.— Usually found along stream in evergreen or peat swamp forest, at *ca.* sea level to 150 m. altitude. Flowering September-January. Fruiting January-April.

Vernacular.— Tanghon (ตังหน) (Surat Thani, Trang, Narathiwat)

Uses.— Young leaves are edible as vegetable.

11. ***Calophyllum molle*** **King,** Jour. Asiatic Soc. Bengal, II. 59: 177. 1890; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 307. 1956; T. C. Whitmore, Tree Fl. Malaya 2: 188. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 641. *fig.* 40, h, j. 1980. Type: Malaya, Penang Hill, March (fl.) or June (fr.), 1888, *Curtis, 1426* (syntypes, K, SING). Figure 12.

Thailand.— PENINSULAR: Narathiwat.

Distribution.— Malay Peninsular, possibility also western Borneo.

Ecology.— In evergreen forest, at *ca.* 200-300 m. altitude.

Vernacular.— Tanghon bai khon (ตังหนใบขน) (by first author)

12. ***Calophyllum canum*** **Hook. f.,** Fl. Brit. India 1: 271. 1874; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 306. 1956; T. C. Whitmore, Tree Fl. Malaya 2: 176. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 371. 1980. Type:Malaya, Malacca, 26 March 1865/1866, *Maingay 1645* (Kew dist. 175) (holotype, K). Figure 13.

—*C. borneense* Vesque, Ephamosis 2: *tt.* 28,29. 1889. Type: Borneo, [Sarawak, Kuching], *Beccari, PB 2101* (holotype, P; isotypes, A (frag.), FI, G, K, M).

Large tree up to 30 m tall; trunk bole and straight, without buttresses. ***Outer bark*** grayish-brown to grayish-black, smooth to lenticellate fissured, sometimes with hoop-marked. Slash-marked pink to red; exudate opaque whitish. ***Youngest twigs*** flattened, with grayish-brown pubescent or waxy; internode 1.5-3 cm long. Uppermost pair of axillary bud 1-2.5 mm long. ***Terminal buds*** 1-1.2 cm long, with grayish-brown pubescent. ***Leaves*** petiolate, 1.5-2 cm long, broadly concave above and convex below, waxy or grayish-brown pubescent to glabrous. Lamina oblong to elliptic-oblong, 8-15 by 3.5-6 cm; apex acute to acuminate, base cuneate, occassionally sub-attenuate, margin entire; coriaceous, drying grayish-brown to reddish above and reddish-brown below; midrib on upper surface depressed in channel about 2/3-4/5 of lamina length, under one raised, lateral veins on the both surface distinct, 12-18 veins/0.5 cm. ***Inflorescences*** axillary, covered by grayish-brown pubescent, 3-5 cm long, about 13 flowers/inflorescence, pedicels 0.3-0.6 cm long. Tepals 4, the outer pair elliptic to oval, 5-6.5 by 4-6 mm, dorsally grayish-brown pubescent; inner one obovate, 5.5-7 by 5-6 mm, dorsally pubescent in band. Stamens about 564-665 per flower, filament 3.5-4 mm long, anther 0.5-1 mm long. Ovary 1.5-2 mm long, style 3-4 mm long. ***Fruits*** unknown.

Thailand.— PENINSULAR: Narathiwat.

Distribution.— Malaya, Sumatra and northwestern Borneo.

Ecology.— In Evergreen Forest, at *ca.* 200-300 m. altitude.

Vernacular.— Tanghon khaao (ตังหนขาว) (by first author).

13. ***Calophyllum calaba* L.,** Sp. Pl. 732. 1753; P. F. Stevens, Jour. Arnold Arb. 61: 256. 1980. Syntypes: Ceylon [Sri Lanka], *Hermann* 1: 65, 2: 42, 52, 3: 3 (BM). Figure 14.

—*C. calaba* L. var. *bracteatum* (Wight) P. F. Stevens, Jour. Arnold Arb. 61: 261. 1980. Syntypes: Burma, Tenasserim, *Griffith 439* (K), *synonym novum.*

—*C. calaba* L. var. *cuneatum* (Symington ex M. R. Henderson ษ Wyatt-Smith) P. F. Stevens, Jour. Arnold Arb. 61: 267. 1980. Type: Malaya, Pahang, Cameron Highlands, 14 May 1936, *SFN 31232 coll. Holttum 439* (holotype, SING; isotypes, A, K, LAE, SING), *synonym novum.*

—*C. curtisii* Ridl., Jour. Asiatic Soc. Bengal, II. 59: 176. 1890. Type: Malaya, Penang, Government Hill, 500 feet [150 m.], Dec. 1855, *Curtis 523* (isotypes, BM, BO, K), *synonym novum.*

—*C. saigonense* Pierre, Fl. Forest. Cochinch. 1: *pl.* 105. 1885. Type: Cochinchine, Beucar, ad flumen Saigon, Dec. 1869, *Pierre 3649* (lectotype, P; isolectotypes, K, P), *synonym novum.*

Thailand.— NORTH-EASTERN: Udon Thani, Nong Khai; EASTERN: Buri Ram, Surin, Roi Et, Yasothon, Si Sa Ket, Ubon Ratchathani; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Ranong, Chumphon, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Songkhla, Pattani, Yala, Narathiwat.

Distribution.— Vietnam to Borneo, perhaps also the Sunda Islands and Timor.

Ecology.— In peat swamp forest, beach forest to and evergreen forest in the Peninsular. Semi-evergreen forest to dry dipterocarps forest with pine in other part of the country, at *ca.* 800-1000 m. altitude, except the Northern. Flowering August-December. Fruiting October-April.

Vernacular.— Pha uung (พะอูง) (Nong Khai); Pa-ong (ปะอง) (Khmer-Surin); Pa-ung (ป๊ะอุ้ง) (Suai-Surin); Phanghan klet raet (พังหันเกล็ดแรด) (Chanthaburi).

Uses.— The wood is used for construction such as house, furniture. The fruit is edible.

14. ***Calophyllum rupicola* Ridl.,** Trans. Linn. Soc. Bot. II. 3: 278. 1893, Fl. Malay Penin. 1: 182. 1922; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 346 ("*C. rupicolum*"). 1956; T. C. Whitmore, Tree Fl. Malaya 2: 168. 1973 ("*C. rupicolum*"); P. F. Stevens, Jour. Arnold Arb. 61: 515. 1980. Type: Malaya, Pahang, Tahan River, anno 1891, *Ridley 2636* (holotype, SING; isotypes, BM, K). Figure 15.

—*C. rupicola* Ridl. *variety*; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 347. *pl.* 27. 1956, *pro parte.*

—*C. rupicola* Ridl. var. *elatum* T. C. Whitmore, Gard. Bull. Singapore 26: 270. 1973, *pro parte, typo haud incluso.*

Thailand.— PENINSULAR: Narathiwat.

Distribution.— Northeastern Malaya and scattered in Sumatra.

Ecology.— Peat swamp forest and along stream on granite bedrock in evergreen forest, at *ca.* 200-270 m. altitude. Flowering October-November. Fruiting December-April.

Vernacular.— Tanghon nam (ตังหนน้ำ) (by first author)

15. ***Calophyllum pisiferum* Planchon & Triana,** Ann. Sci. Nat. Bot. IV. 15: 294. 1862; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 345. 1956; T. C. Whitmore, Tree Fl. Malaya 2:172. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 518. *fig.* 32, k, l. 1980. Type: Malaya, Malacca, Nov. 1837, *Gaudichaud 86* (lectotype, G; isolectotype, P). Figure 16.

—*C. retusum* Wall. ex Choisy var. *cambodgense* Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 321. 1910. Type: Cambodge, Dom-Phaong, *Hahn 86* (holotype, P).

—*C. retusum* Wall. ex Choisy var. *cochinchinense* Pitard in Lecomte, Fl. Gen. Indo-Chine 1(4): 321. 1910. Type: Cochinchine [Vietnam], Ti Tinh, *Thorel 1395* (lectotype, P; isolectotypes, B, K).

—*C. sangkae* Craib, Kew Bull. 1925: 18. 1925, Fl. Siam. Enum. 1: 122. 1931. Type: Siam [Thailand], Surin, Sangka, *ca.* 300 m., 4 Jan. 1924, *Kerr 8283* (holotype, K; isotype, P).

Thailand.— SOUTH-EASTERN: Prachin Buri, Chanthaburi, Trat.

Distribution.— Southern Vietnam to Borneo, scattered, excluding Java.

Ecology.— Along stream in semi-evergreen forest, at *ca.* sea level-730 m. altitude. Flowering October-November. Fruiting November-January.

Vernacular.— Kathanghan bailek (กระทังหันใบเล็ก) (Chanthaburi, Trat); Pa-ong (ปะอง) (Suai-Surin).

Uses.— The branches are used for house and boat poles.

16. ***Calophyllum depressinervosum* M. R. Henderson & Wyatt-Smith,** Gard. Bull. Singapore 15: 335. *pl.* 17. 1956; T. C. Whitmore, Tree Fl. Malaya 2: 179.1973; P. F. Stevens, Jour. Arnold Arb. 61: 389. *fig.* 21, f. 1980. Type: Malaya, Pinang, Moniot's Road, 1000 feet [305 m.], May 1886, *Curtis 830* (holotype, SING; isotypes, K! (photograph), SING). Figure 17.

Thailand.— SOUTH-EASTERN: Chanthaburi(?); PENINSULAR: Chumphon, Krabi, Nakhon Si Thammarat, Trang, Narathiwat.

Distribution.— Cambodia to Borneo.

Ecology.— Usually in evergreen forest in the Peninsular, at *ca.* 100-200 m. altitude. Flowering unknown. Fruiting January-April.

Vernacular.— Phanghan bailek (พังหันใบเล็ก) (Chanthaburi)(?).

Notes.— No specimen of this species from south-eastern Thailand has been seen by this study.

17. ***Calophyllum soulattri* Burman f.,** Fl. Indica, 121. 1768; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore 15: 319. 1956; T. C. Whitmore, Tree Fl. Malaya 2: 192. 1973; P. F. Stevens, Jour. Arnold Arb. 61: 277. 1980; T. Anderson in Hook. f. Fl. Brit. India 1: 276. 1874. Type: Java, *Burman s.n.* (G). Figure 18.

—*Apoterium sulatri* Blume, Bijd. Fl. Nederl. Indie 5: 218. 1825. Type: Java, *Blume s.n.* (lectotype, L, herb. Lugd. Bat. 903, 343-183).

—*C. spectabile* Willd. var. *ceramicum* Boerl. Catal. Pl. Phanerog. Horto Bot. Bogor. 2: 80. 1901. Type: Cult. hort. Bogor. (semina ex Ceram) sub numero *VI C 46* (holotype, BO; isotypes, BO, US).

Thailand.— SOUTH-WESTERN: Kanchanaburi PENINSULAR: Chumphon, Ranong, Surat Thani, Krabi, Nakhon Si Thammarat, Phatthalung, Trang, Songkhla.

Distribution.— Vietnam to Australia (Northern Territory), the Solomon Islands, and Palau Island; more or less naturalized in the Mascarenes.

Ecology.— Usually found along stream in evergreen forest or in peat swamp area, at *ca.* 50-300 m. altitude. Flowering and fruiting all year.

Vernacular.- Tanghon baiyai (ตังหนใบใหญ่) (Surat Thani).

Uses.— The wood is not very durable, it is used for masts and spars and in house construction throughout its range.

Essential notes on Thai *Calophyllum*

1. The name "*C. polyanthum* Wall. ex Planchon & Triana" in Ann. Sc. Nat., Ser. 4, xv. p. 278 (1861) reported by Craib (1931) is transfered to the right author "*C. polyanthum* Wall. ex Choisy", Descr. Guttif. Inde, 43. (1849) reported by Stevens (1980) because of the priority.

2. *Calophyllum polyanthum* seems to be closely related to *C. touranense.* However, these two taxa can be distinguished from each other by the following characters:

2.1 The terminal bud of the former species is usually 1-2 cm. long but it is only 0.5-0.7 cm. in the latter species.

2.2 The fruit apex of the former species is more or less pointed while that of the latter species is usually rounded.

2.3 On the leaf blade, the number of veins per the length of 0.5 cm. of the former species is about 7-15(-20), whilst in the latter species it is about 6-9(-10).

2.4 The size of outer pair of tepals of the former species is less than or about half the length of the inner one while that of the latter species equals to the inner one.

2.5 The number of stamens per flower of the former species is about 200-277, but it is about 154-200 in the latter species.

3. This study could not be able to divided *C. calaba* into two varieties as suggested by Stevens (1980) because the different characters between the two are not clear.

4. Smitinand (1980) reported the name "*C. siamense* Pierre" with its habit (tree) and local name "Pha ong (Loei)". This would means that he also remarked its locality of distribution. However, there is no description or a specimen cited for this species. The authors were unable to find the first publication, which may be reported by Pierre in 1885. Thus the botanical characteristic of this species remains unknown.

5. The report by the Forest Herbarium (2001) on Thai *Calophyllum* was actually based on the work of Sangkaew (1999). However, several vernacular names are problematic. We suggest using those of vernacular names presented in this current study instead.

6. *Calophyllum canum*, *C. sclerophyllum* and *C. teysmannii* are new records for Thailand.

7. There is a specimen of *C. depressinervosum*, herbarium sheet number "BKF 2484 (SN 027933), collected by "Put" (Collector number *Put No. 427*) from Chanthaburi, Southeastern Thailand. However, the authors did not find this species in the Southeastern forest complex. The distribution range of this species, by this study, is from Chumphon to Narathiwat, in Southern Thailand only.

8. The color of exudate from the mature trunk is a useful character when used with other characters for field identification.

9. No endemic species of *Calophyllum* has been reported from Thailand. All native *Calophyllum* species are also found in neighbouring countries: Indo-China (Gagnepain, 1944), Malesia (Henderson and Wyatt-Smith, 1956), Burma (Kurz, 1877), India (Anderson, 1973) and Java (Baker and Brink, 1963).

CONCLUSIONS

The circumscriptions of the genus *Calophyllum* in Thailand were reconsidered on the basis of morphological observations. 17 species of the genus are recognized and can be concluded as shown in Table 1.

Table 1 Thai *Calophyllum* species naturally found by this study in comparison to the previous works.

No.	Species	Craib (1931)	Smitinand (1980)	Stevens (1980)	This study	Distribution in Thailand (according to this study)					
						North	Eastern	North-Eastern	South-Western	South-Eastern	Peninsular
1	*C. calaba*	—	—	—	√	—	√	√	—	√	√
	-var. *bracteatum*	—	—	√	*syn. nov.* of *C. calaba*	—	—	—	—	—	—
	-var. *cuneatum*	—	—	√	*syn. nov.* of *C. calaba*	—	—	—	—	—	—
2	*C. canum*	—	—	—	√, new record	—	—	—	—	—	√
3	*C. curtisii*	—	√	*syn.* of *C. calaba* var. *bracteatum*	*syn. nov.* of *C. calaba*	—	—	—	—	—	—
4	*C. depressinervosum*	—	√	√	√	—	—	—	—	—	√
5	*C. dryobalanoides*	√	√	√	√	—	—	—	—	√	—
6	*C. inophyllum*	√	√	√	√	—	—	—	√	√	√
7	*C. macrocarpum*	—	√	√	√	—	—	—	—	—	√
8	*C. molle*	—	√	—	√	—	—	—	—	—	√
9	*C. pisiferum*	—	√	√	√	—	—	—	—	√	—
10	*C. polyanthum*	√	√	√	√	√	—	√	√	—	√
11	*C. pulcherrimum*	√	√	syn. of *C. tetrapterum*	syn. of *C. tetrapterum*	—	—	—	—	—	—
12	*C. rupicola*	—	—	√	√	—	—	—	—	—	√
13	*C. saigonense*	√	√	*syn.* of *C. calaba* var. *bracteatum*	*syn. nov.* of *C. calaba*	—	—	—	—	—	—

Table 1 (cont.)

No.	Species	Craib (1931)	Smitinand (1980)	Stevens (1980)	This study	Distribution in Thailand (according to this study)					
						North	Eastern	North-Eastern	South-Western	South-Eastern	Peninsular
14	*C. sangkae*	√	*syn.* of *C. pisiferum*	*syn.* of *C. pisiferum*	*syn.* of *C. pisiferum*	—	—	—	—	—	—
15	*C. sclerophyllum*	—	—	—	√, new record	—	—	—	—	—	√
16	*C. siamense*	—	√	—	—	—	—	—	—	—	—
17	*C. smilesianum*	√	—	syn. of *C. polyanthum*	syn. of *C. polyanthum*	—	—	—	—	—	—
	-var. *lutea*	√	—	syn. of *C. polyanthum*	syn. of *C. polyanthum*	—	—	—	—	—	—
18	*C. soulattri*	—	√	√	√	—	—	—	√	—	√
19	*C. symingtonianum*	—	√	√	√	—	—	—	—	—	√
20	*C. tetrapterum*	—	√	√	√	—	—	—	—	√	√
21	*C. teysmannii*	—	—	—	√, new record	—	—	—	—	—	√
22	*C. thorelii*	√	√	√	√	—	—	√	—	√	—
23	*C. touranense*	—	—	√	√	—	√	√	√	—	—
24	*C. williamsianum*	√	—	syn. of *C. polyanthum*	syn. of *C. polyanthum*	—	—	—	—	—	—
Total		**9 species, 2 varieties**	**15 species**	**13 species, 2 varieties**	**17 species**	**1 species**	**2 species**	**4 species**	**4 species**	**6 species**	**13 species**

Remarks: √ = presence; — = absence; *syn.* = synonym; *syn. nov.* = synonym novum.

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APPENDIX

Index to collector numbers of the specimens seen [Collector (s) collector number: species (Herbarium)/...]

Beusekom, C. F. & C. Charoenpol 1724: 2 (BKF)/ **Bloembergen,** S. 536: 17 (BK)/ **Boonchu,** C. s.n.: 17 (BKF)/ **Boonpeng, D.** 192: 15 (BKF); 706: 3 (BKF)/ **Charoenphol, C.** *et al.* 5106: 15 (BKF)/ **Chermsirivatthana, C. & Kasem** 1453: 9 (BK)/ **Chit** 300: 13 (BKF)/ **Chitmaitree,** T. 28: 9 (BK)/ **Collins, D. J.** 942: 9 (BK); 1127: 1 (BK)1779: 13 (BK)/ **Din** 177: 13 (BKF)/ Fukuoka, N. T-62568: 3 (BKF)/ **Fukuoka, N. & M.** Ito T-34637: 2 (BKF)/ **Geesink, R. *et al.*** 6579: 1 (BKF); 7561: 13 (BKF)/ **Jaray** 167: 9 (BK)/ **Joonlanand, S.** s.n.: 2 (BKF)/ **Kerr, A. F. G.** s.n.: 9 (BK); s.n.: 13 (BK); 5180: 3 (BK); 6930: 10 (BK); 8271: 13 (BK); 8283: 15 (BK); 8526: 13 (BK); 8752: 3 (BK); 9175: 10 (BK); 9368a,b: 1 (BK); 9435: 15 (BK); 9462: 4 (BK); 9556: 1 (BK); 11217: 9 (BK); 11318: 13 (BK); 11733: 13 (BK); 13853: 13 (BK); 14213: 10 (BK); 16065: 13 (BK); 17291: 13 (BK); 17771: 10 (BK); 17774: 15 (BK); 17993: 13 (BK); 18419: 13 (BK); 18567: 10 (BK); 19035: 17 (BK)/ **Kid** 216: 3 (BKF)/ **Lakshnakara, M. C.** 946: 9 (BK)/ **Manee, S.** 28: 9 (BKF)/ **Mauric, A.** 15: 13 (BKF)/ **Maxwell, J. F.** s.n.: 1 (BK); 74-404: 1 (BK); 75-430: 9 (BK); 76-205: 13 (BK); 76-592: 13 (BK); 85-65: 13 (BKF, PSU); 85-417: 10 (BKF, PSU); 85-766: 17(BKF); 85-1181: 13 (BKF); 86-261: 13 (BKF); 86-546: 17 (BKF, PSU); 87-194: 17 (BKF, PSU)/ **Nitrasirirak,** P. 206: 10 (BKF)/ **Niyomdham, C.** 1952: 14 (BKF); 4836a,b: 8 (BKF)/ **Niyomdham, C. & D. Sriboonma** 1623: 14 (BKF)/ **Niyomdham, C. & P. Puudjaa** 4717: 8 (BKF)/ **Niyomdham, C. & W. Ueachirakan** 1815: 7 (BKF); 1916: 14 (BKF); 1935: 14 (BKF)/ **Niyomdham, C. *et al.*** 654: 7 (BKF); 1136: 13 (BKF); 1225a,b: 13 (BKF); 2250: 6 (BKF)/ **Paisooksantivatana, Y. & S. Sutheesorn** 1065-82: 13 (BK); 1070-82: 13 (BK)/ **Phengklai, C. & T. Smitinand** 6105: 13 (BKF)/ **Phengklai, C. *et al.*** s.n.: 3 (BKF); 3331: 13 (BKF); 3624: 13 (BKF); 7049: 3 (BKF); 7089: 3 (BKF); 7105: 3 (BKF)/ **Phloenchit** 624: 6 (BKF)/ **Phusomsaeng, S. & T. Smitinand** 240: 6 (BKF)/ Pooma, R. 728: 2 (BKF)/ **Pooma, R. *et al.*** 1446: 3 (BKF)/ **Premrasami, T.** s.n.: 13 (BKF)/ **Put** 183: 5 (BKF); 427: 16 (BKF)(?); 566: 13 (BK); 567: 10 (BK); 1155: 13 (BK); 1156: 13 (BK); 1562: 17 (BK); 3668: 13 (BK); 3670: 13 (BK); 3785: 3 (BK); 362/359: 13 (BK)/ **Sangkaew, S.** (all in KUFFH)1: 4; 2: 4; 3: 3; 4: 9; 5: 13; 6: 13; 7: 2; 8: 15;

9: 10; 10: 1; 11: 13; 12: 1; 13: 13; 14: 17; 15: 6; 16: 6; 17: 16; 18: 16; 19: 10; 20: 10; 21: 6; 22: 15; 23: 13; 24: 16; 25: 13; 26: 6; 27: 6; 28: 10; 29: 1; 30: 15; 31: 13; 32: 1; 33: 3; 34: 17; 35: 17; 36: 17; 37: 16; 38: 13; 39: 13; 40: 17; 41: 5; 42: 10; 43: 13; 44: 11; 45: 16; 46: 11; 47: 14; 48: 12; 49: 13; 50: 3; 51: 6; 52: 10; 53: 7; 54: 11; 55: 12; 56: 8; 57: 8; 58: 10; 59: 10; 60: 1; 61: 9; 62: 10; 63: 7; 64: 14; 65: 8; 66: 3; 67: 1; 68: 10; 69: 13; 70: 15; 71: 14; 72: 7; 73: 10; 74: 10; 75: 13; 76: 14; 77: 10; 78: 10; 79: 13; 80: 13; 81: 10; 82: 10; 83: 15; 84: 15; 85: 1; 86: 1; 87: 101; 88: 10; 89: 14; 90: 16; 91: 10; 92: 2; 93: 5/ **Sangkhachan, B.** 317: 1 (BKF); 1185: 13 (BKF)/ **Sangkhachan, B. *et al.*** 1067: 14 (BKF)/ **Sangkhachan, P.** 201: 13 (BK)/ **Santisuk, T.** s.n.: 2 (BKF); s.n.: 3 (BKF); s.n.: 13 (BKF); 797: 13 (BKF); 1148: 3 (BKF); 6821: 3 (BKF)/ **Santisuk, T. *et al.*** s.n.: 17 (BKF); 5: 3 (BKF)/ **Shimizu, T.** *et al.* T-20574: 3 (BKF)/ **Sirirugsa, P.** 592: 10 (PSU); 835: 13 (BKF)/ **Siwanna, W.** s.n.: 13 (BKF)/ **Smitinand, T.** s.n.: 13 (BKF); 4106: 3 (BKF); 4157: 13 (BKF); 5722: 15 (BKF); 8079: 13 (BKF); 90-38: 3 (BKF); 11780: 3 (BKF); 11960: 7 (BKF)/ **Smitinand, T. & J. Turbang** 10504: 13 (BKF)/ **Smitinand, T. & R. G. Robbins** 7913: 2 (BKF)/ **Smitinand, T. *et al.*** 7708: 3 (BKF); 7787: 3 (BKF)/ **Somkid** 535: 9 (BKF)/ **Sutheesorn, S.** 109: 15 (BK); 1070: 13 (BK); 2204: 17 (BK); 2227: 10 (BK); 5342-82: 13 (BK); 5358: 13 (BK)/ **Taengsuwan, J.** s.n.: 9 (BKF)/ **Thaew** 77a,b: 9 (BK)/ **Vacharapong** 064: 9 (BK)/ **Vanpruk, T. S.** 268a,b: 9 (BKF); 772: 9 (BKF)/ **Wanarak, A.** 62: 13 (BK)/ **Winit** 1375a: 3 (BKF); 1375b: 3 (BK)

Remarks: A number following a colon representing the *Calophyllum* species according to the key to species, they are; 1 = *C. thorelii;* 2 = *C. touranense*; 3 = *C. polyanthum*; 4 = *C. dryobalanoides*; 5 = *C. symingtonianum*; 6 = *C. macrocarpum*; 7 = *C. sclerophyllum*; 8 = *C. teysmannii*; 9 = *C. inophyllum*; 10 = *C. tetrapterum*; 11 = *C. molle*; 12 = *C. canum*; 13 = *C. calaba*; 14 = *C. rupicola*; 15 = *C. pisiferum*; 16 = *C. depressinervosum*; 17 = *C. soulattri*

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