

Systematics of the Thai Calophyllaceae and Hypericaceae with comments on the Kilmeyeroidae (Clusiaceae)

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ABSTRACT

The Calophyllaceae and Hypericaceae are revised for Thailand and their relationships to the Clusiaceae and Guttiferae are briefly discussed. Thirty-two species are definitively recognised in six genera, namely: *Calophyllum* L., *Kayea* Wall., *Mammea* L. and *Mesua* L. in the Calophyllaceae and *Cratoxylum* Blume. and *Hypericum* L. in the Hypericaceae. A further four species of *Calophyllum* are tentatively noted as likely to occur in Thailand. Descriptions, full synonyms relevant to the Thai taxa, distribution maps, ecology, phenology, vernacular names, specimens examined and provisional keys are given. All species previously classified in the genus *Mesua* have been moved to the genus *Kayea*, except *Mesua ferrea* L. Two taxa were found to be endemic to Thailand: *Mammea harmandii* (Pierre) Kosterm. and *Hypericum siamense* N. Robson. The distribution for the families in Thailand was found to vary with the Thai Calophyllaceae being found mainly in Central and Peninsular Thailand whilst the Thai Hypericaceae were found mainly in the North and the North-East of Thailand. Overall the numbers of collections housed in herbaria are few and more collections are necessary in order to give a comprehensive account of their distributions in Thailand.

KEYWORDS: Guttiferae, Flora of Thailand.

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INTRODUCTION

The present work forms the basis of an account being prepared for the Flora of Thailand. It is largely based on the examination of 2,345 specimens from worldwide herbaria including: A, AAU, ABD, B, BK, BKF, BM, C, CAL, CMUB, E, G, K, KKK, L, LINN, NY, P, PSU, QBG, SING, TCD, U and UPS. All descriptions are based on observations made from herbarium material and living plants observed while in the field. Dimensions used are based on herbarium specimens and living plants measured in the field. For dry specimens, flowers were softened in water before measurements were taken. Vernacular names and geographical information were taken from specimens and the literature. Flower, and bark exudate colours in *Hypericum* and *Cratoxylum* always refer to fresh material: all other colours are drawn

from herbarium notes or directly from dried material. Ecological information was taken from specimens, from field observations and from the literature. Distribution maps were constructed using Arc-GIS 9, Version 9.1. These maps show the distribution of all species in Thailand. The co-ordinates of localities used have been taken from label data, and in the cases where only province names have been provided, a co-ordinate point was mapped in the centre of that province to show the presence of the specimen. All types that have been seen are indicated by (!) after the herbarium abbreviation. Where a new lectotype has been chosen, this is indicated after the designated specimen. All lectotypes have been chosen on the same basis: that is that they are the best available of all potential lectotype specimens or, in rare cases, the sole available specimen. In the synonymy, homotypic

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synonyms are indicated by the identity sign ($\equiv$). Bar codes are given where possible; but, for example, neither ABD or LINN use bar codes and in many herbaria not all specimens are bar-coded. It is hoped that this account will enable the keys, descriptions and distributional information on taxa to be refined before they are published in the Flora of Thailand. Furthermore, it is clear that a number of taxa are known from very few collections indeed, sometimes only a single collection (e.g., *Kayea elegans* King): a situation repeatedly drawn attention to as a general problem for many taxa in Thailand (Parnell *et al.*, 2003; van Welzen *et al.*, 2011).

The Calophyllaceae and Hypericaceae and the Clusiaceae and the Guttiferae

The families Calophyllaceae and Hypericaceae are dealt with together in this paper as their status as separate families has varied over time. Indeed, in the past, they have been dealt with as one family under the name Guttiferae or Clusiaceae, and that is how they were first proposed to be treated for the Flora of Thailand when this work commenced.

The Clusiaceae, Calophyllaceae and Hypericaceae belong to the order Malpighiales (Chase *et al.*, 1993; Davis *et al.*, 2004; Stevens, 2006) which contains 700 genera and over 16,000 species in 30 families (Tokuoka & Tobe, 2006; Wurdack & Davis, 2009). The phylogenetic placement of this order is poorly understood; it may lie either in the fabid clade of the rosids (rosid I) or the malvid clade (rosid II) (APG IV, 2016). Phylogenetic relationships within the Malpighiales are also not fully resolved (Stevens, 2001 onwards; Davis *et al.*, 2004; APG II, 2003; Tokuoka & Tobe, 2006; APG III, 2009; Wurdack & Davis, 2009; Sun *et al.* 2016) though the interfamily relationships are now better understood (APG IV, 2016). Most recent phylogenetic studies have been based on molecular analyses, using plastid and nuclear gene regions (Savolainen *et al.*, 2000a, 2000b; Soltis *et al.*, 2000; Stevens, 2001 onwards; APG II, 2003; Davis *et al.* 2004, 2005; Tokuoka & Tobe, 2006; Wurdack & Davis, 2009; APG III, 2009; APG IV, 2016; Sun *et al.* 2016). Wurdack & Davis (2009) showed that the Clusiaceae are polyphyletic with the two commonly recognised subfamilies of the Clusiaceae *s.l.* not forming a clade: subfamily Kielmeeroideae was shown to be sister to the Hypericaceae and Podostemaceae, while subfamily

Clusioideae was sister to the Bonnetiaceae (Wurdack & Davis, 2009). So as to ensure monophyletic family circumscriptions Wurdack & Davis (2009) reinstated the Calophyllaceae, a decision repeatedly and recently re-confirmed (APG IV, 2016). Sun *et al.* (2016) undertook a mega-analysis of a super-matrix of 9,300 species and confirmed that the Podostemaceae and Hypericaceae form a clade (100% Bootstrap support [BS]) with the Calophyllaceae being that clade's sister (93% BS), this latter clade being sister to a more weakly supported clade (72% BS) comprising the Clusiaceae and Bonnetiaceae and with the whole lot forming a clade with 100% BS within the Malpighiales. Sun *et al.* (2016) also indicate that *Mesua* in the Calophyllaceae is not monophyletic necessitating the transfer of a number of species away from this genus. Some of these relationships appear difficult to accept from a morphological perspective. In particular, the Podostemaceae are an aquatic family of angiosperms that occur on rocks in waterfalls and rapids (Kato, 2004) and appear quite different to the other families in the Malpighiales in terms of habit, indeed different to any other family of Angiosperm. Koi (2005) suggested that saltational evolution might have occurred to give rise to the Podostemaceae, as there is a lack of intermediate species between this family and the Clusiaceae *s.l.* and Hypericaceae. But there are morphological similarities linking them to each other, including various types of secretory structure and secondary products (Kubitzki *et al.*, 1978; Stevens, 2006; Wurdack & Davis, 2009).

The Guttiferae (Clusiaceae, **nom. alt.**) *sensu lato*, comprises 27 genera and 1,050 species. Stevens (2006) considered there to be two subfamilies: Kielmeeroideae and Clusioideae.

The Kielmeeroideae, now considered a separate family Calophyllaceae (Stevens, 2001 onwards; APG III, 2009; APG IV, 2016; Mabberley, 2017) contain two tribes, namely tribe Calophylleae with 11 genera and tribe Endodesmieae with two genera (Stevens, 2001 onwards). They are characterised by spiral leaves with pellucid dots, moderate-sized cotyledons and perfect flowers and as Stevens (2006) indicates (as Clusiaceae) are found mainly in moist, tropical, lowland or lower montane forests. The majority of genera are found in primary forests, some species grow in peat swamp forests (*Calophyllum*

pisiferum Planch. & Triana, *C. rupicola* Ridl., *C. sclerophyllum* Vesque, *C. teysmannii* Miq.), and some grow in black-water floodplains (species of *Caraipa* Aublet, *Haplocathra* Benth.) (Stevens, 2006).

The Clusiaceae, now considered a separate family Clusiaceae (Stevens, 2001 onwards; APG III, 2009; APG IV, 2016; Mabberley, 2017), contain 14 genera and 500 species (Mabberley, 2017) in three tribes (Stevens, 2001 onwards), namely Clusiaceae with five genera, Garcinieae with two genera and Symphonieae with seven genera, and further details are beyond the scope of this publication.

Hypericaceae comprise 8 genera and 560 species (Mabberley, 2017). The family has a worldwide distribution and is divided into three tribes: Vismieae with two genera, Hypericeae with five genera and Cratoxyleae with two genera. Among the two Thai genera, *Hypericum* L. is found in temperate regions and high montane areas in tropical regions whereas *Cratoxylum* is found exclusively in the Old World tropics.

The Calophyllaceae and Hypericaceae of Thailand

In his revision, Sangkaew (1999) reported 17 species of *Calophyllum* L. (under Clusiaceae) in Thailand (*Calophyllum 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*, *C. polyanthum* Wall. ex Choisy, *C. rupicola*, *C. sclerophyllum*, *C. soulattri* Burm.f., *C. symingtonianum* M.R.Hend. & Wyatt-Sm., *C. tetrapterum* Miq., *C. teysmannii*, *C. thorelii* Pierre and *C. touranense* Gagnep. ex P.F.Stevens). Forest Herbarium (2001) reported 29 taxa occurring in Thailand in the Clusiaceae and Hypericaceae together under the label Guttiferae. This latter publication also included all of the 17 *Calophyllum* species recorded by Sangkaew (1999), six species in the genus *Cratoxylum* (Hypericaceae), namely *Cratoxylum arborescens* (Vahl) Blume, *C. cochinchinense* (Lour.) Blume, *C. formosum* (Jack) Dyer, *C. formosum* subsp. *pruniflorum* (Kurz) Goegelein, *C. maingayi* Dyer, *C. sumatranum* (Jack) Blume subsp. *neriifolium* (Kurz) Goegelein, and one species in the genus *Hypericum* (Hypericaceae), namely *Hypericum hookerianum* Wight & Arn. Two species were recorded

in the genus *Mammea* (Clusiaceae): *Mammea harmandii* (Pierre) Kosterm. and *M. siamensis* (Miq.) T.Anderson. Three species were reported in the genus *Mesua* (Clusiaceae), namely *Mesua ferrea* L., *M. ferruginea* (Pierre) Kosterm. and *M. nervosa* Planch. & Triana.

TAXONOMIC ACCOUNT

The following is a brief description of the four genera and 21(–25) species of Calophyllaceae and the two genera and 12 species of Hypericaceae that we have recognised in Thailand respectively:

Calophyllum (Calophyllaceae).—Approximately 186 species, 14 (probably 18) of which occur in Thailand. The distribution is worldwide in tropical areas including Africa, North and South America, Tropical and Temperate Asia, Australasia and the Pacific. They are restricted to areas that are humid and in lowland or montane rainforests but can grow in drier, open areas (Stevens, 1980). Some of the main characteristic features of this genus include fissured bark with exudate, leaves with distinct venation, terminal or axillary inflorescences, four to eight tepals and drupaceous fruits. *Calophyllum inophyllum* is one species in this genus that is of economic importance as it is used in many countries for different purposes. In Java, the seed oil and latex is used to dye batik cloth. The timber is strong and durable and used as a general-purpose timber for masts, bridgework, boat building and cabinet making. The oils produced from the fruits are used to treat ulcers, rheumatism and skin diseases such as eczema, and a decoction of the bark and latex is used both internally and externally as a remedy for many infections and also for skin and eye diseases and rheumatism. In local medicine, the flowers, leaves and seeds are also used. Although this tree grows slowly, it is also used for reforestation and afforestation projects and at shorelines to protect the coast (ICRAF, 2008). The 14 Thai species we so far recognise and describe are: *Calophyllum calaba*, *C. dryobalanoides*, *C. inophyllum*, *C. macrocarpum*, *C. pisiferum*, *C. polyanthum*, *C. rupicola*, *C. sclerophyllum*, *C. soulattri*, *C. symingtonianum*, *C. tetrapterum*, *C. teysmannii*, *C. thorelii* and *C. touranense*. Four other species have been reported by other workers (see discussion below).

Kayea (Calophyllaceae).—Approximately 75 species occur in tropical Asia namely Borneo, Myanmar, Cambodia, India, Laos, Malaysia, Nepal, Singapore, Sri Lanka, Sumatra, Thailand and Vietnam. This genus comprises trees with opposite, glabrous and coriaceous leaves. The inflorescences are large with solitary flowers and there are four sepals and petals present. The fruit is an indehiscent fleshy fruit with one to four seeds. Three species occur in Thailand, namely *Kayea elegans*, *K. ferruginea* Pierre and *K. kunstleri* King.

Mammea (Calophyllaceae).—Approximately 75 species, occurring throughout the tropics in Africa, Central America, Madagascar and Tropical Asia. Madagascar is thought to be the centre of origin for this genus (Stevens, 2006). The species are all trees with clear or coloured resinous sap and are found in areas of low to medium altitude. The leaves are simple and opposite and some have black glandular dots present. The inflorescences are quite often cauliflorous and the fruit is fleshy and coriaceous when dry. There are three species found in Thailand, namely *Mammea brevipes* (Craib) Kosterm., *M. harmandii* and *M. siamensis*.

Mesua (Calophyllaceae).—One species in Tropical Asia, namely *Mesua ferrea*, which has long been cultivated in the area and is found growing naturally at low altitudes. This genus comprises trees with a sticky exudate which dries black. The leaves are opposite, often with dots on the upper surface. The inflorescences are solitary, axillary or terminal and there are four or five sepals and petals present. The fruits of this genus are quite variable and can be drupes, berries or capsules. *Mesua ferrea* is often used in folk medicine for a variety of skin disorders. It is found naturally growing and it is also cultivated throughout Asia and has many other uses also: the seed is used in meal for poultry as it is a good source of protein and energy, it is used for firewood, the timber is used in heavy construction and furniture making, the flowers are used for dyeing fabrics, to stuff pillows and in cosmetic products and an oil called nahor is extracted from the seeds and is used to treat dandruff and rheumatism (ICRAF, 2017).

Hypericum (Hypericaceae).—Approximately 420 species found worldwide but mainly in temperate regions of Africa, North America, Asia, Europe and the former Soviet Union. This genus consists of trees or herbs that show a lot of morphological variation. The leaves are opposite and can be sessile or subsessile. There are four to five sepals and petals present and the flowers are usually yellow and showy. The petals are sometimes spotted with black glands. *Hypericum* species are cultivated as ornamentals as they have showy flowers. In Britain and Ireland, there are over 80 varieties available as garden plants (Lord *et al.*, 2004). Many members of this genus also yield compounds important to the pharmaceutical industry such as flavonoids, tannins, phenol-carbonic acids and xanthenes (Frohne & Pfänder, 2005) and *Hypericum perforatum* L. is known for its medicinal properties, as it is used as a herbal remedy to help mild depression (Frohne & Pfänder, 2005). In Thailand six species occur mainly in the Northern Region. These are *Hypericum henryi* H.Lév. & Vaniot. subsp. *hancockii* N.Robson, *H. hookerianum*, *H. japonicum* Thunb., *H. napaulense* Choisy, *H. patulum* Thunb. and *H. siamense*.

Cratoxylum (Hypericaceae).—Contains eight species in three sections (Kochummen, 1973) found in northeastern India and southern China to western Malesia at low altitudes or in low montane areas. Five species occur in Thailand. Species vary from deciduous to evergreen trees or shrubs that are usually glabrous and exude a yellow resinous sap. The leaves are papyraceous and usually have pellucid dots present. The inflorescences are terminal panicles or short terminal cymes or sometimes axillary cymes. There are five sepals and petals present and the corolla is usually pink (red) or white. The genus *Cratoxylum* is used as a source of timber (Heywood, 1993) and the wood is used for joinery and for light construction and furniture making (MTC, 2017). The Thai taxa are *Cratoxylum arborescens*, *C. chinense*, *C. formosum* subsp. *formosum*, *C. formosum* subsp. *pruniflorum*, *C. maingayi* and *C. neriifolium* Kurz.

KEY TO THE FAMILIES

1. Fruit indehiscent, with few, often large seeds
1. Fruit dehiscent, with many small seeds

1. Calophyllaceae
2. Hypericaceae

1. CALOPHYLLACEAE

Evergreen trees or shrubs with canals or glands present in all parts of the plant; usually glabrous, uni-/multicellular hairs sometimes present. *Leaves* simple, petiolate, opposite, alternate or whorled. *Inflorescences* axillary or terminal, sometimes comprising single flowers, bisexual or unisexual, radially symmetric.

Tepals 4–8 or *Calyx* 2–5, free sepals. *Corolla* petals 4–5, free. *Stamens* 4– ∞ , aggregated into fascicles. *Ovary* superior, carpels 1–many, ovules 2– ∞ . *Fruits* berries, drupes or capsules, size varies immensely. *Seeds* $\pm$ winged, $\pm$ arillate; cotyledons often huge.

Pantropical with 14 genera and 750 species; 4 genera and 21(–25) species in Thailand.

KEY TO THE GENERA

- 1. Ovary 1-celled
 - 2. Stigma peltate; ovule 1
 - 2. Stigma 4-fid; ovules 4(–8)
- 1. Ovary 2(–many)-celled
 - 3. Sepals 2; ovary 2(–many)-celled
 - 3. Sepals 4–5; ovary 2-celled

1. *Calophyllum*

2. *Kayea*

3. *Mammea*

4. *Mesua*

1. CALOPHYLLUM

L., Sp. Pl.: 513. 1753; L., Gen. Pl. ed. 5: 229. 1754; Choisy, Mém. Soc. Hist. Nat. Paris 1: 228. 1823; Choisy in DC., Prodr. 1: 562. 1824; Endl., Gen. Pl.: 1028. 1840; Choisy, Descr. Guttif. Inde: 41. 1849; Miq., Fl. Ned. Ind. 1(2): 509. 1859; Planch. & Triana, Ann. Sci. Nat. Bot. Sér. 4, 15: 241. 1862; T. Anderson in Hook. f., Fl. Brit. India 1: 271. 1874; Vesque, Epharosis 2: 6. 1889; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 172. 1890; Vesque in DC. Monogr. Phan. 8: 529. 1893; Trimen, Handb. Fl. Ceylon 1: 98. 1893; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 220. 1895; Pit. in Lecomte, Fl. Indo-Chine 1(4): 316. 1910; Ridl., Fl. Malay Penins. 1: 181. 1922; Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 21: 192. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 268. 1943; Perrier de la Bathie in Humbert, Fl. Madagasc. 136: 3. 1951; M.R. Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 285. 1956; Maheshw., Bull. Bot. Surv. India 2: 139. 1960; Backer & Bakh. f., Fl. Java 1: 384. 1963; A.C. Sm. & S.P. Darwin, J. Arnold Arbor. 55: 216. 1974; P.F. Stevens, Austral. J. Bot. 22: 349. 1974; P.F. Stevens, J. Arnold Arbor. 61: 167. 1980; H.W. Li *et al.*, Flora of China 13: 38–40. 2007. $\equiv$ *Ponna* Rheede ex. Boehm., Ludw. Def. Gen. Pl. 239. 1760, **nom. illeg. superfl.** $\equiv$ *Balsamaria* Lour., Fl. Cochinch. 2: 469. 1790. **nom. illeg. superfl.?** Type species: *Calophyllum inophyllum* L.

— *Calaba* Mill., Gard. Dict. Abr., ed. 4. 1754.

— *Augia* Lour., Fl. Cochinch.: 337. 1790, **nom. rej.**, *pro minore parte*. Type species: *Augia sinensis* Lour. [see Stevens, 1980].

— *Apoterium* Blume, Bijdr. Fl. Ned. Ind. 5: 218. 1825. Type species: *Apoterium sulatri* Blume.

Trees with fissured bark usually yellow-brown to grey-brown, with two different kinds of exudate: a clear honey exudate or an opaque white exudate. *Leaves* simple, petiolate, opposite, coriaceous; close, fine parallel veins from midrib towards margin, some having distinct intramarginal veins, veins are usually distinct; the midrib is depressed on upper surface. *Inflorescences* terminal or axillary. *Floral parts* tepals 4 or 8, rarely more; flowers are similar among species; white; bracts and bracteoles ovate and caducous. *Stamens* 30–600; usually glabrous; basifixed; vertically dehiscent; filaments are slender and joined at base into 4–6 bundles. *Ovary* 1-celled; 1 ovule; glabrous; stigma peltate. *Fruit* drupe; ovoid to globose; varying from yellow/green to orange/brown to black. *Seed* with large cotyledons.

Distribution.— 186 species in Africa (Tropical, Madagascar and the Mascarenes), Asia Temperate (East and Southeast Asia), Asia Tropical (Indian Subcontinent, Malesia), Pacific, Australasia, North, Central and South America (Mexico to Argentina including Caribbean); 14 (probably 18) species in Thailand.

Subsequent to the preparation of this account Gardner *et al.* (2015) confirmed the report of Sangkaew (1999) concerning the occurrence of *Callophyllum molle* in Thailand. This species is known as a rare tree of lowland evergreen forest in Narathiwat which represents an extension of its

known range in the Malay Peninsula. Gardner *et al.* (2015) also report two specimens of the otherwise Malesian *Calophyllum wallichianum* Planch. & Triana from lowland evergreen or evergreen bamboo forest in Phangnga, Ranong. The latter species is similar to *Calophyllum macrocarpum* and would key out along with it in the key below; whilst the former species is the only species of Thai *Calophyllum* that is obviously hairy on its leaves, especially on the undersurface of the young leaves. Gardner *et al.* (2015), Sangkaew (1999) and Stevens (1980) also report the occurrence of *Calophyllum depressinervosum* from south and southeast Thailand, and Gardner *et al.*

(2015) and Sangkaew (1999) that of *C. canum* from southernmost Thailand. *Calophyllum depressinervosum* obviously has acuminate leaves with the latex canals clearly impressed, and *C. canum* has a distinctive swollen terminal bud, flowers with very large numbers of stamens and leaves with a wavy margin. At the time of writing of this account we had not seen specimens of these species. Apart from their inclusion in the key below and its general improvement, we require further information to confirm the colour of their bark exudates; therefore, we would welcome further relevant information on all of the above species.

KEY TO THE SPECIES

1. Bark exudate a clear honey colour
 2. Outer pair of tepals dorsally pubescent
 3. Tepals more than 8; outer pair of tepals equalling the next pair in shape and size **14. *C. touranense***
 3. Tepals 8 or fewer; outer pair of tepals not equal to the next pair in shape and size
 4. Stamens less than 100; fruit ≤ 1 cm in diameter **1. *C. calaba***
 4. Stamens more than 100; fruit > 1 cm in diameter
 5. Leaf apex acuminate to rarely acute; branchlets 4-angled **4. *C. macrocarpum***
 5. Leaf apex acuminate, retuse, or cuspidate; branchlets terete
 6. Branchlets flattened or rarely terete; leaf apex acuminate to acute **6. *C. polyanthum***
 6. Branchlets terete; leaf apex cuspidate to retuse
 7. Stamens less than 200; inflorescences terminal and from upper leaf axils; fruit spherical to ellipsoid, drying light green to purple **13. *C. thorelii***
 7. Stamens more than 200; inflorescences axillary racemes; fruit ovoid to rotund, drying reddish-brown to almost black **8. *C. sclerophyllum***
 2. Outer pair of tepals dorsally glabrous
 8. Leaves slightly coriaceous; fruit ellipsoid to obovoid; stamens less than 70 **10. *C. symingtonianum***
 8. Leaves coriaceous; fruit ellipsoid, globose, obovoid or subglobose; stamens usually more than (65–)70, if 70 or less then other characters not as above
 9. Leaf apex retuse to round **3. *C. inophyllum***
 9. Leaf apex acute to acuminate
 10. Stamens 35–90; tepals (4–)8; intramarginal veins absent **11. *C. tetrapterum***
 10. Stamens 65–220; tepals 8; intramarginal veins present
 11. Tree without buttresses; inflorescences terminal and from upper leaf axils, usually covered with brown pubescence; fruit ovoid, apex acute to acuminate **2. *C. dryobalanoides***
 11. Tree with/without buttresses, if present, small (to < 1 m); inflorescences in racemes, usually glabrous, but occasionally covered with brown pubescence; fruit ellipsoid to subglobose, apex acute to round **12. *C. teysmannii***
 1. Bark exudate not a clear honey colour, somewhat opaque, usually milky white/yellow
 12. Youngest twigs glabrous **7. *C. rupicola***
 12. Youngest twigs pubescent
 13. Fruit yellow-green or pale brown **1. *C. calaba***
 13. Fruit orange or purple or black
 14. Youngest twigs and base of inflorescences orange pubescent; flowers in axillary racemes; leaves ovate or elliptic **5. *C. pisiferum***
 14. Youngest twigs and base of inflorescences red-brown pubescent; flowers axillary, in cymes; leaves oblong-ovate to elliptic-ovate **9. *C. soulattri***

1. *Calophyllum calaba* L., Sp. Pl.: 732. 1753; P.F.Stevens, J. Arnold Arbor. 61: 256. 1980; P.F.Stevens in Jarvis *et al.*, Regnum Veg. 127: 28. 1993. Type: Sri Lanka, *Herb. Hermann* 3: 3, No. 202 (lectotype **BM [BM000621800!], designated by Stevens [1993]).**

— *Calophyllum saigonense* Pierre, Fl. Forest. Cochinch. 1: t. 105. 1885; Vesque in DC. Monogr. Phan. 8: 602. 1893; Pit. in Lecomte, Fl. Indo-Chine 1(4): 318. 1910; Craib in Schmidt, Bot. Tidsskr. 32: 328. 1915; Craib, Fl. Siam. 1: 121. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 274. 1943; Pham & Nguyễn, Cây-Có Miền Nam Viet-Nam 179. 1960; Pham, Cây-Có Miền Nam Viet-Nam 2(2): 303. 1970; H.Keng, Gard. Bull. Singapore 28: 245. 1976. Type: Cochinchine, Beucar, *Pierre* 3649 (lectotype **P!** designated by Stevens [1980]; isolecotypes **E** [E00209519!], **K** [K000380003!], **P!**).

— *Calophyllum curtisii* Ridl., J. Asiatic Soc. Bengal Pt. 2, Nat. Hist. 59: 176. 1890; Curtis, J. Straits Branch Roy. Asiatic Soc. 25: 78. 1894; Ridl., Fl. Malay Penins. 1: 185. 1922; M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 321. 1956; Kochummen, Malayan Forest Rec. 2(17): 221. 1965; Whitmore, Tree Flora of Malaya 2: 177. 1973; Corner, Gard. Bull. Singapore Suppl. 1: 104. 1978. Type: Malaysia, Malacca, Penang, *Curtis* 523 (lectotype **K** [K000199886!], designated here; isolecotypes **BM** [BM000611470!], **BO** not seen).

Trees to 30 m tall; dbh 20 cm; bole straight without buttresses; outer bark deeply fissured yellow to grey-yellow, inner bark red-pink; exudate clear honey coloured or yellow or white, sticky. *Branchlets* flattened to terete, some smooth-waxy, some showing tiny minute hairs on stems, tomentose; internodes 1–3 cm long. *Leaves* petioled, petiole 0.3–1.9 cm long; young leaves reddish pubescent, blade 3.5–11.2 × 0.9–4.4 cm, elliptic to ovate, concave above and convex below, base cuneate to attenuate to slightly acute, apex acute to round, sometimes cuspidate; venation very obvious on both surfaces, midrib depressed on upper surface and pronounced on lower surface, orange/brown on lower surface and red/light tan on upper surface, midrib wide (2 mm) on lower surface, narrowing towards apex to approximately 1 mm wide, upper and lower surface smooth, coriaceous, green/orange/yellow/brown; secondary veins present, dense, arising at same points on both sides of the midrib, approximately 0.5 mm apart,

intramarginal vein inconspicuous but present. *Inflorescence* axillary, covered in brown pubescence, 3–15 flowers per inflorescence, pedicels 0.3–2.8 cm long. *Floral parts* tepals 4, sometimes 6, the outer pair elliptic-obovate to ovate, 3–5 × 2–3 mm, sometimes dorsally brown pubescent, inner one elliptic-oblong, 4.5–7 × 1.5–3 mm, rarely dorsally pubescent. *Stamens* in fascicles, approximately 20–95 per flower; filaments 2–6 mm long; anthers 1–1.2 mm long, orange. *Ovary* 1.5–2 mm long; style 2–4 mm long. *Fruit* ellipsoid to ovoid, apex rounded, 0.5–1 × 0.5–0.8 cm, yellow-green to pale brown when ripe.

Thailand.— (Map 1.1.1): NORTH-EASTERN: Nong Khai [Chaiyaburi, 21 Feb. 1924, *Kerr* 8526 (**ABD, BK, BM, E, K, TCD**)]; EASTERN: Buri Ram [21 Nov. 1976, *Phengklai et al.* 3331 (**A, BKF, PSU**)]; Surin [4 Dec. 1976, *Phengklai et al.* 3624 (**A, BKF, PSU**)]; Sangkha, 13 Jan. 1924, *Kerr* 8271 (**ABD, BK, BM, C, K, P, TCD**)]; Roi Et [5 Feb. 1925, *Wanarale* 62 (**BK, K**); T. Banna, Suwanaphum, 13 Aug. 1982, *Sutheeso* 5342 (**BK**); *ibid.* 17 Aug. 1982, *Sutheeso* 5358 (**BK**)]; Yasothorn [Mar. 1982, *Smitinand s.n.* (**BKF**)]; Si Sa Ket [Kantharalak District, 23 Mar. 1966, *Sangkha* 201 (**BK**); 20 Jan. 1965, *Phengklai* 900 (**C, K, L, P**); 20 Jan. 1965, *Phengklai* 38105 (**E**); Chong Bat Lak, Kantaralak, 11 Apr. 1976, *Maxwell* 76-205 (**AAU, BK, L**); Kantaralak District, Dongkrak Range, Chong Bat Lak, 20 Aug. 1976, *Maxwell* 76-592 (**AAU, BK, L**)]; Ubon Ratchathani [Lam Don Hoi, 4 Dec. 1968, *Smitinand & Turbang* 10504 (**BKF**); Khong Chiam Falls, 16 Oct. 1990, *Smitinand* 90-267 (**BKF**)]; SOUTH-EASTERN: Chon Buri [Nong Yai Bu, 1914, *Collins* 645 (**K**); Sri Racha, Na Phrow, Apr. 1922, *Collins* 804 (**ABD, BM, K**); Hup Bon, Sri Racha Forest, 25 Oct. 1927, *Collins* 1661 (**BM, K**); Sri Racha Forest, 23 Dec. 1927, *Collins* 1779 (**BK, K**)]; Chanthaburi [Ban Chao Lao, 8 Feb. 1991, *Chayamarit* 281 (**BKF**); Khao Sabap, 7 Jan. 1930, *Kerr* 17993 (**A, B, BK, BM, C, K, L**)]; Trat [Khao Saming, 26 Jan. 1927, *Put* 566 (**BK, K, L**); Ko Chang, Khlong Son, 1 Mar. 1900, *Schmidt* 668 (**C, K**); Ko Kut, Ao Salad, 9 Apr. 2002, *Phengklai et al.* 13582 (**BKF**)]; PENINSULAR: Chumphon [Bang Son, 9 Jan. 1927, *Kerr* 11318 (**A, BK, C, K, L, P**)]; Ranong [Ban Nakha, 9 Dec. 1976, *Santisuk* 797 (**A, BKF**); Khlong Nakha, 24 Feb. 1974, *Geesink et al.* 7561 (**AAU, BKF, C, K, L, P**); Ban Laem Lieng, 1 Feb. 1927, *Kerr* 11733 (**A, BK, BM, C, K, L, P**); 14 Jan. 1929,

Kerr s.n. (BK); Surat Thani [Khao Tham Nong, Na San, 19 June 1966, *Sakol 1070 (BK)*; Ko Pa-ngan, 4 Nov. 1927, *Put 1155 (BK, BM, K)*; *ibid.*, 4 Nov. 1927, *Put 1156 (BK, BM, K, L)*; Chaiya, 10 Jan. 1935, *Seidenfaden 2576 (C)*; Ko Tao, 23 Sept. 1928, *Kerr 16065 (A, BK, BM, C, K, L, P)*; Than Khanon, *Pierre s.n. (BKF)*; Phangnga [Ko Kho Khao, 4 Dec. 1965, *Sangkhachand 1185 (BKF, K, L)*; between Thai Muang & Thung Maphrao, 29 Jan. 1958, *Smitinand 4157 (BKF)*; Laem Lieng to La-un, 7 Mar. 1930, *Kerr 18419 (K, L)*; Ko Yao Yai, 2 Mar. 1929, *Kerr 17291 (A, BK, BM, C, K, L, P)*; Phuket [Tha-chai-chat, Dec. 1986, *Phengkklai & Smitinand 6105 (AAU, BKF, L, P)*; Krabi [Ao Luek, 15 Mar. 1930, *Kerr 18567 (L)*; Phatthalung [20 Oct. 1938, *Siwanna s.n. (BKF)*; Trang [Hat Chao Mai NP, Sikao District, 14 Dec. 1995, *Mauric 15 (BKF)*; without locality, 27 May 1934, *Poillane 23626 (BKF)*; Satun [Tarutao, Son Bay, 29 Feb. 1980, *Congdon 400 (A, AAU, PSU)*; Ky Island, Tarutao, 22 Mar. 1980, *Congdon 493 (A, AAU)*; Tarutao Island, 26 Apr. 1981, *Congdon 1260 (A)*; Kanchanadit, 3 Jan. 1928, *Kerr 13653 (BK, BM, K)*; Songkhla [Kobe Island, Sathingpra District, 26 May 1984, *Srirugsa 835 (A, BKF, PSU)*; Khlong Hoi Khong, Hat Yai District, 11 Jan. 1985, *Maxwell 85-65 (A, BKF, PSU)*; Kho Hong Hill/Prince of Songkla University Campus, 29 Dec. 1985, *Maxwell 85-1181 (A, AAU, BKF, L, PSU)*; Kho Hong Hill/Hat Yai, 27 Apr. 1986, *Maxwell 86-261 (A, BKF, L, PSU)*; Pattani [21 July 1990, *Santisuk s.n. (BKF)*; Yala [30 Jan 1931, *Put 3668 (BK, BM, C, K, L)*; *ibid.*, 30 Jan 1931, *Put 3670 (A, BK, BM, C, K, L, P)*; Narathiwat [Khok Mai Ruea, Tak Bai, 12 Jan. 1986, *Niyomdham et al. 1136 (A, AAU, BKF, C, K, L, P)*; *ibid.*, 25 Apr. 1986, *Niyomdham et al. 1225 (A, BKF, C, K, L, P)*; Unknown locations [*Unknown collector 177 (BKF)*; 10 Jan. 1974, *Conran 291 (PSU)*; *Hewitt 2063 (BM, K)*].

Distribution.— Andaman Islands, Vietnam to Borneo, Sumatra, Java and the Lesser Sunda Islands.

Ecology and phenology.— Savannah, evergreen forest, secondary forest; from near sea level to 650 m elevation. Flowering: August–December Fruiting: October–April.

Vernacular.— Pha ung (พะอูง); pa-ong (ปะอูง); pa-ung (ปะอู้ง); phanghan klet raet (พังหันเกล็ดแรด) (Sangkaew, 1999).

Uses.— The wood is used in house construction. The fruits are edible (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

2. *Calophyllum dryobalanoides* Pierre, Fl. Forest. Cochinch. 1: t. 106. 1885; Vesque in DC., Monogr. Phan. 8: 601. 1893; Pit. in Lecomte, Fl. Indo-Chine 1(4): 319. 1910; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 274. 1943, *pro minore parte*; Pham & Nguyễn, Cây-Có Miền Nam Viet-Nam, 179. 1960; Pham, Cây-Có Miền Nam Viet-Nam, 2(2): 302. 1970; P.F.Stevens, J. Arnold Arbor. 61: 232. 1980. Type: Cochinchine (Vietnam), *Pierre 83* (lectotype **P** [P00526184!], designated by Stevens [1980]; isolectotypes **A** [A000672326!], **BM** [BM000611356!], **C** [C10009442!, fruits only], **K** [K000677426!], **L** [L0011725!, L0011726?], **P** [P00526185!, P00526186!], **SING** [SING0054598!].

Trees to 30 m tall; dbh 20 cm; bole straight without buttresses; outer bark fissured, brown-yellow or grey-yellow; exudate clear honey coloured. *Branchlets* quadrangular, slender, some with slightly brown pubescence, or waxy or glabrous; internode 1–2.5 cm long. *Leaves* petioled, petiole 0.6–1.5 cm long; blade 4–8.9 × 1.5–3.5 cm, lanceolate to elliptic-entire, coriaceous, very smooth, dark green adaxially, paler green abaxially, base cuneate to slightly acute, apex acuminate; venation very pronounced, midrib not obvious on either surface, more pronounced on lower surface, yellow, distance between veins 0.2–0.8 mm, veins evenly spaced and meeting at the same points on opposite sides of the midrib, intra-marginal veins present. *Inflorescence* terminal and from upper leaf axils, 7–37 flowers per inflorescence, covered with brown pubescence, pedicels 0.6–1 cm long. *Floral parts* tepals 8, the outer pair oval to suborbicular, 3.5–5 × 3–4 mm, dorsally slightly brown pubescent on outer side near base or glabrous, inner one obovate to suborbicular, 4–6 × 5–6 mm, glabrous, the next two the same shape and size, elliptic-obovate, 4–5 × 3.5–4 mm, glabrous, white. *Stamens* in fascicles, 140–170 stamens per flower; filament 2–3 mm long; anther 0.6–1 mm long, orange/yellow. *Ovary* 1.5–2 mm long, style 1.5–3 mm long. *Fruit* ovoid, apex acute to acuminate, 1–1.5 × 0.7–1 cm, green.

Thailand.— (Map 1.1.2): SOUTH-WESTERN: Phetchaburi [Amphoe Kaeng Krachan, Kaeng Krachan NP, on road from Ban Krang Camp to Khao Phanoen Thung Ranger Substation, 12 Aug. 2002, *Middleton et al.* 999 (A)]; SOUTH-EASTERN: Trat [Ko Chang, Khlong Mayom, Salak Khok, 6 Apr. 1923, *Kerr* 6390 (ABD, BM); Ko Chang, Khlong Non Si, 24 Sept. 1924, *Kerr* 9175 (BM); Bo Rai, 28 Nov. 1924, *Kerr* 9462 (BK, K, L)].

Distribution.— Cambodia, Vietnam.

Ecology and phenology.— Evergreen forest, secondary forest, near freshwater; from 50 to 1200 m elevation. Flowering: September–December. Fruiting: January–March. (August).

Vernacular.— Pha-ong (พ้อง) (Sangkaew, 1999).

Uses.— The wood is used in construction. Fragrant oil emitted from the flower is used in hair dressing (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Data Deficient (DD).

3. *Calophyllum inophyllum* L., Sp. Pl.: 513. 1753; Burm.f., Fl. Ind. 120. 1768; G.Forster, Fl. Ins. Austral.: 41. 1768; Choisy in DC. Prodr. 1:562. 1824; Blume, Bijdr. Fl. Ned. Ind. 5: 217. 1825; Blanco, Fl. Filip.: 612. 1837; Wight, Icon. Pl. Ind. Orient.: t. 77. 1839; Thwaites, Enum. Pl. Zeyl.: 51. 1858; Miq., Fl. Ned. Ind. 1(2): 510. 1859; Planch. & Triana, Ann. Sci. Nat. Bot. Sér. 4, 15: 282. 1862; Benth., Fl. Austral. 1: 183. 1863; T.Anderson in Hook.f., Fl. Brit. India 1: 273. 1874; F.Muell., Descr. Ecology and Phenology Papuan Pl.: 36. 1875; Vesque, Epharosis 2: t. 1. 1889; Vesque in DC. Monogr. Phan. 8: 544. 1893; Brandis, Indian Trees: 54. fig. 43. 1907; Pit. in Lecomte, Fl. Indo-Chine 1(4): 324. 1910; Heckel, Ann. Mus. Hist. Nat. Marseille 2(10): 262, pl. 25. 1912; Koord-Schum., Syst. Verz. 1: 4. 1912; Merr., Enum. Philipp. Fl. Pl. 3:79. 1923; Craib, Fl. Siam. 1: 120. 1925; Kaneh., Fl. Micron. 234, fig. 106 1933; Merr., Trans. Amer. Philos. Soc. 24(2): 269. 1935; Kaneh., Formosan Trees. Rev. ed.: 473. fig. 433. 1936; Sastri *et al.*, Wealth India 2: 18. 1950; Heyne, Nutt. Pl. Ned.-Ind. ed. 3, 1: 1083. 1950; M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 314. pl. 1C. 1956; N.Robson in Exell & Wild, Fl. Zambes. 1: 394. t.

76. 1961; H.L.Li, Woody Fl. Taiwan: 601. fig. 235. 1963; Baker & Bakh.f., Fl. Java 1: 386. 1965; Whitmore, Guide Forests Brit. Solomon Is.: 77. 1966; Whitmore, Tree Flora of Malaya 2: 186. 1973; P.F.Stevens, Austral. J. Bot. 22: 374. 1974; A.C.Sm. & Darwin, J. Arnold Arbor. 55: 223. figs. 6–8. 1974; P.F.Stevens, J. Arnold Arbor. 57: 170. 1976; Bamps *et al.* in Polhill, Fl. Trop. E. Africa, Guttiferae: 3. 1978; Perry, Med. Pl. E. & SE. Asia, 173. 1980; P.F.Stevens, J. Arnold Arbor. 61: 324. 1980; S.Gardner *et al.*, Field Guide Forest Trees N. Thailand: 53. 2000; H.W.Li *et al.*, Fl. China 13: 53. 2007. Type: Sri Lanka, *Herb. Hermann* 2: 82, No. 201 (lectotype BM [BM000621780!], designated by Stevens [1980]).

— *Balsamaria inophyllum* Lour., Fl. Cochinch. 2: 470. 1790. Type: *Unknown collector s.n.* possibly *Loureiro s.n.* (holotype BM [BM000611357!]).

— *Calophyllum ovatifolium* Noronha, Verh. Batav. Genootsch. Kunsten 5(4): 13. 1790 Type: not located.

— *Calophyllum bingator* Roxb., Hortus Bengal. 41. 1814, **nom. nud.**; Don, Gen. Syst. 1: 622. 1831; Roxb., Fl. Ind. 2: 607. 1832. Type: Moluccas, *Ambon, Rumphius, Herb. Amboin.* 2: t. 71. 1741.

— *Calophyllum blumei* Wight, Illus. Ind. Bot. 1: 128. 1840; Walp., Rep. Bot. Syst. 1: 397. 1842. Type: not located.

Trees 7–30 m tall; dbh 11–12 cm; bole ± straight, without buttresses; outer bark slightly fissured, rough, grey to brown; exudate the colour of clear honey. *Branchlets* striate, slightly brown pubescent or glabrous, yellow-greenish sap in centre of branchlets; internode 2–3 cm long. *Leaves* petioled, petiole 1.5–3 cm long; blade 8–15 × 4–8 cm, elliptic-obovate, sometimes oblong, obtuse, rounded, coriaceous, dark green and concave adaxially, dull green and convex abaxially, rarely glaucous, base cuneate to attenuate, apex retuse to round, rarely acute or emarginate; midrib depressed on upper surface in channel about ¾ of lamina length, underside raised, secondary veins present, dense and distinct on both surfaces, 6–8 veins per 0.5 cm. *Inflorescence* axillary panicles 5–10 cm long, pubescent or glabrous, up to 12 flowers per inflorescence, pedicels 0.6–4 cm long. *Floral parts* tepals 8, reflexed when flower is fully open, the outer pair oval to suborbicular, glabrous, imbricate, the next pair elliptic and the 2 inner pairs elliptic to

obovate. *Stamens* in fascicles but not distinct fascicles, 40–250 stamens per flower; filaments 4–5 mm long, white to yellow-green; anthers 1–1.5 mm long, bright yellow/orange. *Ovary* subglobose, 1.5–3.5 mm long; style 5–7 mm long with flat stigma, almost white, 8–9 mm long; 1 ovule, red. *Fruit* globose, apex round, 2.5–3.2 × 3 cm.

Thailand — (Map 1.1.3): NORTHERN: Chiang Mai [27 June 1914, *Kerr 3265* (ABD, BM, E, K)]; Phayao [Kwan Phayao, 3 July 1994, *BGO Staff 1108* (QBG)]; Phrae [1 July 1911, *Vanpruk 268* (BKF, K)]; NORTH-EASTERN: Mukdahan [15 June 1932, *Lakshnakara 946* (ABD, BK, BM, K, TCD)]; SOUTH-WESTERN: Kanchanaburi [19 Jan. 1907, *B.S. 390* (BK)]; CENTRAL: Saraburi [3 Mar. 1987, Pukhae, 14 km from North of Saraburi, in direction of Lopburi, *Lambinon 87/08* (AAU)]; Krung Thep Maha Nakhon [beside the library, Kasetsart University, Bang Khen, 26 Nov. 1970, *Watdahnahsahp 16* (A, L, PSU)]; 28 May 1922, *Marcan 849* (ABD, BM); 3 Apr. 1922, Paknam, *Marcan 987* (BM); 13 July 1920, *Kerr 4344* (ABD, BM, K, TCD); Kasetsart University Campus, Bang Khen, 22 Apr. 1975, *Maxwell 75-430* (AAU, BK); Paknam, July 1924, *Kerr s.n.* (BM); Royal Palace, 21 Oct. 1960, *Smitinand s.n.* (BKF)]; SOUTH-EASTERN: Chon Buri [14 Aug. 1981, *Apiom et al. 9* (KKU)]; Pattaya seaside, 22 Jan. 1955, *Chotmaiwee 28* (BK); Ko Kram Island, Pattaya, East Coast, 22 Aug. 1923, *Collins 942* (ABD, K, TCD); Kasetsart University, Sri Racha Campus, 22 Dec. 2004, *Maxwell 04-827* (CMUB)]; Rayong [Chak Phong, Klaeng, 29 June 2004, *Kertsawang 319* (QBG)]; Phae Arboretum, Phae District, 23 Nov. 1979, *Shimizu et al. T-23297* (L)]; Trat [Ko Kut SW, 21 Nov. 1970, *Charoenphol et al. 5111* (AAU, E)]; Ko Kradat, 15 Feb. 1900, *Schmidt 546* (C); 1928; PENINSULAR: Chumphon [Hat Sai Ri, 18 Feb. 1968, *Vachanapong 64* (BK)]; Saek Island, Parlenam, 9 June 1969, *Jaram 167* (BM)]; Surat Thani [Ko Tao, 1 Jan. 1927, *Kerr 11217* (ABD, BK, BM, K)]; Phangnga [North of Thung Maphrao, 19 July 1972, *Larsen et al. 31115* (AAU, K, L, P)]; Phuket [23 May 1982, *Ubolchalaket 111* (P)]; Phatthalung [Oct. 1915, *Vanpruk 772* (BKF, K)]; Satun [Tarutao, near Malacca Creek, 20 Oct. 1979, *Congdon 115* (A, PSU)]; west side of Pulau Adang, 20 Oct. 1979, *Congdon 115A* (P); Tarutao NP, Ao Son, 10 Nov. 1979, *Congdon 147* (A, AAU, PSU); La-ngu, Ko Pulon Mai Phai, 10 Apr. 2003, *Phengkklai et al. 14760* (BKF); Tarutao Island, 20 Apr. 1969, *Chermsirivathana &*

Kasem 1453 (BK)]; Songkhla [Prince of Songkla University Campus, Hat Yai, 16 June 1983, *Warapohn 16* (A, PSU)]; Kho Hong Hill, Hat Yai, 3 Oct. 1991, *Songsiri 17* (PSU)]; PSU Campus, Hat Yai, 25 Dec. 1979, *Congdon & Hamilton 489* (A, PSU)]; Ko Kham Island, Chana, *Sirirugsa PS425* (PSU)]; Unknown location [*Kerr 2486* (BKF)].

Distribution.— widespread from East Africa to Australia.

Ecology and phenology.— Evergreen and deciduous forests, marshy ground, sandy and rocky shorelines; from near sea level to 300 m. Flowering: October–December. Fruiting: all year. Visited by bees.

Vernacular.— Kra thing (กระตึง); saraphi thale (สารภีทะเล); thing (ทิง) (Sangkaew, 1999).

Uses.— This species is used for various purposes due to its high durability. The wood is used in underwater construction and for furniture making. The seed oil is used in soap making and as medicine to treat conditions such as rheumatism and skin infections. The plant also has many other medicinal uses due the presence of saponins and hydrocyanic acid (Sangkaew, 1999; Stevens, 1980).

Conservation.— IUCN Global Status: Least Concern (LC); Regional (Thailand) Status: Least Concern (LC).

4. *Calophyllum macrocarpum* Hook.f., Fl. Brit. Ind. 1: 273. 1874; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 179. 1890; Vesque in DC., Monogr. Phan. 8: 603. 1893; Ridl., J. Straits Branch Roy. Asiat. Soc. 33: 48. 1900; Ridl., Fl. Malay Penins. 1: 187. 1922; M.R.Hend., Gard. Bull. Straits Settlm. 4: 224. 1928; M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 317. 1956; Kochummen, Malayan Forest Rec. 2(17): 218. 1965; Burkill, Dict. Econ. Prod. Malay Penin. 2(1): 416. 1966; Meijer, Bot. Bull. Herb. Forest Dept., Sabah 7:16. 1967; Whitmore, Tree Flora of Malaya 2: 187. 1973; H.Keng, Gard. Bull. Singapore 28: 244. 1976; Corner, Gard. Bull. Singapore Suppl. 1: 104. 1978; P.F.Stevens, J. Arnold Arbor. 61: 452. fig. 28, g, h. 1980. Type: Malaysia, Malacca, *Maingay 1728* (lectotype K [K000199888! & K000199889! – a single specimen on two sheets], designated by Stevens [1980]).

Trees 25–35 m tall; dbh up to 110 cm; bole straight, usually without buttresses; outer bark deeply fissured, fissures boat-shaped, yellow-brown to dark-brown to black, some areas of bark emitting a reddish hue, inner bark brown to black; exudate the colour of clear honey. *Branchlets* flattened, 4-angled, slight brown pubescence at node, internodes 0.5–4 cm long. *Leaves* petioled, petiole 1.5–3.2 cm long; blade 8–16.5 × 3–4.6 cm, elliptic to oblanceolate to lanceolate, concave adaxially, convex abaxially, coriaceous, very smooth, light green to khaki green, base cuneate to acute, apex acuminate to rarely acute; venation pronounced on both surfaces, midrib on upper surface depressed in channel approximately ½ of lamina length, very pronounced on lower surface, arising at same point on both sides of midrib, approximately 0.5 mm apart, 5–10 veins per 0.5 cm. *Inflorescence* axillary; 5–15 flowers per inflorescence; covered with red-brown pubescence; pedicels 0.7–3.3 cm long. *Floral parts* tepals 8 (rarely 10), the outer pair ovate to suborbicular, 6–7 × 5–6 mm, dorsally densely pubescent; inner ones ovate to elliptic to oblong-elliptic, 7–17.5 × 3–8 mm, dorsally pubescent; the next 2 with the same shape and size, oblong-elliptic, 6–13 × 2–3 mm, dorsally slightly pubescent. *Stamens* in fascicles, 160–200 per flower; filament 3–6 mm long; anther 1–1.3 mm long. *Ovary* 2–3 mm long; style 3–5 mm long, stigma peltate. *Fruit* ellipsoid; 6.5–15 × 4.5–8 cm; acute at apex; yellow-green when ripe, drying wrinkled with longitudinal striations and dark brown.

Thailand — (Map 1.1.4): PENINSULAR: Nakhon Si Thammarat [Krung Ching Waterfall, 21 Feb. 1991, *Niyomdham et al.* 2250 (BKF)]; Trang [Khao Chong, 30 Apr. 1969, *Phusomsaeng & Smitinand* 240 (BK, K, L, P)]; 15 June 1973, *Phusomsaeng et al.* 1617 (BKF, L)]; Narathiwat [Khao Sam Sip, 25 Sept. 1996, *Niyomdham* 4792 (BKF)].

Distribution — Malay Peninsula to Borneo excluding Java.

Ecology and phenology. — Evergreen rainforest; from 100 to 220 m elevation. Flowering: May–July. Fruiting: August–June.

Vernacular. — Chuat (ชวต) (*Phusomsaeng & Smitinand* 240); tang hon (ตังหน) (Sangkaew, 1999).

Uses. — The wood is used in construction and furniture making (Sangkaew, 1999).

Conservation. — IUCN Regional (Thailand) Status: Data Deficient (DD).

5. *Calophyllum pisiferum* Planch. & Triana, Ann. Sci. Nat., Bot. Sér. 4, 15: 294. 1862; Ridl., Fl. Malay Penins. 1: 184. 1922; M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 345. 1956; Whitmore, Tree Flora of Malaya 2: 172. 1973; P.F.Stevens, J. Arnold Arbor. 61: 518. fig. 32, k, l. 1980. Type: Malaysia, Malacca, *Gaudichaud* 86 (lectotype **G** [G00032033!], designated by Stevens [1980]; isolectotypes **P** [P01900978!, P01900979!]).

— *C. retusum* Wall. ex Choisy var. *cochinchinense* Pit. in Lecomte, Fl. Indo-Chine 1(4): 321. 1910; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 275. 1943; Pham & Nguyễn, Cây-Có Miền Nam Viet-Nam, 179. 1960; Pham, Cây-Có Miền Nam Viet-Nam, 2(2): 303. 1970. Type: Cochinchine (Vietnam), *Thorel* 1395 (lectotype **P** [P01900966!], designated by Stevens [1980]; isolectotypes **P** [P01900967!, P01900968!], **B** not seen, **K** [K000380005!], **G** [G00032033!]).

— *Calophyllum retusum* Wall. ex Choisy var. *cam-bodgense* Pit. in Lecomte, Fl. Indo-Chine 1(4): 321. 1910; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 275. 1943; Pham, Cây-Có Miền Nam Viet-Nam, 2(2): 303. 1970. Type: Cambodia, *Hahn* 86 (holotype: **P**! [P01900969!]).

— *Calophyllum sangkae* Craib, Bull. Misc. Inform. Kew 1925: 18. 1925; Craib, Fl. Siam. 1: 122. 1925. Type: Thailand, Surin, *Kerr* 8283 (lectotype **K** [K000380004!], designated here; isolectotypes: **ABD** [ABDUH:2/518!], **BM** [BM000611358!], **BK**!, **P** [P00526175!]).

— *Calophyllum motleyi* Ridl., Bull. Misc. Inform. Kew 1938: 122. 1938. Type: Indonesia, Borneo, *Motley* 865 (holotype **K** [K000380013!]).

— *Calophyllum retusum* auct. non Wall. ex Choisy: T.Anderson in Hook.f., Fl. Brit. India 1: 272. 1874, *pro parte*; Pierre, Fl. Forest. Cochinch. 1: pl. 102. 1865; Vesque, Epharmosis 2: t. 25. 1889; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 50: 176. 1890, *pro majore parte*.

Shrubs to 5 m or trees to 35 m tall; dbh 60 cm; bole straight without buttresses; outer bark fissured, brown-yellow to grey-brown, inner bark dark red; exudate clear to slightly opaque. *Branchlets* slightly



Map 1.1.1 Distribution of *Calophyllum calaba* in Thailand.



Map 1.1.2 Distribution of *Calophyllum dryobalanoides* in Thailand.



Map 1.1.3 Distribution of *Calophyllum inophyllum* in Thailand.



Map 1.1.4 Distribution of *Calophyllum macrocarpum* in Thailand.

flattened to rectangular, covered in minute orange pubescence; internodes 1–2.5 cm long. *Leaves* petioled, petiole 0.3–0.7 cm long; blade 3.5–10.8 × 1–3.3 cm, elliptic or ovate, coriaceous, smooth, orange/yellow to brown concave adaxially, convex abaxially, base round to cuneate, apex acute to round; venation distinct on both surfaces, midrib depressed on upper surface and pronounced on lower surface, secondary veins not arising at same points of midrib and some splitting again forming intersecondary veins, 7–13 veins per 0.5 cm. *Inflorescences* axillary, racemose, covered with brown pubescence, 7–15 flowers per inflorescence, pedicels 0.5–1.5 cm long. *Floral parts* tepals 4, the outer pair ovate, 4–5 × 2–3 mm, dorsally brown pubescent, inner pair elliptic to obovate-elliptic, 5–7 × 3–5 mm, slightly dorsally pubescent to glabrous. *Stamens* in fascicles, approximately 30–70 stamens per flower; filaments 3–3.5 mm long; anthers 0.4–0.6 mm long, oblong-elliptic. *Ovary* 1.5–3 mm long; style 4–5 mm long. *Fruit* oval to ellipsoid with an acute apex, 0.9–1.3 × 0.7–1 cm, rough ridges on surface, orange when ripe.

Thailand.— (Map 1.1.5): EASTERN: Surin [Sangka, 14 Jan. 1924, *Kerr* 8283 (**ABD, BK, BM, P**)]; SOUTH-EASTERN: Prachin Buri [Huai Kasian, 14 Nov. 1964, *Sakol* 109 (**BK**)]; Chanthaburi [East of Makam, 18 Jan. 1958, *Sørensen et al.* 464 (**C**)]; Trat [Ko Kut SW, 21 Nov. 1970, *Charoenphol et al.* 5097 (**AAU, BKF, P**); *ibid.*, 21 Nov. 1970, *Charoenphol et al.* 5106 (**AAU, BKF, C, K**)]; Ko Kut, 6 Apr. 1959, *Smitinand* 5722 (**BKF**); Khao Saming, 26 Nov. 1924, *Kerr* 9435 (**BK, BM, C, K, L, P**); Khao Kuap (or Panom Tom), 25 Dec. 1929, *Kerr* 17774 (**A, BK, BM, C, K, L, P**); Waterfall, Kudi Island, 9 Apr. 2002, *Leeratiwong* 2002-32 (**PSU**)]; PENINSULAR: Narathiwat [Pawai, Su-ngai Padi, 25 Aug. 1988, *Niyomdham & Ueachirakan* 1916 (**AAU, BKF, C, K, L, P**); *ibid.*, 5 Sept. 1988, *Niyomdham & Ueachirakan* 1935 (**AAU, BKF, E, K, L, P**); Su-ngai Padi, 10 Oct. 1988, *Niyomdham* 1952 (**AAU, BKF, K, L**)].

Distribution.— Laos, Cambodia, southern Vietnam, Malaysia and Indonesia.

Ecology and phenology.— Evergreen forest, peat swamp forest, by water, in rocky areas from near sea level to 1700 m elevation. Flowering: October–January. Fruiting: November–April.

Vernacular.— Katanghan nam (กะตังหันน้ำ) (*Kerr* 9435); ka thang han bai lek (กะตังหันใบเล็ก)

(*Leeratiwong* 2002-32); pa-ong (ปะออง) (Sangkaew, 1999).

Uses.— Branches are used for constructing houses and boat poles (Sangkaew, 1999).

Conservation.— IUCN Global Status: Least Concern (LC); Regional (Thailand) Status: Near Threatened (NT).

6. *Calophyllum polyanthum* Wall., Numer. List 4844. 1821, **nom. nud.**; Wall. ex Choisy, Descr. Guttif. Inde: 43. 1829; Choisy, Mém. Soc. Phys. Genève 12: 423. 1851; Planch. & Triana, Ann. Sci. Nat., Bot. Sér. 4, 15: 278. 1862; Bedd., Fl. Sylv. S. India 3: 22. 1871; T. Anderson in Hook.f., Fl. Brit. India 1: 274. 1874; Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43: 88. 1874; Kurz, Forest Fl. Burma 1: 95. 1877; Gamble, List Trees Darjeeling Dist.: 7. 1878; W.Theob., Burma 2: 636. 1883; Vesque, Epharmosis 2: t. 6. 1889; Vesque in DC., Monogr. Phan. 8: 555. 1893; Prain, Bengal Pl. 1: 246. 1903; Brandis, Indian Trees: 54. 1907; A.M.Cowan & Cowan, Trees N. Bengal: 17. 1929; Craib, Fl. Siam. 1: 121. 1925; Kanjilal *et al.*, Fl. Assam 1: 14. 1934; Sastri *et al.*, Wealth India 2: 19. 1950; Maheshw., Bull. Bot. Surv. India 2: 144. 1960; Dutt *et al.*, Indian Forester 100: 65. 1974; P.F.Stevens, J. Arnold Arbor. 61: 220. 1980; S.Gardner *et al.*, Field Guide Forest Trees N. Thailand: 53. 2000; H.W.Li *et al.*, Fl. China 13: 39. 2007. Type: India, Assam, *Wallich* 4844 (holotype **G** not seen (fide Stevens, 1980); isotypes **BM** [BM000611322!], **FI** [FI010322!], **G** [G00355193!], **GH** [GH00067241!], **K** [K001104055!], **P** [P00526192!]).

— *Calophyllum smilesianum* Craib, Bull. Misc. Inform. Kew 1924: 85. 1924; Craib, Fl. Siam. 1: 122. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 270. 1943. Type: Thailand, *Kerr* 5792 (lectotype **K** [K000677427!]) second step designated here – first step designated by Stevens [1980]; isolectotypes **BM** [BM000611353!], **E!**, **P** [P00526163!]). — *Calophyllum smilesianum* Craib var. *luteum* Craib, Bull. Misc. Inform. Kew 1924: 86. 1924; Craib, Fl. Siam. 1: 122. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 271. 1943. Type: Thailand, Doi Pahom Pok, *Kerr* 5180 (lectotype **K** not seen, designated by Stevens [1980]; isolectotypes **ABD** [ABDUH:2/519!], **BK!**, **BM** [BM000611354!]).

— *Calophyllum williamsianum* Craib, Bull. Misc. Inform. Kew 1924: 86. 1924; Craib, Fl. Siam. 1: 122. 1931; Gagnep. in Humbert, Suppl. Fl. Indo-Chine Suppl. 1: 270. 1943. Type: Thailand, Doi Tiu (Nan), *Kerr 5038* (lectotype **K!** [bar code not available], designated by Stevens [1980]; isolectotypes **BK** [BK255126!], **E** [E00209520!], **P** [P00526164!]).

Trees 6–40 m tall; dbh 150–400 cm; bole straight without buttresses; outer bark slightly fissured, brown-grey/yellow; exudate the colour of clear honey. *Branchlets* flattened, sometimes terete, brown, slightly pubescent. *Leaves* petioled, petiole 1.2–2.5 cm long, slightly pubescent to glabrous; blade 3–19 × 1.8–6.5 cm, round to obovate-oblong, yellow to dark brown, base attenuate to cuneate, apex acuminate to acute, lateral veins distinct on both surfaces, very slender, radiating at same points from both sides of the midrib and fading near the edges of the leaves, midrib pronounced on lower surface and faint on upper surface, depressed in channel on upper surface about $\frac{2}{3}$ of the lamina length, brown/black on upper surface and orange/yellow on lower surface. *Inflorescence* terminal and from upper leaf axils, covered in brown pubescence, pedicels 1–1.8 cm long. *Floral parts* tepals 8, the outer pair oval to suborbicular, 3–4 × 3–3.5 mm, dorsally grey-brown pubescent, inner ones ovate, 5–8 × 4.5–5.5 mm, dorsally slightly pubescent and densely so towards base, the next 2 with the same shape and size, ovate, 6–6.5 × 5–5.5 mm, slightly pubescent along margin towards base, yellowish-white. *Stamens* in fascicles, approximately 200–277 per flower; filaments 2.5–4.5 mm long; anthers 1–1.7 mm long, oblong, basally connate, orange/brown, centre of anther darker. *Ovary* 2–2.2 mm long; style 3.5–4 mm long; stigma peltate. *Fruit* ovoid to globose, 3–4 × 2–3 cm, acute to round at apex, smooth or flaking at surface, green or black when ripe. *Seeds* 35 × 30 mm.

Thailand —(Map 1.1.6): NORTHERN: Mae Hong Son [North Mae Hong Son, en route to Doi Chang, 31 May 1977, *Santisuk 1148* (**A**, **BKF**)]; Chiang Mai [Doi Ka, 8 Apr. 1925, *Winit 1375* (**BK**, **BKF**, **K**); Mae Taeng, 5 Dec. 1977, *Santisuk 1491* (**A**, **C**, **K**, **L**, **P**); Doi Pa Kao, Apr. 1912, *Kerr 2608* (**BM**, **E**, **K**); Mae Chaem, 9 Sept. 1912, *Kerr 2691* (**K**); Mae Sanga Watershed Management Unit, Mae Chaem District, 6 May 2000, *Sookchaloem et al. 3340* (**BKF**); Doi Inthanon, 26 Apr. 1931, *Put 3765* (**BK**, **BM**, **K**, **L**); eastern side of Doi Inthanon, 6

Feb. 1998, *Konta & Phengkklai 4003* (**BKF**); Chom Thong District, Doi Hua Sua, 17 Dec. 1998, *Konta et al. 4673* (**BKF**); Doi Tiu, 8 Mar. 1921, *Kerr 5038* (**ABD**, **BM**, **E**, **K**, **P**); Doi Pahom Pok, Muang Fang, 1 Apr. 1921, *Kerr 5180* (**ABD**, **BK**, **BM**, **K**); Doi Inthanon, Mae Cham, 19 Oct. 1988, *Santisuk 6821* (**BKF**); Doi Inthanon NP, 27 July 1988, *Phengkklai et al. 7049* (**BKF**, **C**, **P**); *ibid.*, 28 July 1988, *Phengkklai et al. 7089* (**BKF**); *ibid.*, 28 July 1988, *Phengkklai et al. 7105* (**BKF**); *ibid.*, 28 July 1988, *Phengkklai et al. 7155* (**AAU**, **C**, **K**, **P**); *ibid.*, 2 Nov. 1962, *Smitinand et al. 7708* (**BKF**); *ibid.*, 10 Nov. 1962, *Smitinand et al. 7787* (**BKF**); Doi Inthanon, Khum Mae Wang, 7 Feb. 1998, *Phengkklai et al. 10881* (**BKF**); Doi Inthanon, Doi Hua Suea, 17 Dec. 1998, *Phengkklai et al. 11297* (**BKF**); west side of Doi Inthanon NP, 6 Aug. 1988, *Fukuoka T-62568* (**BKF**); Doi Inthanon NP, 8 Dec. 1998, *Kanzaki & Kwanchai C654* (**CMUB**); Doi Suthep-Pui, 30 Mar. 2004, *Maxwell 04-175* (**CMUB**); Doi Suthep NP, near Chang Khian Village, 13 June 1996, *Gardner & Kopachan s245b1* (**BM**, **CMUB**); Mae Taeng, Doi Hua Chang, 19 Mar. 1990, *Smitinand 90-38* (**E**, **K**, **P**); Forest station to the top, Doi Chang, Mae Taeng District, 23 Oct. 1979, *Shimizu et al. T-20574* (**A**, **AAU**, **BKF**, **L**); Nan [Doi Phu Kha, Pua, 2 July 1999, *Srisanga et al. 816* (**QBG**); *ibid.*, 26 Feb. 1997, *Pooma et al. 1446* (**A**, **BKF**, **CMUB**); *ibid.*, 26 Sept. 2000, *Srisanga 1725* (**QBG**); *ibid.*, 22 Aug. 2001, *Srisanga 2021* (**QBG**); *ibid.*, 15 May 1992, *Santisuk s.n.* (**BKF**)]; Phitsanulok [Foothill of Phu Mieng Mountain, 27 July 1966, *Larsen 938* (**AAU**)]; NORTH-EASTERN: Phetchabun [Thung Salaeng Luang, 16 Feb. 1968, *Phengkklai s.n.* (**BKF**)]; Loei [Phu Kradung, *Bunpheng 706* (**BKF**); Kao Keo Kang, 10 Apr. 1922, *Kerr 5792* (**ABD**, **BM**, **E**, **K**, **P**); Khao Krading, 14 Mar. 1924, *Kerr 8752* (**ABD**, **BK**, **BM**, **E**, **K**, **P**, **TCD**); Phu Kradung NP, 28 Nov. 1972, *Smitinand 11780* (**BKF**)]; PENINSULAR: Chumphon [Kao Tong, 18 Jan. 1927, *Kerr 11523* (**A**, **BK**, **C**, **K**, **L**, **P**); Trang [Khao Chong Botanical Garden, 10 Aug. 1993, *Smitinand et al. 5* (**BKF**); Chong, 25 Jan. 1957, *Smitinand 4106* (**BKF**)].

Distribution.— India to Southwestern China, Cambodia and Indonesia.

Ecology and phenology.— Evergreen forest and lower montane forest from 60 to 1950 m elevation. Flowering: January–July. Fruiting: May–February.

Vernacular.—Pa-ong (พะอง) (*Kerr 8752*); kho-mai-do (คอไม้ดอ); sa-chum-mun (ชำจุ่มมุน); ma haen doi (มะเหินดอย) (Sangkaew, 1999).

Uses.—Wood is used in construction and furniture making (Sangkaew, 1999).

Conservation.—IUCN Regional (Thailand) Status: Least Concern (LC).

7. *Calophyllum rupicola* Ridl., Trans. Linn. Soc. London, Bot. 3(9): 278. 1893; Ridl., Fl. Malay Penins. 1: 182. 1922; M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 346. 1956; Whitmore, Tree Flora of Malaya 2: 168. 1973; P.F.Stevens, J. Arnold Arbor. 61: 515. 1980. Type: Malaysia, Malacca, Pahang, *Ridley 2636* (holotype **SING**!; isotypes **BM** [BM00946495!], **K**!).

—*Calophyllum rupicola* Ridl. variety?: M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 347, pl. 27. 1956, *pro parte* [not validly published as it is not accepted by the authors and is not given a name; see McNeill *et al.* 2012, Art. 36.1]

—*Calophyllum rupicola* Ridl. var. *elatum* Whitmore, Gard. Bull. Singapore 26: 270. 1973, *pro parte, typo haud excluso*; Whitmore, Tree Flora of Malaya 2: 168. 1973, *pro parte*. Type: ? Malaysia, *FRIM 2538* [K000677416, L0012089, L0012090, SING0055128] is *Calophyllum tetrapterum* var. *tetrapterum*.

Trees 10–35 m tall; dbh 30 cm; without buttresses; outer bark thin, rough with small fissures greyish-brown, inner bark pink; exudate milky-yellow (opaque-whitish), sticky. *Branchlets* terete to quadrangular, smooth though striations present on some specimens, glabrous, brown to red/brown, scars absent. *Leaves* petioled, petiole 0.4–0.9 cm long, blade 5.2–15 × 2.2–3.6 cm, elliptic to lanceolate to obovate-oval, approximately half of leaves glaucous and other half coriaceous, shiny, base narrowly tapering, apex bluntly acute to rounded to slightly cuspidate; midrib prominent on both surfaces though fades and disappears near apex (approximately 10–20 cm from apex) on some specimens, varies from light yellow/green to red/brown on both surfaces, secondary veins present on both surfaces, on upper surface some leaves show fading of venation at/near edges of leaves. *Inflorescence* axillary, pedicels 0.3–0.8 cm long, slender, glabrous. *Floral parts* tepals 4, the outer

pair ovate and the inner pair oblong-elliptic. *Stamens* approximately 50 stamens per flower; anthers 0.4–1 mm long. *Ovary* style 2–2.7 mm long. *Fruit* ovoid-globose, 8 mm diam., wrinkled, pale-yellow to green.

Thailand.—(Map 1.1.7): PENINSULAR: Narathiwat [Waeng, 17 Apr. 1972, *Sangkhachand et al. 1067* (**BKF, C, L**); Pawai, Su-ngai Padi, 17 Sept. 1987, *Niyomdham & Sriboonma 1623* (**BKF**)]; Unknown location [*Unknown collector 57479* (**L**)].

Distribution.—Northeast Malaya to Sumatra.

Ecology and phenology.—Peat swamp forest, evergreen forest from near sea level to 270 m elevation. Flowering: October–November. Fruiting: December–April.

Vernacular.—Tang hon nam (ตังหนน้ำ) (Sangkaew, 1999); tang hon bai lek (ตังหนใบเล็ก) (*Niyomdham & Sriboonma 1623*)

Conservation.—IUCN: Regional (Thailand) Status: Critically Endangered (CR).

8. *Calophyllum sclerophyllum* Vesque, Epharmosis 2: t. 33. 1889; Vesque in DC., Monogr. Phan. 8: 587. 1893; Merr., Bibliogr. Enum. Born. Pl.: 394. 1921; Masam., Enum. Phan. Born.: 476. 1942; Heyne, Nutt. Pl. Ned.-Ind., ed. 3. 1: 1085. 1950; M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 324. 1956; J.A.R. Anderson, Gard. Bull. Singapore 20: 154. 1963; Pukol & Ashton, Checkl. Brunei Trees: 93. 1964; Ashton, Oxford Forest Mem. 25: pl. 32. 1964; Smythies, Common Sarawak Trees 64: pl. 22. 1965; Kochummen, Malayan Forest Rec. 2(17): 214. 1965; Whitmore, Tree Flora of Malaya 2: 191. 1973; J.A.R. Anderson, Trees Peat Swamp Sarawak: 88. 1973; Corner, Gard. Bull. Singapore Suppl. 1: 105. 1978; P.F.Stevens, J. Arnold Arbor. 61: 447. 1980. Type: Borneo, Sarawak, *Beccari PB 2705* (holotype **O** not seen; isotypes **FI** [FI007648!], **K**! [K000380015!], **M** not seen, **P** not seen).

—*Calophyllum rhizophorum* Boerl. & Koord. in Koord.-Schum., Syst. Verz. 2: 40. 1911; J.A.R. Anderson, Trees Peat Swamp Sarawak, fig. 26C. 1973. Type: Indonesia, Sumatra, *Koorders 10333* (holotype **BO** not seen).

—*Calophyllum subcluridum* Wyatt-Sm., Malayan Forest Rec. 17: 113. 1952; **nom. nud.**

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

Trees 20–45 m tall; dbh up to 300 cm; outer bark shallowly fissured, scaly pale green to light brown, inner bark fissured, soft, pink to red or dark orange; exudate the colour of clear honey. *Branchlets* sturdy, thick, terete, dark brown to black, pubescent, waxy or glabrous, striations and scars present. *Leaves* petioled, petiole 1.9–2.8 cm long; blade 6.2–16.7 × 3.1–7.9 cm, obovate, oval or rotund, thickly coriaceous, base cuneate to slightly attenuate, apex blunt or mainly retuse; midrib prominent on both surfaces, fading towards apex on upper surface for approximately 2/3 of lamina length, dark brown to black abaxially and light tan to dark brown adaxially, both secondary veins and intramarginal veins present and very prominent on both surfaces. *Inflorescence* axillary racemes, pedicels up to 3 cm long, 9–11 flowers per inflorescence. *Floral parts* tepals 8, the outer pair orbicular to suborbicular, dorsally brown pubescent, the next pair orbicular to suborbicular, the next two pairs obovate. *Stamens* 200–360 per flower; anthers 1.3–1.8 mm long. *Ovary* style 4.5–6.5 mm long. *Fruit* ovoid to rotund with acute or round apex, 2.4 × 1.6 cm; surface very finely wrinkled, drying dull reddish brown to almost black.

Thailand.— (Map 1.1.8): PENINSULAR: Narathiwat [Bang Kuntang, Tak Bai, 7 July 1983, *Niyomdham 654* (BKF); Pa Ye, Su-ngai Padi, 14 Apr. 1988, *Niyomdham & Ueachirakan 1815* (BKF); Bang Nara, 22 Aug. 1973, *Smitinand 11960* (BKF)]

Distribution.— Malay Peninsula to Borneo excluding Java.

Ecology and phenology.— Peat Swamp Forest at near Sea Level. Flowering: July–August. Fruiting: (April) August–December.

Vernacular.— Ya-kang (ยะกัง); kra thing phru (กระทิ้งพรุ) (Sangkaew, 1999).

Uses.— A good timber species used in general construction (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Critically Endangered (CR).

9. *Calophyllum soulattri* Burm.f. ,Fl. Ind.: 121. 1768; F.Muell., J. Roy. Soc. New S. Wales 24: 174. 1890; F.Muell., Bot. Centralbl. 44: 29. 1891; Merr., Interpr. Herb. Amboin. : 371. 1917; Merr., Philipp. J. Sci. 19: 366. 1921; Merr., Enum. Philip. Fl. Pl. 3: 81. 1923; Holthius, Blumea 5: 214. 1942; Heyne, Nutt. Pl. Ind.-Ned. ed. 3. 1: 1085. 1950; Sastri *et al.*, Wealth India 2: 20. 1950, *pro parte*; M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 319. 1956; Maheshw., Bull. Bot. Surv. India 2: 142. 1960; Backer & Bakh.f., Fl. Java 1: 386. 1963; Whitmore, Guide Forests Brit. Solomon Is.: 77. 1966; Burkill, Dict. Econ. Prod. Malay Penin. 2(1): 416. 1966; Whitmore, Gard. Bull. Singapore 22: 15. 1967; Meijer, Bot. News Bull. Forest Dept., Sabah 7: 16. 1967; Pham, Cây-Có Miền Nam Viet-Nam. 2(2): 300. fig. 1970; Foreman, Check List Vasc. Pl. Bougainville: 42. 1971; Whitmore, Tree Flora of Malaya 2: 192. 1973; T.G.Hartley *et al.*, Lloydia 36: 276. 1973; P.F.Stevens, Austral. J. Bot. 22: 399. 1974; P.F.Stevens, J. Arnold Arbor. 57: 175. 1976; H.Keng, Gard. Bull. Singapore 28: 245. 1976; Corner, Gard. Bull. Singapore Suppl. 1: 105. 1978; Perry, Med. Pl. E. SE. Asia, 174. 1980; P.F.Stevens, J. Arnold Arbor. 61: 277. 1980. Type: Indonesia, Java, *Burman s.n.* (holotype: G [G00032034!]).

— *Calophyllum lanceolatum* Warb., Bot. Jahrb. Syst. 13: 381. 1891; **nom. illeg.** ≡ *Calophyllum warburgii* Engl. & Prantl, Nat. Pflanzenfamilien 3(6): 221. 1893; Lauterb., Nova Guinea Bot. 8: 843. 1912; Lauterb., Bot. Jahrb. Syst. 58: 13. 1922; A.C.Sm., J. Arnold Arbor. 22: 345. 1941, *pro majore parte*. Type: Indonesia, Kei Inseln, *Warburg 20048* (lectotype: US [US00114158!], designated here; isolectotypes: A [A00067341!, A00067342!], MICH [MICH1115518!], LAE not seen).

— *Calophyllum hibbardii* Elmer, Leaf. Philipp. Bot. 2: 503. 1908. Type: Philippine Islands, *Elmer 9837* (lectotype L [L0011778!], designated here; isolectotypes A [A00067335!], BM [BM000611478!], BO not seen, E [E00346383!], F [F0057186F!], FI [FI010315!], G not seen, HBG [HBG517738!], K [K000677476!], LY not seen, MO not seen, NY [NY00072325!], US not seen, W not seen).

— *Calophyllum paludosum* C.T.White, J. Arnold Arbor. 31: 98. 1950; Whitmore, Guide Forests Brit. Solomon Is. 77. 1966; Whitmore, Gard. Bull. Singapore 22: 14. 1967. Type: Solomon Islands,



Map 1.1.5 Distribution of *Calophyllum pisiferum* in Thailand.



Map 1.1.6 Distribution of *Calophyllum polyanthum* in Thailand.



Map 1.1.7 Distribution of *Calophyllum rupicola* in Thailand.



Map 1.1.8 Distribution of *Calophyllum sclerophyllum* in Thailand.

BSIP (Walker & White) 192 (holotype **BRI** [BRI-AQ0340217!]; isotypes **A** [A00067323!], **CANB** [CANB189036!], **K** [K00038002!], **LAE** not seen, **MEL** [MEL75509!]).

— *Calophyllum wallichianum* auct. non Planch. & Triana: Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 45:119. 1876; Theobald, Burma 2: 637. 1883; Maheshw., Bull. Bot. Surv. India 2: 146. 1960.

Trees 10–20 m tall; dbh up to 30 cm; bole straight, with/without buttresses, if present, small; outer bark shallowly fissured, almost smooth, light brown, heartwood dark brown; exudate white. *Branchlets* flattened, with reddish-brown pubescence, internodes 3–10 cm long. *Leaves* petioled, petiole 1.1–2.3 cm long; blade 6–30 × 3–7.5 cm, oblong-ovate to elliptic-ovate, coriaceous, yellow-brown, sparsely hairy to almost glabrous, base cuneate to slightly acute, apex acute to acuminate; venation very obvious, arising at same point from both sides of the midrib, midrib wider and more apparent on lower surface, depressed in channel on upper surface for about ½ of lamina length, dark green above and pale green underneath, immature leaves with light brown midribs. *Inflorescence* axillary, in cymes, sometimes appearing paniculate, 11–29 flowers per inflorescence, covered with brown pubescence, pedicels 1–3 cm long. *Floral parts* tepals 4, the outer pair oval to suborbicular, 3–4.5 × 4.5–5 mm, glabrous or slightly pubescent at margin, inner ones obovate, 5–6.5 × 5–6 mm, glabrous or slightly pubescent at margin, tepals, filaments and style white. *Stamens* in fascicles, 59–97 stamens per flower; filaments 3–5 mm long; anthers 1–2.6 mm long, white or yellow. *Ovary* 2–2.5 mm long; style 3–5 mm long. *Fruit* ovoid to spherical, 0.8–1 × 0.7–1 cm, round at apex, stalk 2–2.9 cm long, purple to black.

Thailand — (Map 1.1.9): SOUTH-WESTERN: Kanchanaburi [Thung Phra Ruesi, 5 May 1992, *Smitinand* 255 (**BKF**)]; PENINSULAR: Chumphon [Bang Son, 13 Mar. 1928, *Put* 1562 (**BK**, **BM**, **K**); Tongtapai Sara, 13 Apr. 1967, *Sutheeso* 2204 (**BKF**)]; Krabi [Khao Pra-Bang Khram Wildlife Sanctuary, 14 Jan. 2006, *Maxwell s.n.* (**CMUB**)]; Nakhon Si Thammarat [Phrom Lok Falls, Khao Luang NP, Phrom Khiri District, 24 Feb. 1987, *Maxwell* 87-194 (**A**, **BKF**, **L**, **P**, **PSU**)]; Phatthalung [Tamot Falls NP, Tamot, 9 Aug. 1986, *Maxwell* 86-546 (**A**, **AAU**, **BKF**, **L**, **PSU**)]; Trang [Bangsak, 19 Apr. 1930, *Kerr* 19035 (**A**, **BK**, **BM**, **K**, **L**, **P**)]; Satun

[Tarutao Island, Talo-Oo-Dang, 27 Apr. 1981, *Congdon* 1261 (**A**, **AAU**, **PSU**)]; Songkhla [Ton Nga Chang Reserve, Hat Yai, 27 Aug. 1981, *Sirirugsa* 442 (**PSU**); *ibid.*, 2 Aug. 1985, *Maxwell* 85-766 (**A**, **AAU**, **BKF**, **L**, **PSU**)]

Distribution.— Cambodia, Vietnam, Malaysia to Australia.

Ecology and phenology.— Primary evergreen forest, by water, peat swamp area, found on granitic bedrock from 50 to 500 m elevation. Flowering: March–October. Fruiting: all year.

Vernacular.— Tang hon loko (ตังหนโล๊ะโก๊ะ) (*Kerr* 19035); tang hon bai yai (ตังหนใบใหญ่) (Sangkaew, 1999).

Uses.— Used for masts and spars and in house construction (Stevens, 1980).

Conservation.— IUCN Global Status: Least Concern (LC); Regional (Thailand) Status: Least Concern (LC).

10. *Calophyllum symingtonianum* M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 338. pl. 18. 1956; Kochummen, Malayan Forest Rec. 2(17): 222. 1965; Whitmore, Tree Flora of Malaya 2: 192. 1973; P.F.Stevens, J. Arnold Arbor. 61: 229. 1980. Type: Malaysia, Malacca, Pahang, *Nur SFN* 32633 (holotype **SING** [SING0055134!]; isotypes **A** [A00067289!], **K** [K000677413!], **KEP** not seen, **L** [L0012087!], **MO** not seen, **P!**, **S** [S11-34387!], **UC** not seen, **US** [US00114173!]).

Trees to 40 m tall; up to dbh 300 cm; without buttresses; outer bark fissured, rough, greyish-brown to yellowish-brown, inner bark pink; exudate the colour of clear honey, sticky. *Branchlets* terete, glabrous, smooth, thin, dark brown to greyish. *Leaves* petioled, petiole 1–1.3 cm long; blade, 6.3–9.4 × 2.4–3 cm, elliptic to lanceolate, slightly coriaceous, smooth, green to red/brown, base tapering to acute, apex acuminate; midrib discrete on both surfaces, slightly more prominent on lower surface, light green to brown on upper surface and pale green to yellow on lower surface, secondary veins present, arising from same points on both sides of the midrib, *Inflorescence* terminal and from upper leaf axils, some with pale brown pubescence. *Floral parts* tepals 8; outer pair of tepals dorsally glabrous or (occasionally) dorsally slightly pubescent towards

base. *Stamens* 46–70 per flower. *Fruit* ellipsoid to slightly obovoid, apex acute to round, 2.5 cm long, glabrous and wrinkled, dull reddish brown to dark purple when dry.

Thailand.— (Map 1.1.10): Trang, Songkhla, Yala (locations taken from Sangkaew, 1999), Unknown location [No collector name or number (**BKF**)].

Distribution.— Malay Peninsula.

Ecology and phenology.— Evergreen forest from 460 m elevation. Flowering: unrecorded. Fruiting: February–April.

Vernacular.— Tang hon (ตังหน) (Sangkaew, 1999).

Uses.— Hard wood used to build houses (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Data Deficient (DD).

11. *Calophyllum tetrapterum* Miq., Pl. Jungh.: 291. 1854; P.F.Stevens, J. Arnold Arbor. 61: 505. 1980. Type: Indonesia, Sumatra, *Junghuhn s.n.* (holotype **U!; isotypes **BO**!, **L**!).**

— *Calophyllum bancanum* Miq., Fl. Ned. Ind., Eerste Bijv. 1(3): 499. 1861; Kurz, Natuurr. Tijdschr. Ned.-Indië 27: 192. 1864; F.Muell. in Walp. Ann. Syst. Bot. 7: 357. 1868; Scheffer, Natuurr. Tijdschr. Ned.-Indië 31: 354. 1870, 32: 405. 1873. Type: Indoneaia, Bangka, *Teysmann HB 3214* (holotype **U** [U0002361!]; isotypes **BO** not seen, **K** [K0006774557!], **L** [L0012098!]).

— *Calophyllum gracile* Miq., Fl. Ned. Ind., Eerste Bijv. 1(3): 498. 1861; F.Muell. in Walp. Ann. Syst. Bot. 7: 357. 1868.— *Calophyllum pulcherrimum* Wall ex. Choisy var. *gracile* (Miq.) Boerl., Cat. Hort. Bogor. 2: 82. 1901. Type: Indonesia, Sumatra, *Teysmann HB 649* (holotype **U**; isotypes **BO** not seen, **K** [K000677459!], **L**!, **MEL** not seen).

— *Calophyllum floribundum* Hook.f., Fl. Brit. India 1: 272. 1874; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 175. 1890; Ridl., Fl. Malay Penins. 1: 184. 1922; M.R.Hend., Gard. Bull. Straits Settle. 4: 224. 1928; M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 332. pl. 16. 1956; Smythies, Common Sarawak Trees 61. 1965; Kochummen, Malayan Forest Rec. 2(17): 215. 1965; Burkill, Dict. Econ.

Prod. Malay Penin. Ed. 2. 1: 412. 1966; Whitmore, Tree Flora of Malaya 2: 180. 1973; Corner, Gard. Bull. Singapore, Suppl. 1: 104. 1878. Type: Malaysia, Malacca, *Maingay 1660* (lectotype **K** [K000199894!], designated by Stevens [1980]).

— *Calophyllum prainianum* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 175. 1890; Vesque in DC Monogr. Phan. 8: 550. 1893; Ridl., Fl. Malay Penins. 1: 183. 1922. Types: Malaya, Perak, Larut, *King's Collector [Kunstler] 5366* (syntypes **BM** [BM000946498!], **FI** not seen, **G** not seen, **K**!, **P** [P01900949!], **UC** not seen), *King's Collector [Kunstler] 7243* (syntypes **BM** [BM000946496!], **FI** not seen, **K** [K000677415!], **L** [L0012091!], **P**!).

— *Calophyllum venustum* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 180. 1890; Vesque in DC. Monogr. Phan. 8: 549. 1893; Ridl., Fl. Malay Penins. 1: 186. 1922. Type: Malaysia, Malacca, Perak, Larut, *King's Collector [Kunstler] 7763* (lectotype **L** [L0012092!], designated here; isolectotypes **FI** not seen, **G** not seen, **K** [K000677414!]).

— *Calophyllum foetidum* Ridl., J. Straits Branch Roy. Asiat. Soc. 54: 18. 1910; Fl. Malay Penins. 1: 186. 1922. Type: Singapore, *Ridley 11958* (lectotype **SING** [SING0055098!], designated by Stevens [1980]: isolectotypes **BM**!, **K**!).

— *Calophyllum lanceola* Ridl., J. Straits Branch Roy. Asiat. Soc. 82: 170. 1920; Ridl., Fl. Malay Penins. 1: 82. 1922. Type: Malaysia, Malacca, *Ridley 5751* (holotype **SING**!).

— *Calophyllum rupicola* Ridl. var. *elatum* Whitmore, Gard. Bull. Singapore 26: 270. 1973; Whitmore, Tree Flora of Malaya 2: 169. 1973. Type: Malaya, Malacca, Kelantan, *FRI (Kochummen) 2538* (holotype **KEP** not seen, isotypes **K** [K000677416!], **L** [L0012089!, L0012090!], **SING** [SING0055114!]).

— *Calophyllum globuliferum* Ridl., Bull. Misc. Inform. Kew 1938: 121. 1938. Type: Indonesia, Borneo, Kalimantan, Bangarmassing, *Motley 618* (holotype **K** [K000380016!]).

— *Calophyllum dryobalanoides* auct. non Pierre: Craib, Fl. Siam. 1: 120. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine, 1: 274. 1943, *pro parte*.

— *Calophyllum pulcherrimum* auct. non Wall. ex Choisy: T.Anderson in Hook.f., Fl. Brit. India 1: 271. 1874; Pierre, Fl. Forest. Cochinch. 1: pl. 104A. 1885, *pro parte*; Vesque, Epharmosis 2: t. 21. 1889;

Vesque in DC. Monogr. Phan. 8: 570. 1893, *pro parte*; Curtis, J. Straits Branch Roy. Asiat. Soc. 25: 78. 1894; Pit. in Lecomte, Fl. Indo-Chine 1(4): 321. 1910; Ridl., Fl. Malay Penins. 1: 182. 1922, *pro parte*; Burkill & M.R.Hend., Gard. Bull. Straits Settlm. 3: 347. 1925; Craib, Fl. Siam. 1: 121. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 274. 1943; Pham & Nguyễn, Cây-Cỏ Miền Nam Việt-Nam, 179. 1960; Pham, Cây-Cỏ Miền Nam Việt-Nam. 2(2): 301. fig. 1970.

Trees to 25 m tall; dbh 30 cm; bole straight, with or without small buttresses; outer bark coarsely but shallowly fissured or smooth, grey-brown to dark grey-black, inner bark soft, pink; exudate the colour of clear honey. *Branchlets* terete to flattened, slender, glabrous, internode, 1–3 cm long, brown/red/grey. *Leaves* petioled, petiole 0.5–1.5 cm long; blade 3.5–13.2 × 1.4–4 cm, obovate to elliptic, slightly glaucous, red-brown, some green/yellow and concave adaxially, convex abaxially, coriaceous, base cuneate to attenuate, apex acute to acuminate, midrib not very pronounced on either surface, depressed in channel about ½ of lamina length on upper surface, underside raised, secondary veins present, prominent on both surfaces, dense, arising roughly from the same place on both sides of the midrib, spacing of veins varies from leaf to leaf, approximately 6–17 veins per 0.5 cm, intramarginal veins absent. *Inflorescence* axillary, 3–11 flowers per inflorescence, covered with brown pubescence, pedicels 0.5–2.5 cm long. *Floral parts* tepals (4–)8, sometimes 5, 6, 7 or 8, outer pair ovate, oval to suborbicular, 3–5 × 3–4 mm, glabrous to slightly pubescent along margin and apex, next pair obovate or ligulate, 4–8 × 3–5 mm, glabrous, the next 2 pairs obovate to spatulate, 5–7 × 2–3 mm, or the innermost ones oblong-oblancheolate, 5–6 × 1–1.5 mm, glabrous. *Stamens* in fascicles, 36–86 stamens per flower, filaments, 2–5 mm long, anthers, 1–1.3 mm long, oblong or elliptic-oblong. *Ovary* 1–2 mm long; style 2–4.5 mm long. *Fruit* ovoid-globose, 0.6–1 × 0.5–0.8 cm, acute to round at apex, dark green when ripe.

Thailand.— (Map 1.1.11): SOUTH-EASTERN: Trat [Ko Chang, Jungle at Khlong Non Si, 14 Feb. 1900, *Schmidt* 528 (C, K); Khao Saming, 26 Jan. 1927, *Put* 567 (BK, K, L); Ko Chang, Khlong Mayom, 22 Feb. 1900, *Schmidt* 603a (C, K); Khlong Non Si, Ko Chang, 26 Sept. 1924, *Kerr* 9175 (A, BK, C, E, K, L, P)]; PENINSULAR: Chumphon [Khao

Kaeom, Sawi, 14 Apr. 1967, *Sutheeso* 2227 (BK)]; Ranong [Khuraburi, Ko Phra Thong, 4 Apr. 2003, *Phengklai et al.* 13729 (BKF)]; Surat Thani [Khao Kaup, 25 Dec. 1929, *Kerr* 17772 (BK, BM, K, L)]; Krabi [Khao Pra-Bang Khram Wildlife Sanctuary, 17 Jan. 2006, *Maxwell* 06-655 (CMUB); *ibid.*, 25 Mar. 2006, *Maxwell* 06-201 (CMUB)]; Ao Luek, 15 Mar. 1930, *Kerr* 18567 (A, BK, BM, C, K, P); Trang [Khao Chong, 30 Apr. 1969, *Phusomsaeng & Smitinand* 240 (AAU); Khlong Mayom, Salak Khok, Ko Chang, 6 Apr. 1923, *Kerr* 6930 (BKF, K)]; Satun [Rawi Island, 15 June 1980, *Congdon* 631 (A); Tarutao NP at waterfall above Choe-lae Village east side of Adang, 19 Oct. 1980, *Congdon* 951 (AAU, PSU); Tarutao, 20 Jan. 1928, *Kerr* 14213 (BK, BM, C, K, L, P)]; Songkhla [Ton Nga Chang Reserve, Hat Yai, 30 July 1983, *Srirugsa* 592 (PSU); *ibid.*, 10 Jan. 1984, *Srirugsa* 737 (PSU); *ibid.*, 18 Apr. 1985, *Maxwell* 85-417 (A, AAU, BKF, E, L, PSU)]; Khlong Hoi Khong, Hat Yai, *Maxwell* 85-65 (P); Narathiwat [Waeng, 30 June 1972, *Nitrasirirak* 206 (BKF); Bala-Hala, Waeng, 3 May 1997, *Puudjaa* 573 (BKF); Waeng, *Sangkhachand et al.* 1067 (C)]; Unknown location [Hui Tonpong, 25 Mar. 1920, *Punyabukkana* 874 (ABD, BKF, K)].

Distribution.— Cambodia, Vietnam, Malay Peninsula to Indonesia excluding Java.

Ecology and phenology.— Evergreen forest, tropical rainforest, water areas, peat areas, savannah from near Sea Level to 700 m elevation. Flowering: all year. Fruiting: January–May (October).

Vernacular.— Tang hon (ตังหน) (Sangkaew, 1999).

Uses.— Young leaves are eaten as a vegetable (Sangkaew, 1999).

Conservation.— IUCN Global & Regional (Thailand) Status: Least Concern (LC).

12. *Calophyllum teysmannii* Miq., Fl. Ned. Ind. Suppl. 1(3): 499. 1861; P.F.Stevens, J. Arnold Arbor. 61: 431. 1980. Type: Indonesia, Sumatra, *Teysmann HB* 650 (holotype U [U0002364!]; isotypes BO not seen, L [L0012088!], P [P01900948!]).

— *Calophyllum intramarginale* M.R.Hend. & Wyatt-Sm., Gard. Bull. Singapore 15: 342, pl. 22. 1956. Type: Malaysia, Malacca, *Moysey & Kiah SFN* 31900 (holotype SING [SING0055110!]; isotypes A [A00067279!], K!, KEP not seen).

— *Calophyllum inophylloide* King var. *singaporense* M.R.Hend. & Wyatt-Smith, Gard. Bull. Singapore 15: 316, pl. 9. 1956; Kochummen, Malayan Forest Rec. 2(17): 215. 1965; Smythies, Common Sarawak Trees, 61. 1965; Whitmore, Gard. Bull. Singapore 26: 270. 1973; Whitmore, Tree Flora of Malaya 2: 186. 1973; Corner, Gard. Bull. Singapore Suppl. 1: 104. 1978. Type: Singapore, *Corner SFN 32518* (holotype **SING** [SING0055108!]; isotypes **K** [K000199910!], **KEP** not seen).

Trees 5–35 m tall; dbh 95 cm; bole straight, small buttresses sometimes present, if present up to 70 cm tall; outer bark shallowly fissured and scaly, greyish-brown to dark brown, inner bark orange-brown to black; exudate the colour of clear honey. *Branchlets* flattened, slender; with brown or black pubescence, waxy or glabrous, internodes 0.5–3.5 cm long. *Leaves* petioled, petioles 3–12 mm long; blade 3.5–9 × 1.5–4.5 cm, elliptic-oblong or obovate, otherwise oblong-lanceolate to obovate, concave adaxially, convex abaxially, coriaceous, red-brown to khaki green, base acute to cuneate, apex acute to retuse, midrib depressed in channel on upper surface about 1/3 of lamina length, underside raised, lateral veins on both surfaces distinct but sometimes obscure, 6–10 veins per 0.5 cm, intramarginal veins present. *Inflorescence* racemes, 3–11 flowers per inflorescence, usually glabrous but sometimes covered with brown pubescence, pedicels 0.5–4.3 cm long. *Floral parts* tepals 8, the outer pair oval to suborbicular, 4–5 × 4–4.5 mm, glabrous or slightly pubescent at margin, next pair elliptic, next ones obovate, inner ones ovate to suborbicular, all 5–8 × 5.5–7 mm, glabrous or slightly pubescent at margin, white to pale yellow, green in bud. *Stamens* in fascicles, 65–212 stamens per flower; filaments, 3–4.5 mm long, white; anthers, 1–1.5 mm long, yellow. *Ovary* 1–2.5 mm long; style 2–5 mm long, white, stigma peltate. *Fruit* ellipsoid to subglobose, 2–2.5 × 1.8–2 cm, apex acute to round, striate to smooth, yellow-green to pale brown when ripe.

Thailand.— (Map 1.1.12): PENINSULAR: Narathiwat [Pa Ye, Su-ngai Padi, 14 Apr. 1988, *Niyomdham & Ueachirakan 1815* (AAU, C, E, **K**, **L**, **P**); Pha Khluai, Sukhirin, 17 Apr. 1996, *Niyomdham & Puudjaa 4717* (BKF); Khao Nakharat, Sukhirin, 20 Oct. 1996, *Niyomdham 4836* (BKF); Phru Khok Ka La, 18 Aug. 1997, *Niyomdham et al. 5127* (AAU, BKF); To Daeng, Aug. 1993, *Niyomdham s.n.* (BKF)].

Distribution.—Cambodia, Indonesia, Malaysia.

Ecology and phenology.—Peat Swamp Forest from near sea level to 250 m elevation. Flowering: April–August. (October). Fruiting: (April) July–August.

Vernacular.—Tang hon bai neep (ตังหนใบหนึบ) (Sangkaew, 1999).

Conservation.—IUCN Regional (Thailand) Status: Critically Endangered (CR).

13. *Calophyllum thorelii* Pierre, Fl. Forest. Cochinch. 1: t. 103. 1885; Vesque in DC., Monogr. Phan. 8: 601. 1893; Pit. in Lecomte, Fl. Indo-Chine 1(4): 322. 1910; Craib, Fl. Siam. 1: 122. 1925; Gagnep. in Humbert, Fl. Suppl. Indo-Chine 1: 269. 1943; P.F.Stevens, J. Arnold Arbor. 61: 218. 1980. Type: Cochinchine (Vietnam), *Pierre 34* (lectotype **P** [P01900945!], second step designated here; first step designated by Stevens [1980]; isolectotypes **A** [A00067243!], **BM** [BM000611352!], **K** [K000677428!], **P** [P01900946 !, P01900947 !]).

— *Calophyllum thorelii* Pierre var. *oxycarpum* Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1:270. 1943; **nom. inval.**

Trees to 30 m tall; dbh up to 35 cm; outer bark deeply fissured, brownish-yellow, inner bark (slash-mark) pink to reddish-brown; exudate the colour of clear honey. *Branchlets* terete, smooth, light to dark red-brown, longitudinally ridged, scars present. *Leaves* petioled, petioles 2.2–3 cm long, blade elliptic to oblanceolate, occasionally oblong, 8.1–15 × 2.9–4.8 cm, strongly coriaceous, green to light dull brown adaxially, yellow to tan abaxially, base cuneate to gradually tapering, apex cuspidate, occasionally acute, leaf edges curling when dry, midrib depressed and glaucous adaxially, very prominent and yellow-tan abaxially, secondary and intramarginal veins present, prominent on both surfaces, 0.8 mm apart, arising from same points on opposite sides of the midrib. *Inflorescence* terminal and from upper leaf axils. *Floral parts* tepals 8, outer pair ovate to oval, dorsally pubescent, next pair ovate to obovate-oblong, next 2 pairs obovate to elliptic-oblong. *Stamens* 124–178 per flower. *Fruit* spherical to ellipsoid, 1.8–2.8 × 1.2–2 cm, light green to purple, stringy fibres present inside fruit.



Thailand.— (Map 1.1.13): NORTHERN: Lampang [Mt. Salor, 29 Oct. 1925, *Winit 1492* (BK)]; Nakhon Sawan [Nakawn Tai, 11 Apr. 1922, *Kerr 5816* (BK)]; EASTERN: Nakhon Ratchasima [Kao Lam, Kanat, 14 Jan. 1925, *Kerr 9978* (BK)]; *ibid.*, 14 Jan. 1925, *Kerr 9979* (BK)]; CENTRAL: Saraburi [Sam Lan, no date, *Geesink et al. 6800* (BKF)]; SOUTH-EASTERN: Chon Buri [Nong Ta Yu, Sri Racha Forest, 12 Jan. 1926, *Collins 1127* (C, K, L)]; Phra Chedi Mountains, Sri Racha District, 6 Mar. 1975, *Maxwell 75-210* (AAU, BK, L)]; Chanthaburi [at Chanthaburi River on path leading to Prachadu Hill, Feb. 1916, *Collins 563* (ABD, BM, K)]; Laem Sing, 23 Nov. 1924, *Kerr 9368* (BK, C, K, L, P)]; Khao Sabap, Chanthabun, 5 Dec. 1924, *Kerr 9556* (A, BK, C, K, L, P)]; Trat [Ko Chang Island, Ao Ong Kang, 7 May 1974, *Geesink et al. 6579* (AAU, BKF, C, K, L, P)]; Ko Chang, 7 May 1974, *Maxwell 74-404* (AAU, BK)]; Unknown locations [*Winit 1751* (BK)].

Distribution.— Vietnam.

Ecology and phenology.— Rocky deciduous forest, evergreen forest, bamboo jungle from 30 to 400 m elevation. Flowering: October–January. Fruiting: December–May.

Vernacular.— Kang han (ก้างหัน); ka thang han (กะทังหัน) (Sangkaew, 1999).

Uses.— Wood is used for construction and the fruits are edible. The flowers are very fragrant (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Near Threatened (NT).

14. *Calophyllum touranense* Gagnep. ex P.F. Stevens in J. Arnold Arbor. 61: 226. 1980. Type: Indochina (Vietnam), *Clemens & Clemens 4162* (holotype A [A00067245!]; isotypes K [K000677429!], NY [NY00066984!], P [P01900942!]).— *C. touranense* Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1: 271. 1943, **nom. inval.** (description in French only); Phạm-hoàng Hộ, Cây cỏ Việt nam, 1(1): 573 1588, 1991.

Trees 7–25 m tall; dbh 100 cm; outer bark whitish-grey or brownish-yellow, deeply fissured, inner bark (slash-mark) red; exudate colour of clear honey. *Branchlets* terete flaking, rough to smooth to pubescent, scars present, grey-brown to red-brown.

Leaves petioled, petiole 0.9–1.9 cm long, light tan to brown on lower surface and brown to red on upper surface; blade 5.4–16 × 2.5–5.5 cm, lanceolate, elliptic, ovate to oval, glabrous, brown to red to olivaceous coriaceous, some slightly glaucous, base aequilateral to cuneate, apex acute to acuminate, midrib inconspicuous on both surfaces but more prominent abaxially, wider at base, gradually narrowing towards apex, abaxially almost rectangular and raised approximately 0.1–0.3 mm above surface, secondary veins present and weakly prominent on both surfaces, intramarginal veins present. *Inflorescence* terminal, from upper leaf axils and from adjacent foliate axils, pedicels 0.3–0.6 cm long. *Floral parts* tepals (8)9–13, outer pair suborbicular, dorsally pubescent, the next pair suborbicular, the inner pair elliptic. *Stamens* approximately 400; filaments up to 4 mm long; anthers oblong. *Ovary* approximately 1.5–(3) mm long; style (3–5) mm long. *Fruit* spherical to globose, 2.5–4 × 1.5–2.2 cm, round at apex; wrinkled with longitudinal striations, purple/red to black when dry; greenish brown when ripe.

Thailand.— (Map 1.1.14): NORTH-EASTERN: Phetchabun [Thung Salaeng Luang, 12 Dec. 1993, *Pooma 728* (BKF)]; Nakhon Phanom [Phu Lankha, 16 Dec. 1968, *T.P. 1951* (BKF)]; EASTERN: Nakhon Ratchasima [Khao Yai NP, Khao Khieo, 18 Oct. 1969, *van Beusekom & Charoenphol 1724* (A, BKF, C, K, L, P)]; Khao Yai NP, Khao Laem, 19 Oct. 1969, *van Beusekom & Charoenphol 1765* (BKF, L)]; Khao Yai NP, 19 Nov. 1962, *Smitinand & Robbins 7913* (BKF)]; Khao Rom, Khao Yai, 3 Dec. 1983, *Fukuoka & Ito T-34637* (BKF)]; Khao Yai NP, 8 Sept. 1979, *Santisuk s.n.* (BKF)]; Unknown locations [17 Dec. 1968, *C.P. 1957* (BKF)]; 11 Sept. 1938, *Poilane 277/9* (27719?) (BKF)]; *Santisuk s.n.* (BKF)].

Distribution.— Vietnam.

Ecology and phenology.— Evergreen forest, montane forest, rocky or stony ground from 650 to 1500 m elevation. Flowering: January–March (October). Fruiting: February–June and September–October.

Vernacular.— Tang hon khao (ตังหนเข่า) (Sangkaew, 1999).

Uses.— Used in house construction (Sangkaew, 1999).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

2. KAYEA

Wall., Pl. Asiat. Rar. 3: 5. 1832; Wight, Ill. Ind. Bot.: 129. 1840; Thwaites, Enum. Pl. Zeyl. 51. 1858; Planch. & Triana, Ann. Sci. Nat. Sér. 4, 15: 296. 1861; Benth. & Hook.f., Gen. Pl. 1: 176. 1862; T.Anderson in Hook.f., Fl. Brit. Ind. 2: 276. 1874; Kurz, Forest Fl. Burma 1: 96. 1877; Engl. & Prantl, Nat. Pflanzenfam. 3(6): 222. 1895; Brandis, Indian Trees: 56. 1907; Pit., Fl. Indo-Chine 1(4): 325. 1910; Ridl., Fl. Malay Penins. 1: 188. 1922. Type species: *Kayea floribunda* Wall.

Trees or shrubs; glabrous. *Leaves* opposite, blade lanceolate, coriaceous; veins distant, not

prominent. *Inflorescences* solitary and large, or in terminal or axillary panicles and small. *Calyx* sepals 4, imbricate. *Corolla* petals 4, imbricate, white or pink. *Stamens* numerous; filaments basally connate or free; anthers small; dehiscence vertical. *Ovary* 1-celled; ovules 4 (rarely 8); style slender; stigmas narrow, 4-fid. *Fruit* fleshy, indehiscent, 1–4 seeded, enclosed in enlarged calyx (in majority of species). *Seeds* thick, testa thin, woody.

Distribution.— 75 species in tropical Asia: Borneo, Myanmar, Cambodia, Ceylon, India, Indonesia, Malaysia, Philippines; 3 species in Thailand.

KEY TO THE SPECIES

1. Inflorescence not solitary, axillary or terminal, usually paniculate; fruit globose
1. Inflorescence solitary, axillary or terminal; fruit not globose
2. Fruit ovoid to ellipsoid, <5 cm long, with persistent calyx; leaf apex acuminate to cuspidate
2. Fruit ellipsoid, >7 cm long, with or without persistent calyx; leaf apex long caudate

2. *K. ferruginea*

3. *K. kunstleri*

1. *K. elegans*

1. *Kayea elegans* King, J. Asiat. Soc. Beng., Pt. 2, Nat. Hist. 59(2): 183. 1890; Vesque in DC., Monogr. Phan. 8: 622. 1893. ≡ *Mesua elegans* (King) Kosterm., Reinwardtia 6: 427. 1969; Whitmore, Tree Flora of Malaya 2: 162–236. 1973; Turner, Gard. Bull. Singapore 47: 264. 1995. Type: Malaysia, Malacca, Larut, Perak, *King's Collector 7346* (lectotype **K** [K000677315!], designated here; isoelectotypes **BM** [BM000611304!], **BO** not seen, **GH**!).

— *Kayea caudata* King in J. Asiat. Soc. Beng., Pt. 2, Nat. Hist. 59(2): 183; 1890; Vesque in DC., Monogr. Phan. 7: 621. 1893. Type: Malaya, Malacca, Perak, *King's Collector 7937* (holotype **K** [K000677312!]).

Trees 12–18 m tall; outer bark and inner bark red. *Branchlets* drooping, slender, thin, terete, scarring present, yellow/brown/grey; exudate not recorded. *Leaves* petioled, petioles 0.4–0.7 cm long; blade 5.6–9.9 × 1.6–2.6 cm, oblong to elliptic to lanceolate in shape, base cuneate, some almost angustate, apex long caudate, apex length 1.3–2 cm long, upper and lower surfaces glaucous, some slightly coriaceous, rigid, some undulate, midrib pale yellow and depressed on upper surface, yellow-tan and slightly prominent on lower surface (almost depressed); veins visible, no intramarginal veins present, very faint on upper surface, veins not arising at same point on opposite side of midrib. *Inflorescence* solitary,

axillary or terminal, ca 10 mm diam., pedicel up to 10 cm long with several ovate-acute bracts at its base. *Calyx* sepals equal, coriaceous. *Corolla* petals oblong, acute, smaller than sepals, white. *Ovary* ovoid, attenuate. *Fruit* ellipsoid and tapering into a stout beak, surface smooth with ridges at 4 corners, 7.5–8.2 × 2.7–3.8 cm, ochrish grey, endocarp thin. *Seeds* 3–6, oblong to round to almost square, covered in a thin paper-like layer inside fruit, black.

Thailand.— (Map 1.2.1): PENINSULAR: Ranong [Khlong Kam Phuan, 26 Apr. 1973, *Geesink & Santisuk 4950* (**AAU**, **BKF**, **L**, **P**)].

Distribution.— Malay Peninsula, Singapore.

Ecology and phenology.— Evergreen forest from 450 to 600 m elevation. Flowering: approximately March. Fruiting: approximately April.

Conservation.— IUCN: Global Status: Least Concern (LC); Regional (Thailand) Status: Critically Endangered (CR).

2. *Kayea ferruginea* Pierre, Fl. Cochinch. t. 99. 1889; Ridl., J. Straits Branch Roy. Asiat. Soc. 54, 21. 1897; Pit. in Lecomte, Fl. Indo-Chine 1(4): 326. 1910; Ridl., Fl. Malay Penins. 1: 189–190. 1922; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 276. 1943. ≡ *Mesua ferruginea* (Pierre) Kosterm.,

Reinwardtia 6: 427. 1969; Whitmore, *Tree Flora of Malaya* 2: 230. 1973; Turner, *Gard. Bull. Singapore* 47: 264. 1995. Type: Vietnam, *Pierre 1050* (lectotype **K** [K000677333!], designated here; isolectotypes **A** [A00067758!], **GH!**, **K!**, **NY** [NY00075970!], **P!**). Syntype: Vietnam, *Pierre 4564* (**P!**).

Trees or shrubs 8–12 m tall; dbh 25 cm; outer bark grey-brown, smooth to scaly, inner bark pink to red, exudate not recorded. *Branchlets* green/grey/brown/black, smooth to slightly flaking, scars present, round. *Leaves* petioled, petiole 0.7–1.1 cm long, bronze to green/yellow; midrib very pronounced on lower surface, very depressed in channel on upper surface; blade 5–14.7 × 2.1–4.6 cm, elliptic to lanceolate, coriaceous to smooth, with a slight shine to glaucous and dull, base cuneate, apex acute, some acuminate, secondary veins approximately 16 on each side of blade, 10–14 mm apart, intersecondary veins present, tertiary veins dense and intramarginal veins present, all very faint and fine. *Inflorescence* paniculate, pedicel up to 3 cm long, forming a rounded ball of small spheres, approximately 15 clustered together at terminal point, each ca 1.5 cm long, usually 3–5 flowers clustered in leaf-axils. *Calyx* sepals persistent, in 2 opposite pairs. *Corolla* petals acute, oblong, imbricate, white. *Stamens* in fascicles, numerous, anther & filament approximately 2.5 mm long, anthers orange/yellow. *Ovary* with long single style protruding. *Fruit* globose, with acute tip, 3–3.5 × 2.5–3.5 cm, texture rough, brown, pedicel 3 mm long, enlarged calyx surrounding the fruits. *Seeds* 1.

Thailand.— (Map 1.2.2): PENINSULAR: Surat Thani [Bang Yai River Street, 4 June 1966, *Sakol 1018* (**BK**); Ban Duara, Sept. 1924, *Bourke 2501* (**BK**, **K**); Narathiwat [Tak Bai, 29 Apr. 1984, *Niyomdham 778* (**BKF**, **P**); Tak Bai, Ban Khunthong, 29 Apr. 1984, *Niyomdham 810* (**BKF**, **K**, **P**)].

Distribution.— Cambodia, Malay Peninsula, Singapore.

Ecology and phenology.— Common along rivers and streams, near sea level. Flowering: March–June.

Vernacular.— Bunnak nam (บุญนาคน้ำ), la-do-pa-he (ลาดอปาเฮ) (*Niyomdham 778*).

Conservation.— IUCN Regional (Thailand) Status: Data Deficient (DD).

3. *Kayea kunstleri* King, *J. Asiat. Soc. Bengal*, Pt. 2, Nat. Hist. 59(2): 182. 1890; Vesque in DC. Monogr. Phan. 8: 620. 1893; Ridl., *Fl. Malay Penins.* 1: 190–191. 1922. ≡ *Mesua kunstleri* (King) Kosterm., *Reinwardtia* 6: 427. 1969; Whitmore, *Tree Flora of Malaya* 2: 228. 1973. Type: Malaysia, Malacca, Larut, Perak, *King's Collector 6850* (lectotype **K** [K000677324!], designated here; isolectotypes **BM** [BM000611308!], **A** [A00067764!], **BO** not seen, **FI** [FI010334!], **SING** [SING0194784!], **GH!**). Syntypes: Malaysia, Malacca, Perak, Malaysia, *King's Collector 3301* (**BO** not seen, **SING** [SING0194782!]); Penang, *Curtis 1419* (**SING** [SING0194783!]); Malacca, *Maingay 176* (not located).

— *Kayea curtisii* King, *Ann. Roy. Bot. Gard. Calcutta* 5: 144, t. 174B. 1896. Type: Malaysia, Malacca, Penang, *Curtis 805* (lectotype **K** [K000677313!], designated by Whitmore [1973]; isolectotype **BO** not seen, **SING** [SING0194787!]).

— *Kayea rivulorum* Ridl., *J. Straits Branch Roy. Asiat. Soc.* 54: 22. 1910. Syntypes: Malacca, Malaysia, *Goodenough 1976* (**SING** [SING0194794!]); Selangor, Malaysia, *Ridley 7349* (**GH!**, **SING** [SING0194793!]).

Shrubs to small trees, 0.5 to 8 m tall; dbh 10–30 cm; outer bark brown, inner bark pink; exudate whitish-cream. *Branchlets* brown/red to light brown, thin, striate, scars present. *Leaves* petioled, petiole 0.4–1.6 cm long, blade 6.7–11.6 × 1.4–3.6 cm, elliptic to oblanceolate, dull green to brown to orange/yellow, some glaucous, some dots/glands present, base cuneate to acute, apex cuspidate (often with an obvious mucro), a few acuminate, coriaceous to thin and delicate, venation extremely faint on some leaves, varying from leaf to leaf, veins appear to fade on older leaves, arising at different points on either side of the midrib, midrib pale cream to green on upper surface and light brown to tan on lower surface, not very obvious on either surface, slightly more prominent on lower surface. *Inflorescence* solitary, axillary or terminal, pedicel length 1.5–3 cm long, smooth, bud smooth. *Calyx* sepals outer 2 smaller, round-oval, green, inner 2 larger, elliptic, white, persistent. *Corolla* petals oblong-acuminate, caducous, white, up to 1 cm long. *Stamens* numerous, in fascicles, anther & filament 1.5–2 cm long, filament cream, anthers round to almost oblong, yellow. *Ovary* yellow, style 1. *Fruit* ovoid to ellipsoid, 3.5–4.5 cm long texture wood-like



Map 1.1.13 Distribution of *Calophyllum thorelii* in Thailand.



Map 1.1.14 Distribution of *Calophyllum touranense* in Thailand.



Map 1.2.1 Distribution of *Kayea elegans* in Thailand.



Map 1.2.2 Distribution of *Kayea ferruginea* in Thailand.

with scales, green outside, cream inside, fruiting calyx yellow-greenish, persistent. *Seeds* 1–4.

Thailand.—(Map 1.2.3): PENINSULAR: Krabi [4 Apr. 1930, *Kerr 18842* (**BK, BM, C, K, L, P**)]; Nakhon Si Thammarat [Khao Luang, near Khiri Wong Village, 16 May 1968, *van Beusekom & Phengkklai 778* (**BKF**)]; Phatthalung [10 km East of Na Thawi, 24 Nov. 1990, *Larsen et al. 41691* (**AAU**)]; Satun [Thale Ban NP, 12 July 2000, *Middleton et al. 391* (**A, BKF**)]; Songkhla [Kho Hong Hill, Hat Yai, 17 May 1960, *Chirayupin 2* (**BK**)]; Kho Hong Hill, Hat Yai, 1997, *Sritungnant 11* (**PSU**); *ibid.*, 21 Sept. 1976, *Cheuntai 18* (**PSU**); *ibid.*, 4 Jan. 1974, *Cannon JRC 243* (**PSU**); *ibid.*, 30 Oct. 1990, *Larsen et al. 40956* (**AAU**); *ibid.*, 4 June 1992, *Larsen et al. 42652* (**AAU, P**); *ibid.*, Hat Yai, 1 Sept. 1984, *Maxwell 84-179* (**PSU**); *ibid.*, 31 Dec. 1985, *Maxwell 85-1186* (**PSU**); Hat Yai, 16 Apr. 1963, *Pradit 190* (**BK**); PSU, behind Biology Building, 2 Feb. 1979, *Congdon & Hamilton 249* (**PSU**); Khuan Mit, south of Hat Yai, 29 Apr. 1979, *Congdon & Hamilton 403* (**PSU**); Sadao, 12 May 1970, *Sutheesoan 1683* (**BK**); Utopao, 14 May 1919, *Kerr 3684* (**BM, K**); PSU Campus, 11 Apr. 1976, *Sutheesoan 3692* (**BK**); Ban Thepha, 24 Mar. 1928, *Kerr 14742* (**BK, BM, C, K, L, P**); Prakawp, 10 July 1928, *Kerr 15846* (**BK, BM, K, L**); Khao Mot Daeng, Kho Hong, Hat Yai, 6 Oct. 1991, *Larsen et al. 42186* (**AAU, BKF, P, PSU**); Yo Island, Muang District, 27 Aug. 1986, *Maxwell 86-624* (**BKF, L, PSU**); Yala [Banang Station, 23 July 1923, *Kerr 7376* (**BK, BM, K**)]; Narathiwat [Waeng, *Phusomsaeng 440* (**L**)]; Khao Re Chan, To Mo, 20 Apr. 1931, *Lakshnakara 728* (**BK, BM, C, K, L, P**); Khao Cha Bor, To Mo, 27 Apr. 1931, *Lakshnakara 816* (**BM, C, K, L, P**); Waeng, 13 Aug. 1972, *Phusomsaeng et al. 1027* (**BKF**); Nikhom Waeng, 14 Apr. 1968, *Prayad 1296* (**BK**); *ibid.*, 28 Apr. 1968, *Prayad 1331* (**BK**); Sungei Padi, Chatwarin Falls, 5 Mar. 1974, *Larsen & Larsen 32998* (**AAU, BKF, K, L, P**); Waeng, *Phusomsaeng BKF 41118* (**K**); Unknown locations [Ban Tu Gor, Tan Yong Mas, 30 Apr. 1931, *Lakshnakara 843* (**BM, C, K, L, P**); *Sirirugsa s.n.* (**PSU**)].

Distribution.— Malay Peninsula, Singapore.

Ecology and phenology.— Evergreen forest; open disturbed growth from 50 to 600 m elevation. Flowering: March–June. Fruiting: July–September.

Vernacular.— Nakaboot (*Maxwell 84-179*).

Conservation.— IUCN Global & Regional (Thailand) Status: Least Concern (LC).

3. MAMMEA

L., Sp. Pl.: 512. 1753; Juss., Gen. Pl.: 257. 1789; Benth. & Hook.f., Gen. Pl. 1: 176. 1862; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 219. 1895; Kosterm., Pengum. Lemb. Pusat Penjel. Kehut 72: 15. 1961; Backer & Bakh.f., Fl. Java 1: 384. 1963; Whitmore, Tree Flora of Malaya 2: 226. 1973; P.F.Stevens, Aust. J. Bot. 22: 413–423. 1974. Type species: *Mammea americana* L. (lectotype designated by Britton & P.Wilson, Scient. Surv. Porto Rico 5: 583. 1924).

— *Calysaccion* Wight, Ill. Ind. Bot. 1:130. 1840. Type species: *Calysaccion longifolium* Wight.

Trees; exudate clear or coloured and resinous. *Leaves* simple, opposite, blade entire, often coriaceous and persistent, stipules absent, some with black glandular dots. *Inflorescences* terminal or axillary, some often cauliflorous, solitary or cymose, bisexual or unisexual, sometimes in clusters in axils of fallen leaves. *Calyx* sepals 2, entirely closed and united in bud, later splitting into 2 reflexed sepals during flowering. *Corolla* petals 4–6, free or nearly entirely connate, usually white. *Stamens* numerous, free or basally connate, dehiscence vertical. *Ovary* 2 (–many) celled; ovules 4; style short or not present, if present, stigma peltate. *Fruit* fleshy, coriaceous when dry. *Seeds* 1–4, embryo with 2 fused cotyledons.

Distribution.— 75 species in Borneo, Myanmar, China, Indonesia (Flores, Java), Philippines, Samoa, North and South America; 3 species in Thailand.

KEY TO THE SPECIES

1. Emarginate leaves absent
1. At least some emarginate leaves present
 2. Leaves obovate or elliptic; 11–29.5 cm long; pedicels up to 0.5 cm long
 2. Leaves obovate, oblanceolate or oblong; 7.5–25 cm long; pedicels longer than 0.5 cm

2. *M. harmandii*

1. *M. brevipes*
3. *M. siamensis*

1. *Mammea brevipes* (Craib) Kosterm. in Pengum. Lemb. Pusat Penjel. Kehut 72: 13. 1961; Whitmore, Tree Flora of Malaya 2: 226. 1973. $\equiv$ *Ochrocarpos harmandii* Pierre var. *brevipes* Craib, Fl. Siam. 1: 119. 1925. Type: Thailand, Phetchabun, *Kerr 5706* (lectotype **K** [K000677516!], designated here; isoelectotype **BM** [BM000611511!]).

—*Ochrocarpus* [*sic*] *siamensis* auct. non T. Anderson: Ridl., Fl. Malay Penins. 1: 180. 1922. based on *Robinson 6304* (**K!**).

Trees 8–12 m tall; outer bark smooth to rough, dark brown to grey; exudate not recorded. *Branchlets* terete. *Leaves* petioled, 0.6–2 cm long; blade 11–29.5 $\times$ 5–11 cm, elliptic to obovate, coriaceous, leaf edges slightly curling downwards especially near the leaf base, base cuneate some almost angustate, apex rounded or cuspidate, if cuspidate, tips 3–4 mm long, at least some emarginate, some glaucous, khaki green to dark green adaxially, pale yellow abaxially, midrib raised and yellow abaxially, dark brown-green adaxially, secondary, intersecondary, tertiary and intramarginal veins visible, secondary veins 10–15 per side, 7–10 mm apart. *Inflorescence* many flowers clustered together, shortly petioled, pedicels terete, up to 0.5 cm long, borne on inconspicuous irregularly rounded protuberances 3–5 mm wide, each subtended by 4–8 closely imbricate bracts. *Calyx* sepals elliptic, 7–9 $\times$ 5–7 mm, persistent, papyraceous, obtuse or slightly acute at apex with 15–18 parallel nerves. *Corolla* petals 4–6, obovate to round, 10–17 $\times$ 4–8 mm. *Stamens* in fascicles, approximately 200, anthers oblong, 1–3 mm long, free or weakly connate at the base. *Ovary* ellipsoid; 2–2.5 mm diam., style terete, approximately 2 mm long, stigma peltate; 2-lobed, approximately 2 mm diam. *Fruit* oval to elliptic, 2–2.7 $\times$ 1–1.3 cm, hard, wood-like, purple/red, petiole up to 3 mm long. *Seeds* seed(s) embedded in pulp, when fresh.

Thailand.— (Map 1.3.1): NORTH-EASTERN: Phetchabun [Muang, 28 Mar. 1922, *Kerr 5706* (**ABD, BM, K**); Chondaen, 8 Mar. 1931, *Kerr 20392* (**ABD, BK, BM, E, K**)].

Distribution.— Endemic.

Ecology and phenology.— Evergreen forest, on limestone from 400 to 500 m elevation. Flowering: March.

Conservation.— IUCN Regional (Thailand) Status: Critically Endangered (CR).

2. *Mammea harmandii* (Pierre) Kosterm., Addit. Notes Mimos.; the Genera *Mammea* L. and *Ochrocarpos* Thou.: 13. 1956; Kosterm., Commun. Forest Res. Inst. Bogor 72: 22. 1961. $\equiv$ *Ochrocarpus harmandii* Pierre, Fl. Cochinch. 3: t. 93. 1883; Pit. in Lecomte, Fl. Indo-Chine 1(4): 295. 1910; Petelot, Pl. medic. Cambodge, Laos, Vietnam (Recherches agron. C.L.V. 14) 1: 59. 1952. $\equiv$ *Calysaccion harmandii* (Pierre) Pierre, Bull. Soc. Linn. Paris 2: 1226. 1896–1897. Type: Laos, *Harmand 1072* (lectotype **P** [P00642270!], designated here; isoelectotype **P** [P00642271!]).

Trees 6–10 m tall, dbh 25–30 cm; outer bark reddish-brown, inner bark dark red to pale flesh-like; exudate yellow, sticky. *Branchlets* terete with longitudinal ridges, smooth. *Leaves* petioled, 1–1.7 cm long, blade 13.1–17 $\times$ 4.4–5.6 cm, obovate, lanceolate, elliptic, coriaceous, undulate, base cuneate, apex mostly cuspidate, few round or acute, midrib raised and light green-brown abaxially, green-brown adaxially, netted veining visible, obscure, no intra-marginal veins present. *Inflorescence* clusters of flowers borne on the branches, flowers arising on branches where small branches join larger branches, arising from separate points but close together on the branches. *Calyx* sepals elliptic, persistent. *Corolla* petals 2, elliptic, longitudinal veins present on petals. *Stamens* oblong, anther and filament 3 mm long. *Ovary* globose; stigma peltate; style up to 4 mm long. *Fruit* ellipsoid, rough, 2.3–2.5 $\times$ 1.0–1.4 cm, yellow, vertically dehiscent, tip acute, petiole up to 1–2.2 cm long.

Thailand.— (Map 1.3.2): NORTHERN: Chiang Rai [Doi Tung, near Temple, 17 May 1992, *Santisuk s.n.* (**BKF**)]; EASTERN: Nakhon Ratchasima [Sakaerat, 22 Oct. 1971, *van Beusekom et al.* 3291 (**BKF, C, K, L, P**); Khao Phrik, Sikhieo District, 9 May 1976, *Maxwell 76-307* (**L**); CENTRAL: Saraburi [Sam Lan Forest, Muang District, 1 Mar. 1975, *Maxwell 75-174* (**AAU, BK, L**); *ibid.*, 17 July 1976, *Maxwell 76-434* (**AAU, BK, L**)]; Unknown location: [8 Feb. 1956, *Smitinand s.n.* (**BKF**)].

Distribution.— Laos, Malay Peninsula (Langkawi).

Ecology and phenology.— Evergreen forest, deciduous forest from 150 to 650 m. Flowering: February–May. Fruiting: July–October.

Conservation.— IUCN Regional (Thailand) Status: Data Deficient (DD).

3. *Mammea siamensis* (Miq.) T.Anderson, J. Linn. Soc. 9: 261. 1867; Hook.f., Fl. Brit. Ind. 1: 271. 1874; Vesque in DC., Monogr. Phan. 8: 527. 1893; Kosterm., Pengum. Lemb. Pusat Penjel. Kehut 72: 26. 1961; Whitmore, Tree Flora of Malaya 2: 226. 1973. $\equiv$ *Calysaccion siamense* Miq., Mus. Bot. 1: 209. 1863. $\equiv$ *Ochrocarpos siamensis* (Miq.) T.Anderson in Hook.f. Fl. Brit. Ind. 1: 270–271. 1874; Kurz, Forest Fl. Burma 1: 94. 1877; Gamble, Man. Ind. Timb. 56. 1881; Pierre, Fl. Cochinch. t. 94–96. 1885; Pit. in Lecomte, Fl. Indo-Chine 1(4): 293–294. 1910; Ridl., Fl. Malay Penins. 1: 180. 1922; Craib, Fl. Siam. 1:119. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 254. 1943. Type: Thailand, Bangkok, *Teijsman s.n.* (holotype? **BO** not seen; isotypes: **L** [L0012276!], **U** [U0002418!]).

Trees to 20 m tall, dbh 10–30 cm; outer bark thick, roughly cracked and flaking, sometimes smooth or slightly fissured, dark grey, inner bark red; exudate pale yellow. *Branchlets* smooth, yellowish. *Leaves* shortly petioled, petiole 0.5–1.5 cm long, blade 7.5–25 $\times$ 2.5–7 cm, oblanceolate, obovate or oblong, coriaceous, young leaves purple, mature dark-green above, yellow-green abaxially, base narrowly cuneate, apex blunt to slightly cuspidate, some emarginate, midrib dark green adaxially, green abaxially, side veins numerous on both surfaces. *Inflorescence* clustered on old woody twigs behind leaves, pedicels light green to yellow, up to 2 cm long. Male and female flowers on separate trees, flowers approximately 1.2–2.5 cm long, white or pale yellow. *Calyx* sepals elliptic, 2–7 mm long, light green. *Corolla* petals 4, oblong, 6–8 mm long. *Stamens* between 60–90 stamens per flower, filaments white, free, anthers yellow, 1–2 mm long. *Ovary* style and ovary light green maturing darker green, style 1, short with 2-lobed stigma. *Fruit* oval to ellipsoid with short blunt tip, up to 4 $\times$ 2.5 cm but usually smaller, 2-valved, rind with sparse white latex, juicy and dull yellow inside, orange on outside. *Seeds* 1, with thin yellow coating (aril).

Thailand.— (Map 1.3.3): NORTHERN: Chiang Mai [Chiang Mai University, Biology Department, 3 June 1992, *Palee 30* (**A**, **CMUB**, **E**, **P**); Suan Kao, Mae Rim, 5 Mar. 2002, *Glamwaewong 156* (**QBG**); Doi Suthep, on lower slopes, 14 Mar. 1909, *Kerr 548* (**BM**, **K**, **P**); Doi Suthep, Ban Salienue, Hot, 18

Feb. 1960, *Kasin 806* (**BK**); Doi Suthep, 21 Oct. 1958, *Sørensen et al. 5810* (**C**); *ibid.*, 1958, *Sørensen et al. 5829* (**C**); Muang Tun, 30 June 1922, *Kerr 6193* (**ABD**, **BK**, **BM**, **K**); Doi Suthep, between the Agricultural Station and TV-7 Station, 9 June 1988, *Maxwell 88-739* (**AAU**, **L**); East side, 76/1 Soi 5, Suthep Road, 8 Mar. 1992, *Maxwell 92-70* (**A**, **CMUB**, **E**, **P**); Huai Kao Arboretum, Muang, 12 Mar. 1986, *Phengkklai s.n.* (**BKF**); Doi Suthep, *Kerr s.n.* (**BM**); Lampang [Jaehomwittaya School, Chaehom District, 16 Feb. 2001, *Panatkool 464* (**CMUB**); Phetchabun [Ban Wang Saphung, Wang Pong District, 1 Feb. 2001, *Wongprasert 012-31* (**BKF**); EASTERN: Nakhon Ratchasima [Sakaerat. Pak Thong Chai District, Reforestation Station, 21 Apr. 1987, *Soejarto et al. 6022* (**A**, **L**); Khao Phrik, Sikieo District, 9 May 1976, *Maxwell 76-307* (**BK**); SOUTH-WESTERN: Phetchaburi [18 Feb. 1923, Marcan 1176 (**ABD**, **BM**); Khao Wong, 2 Mar. 1963, *Sakol 459* (**BK**); CENTRAL: Krung Thep Maha Nakhon [1899, *Zimmermann 105* (**BM**, **L**); Krungthep, 2 Mar. 1927, *Lakshnakara 305* (**ABD**, **BK**, **K**); *ibid.*, 8 June 1931, *Lakshnakara 854* (**BK**, **BM**); Marcan 1707 (**ABD**, **BM**); Unknown collector 5953 (**L**); Feb. 1955, *Phloenchit s.n.* [**BKF** 11561] (**BKF**); SOUTH-EASTERN: Chon Buri [Naphro, Near Sri Racha, 19 Apr. 1923, *Collins 789* (**ABD**, **BK**, **E**, **K**); PENINSULAR: Chumphon [Unknown collector 4360 (**K**); Songkhla [Ma Be Ya Village, Foothills of Klong Rhang Hill, Na Mom District, 15 Feb. 1986, *Maxwell 86-70* (**A**, **L**, **PSU**); PSU, Hat Yai District, 7 June 1986, *Maxwell 86-343* (**A**, **BKF**, **PSU**); Wat-Pako, Sathingpra, 23 Apr. 1974, *Vitchu V30* (**PSU**)].

Distribution.— Laos, Malay Peninsula (Penang).

Ecology and phenology.— Dry, mixed evergreen forest, deciduous forest, on granite bedrock from 50 to 460 m elevation. Flowering: February–June. Fruiting: June. The flowers contain aromatic oil and the species is widely cultivated.

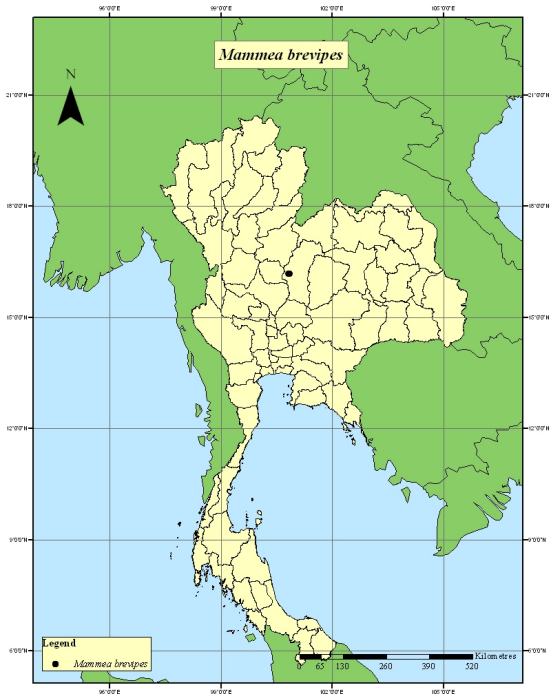
Vernacular.— Sarapee (สารปี) (*Palee 30*); Sa ra pi (สารปี) (*Lakshnakara 854*).

Uses.— The pollen is used by Thai people as a cosmetic. The flowers are used to make necklaces.

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).



Map 1.2.3 Distribution of *Kayea kunstleri* in Thailand.



Map 1.3.1 Distribution of *Mammea brevipes* in Thailand.



Map 1.3.2 Distribution of *Mammea harmandii* in Thailand.



Map 1.3.3 Distribution of *Mammea siamensis* in Thailand.

4. MESUA

L., Sp. Pl.: 515. 1753; Juss., Gen. Pl. : 258. 1789; Wight, Prodr. Fl. Ind. Orient. 102. 1834; Miq., Fl. Ned. Ind. 1(1): 509. 1859; Planch. & Triana, Ann. Sci. Nat., Bot. Sér. 4, 15: 298. 1861; Benth. & Hook.f., Gen. Pl. 1: 176. 1862; T.Anderson in Hook.f., Fl. Brit. Ind. 2: 276. 1874; Kurz, Forest Fl. Burma 1: 96. 1877; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 184–185. 1890; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 218–219. 1895; Prain, Bengal Pl. 1: 245. 1903; Pit. in Lecomte, Fl. Indo-Chine 1(4): 328. 1910; Gamble, Fl. Madras 76. 1915; Haines, Bot. Bihar Orissa 2: 55. 1921; Ridl., Fl. Malay Penins. 1: 191. 1922; Whitmore, Tree Flora of Malaya 2: 227–228. 1973; Kosterm. in Dassan., Rev. Handb. Fl. Ceylon 1: 107. 1980; Gamble, Man. Ind. Tim. (ed. 2a) 59. 1992; H.W.Li *et al.*, Fl. China 13: 38. 2007. Type species: *Mesua ferrea* L.

Trees; inner bark usually with sticky exudate drying black. *Leaves* opposite, blade coriaceous, often with dots, veins numerous, slender. *Inflorescences* solitary, axillary or terminal. *Calyx* sepals 4–5, imbricate. *Corolla* petals 4–5, imbricate. *Stamens* numerous, filaments basally connate. *Ovary* superior, 2-celled; ovules 4; style long; stigma peltate, stigma lobes broad. *Fruit* fleshy or woody, drupe, berry or capsule, 1–4 seeded. *Seeds* testa fragile, aril absent.

Distribution.— 5 species in tropical Asia; 1 species in Thailand.

Mesua ferrea L., Sp. Pl.: 515. 1753; Burm.f., Fl. Ind. 121. 1768; Choisy in DC. Prodr. 1: 562. 1824; Wight, Prodr. Fl. Ind. Orient.: 102. 1834; Wight, Icon. Pl. Ind. Orient.: t. 118. 1839; Graham, Cat. Pl. Bombay: 26. 1839; Thwaites, Enum. Pl. Zeyl.: 5. 1858; Miq., Fl. Ind. Bat. 1: 509. 1860; Planch. & Triana, Ann. Sci. Nat., Bot. Sér. 4, 15: 299. 1861; Dalzell & Gibson, Bombay Fl.: 31. 1861; Beddome, Fl. Sylv. S. India: t. 64. 1871; T.Anderson in Hook.f., Fl. Brit. Ind. 2: 277. 1874; Kurz, Forest Fl. Burma 1: 97. 1877; Gamble, Man. Ind. Timb.: 27. 1881; Pierre, Fl. Cochinch. 7: t. 97. 1885; Watt, Dict. Econ. Prod. India 5: 236. 1891; Vesque in DC., Monogr. Phan. 8: 630. 1893; Talbot, Trees Bombay Pres.: 16. 1894; Woodrow, J. Bombay Nat. Hist. Soc. 1: 81. 1901; Prain, Bengal Pl. 1: 246. 1903; Brandis, Indian Trees: 55. 1907; Gamble, Fl. Madras 1: 77. 1915; Haines, Bot. Bihar Orissa 2: 55. 1921;

Ridl., Fl. Malay Penins. 1: 192. 1922; Kirtikar & Basu, Indian Med. Pl. 2(1): 274. 1933; Kamjilal, Fl. Assam 1: 111. 1934; Kitamura, Fauna Fl. Nepal Himalaya 1: 179. 1955; MacMillan, Trop. Pl. & Gard. 5: 87. 1956; Sastri, Wealth of India 6: 349. 1962; Maheshwari, Bull. Bot. Surv. India 5: 337. 1963; Whitmore, Tree Flora of Malaya 2: 227–228. 1973; Kosterm. in Dassan., Rev. Handb. Fl. Ceylon 1: 107. 1980; Gamble, Man. Ind. Tim. (ed. 2a) 59. 1992; H.W.Li *et al.*, Fl. China 13: 38. 2007. Type: Sri Lanka, *Herb. Hermann 1*: 38, No. 203 (lectotype BM [BM000621365!], designated by Maheshwari [1963] (see Jarvis, 2007 for further details)

— *Nagassarium* Rumph., Herb. Amboin. 7: 3, t. 2. 1750. **nom. inval.**— *Calophyllum nagassarium* Burm., Fl. Ind.: 121. 1768. ≡ *Mesua nagassarium* (Burm.f.) Kosterm., Ceylon J. Sci., Biol. Sci. 12: 71, 1976; Kosterm. in Dassan., Rev. Handb. Fl. Ceylon 1: 107, 1980; P.F. Stevens, J. Arnold Arbor. 61: 682, 1980. Type: [Indonesia, Amboina and Java], *Herb. Burman s.n.* (holotype: **G** not seen).

— *Mesua speciosa* Choisy in DC. Prodr. 1: 562. 1824. Type: India, *Rheed. Hort. Malab.* 3: 63, t. 53.

Trees up to 30 m tall, dbh 95 cm; bole straight, cylindrical, often fluted at base; outer bark ash-grey turning dark-dull brown, scaly, irregularly fissured, inner bark brownish-red to pink or red; exudate aromatic, clear; sapwood creamy white to pinkish-brown; heartwood dark red, hard, tough and heavy. *Branchlets* young twigs slender, grey and terete, end bud inconspicuous. *Leaves* petioled, 0.4–1.2 cm long, green above and below; blade 1–15 × 1–18 cm, elliptic, oblong or lanceolate, glaucous abaxially, coriaceous or delicate, base acute or obtuse, apex acute, young leaves pink, midrib faint and depressed on both surfaces, slightly more pronounced on lower surface, side veins very fine, almost invisible, secondary, intersecondary, tertiary and intramarginal veins faint especially on young leaves, numerous, somewhat patent, invisible on the white waxy lower surface. *Inflorescence* solitary, axillary, on short peduncles, 0.8–2.3 cm long, slender, 4–10 cm diam., sweet scented. *Calyx* sepals 4, 12–15 mm long, imbricate, in 2 rows, small outer pair and larger inner pair; light green, persistent, densely velvety puberulous outside, orbicular, imbricate, fleshy. *Corolla* petals 4, 16–40 mm long, white, cuneate, obovate or obcordate, curled and erose at the margins, brown/purple

striations present, caducous. *Stamens* numerous; anthers large, linear 4–10 mm long, orange-golden-yellow. *Ovary* up to 5 mm, ovoid, 2-locular; style 1–1.1 cm long; stigma peltate. *Fruit* ovoid to ellipsoid with conical point, 2.5–3.5 cm, striate; sepals enlarged up to 4 cm long, calyx persistent, dark orange or purple/brown, pericarp tough. *Seeds* 1–4, up to 2.4 cm woody, smooth, glossy brown, oily.

Thailand.— (Map 1.4.1): NORTHERN: Mae Hong Son [Pang Mu, 8 July 1958, *Smitinand* 4597 (BKF)]; Chiang Mai [CMU, in front of Humanities Faculty, Muang District, 13 Jan. 2001, *Intien* 15 (A, CMUB); *ibid.*, 5 Aug., 1995, *Tumersnis* 32 (CMUB); Huai Pu, QBG, Mae Rim, 20 Mar. 1998, *Watthana* 86 (QBG); Huai Kao Arboretum, 7 June 2000, *Sankamethawee* 122 (CMUB); *ibid.*, 15 Feb. 1992, *Pooma* 632 (BKF); *ibid.*, 15 May 1995, *BGO Staff* 3366 (BKF, QBG); Muang, *Brun et al.* 159 (C); Maesa Botanic Garden, 22 Aug. 1989, *Pooma* 291 (BKF); Botanic Garden, Mae Rim, 25 May 1994, *BGO Staff* 710 (QBG); Doi Suthep, 1 July 1998, *Pongamornkul* 131 (QBG); *ibid.*, 11 June 1910, *Kerr* 1211 (BM, K, TCD); *ibid.*, Oct. 1970, *Dixen s.n.* (AAU)]; Doi Suthep, East side, Khonthathan Falls Area, May 1991, *Maxwell* 89-631 (E); Doi Suthep Pui NP, Park HQ, Muang, 13 Sept. 1995, *Kopachon* s162b1 (BM, CMUB); *ibid.*, 6 Nov. 1997, *Sritong*, s162b2 (CMUB); Danta Bua, 31 July 1914, *Kerr s.n.* (BM); Chiang Dao Watershed Station, 4 June 1973, *Geesink et al.* 5687 (AAU, BKF, C, E, K); Chaiprakan, Sidongyen Subdistrict, Lahn Village, 24 May 1991, *Maxwell* 91-472 (A, E, P); Phayao [Doi Luang NP, east side of Jahn Bah Tawng, Muang District, 6 May 1997, *Maxwell* 97-451 (A, CMUB); *ibid.*, 9 Aug. 1997, *Maxwell* 97-844 (A, BKF, CMUB)]; Sukhothai [Mt. Khao Luang, 2 May 1922, *Kerr* 5916 (AAU, ABD, BK, BM, K)]; CENTRAL: Krung Thep Maha Nakhon [Phrayathai, 10 Feb. 1955, *Agooroo* 22 (BKF); 1899, *Zimmermann* 110 (BM, K, L, P); 20 Feb. 1921, *Marcan* 581 (BM, K); 7 Mar. 1926, *Marcan* 1998 (BM, K); *Kerr s.n.* (BM)]; SOUTH-EASTERN: Chanthaburi [Cultivated in Arboretum, Makham District, 29 Mar. 1995, *Santisuk et al. s.n.* (BKF)]; PENINSULAR: Ranong [Khao Phota Luang Kao, 22 June 1974, *Geesink et al.* 7434 (BKF, K); Hat Hin Dam, 24 Apr. 1974, *Larsen & Larsen* 33352 (AAU, K, P)]; Phuket [Muang Mai, 9 Mar. 1929, *Kerr* 17400 (ABD, BK, BM, C, E, K, TCD)]; Krabi [Apr. 1915, *Vanpruk*

720 (BKF, K)]; Nakhon Si Thammarat [28 Mar. 1955, *Thaworm* 50 (BKF)]; Trang [Chong, 8 Apr. 1949, *Boongird* 62 (A); Khao Chong, 14 Apr. 1969, *Phusomsaeng* 171 (C, E, K, P); *ibid.*, 1 Mar. 1966, *Bunnab* 376 (BKF, L); *ibid.*, 13 June 1969, *Sangkhachand* 1863 (BK); Chong, 25 Jan. 1958, *Smitinand* 4117 (BKF); Kantang, 14 Mar. 1929, *Kerr* 17485 (ABD, BK, BM, C, K, TCD)]; Yala [Banglang, Thanto, 20 Sept. 1992, *Niyomdham* 5126 (BKF)]; Narathiwat [Nikhom Waeng, 22 Sept. 1966, *Prayad* 417 (BK); Khao E-dang, Sukhirin, 23 Aug. 1998, *Puudjaa* 498 (BKF); Waeng, 6 Sept. 1966, *Sangkhachand* 1317 (BKF, L); Su-ngai Padi, Chatwarin Falls, 5 Mar. 1974, *Larsen & Larsen* 32998 (L)].

Distribution.— Sri Lanka, India, tropical Nepal, Myanmar, Cambodia, Laos, Vietnam, Malaysia.

Ecology and phenology.— Evergreen forest, deciduous forest, near the sea, on limestone from 10 to 1050 m elevation. Flowering: February–May. Fruiting: May–October.

Vernacular.— Mai bun nak (ไม้ปูนนาค) (*Vanpruk* 720); bun nak (ปูนนาค) (*Kerr* 5916).

Uses.— The wood from this species is one of the strongest woods found in Asia and is used for construction work, for railway sleepers and in boat building. Oil from the seed is used in soap making and the flowers and flower buds are used in cosmetics and perfumery. In India the leaves and flowers are also used as hair decorations and the fruits are sometimes eaten.

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

2. HYPERICACEAE

Evergreen or deciduous herbs, shrubs or trees with glands or canals present in most parts of the plant, uni/multicellular hairs usually present. *Leaves* opposite, alternate or whorled. *Inflorescences* terminal or cymose; flowers single, perfect. *Calyx* (2–)4–5 sepals, free. *Corolla* (3–)45 petals, free. *Stamens* 9–∞, free, connate or fasciculate, nectary absent. *Ovary* superior, 1–∞ ovules. *Fruit* capsule or baccate (berry-like), sometimes drupe, ± wings.

Distribution.— Worldwide with 8 genera and 560 species; 2 genera and 11 species in Thailand.

KEY TO THE GENERA

1. Herbs with horizontal runners; flowers usually yellow
1. Deciduous to evergreen trees or shrubs; flowers pink or white

1. *Hypericum*
2. *Cratoxylum*

1. HYPERICUM

L., Sp. Pl.: 783. 1753; L., Gen. Pl. 5: 341. 1754; Juss., Gen. Pl.: 257. 1789; Wight, Prodr. Fl. Ind. Orient.: 99. 1834; Dyer in Hook.f., Fl. Brit. India 1: 253. 1874; Gamble, Man. Ind. Timb.: 48. 1881; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 215. 1895; Prain, Bengal Pl. 1: 243. 1903; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 284. 1910; Craib, Bull. Misc. Inform. Kew: 66. 1913; Gamble, Fl. Madras: 69. 1915; Haines, Bot. Bihar Orissa: 2: 51. 1921; Ridl., Fl. Malay Penins. 1: 151. 1922; Craib, Fl. Siam. 1: 110. 1925; R. Keller in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 25: 175. 1925, *pro parte* excl. sect. IV Elodea; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 248. 1943; Backer & Bakh.f., Fl. Java 1: 382. 1963; N. Robson, J. Roy. Hort. Soc. 95: 482. 1970; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; N. Robson, Bull. Brit. Mus. (Nat. Hist.), Bot. 12(4): 163–325. 1985; N. Robson, Taxon 39: 134–135. 1990; N. Robson, Syst. Biodivers. 4(1): 19–98. 2005; H.W. Li & N. Robson, Fl. China 13: 2–35. 2007. Type species: *Hypericum perforatum* L. (lectotype designated by Britton & Brown, Ill. Fl. N. U.S. ed. 2, 2: 529. 1913).

Herbs to occasionally trees up to 12 m high; herbs spreading by means of horizontal runners before becoming erect or ascending. *Stems* eventually terete, green to red when young and brown to black when older, fissured when older, stems can turn grey and the cork layers flake off in strips. *Leaves* sessile or subsessile, opposite, entire, venation present, sometimes parallel, glands of two types, dark glands are blackish-red cells containing a wax and pale glands are schizogenous intercellular spaces lined by cells which secrete an oil. *Inflorescences* solitary, in three's, cymose or umbellate. *Calyx* 5 sepals, basally connected, shape very variable with the same glands as the leaves, margins entire. *Corolla* 5 petals,

spreading or eventually reflexed, aestivation always contorted, usually yellow or sometimes white, dotted with black glands. *Stamens* numerous, basally connate, distinct, sometimes in five free antepetalous fascicles; anthers dehisce introrsely by longitudinal slits; usually same colour as but shorter than petals, stamen length varies within fascicles, longest stamens on the outside of the fascicle ring. *Ovary* superior; unilocular; styles 2–5; stigmas distinct, persistent, varies in size and shape from narrowly elliptic to ovoid to globose. *Fruit* a woody or coriaceous septicidal capsule. *Seeds* small, globose to ovoid or ellipsoid; sometimes very numerous (over 1000), winged seeds present on species with dehiscent fruit.

Distribution.— 488 species worldwide (absent from tropical lowlands, southern oceanic islands, hot and cold deserts); 6 species in Thailand.

In a number of cases the acknowledged World expert on *Hypericum*, Robson, has used the term 'holotype': we have almost always followed his lead, but believe in a number of cases that Art. 9.10 (Turland *et al.* 2018) should be applied [Art 9.10 deals with the use of 'a term as defined in the Code as denoting a type, in a sense other than that in which it is so defined'. The article indicates that this is to be 'treated as an error to be corrected (for example, the use of the term lectotype to denote what is in fact a neotype)'] We believe that Robson's designation of a holotype is usually correctable under Art. 9.11 (Turland *et al.* 2018) to lectotype. In many cases the use of the term 'holotype' should be construed as the first stage of a necessary lectotypification and that, therefore, second a step lectotypification (Art. 9.17; Turland *et al.* 2018) is required. We are, however, in most cases unwilling to undertake this, preferring it to be undertaken by an expert on this genus in its worldwide context.

KEY TO THE SPECIES

1. Herbs with flowers under 2.5 cm across
 2. Sepals usually toothed with gland-tipped teeth; stems terete; ovary 3-celled
 2. Sepals entire, with/without glands; stems quadrangular; ovary 1-celled
1. Shrubs up to 3m tall, with flowers 5–8 cm across
 3. Sepals 4; petals 4; leaves oblong or ovate-oblong with clear intramarginal vein
 3. Sepals 5; petals 5; leaves oblong, ovate-oblong, elliptic, lanceolate or oblanceolate without intramarginal vein

1. *H. elodeoides*
4. *H. japonicum*

6. *H. siamense*

4. Sepals entire or denticulate; ovate, oblong or elliptic; stems spreading, 2-lined
4. Sepals entire; stems arching or erect

5. *H. patulum*

5. Leaves variable: lanceolate, oblanceolate, elliptic, oblong, obtuse; sepals with obvious longitudinal striations, $\pm$ equal, imbricate; stems arching, young branches compressed; stamens 60–80

3. *H. hookerianum*

5. Leaves narrowly lanceolate to elliptic; sepals without obvious striations, not equal, not imbricate; stems erect, young branches thin; stamens 40–60

2. *H. henryi* subsp. *hancockii*

1. *Hypericum elodeoides* Choisy in DC., Prodr. 1: 552. 1824. Type: Nepal. *Wallich 4812A* (?holotype **G** [GDC] [00210401!]; isotypes **BM** [BM000521690!], **K!**, **S** [S11-31777!], **SING**.

— *Hypericum napaulense* Choisy in DC., Prodr. 1: 552. 1824; Dyer in Hook.f., Fl. Brit. India 1: 253. 1874; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 284. 1910; Craib, Fl. Siam. 1: 111. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 251. 1943; H.W.Li & Li Yan-hui in Li Hsiwen, Fl. Reipubl. Popularis Sin. 50(2): 1–112. 1990; H.W.Li & N.Robson, Fl. China 13: 24. 2007. Type: Nepal, Gossain Than, *Wallich s.n.* (?holotype: **G** [GDC] [G00210678!]; isotypes **BM!**, **K!**).

— *Hypericum pallens* D.Don, Prodr. Fl. Nepal.: 219 (Jan.–Feb.) 1825. Type: West Himalaya, *Wallich 4814* (holotype **K!**).

— *Hypericum setosum* Wall., Numer. List. [Wallich] n. 4814. 1828, **nom. nud.**

— *Hypericum wightianum* Wall., Numer. List. [Wallich] n. 4818. 1828, **nom. nud.**; Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 99. 1834; Gamble, Fl. Madras: 69. 1915. Type: India, Neelgherries, *Wight 336* (lectotype **E** [E00174238!], designated here; isoelectotypes **BM** [BM000551503!], **E** [E00174230!], **K** [K000677235!]).

Shrubs or perennial herbs up to 1 m tall; glabrous; decumbent. *Branchlets* terete, slender, striations present, light golden-brown to dark red-brown. *Leaves* sessile; blade 0.7–2.5 $\times$ 0.4–1.5 cm, elliptic to oblanceolate, base cuneate to slightly tapering, apex slightly acute to rounded to subacuminate, parallelodromous veins faint; round (black) dots sometimes present on upper surface, light green to tan on upper surface and dark brown/black on lower surface, glabrous, delicate, smooth, midrib depressed on upper surface and pronounced on lower surface. *Inflorescence* pedicel up to 5 cm long, solitary or corymbose cymes with up to 17 flowers, thin and delicate, spine-like hairs present on all stalks of inflorescences. *Calyx* sepals, 0.5–0.6 $\times$ 0.1–0.2 cm, oblanceolate, persistent, some with gland-tipped

teeth, apex slightly pointed to round, bracts with black glandular hairs. *Corolla* petals 6–13 mm long, elliptic to oblanceolate, caducous, yellow/cream, with longitudinal lines present, apex slightly pointed. *Stamens* in 3 fascicles. *Ovary* 3-locular; styles 0.9–1.3 mm. *Fruit* ovoid to elliptic, 3-celled, green. *Seeds* 0.5–0.6 mm long.

Thailand.— (Map 2.1.1): NORTHERN: Chiang Mai [Summit of Doi Inthanon, 19 Aug. 1927, *Garrett 421* (**ABD**, **BM**, **E**, **K**, **L**, **P**, **TCD**); Doi Chiang Dao, 23 Oct. 1992, *Pooma 703* (**BKF**); Doi Pa Kao, 8 May 1921, *Kerr 5392* (**ABD**, **BK**, **BM**, **K**); Doi Inthanon, 30 Oct. 1962, *Smitinand et al. 7643* (**BKF**); Doi Chiang Dao, 11 Dec. 1987, *Santisuk s.n.* (**BKF**)].

Distribution.— India, Bhutan, Nepal, South China, Myanmar.

Ecology and phenology.— Marshy areas, on limestone from 1400 to 2500 m elevation. Flowering: May–August and October–December.

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

Notes.— 1. We have carefully chosen the most complete available Wight collection as the lectotype of *Hypericum wightianum* over any Wallich material as Wight (1834) states clearly that he had not seen Wallich's material. His description can only, therefore, be based on *Wight 336*.

2. *Hypericum elodeoides* is a widespread and variable species sometimes separated from *H. napaulense* on the basis of its glandular petal margin, terete stem, acute leaves and ribbed sepals. Robson *et al.* (2014) unite them.

2. *Hypericum henryi* H.Lév. & Vaniot subsp. ***hancockii*** N.Robson, Bull. Brit. Mus. (Nat. Hist.), Bot. 12(4): 261 1985; H.W.Li & N.Robson, Fl. China 13: 12. 2007. Type: China, Yunnan, *Hancock 116* (holotype **K!**; isotype **K!**).

— *Hypericum garrettii* Craib in Bull. Misc. Inform. Kew 1913; 66. 1913, *pro parte*, quoad *Kerr 6300*).

—*Hypericum garrettii* var. *ovatum* Craib, Fl. Siam. 1:111. 1925. Type: Thailand, Chiang Mai, *Kerr 5188* (lectotype **ABD** [ABDUH:2/516!]; isolectotypes: **BK!**, **BM** [BM000617086!], **E** [E00209541!], **K** [K000380029!]; designation of a holotype by Robson [1985] is correctable under Art. 9.11 [Turland *et al.* 2018] to lectotype).

Shrubs to 3 m tall. *Branchlets* terete, erect, slender, smooth, new branches thin, red-brown, internodes 1–2 cm long. *Leaves* sessile; blade 1.5–4.3 × 0.4–2 cm, lanceolate to elliptic, green to golden yellow to red/brown, some 2-toned, sometimes glaucous, glabrous, delicate, base cuneate to rounded, apex acute to cuspidate to obtuse, midrib depressed on upper surface and pronounced on lower surface, fading slightly towards apex, but still visible, secondary veins visible, intersecondary and tertiary veins faint, secondary veins not arising from same point on opposite sides of midrib, some leaves trinerved, black glands present. *Inflorescence* pedicels 0.3–1.5 cm long, branches terete, paniculate, 3 flowers per corymb. *Calyx* sepals, 6 × 4 mm; unequal, obovate to ovate or elliptic, orange. *Corolla* petals 8–25 × 6–15 mm; yellow, ovate. *Stamens* 40–60 per fascicle, anthers longest 5–13 mm, usually half as long as petals, round, yellow. *Ovary* ovoid, styles 4, 4–6 mm long, protruding. *Seeds* brown.

Thailand.— (Map 2.1.2): NORTHERN: Chiang Mai [Doi Inthanon, trail to the summit, Chom Thong District, 22 Mar. 2007, *Byrne 9* (**TCD**); Kio Mae Pan Nature Trail, Doi Inthanon, 22 Mar. 2007, *Byrne 10* (**TCD**); *ibid.*, 22 Mar. 2007, *Byrne 11* (**TCD**); Huai Mae, Klang Pat, Pha Mon, 23 Feb. 1982, *Suvarmasuddhi 318* (**BKF**); Doi Inthanon, Pa Ngem N Peak, 14 July 1922, *Kerr 6300* (**ABD**, **BM**, **K**); higher elevation of Doi Inthanon, 7 Jan. 1983, *Koyama et al. T-32090* (**BKF**); Pa Ngem, 6 Apr. 1925, *Winit 1350* (**ABD**, **BKF**, **K**); Doi Pha Hom Pok, Muang Fang, 2 Apr. 1921, *Kerr 5188* (**ABD**, **BM**, **E**, **K**, **TCD**); 12 Feb. 1983, *Koyama et al. T-33411* (**BKF**); 12 Feb. 1983, *Koyama et al. T-33438* (**BKF**); 23 Mar. 1965, *Phengklai 973* (**C**, **E**); Feb. 1978, *Løjtnant & Niyomdham 166* (**AAU**); 13 Sept. 1967, *Iwatsuki et al. 9690* (**AAU**, **BKF**, **E**, **K**, **L**); Chiang Rai [Doi Tung, NW side of Pa Hung, 25 Dec. 2006, *Maxwell 06-1006* (**CMUB**); Nakhon Sawan [Khlong Lan, Mo Ko Chu Mountain, 3 Jan. 1999, *van de Bult 209* (**BKF**, **CMUB**); NORTH-EASTERN: Sakhon Nakhon [An Gop, Phu Phan NP, 26 Feb. 1993, *Chantaranothai et al. 973* (**TCD**)].

Distribution.— Myanmar, Vietnam, China, Sumatra.

Ecology and phenology.— Evergreen forest, mountain, exposed/open ridges from 280 to 2560 m elevation. Flowering: All year. Fruiting: July–November.

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

3. *Hypericum hookerianum* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 99. 1834; Dyer in Hook.f., Fl. Brit. India 1: 254. 1874; Gamble, Fl. Madras 69. 1915; R.Keller in Engl. & Prant, Nat. Pflanzenfam. ed. 2, 21: 176. 1925; Y.Kimura in Hara, Fl. E. Himalaya 210. 1966; K.M.Matthew in Rec. Bot. Surv. India 20: 45. 1969; N.Robson, J. Roy. Hort. Soc. 95: 490. 1970; N.Robson in Hara & Williams, Enum. Fl. Pl. Nepal 2: 61. 1979; N.Robson, Bull. Brit. Mus. (Nat. Hist.) Bot. 12 (4): 255. 1985; H.W.Li & N.Robson, Fl. China 13: 10. 2007. ≡? *Brathys nepalensis* Blume, Mus. Bot. 2: 19. 1852. ≡ *Norysca hookeriana* (Wight & Arn.) Wight, Il. Ind. Bot. 1: 113. 1840; Blume, Mus. Bot. 2: 22. 1856; Y.Kimura in Nakai & Honda, Nov. Fl. Jap. 10: 98. 1951. Type: India, *Wight 332* (lectotype **K** [K000677209!]; isolectotypes **E** [E00174236!], E00174237!); designation of a holotype by Robson [1985] is correctable under Art. 9.11 [Turland *et al.* 2018] to lectotype.

—*Hypericum garrettii* Craib in Bull. Misc. Inform. Kew 66. 1913, (*pro parte*); Craib, Fl. Siam. 1:110. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 248. 1943. Type: Thailand, Chiang Mai, Doi Inthanon, *Garrett 67* (lectotype **K** [K000380030!], designated here; isolectotypes **BM** [BM000617687!], **E** [E00209544!]).

Shrubs 1–3 m tall. *Branchlets* terete, arching, stems brown, smooth, slender, scars present, young branches compressed. *Leaves* sessile-subsessile; blade 3.3–6.3 × 1.3–2.4 cm, lanceolate, oblanceolate, elliptic, oblong or obtuse, base cuneate, apex somewhat acute to acuminate, delicate, papyraceous, glabrous, few pellucid dots present, vibrant green to red to dull red/black, midrib depressed on both surfaces, adaxial midrib colour very variable, red, yellow/white or dark red, abaxial midrib colour red or brown, secondary, intersecondary and tertiary veins visible, no intramarginal veins. *Inflorescence* terminal,

1–5(–10)- flowered, from apical node, pedicels 0.3–1.6 cm long. *Calyx* sepals 3.5–9 × 2–6.5 mm, oblong, elliptic to obovate-spathulate, rounded, entire ovate to obovate, ± imbricate, green, red/brown, longitudinal veins present. *Corolla* petals 9–18 × 5–12 mm, obovate, entire, caducous bright yellow to golden yellow, longitudinal veins present. *Stamens* 60–80 per fascicle, anthers oblong, 4–6(–8) mm long, approximately $\frac{1}{4}$ – $\frac{1}{2}$ as long as petals, anthers bright yellow to orange-yellow. *Ovary* 3–7 × 4–6 mm long, styles 5, longer than anthers, ovoid to globose. *Fruit* green, ovoid. *Seeds* ca 0.5 mm long, elliptic, dark brown to red.

Distribution.— Thailand (Map 2.1.3): NORTHERN: Mae Hong Son [Doi Chang, 19 Feb. 1968, *Hansen & Smitinand* 12674 (AAU, BKF, E, K, L, P)]; Chiang Mai [Doi Inthanon NP, 29 Jan. 1996, *BGO Staff* 24 (QBG); Doi Inthanon, Pa Ngern N Peak, 12 Oct. 1910, *Garrett* 67 (BM, E, K); Pa Ngern N Rocks, Doi Inthanon, *Garrett* 70 (BM); Kio Mae Pan, 15 Oct. 2003, *Mattapha* 394 (KKU); Doi Inthanon NP, 3 Aug. 1984, *W.N.* 548 (BKF); Doi Pha Hom Pok, 23 Mar. 1965, *Phengklai & Sangkhachand* 973 (BKF); Doi Inthanon NP, 12 Aug. 1995, *Pooma* 1072 (BKF); Doi Pha Hom Pok, 23 Nov. 1998, *Suksathan* 1488 (QBG); Western flank of Doi Inthanon, Mae Pau, 7 Dec. 1969, *van Beusekom & Phengklai* 2397 (AAU, BKF, C, E, P); Inthanon NP, 8 Nov. 1992, *Balick & Nanakorn* 3410 (AAU); Doi Inthanon, Chom Thong 16 Sept. 1995, *Nanakorn et al.* 4396 (QBG); Mae Chaem District: Top area of Doi Inthanon in Doi Inthanon NP, 20 Dec. 1998, *Konta et al.* 4880 (BKF); Kio Mae Pan, Doi Inthanon, 21 Dec. 1997, *Niyomdham* 5244 (BKF); Doi Inthanon, 2 May 1921, *Kerr* 5312 (ABD, BK, BM, K, TCD); Doi Inthanon, Nov. 1986, *Phengklai & Smitinand* 6072 (BKF); *ibid.*, 21 Aug. 1996, *BGO Staff* 7117 (QBG); Doi Chiang Dao, 3 Dec. 1961, *Smitinand & Anderson* 7303 (BKF); Doi Inthanon NP, 4 Aug. 1988, *Phengklai et al.* 7416 (K); *ibid.*, *Phengklai et al.* 7484 (BKF); *ibid.*, 30 Oct. 1962, *Smitinand et al.* 7645 (BKF); Kio Mae Pan, Doi Inthanon, 28 Nov. 1996, *BGO Staff* 7928 (QBG); Doi Inthanon, 31 Dec. 1974, *Geesink et al.* 7998 (K, L); Kio Mae Pan, Doi Inthanon, 20 Dec. 1998, *Phengklai et al.* 11394 (BKF); Doi Chiang Dao, 10 Nov. 1962, *Smitinand & Poore* 30238 (AAU); Doi Inthanon, 28 Nov. 1993, *Larsen et al.* 44980 (AAU); Doi Inthanon NP, forest trail at 42 km along summit road, 7 Oct. 1990, *Chantaranonthai*

et al. 90-626 (K); Doi Inthanon NP, summit of Doi Inthanon, 23 Sept. 1991, *Maxwell* 91-776 (AAU, E, P); higher elevation of Doi Inthanon, Payap District, 19 Dec. 1965, *Tagawa et al.* T-2856 (BKF); near Pagoda, the west side of the main route, Doi Inthanon, 4 Aug. 1988, *Koyama* T-61088 (BKF); Kio Mae Pan, Doi Inthanon, 1998, *BGO Staff* s.n. (QBG); Unknown location [1987, *Robson* s.n. (AAU, BKF)].

Distribution.— Bhutan, Myanmar, China, India (Madras), Nepal, Vietnam.

Ecology and phenology.— Primary evergreen forest, marshy ground, open savannah, swamp from 1850 to 2595 m elevation. Flowering: April–July. Fruiting: September–October.

Vernacular.— Bua thong (บัวทอง) (*BGO Staff* 7117).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

4. *Hypericum japonicum* Thunb. in Murray, Syst. Veg., ed. 14: 702. (May–June) 1784; Thunb., Fl. Jap.: 295. (Aug.) 1784; Choisy, Prodr. Monogr. Hyperic.: 48. 1821; Blume, Bijdr. Fl. Ned. Ind. 5: 143. 1825; D. Don, Prodr. Fl. Nepal.: 219. 1825; Wight, Prodr. Fl. Ind. Orient.: 99. 1834; Choisy in Zoll., Syst. Verz.: 151. 1854; Miq., Ann. Mus. Bot. Lugduno-Batavi 2: 259. 1866; Dyer in Hook.f., Fl. Brit. India 1: 263. 1874; Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43: 84. 1874; Trimen, Fl. Ceylon 1: 93. 1893; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 215. 1895; Bailey, Queensl. Fl. 1: 101. 1899; Prain, Bengal Pl. 1: 243. 1903; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 284. 1910; Koord.-Schum., Syst. Verz.: 187. 1911–1914; Gamble, Fl. Madras: 69. 1915; Haines, Bot. Bihar Orissa. 2: 51 1921; Ridl., Fl. Malay Penins. 1: 151. 1922; Lauterb., Bot. Jahrb. Syst. 5: 58. 1922; Craib, Fl. Siam. 1: 111. 1925; Ridl., Bull. Misc. Inform. Kew: 59. 1926; M.R.Hend., Gard. Bull. Straits Settlement. 4: 222. 1928; Corner, Wayside Trees of Malaya: 324. 1940; Y.Kimura, Bot. Mag. (Tokyo) 54: 87. 1940; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 248. 1943; Backer & Bakh.f., Fl. Java 1: 382. 1963; Ohwi, Fl. Jap.: 631. 1965; N.Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; N.Robson, Taxon 39: 134–135. 1990; H.W.Li & N.Robson, Fl. China 13: 34. 2007. ≡ *Sarothra japonica* (Thunb.) Y.Kimura *et al.*,



Map 1.4.1 Distribution of *Mesua ferrea* in Thailand.



Map 2.1.1 Distribution of *Hypericum elodeoides* in Thailand.



Map 2.1.2 Distribution of *Hypericum henryi* subsp. *hancockii* in Thailand.



Map 2.1.3 Distribution of *Hypericum hookerianum* in Thailand.

Nova Fl. Jap. 10: 235. 1951. Type: Japan, Honshu, *Thunberg s.n.* (lectotype **UPS!**, isolectotype: **BM!**; designation of a holotype by Robson [1985] is correctable under Art. 9.11 [Turland *et al.* 2018] to lectotype).

— *Hypericum chinense* Osbeck, Dagb. Ostind. Resa 244. 1757, *nom. rejic. prop.* Type: China, *Osbeck s.n.* (holotype **S!**) (see note at end of description about rejection of the name).

— *Hypericum pusillum* Choisy, Prod. Monogr. Hyperic.: 50. 1821. Type: not located.

— *Brathys laxa* Blume., Mus. Bot. 2: 19. 1852. ≡ *Sarothra laxa* (Blume) Y. Kimura, Nakai & Honda, Nova Fl. Jap. 10: 241. 1951. Type: Japan, *Pierot 252* (lectotype: **L** [L0012247!], in sched.. Possible syntype: Japan, *Keiske s.n.* (**L** [L0012248!])).

— *Brathys japonica* Blume, Mus. Bot. 2: 19. 1852. Type: Japan, *Siebold s.n.* (holotype **L!**).

— *Hypericum calycatum* Jacquem. ex Dyer in Hook.f., Fl. Brit. India 1: 256. 1874. Type: Japan, Honshu, *Thunberg s.n.* (holotype? **UPS!**; isotype **BM!**).

— *Hypericum thunbergii* Franch. & Sav., Enum. Pl. Jap. 2: 300. 1878. Types: Japan, Yokosaka, *Savatiere 158* (syntypes **P** [P04637564!, P04637565!, P04637566!, P04637568!, P04637570!], Japan, *Sagone 3411* (not located).

Annual or perennial herbs, with erect or decumbent branched stems, 15–45 cm long; stems green, approximately 3 mm wide at base, glabrous. *Branchlets* slender, stems quadrangular. *Leaves* sessile, papyraceous, decussate, sometimes glaucous beneath; blade 6–10 × 2–6 mm, ovate to lanceolate, base cordate-amplexicaul some auricled, apex rounded or obtuse, midrib green adaxially, light green abaxially, side veins 1–8 each side. *Inflorescence* 1–30-flowered, 6–10 mm across, axes green, pedicels up to 1 cm long, flowers terminal, mostly elongated inflorescences, sometimes solitary. *Calyx* sepals ± free, 2–6 mm long, elliptic to oblong-lanceolate, subequal to unequal, apex acute to rounded, 3–5 longitudinal veins present, entire, light green, persistent. *Corolla* petals, orange-yellow; oblanceolate, obovate or elliptic, 2–5 × 1–1.5 mm long; persistent. *Stamens* 7–25 stamens per fascicle, ca 3 mm long, persistent, anthers yellow, filaments light orange. *Ovary* ovoid to subglobose; stigma,

style and ovary light green; styles 3. *Fruit* 3–5 mm long, globose, red. *Seeds* many, approximately 0.5 mm long, cylindrical, brown or yellow, longitudinally ribbed.

Thailand.—(Map 2.1.4): NORTHERN: Mae Hong Son [Khun Yuam, 4 Sept. 1974, *Larsen & Larsen 34138* (**AAU, K, P**)]; Chiang Mai [Doi Inthanon, 23 Feb. 1983, *Unknown collector 28* (**K**)]; Mai Muang Nao Arboretum, 12 Apr. 2001, *Sankamethawee 157* (**A**); Chiang Dao, 7 July 1998, *Pongamornkul 161* (**QBG**); Muang Fang, 6 June 1973, *Sadakorn 227* (**BK**); Doi Suthep, 4 Mar. 1966, *Chermisrivathana & Boonkird 434* (**BK**); Doi Suthep, 23 Mar. 1905, *Unknown collector 485* (**P**); Doi Inthanon, 24 Mar. 1967, *Chermisrivathana & Boonkird 730* (**BK**); *ibid.* 12 Aug. 1995, *Pooma 1070* (**BKF**); Ob Luang tableland, along road from Bo Luang to Om Koi, 12 June 1968, *van Beusekom & Phengklai 1188* (**AAU, BKF, C, E, K, L, P**); Doi Suthep, 23 Mar. 1937, *Deignan 1526* (**A**); west of Fang, 25 Feb. 1958, *Sørensen et al. 1663* (**C**); 10 km south of Bo Luang along the Om Koi trail, 2 July 1968, *Larsen et al. 1942* (**AAU, BKF, C, E, L, P**); Doi Suthep, 14 Mar. 1958, *Sørensen et al. 2701* (**C**); Mae Sanam, 27 June 1978, *Phengklai et al. 4155* (**BKF**); Om Koi, 28 June 1978, *Phengklai et al. 4167* (**BKF**); Doi Suthep, 23 Mar. 1905, *Hosseus 485* (**BM, K**); Bo Luang, 7 June 1973, *Geesink et al. 5833* (**C, E, L, P**); *ibid.*, 12 June 1973, *Geesink et al. 5867* (**BKF, C, E, K, L, P**); Chom Thong, 30 May 1979, *Vidal et al. 6198* (**P**); Ban Tha Ma Kiang, Phrao, 14 June 1997, *Nanakorn et al. 9204* (**QBG**); Om Koi, 20 Jan. 1966, *Hansen et al. 10843* (**C, K, L**); near Bo Luang at 37 km, *Hansen et al. 11017* (**C**); Doi Suthep, east side, above Khonthathan Falls, Muang, 26 Dec. 1988, *Maxwell 88-1408* (**L**); Ban Pa Pae, Mae Taeng District, 7 Nov. 1990, *Maxwell 90-1244* (**A**); Ban Tha Ma Kiang, San Sai Subdistrict, Phrao Valley, Phrao, 1 Aug. 1992, *Maxwell 92-403* (**A, E, P**); summit of Doi Poa Lohn, Mae Seuk Subdistrict, Mae Jam District, 14 Jan. 1997, *Maxwell 97-38* (**A, BKF**); Doi Inthanon, 23 July 1988, *Tsugaru T-61735* (**A, AAU, BKF**); San Pa Tong, 10 Jan. 1986, *Paiseeksantivatana Y 1742-86* (**BK**); Chiang Rai [Chiang Khien, 3 Mar. 1912, *Kerr 2486* (**BM, E, K, TCD**); *ibid.*, 3 Mar. 1912, *Kerr 2486A* (**BM**); Ban Dai, Sidonmun subdistrict, group 3, Chiang Saen, 6 Mar. 1989, *Maxwell 89-312* (**L**); Nan [Doi Phu Kha NP, Pua, 4 Nov. 1999, *Srisanga 1119* (**QBG**); *ibid.*, 25 May 2000, *Srisanga 1399* (**QBG**); Tak [Huai Khek, Lom Sak 23 Feb.

1964, *Hansen et al.* 11236 (**BKF, C**); NORTH-EASTERN: Loei [Phu Kradung, 19 Mar. 1948, *Juntabendlham* 149 (**BK**); *ibid.*, 19 Mar. 1974, *Chermsirivathana & Boonkird* 1885 (**BK**); *ibid.*, 19 Mar. 1974, *Chermsirivathana & Boonkird* 1889 (**BK**); *ibid.*, 16 Jan. 1966, *Hennipman* 3704 (**BKF, C, L**); *ibid.*, 1970, *Charoenphol et al.* 4808 (**AAU**); Sakon Nakhon [Phu Phan NP, ca 100 km west of Park HQ, 19 Oct. 1990, *Chantaranonthai & Parnell* 90/799 (**TCD**)]; EASTERN: Chaiyaphum [Thung Kra Mang, Phu Khieo, 9 Aug. 1972, *Larsen et al.* 31604 (**AAU, K, L, P**)]; SOUTH-EASTERN: Chanthaburi [Pong Nam Ron, 11 Mar. 1956, *Smitinand* 3286 (**BKF, K, L, P**); Khao Phloi Waen, 10 Jan. 1930, *Kerr* 18049 (**K, TCD**)]; PENINSULAR: Surat Thani [Thung Luang, 1 Apr. 1927, *Kerr* 12512 (**ABD, BM, K**)]; Unknown location [*Unknown collector* 49 (**KKU**)]

Distribution.— India, Sri Lanka, Bhutan, Nepal, Myanmar, Cambodia, Laos, Vietnam, China, S Korea, Taiwan, Russia, Japan, Malaysia, Singapore, Indonesia (Sumatra to Irian Jaya), Philippines, South-East and South Australia, New Zealand.

Ecology and phenology.— Deciduous forest, bamboo forest, wet grassland, bog, savannah from 50 to 2500 m elevation. Flowering: April–June (October). Fruiting: Apr.–June (November).

Vernacular.— Bua thong (บัวทอง) (*Pongamornkul* 161).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

Notes.— The name *Hypericum chinense* Osbeck has never been used since it was published. Merrill (1916) pointed out its priority over *H. japonicum* Thunb. in Murray but thought the name *H. chinense* L. applied to the same species. *Hypericum chinense* L. is a cultivated shrub and this name has been used almost exclusively in botanical and horticultural literature until 1985, when Robson (1985) pointed out the above synonymy. Since then *H. chinense* L. has been replaced by *H. monogynum* L., and *H. japonicum* Thunb. in Murray has been conserved over *H. chinense* Osbeck; see Robson (1990) for more information regarding the name.

Robson (1985) uses the author citation ‘Thunb. ex Murray’ as the authority for a number of species of *Hypericum*, but Bartholomew *et al.* (1997) argue correctly that the citation should be Thunb. in Murray.

5. *Hypericum patulum* Thunb. in Murray, Syst. Veg., ed. 14: 700. (May–June) 1784; Thunb., Fl. Jap.: 295, t. 17. (Aug.) 1784; Curtis, Bot. Mag. 50: t. 5693. 1823; Choisy in DC., Prod. 1: 545. 1824; Dyer in Hook.f., Fl. Brit. India 1: 254. 1874; Gamble, Man. Ind. Timb.: 48. 1881; Gamble in Humbert, Suppl. Fl. Indo-Chine 1(3): 248. 1943; Zollinger, Syst. Verz. 1–2: 151. 1854; Maxim. in Bull. Acad. Imp. Sci. Saint-Pétersbourg 27: 429. 1882; Hemsl., J. Linn. Soc., Bot. 23: 73. 1886; Kuntze, Rev. Gen. Bot. 1: 60. 1891; Koehne, Deut. Dendrol.: 415. 1893; R.Keller, Bull. Herb. Boissier 5: 638. 1897; Diels, Bot. Jahrb. Syst. 29: 476. 1900; H.Lév., Bull. Soc. Bot. France 53: 499. 1906; R.Keller in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 21: 176. 1925; Rehder, J. Arnold Arbor. 15: 100. 1934; Y.Kimura, Bot. Mag. (Tokyo) 54: 88. 1940; Y.Kimura in Nakai & Honda, Nov. Fl. Jap. 10: 100, f. 41. 1951; Lauener, Notes Roy. Bot. Gard. Edinburgh 27: 4. 1966; N.Robson, J. Roy. Hort. Soc. 95: 491. 1970; N.Robson, Bull. Brit. Mus. (Nat. Hist.), Bot. 12(4): 261 1985; H.W.Li & N.Robson, Fl. China 13: 13. 2007. = *Komana patula* (Thunb. in Murray) Y.Kimura ex Honda, Nom. Pl. Japonic. 509. 1939. = *Norysca patula* (Thunb. in Murray) Voigt, Hort. Suburb. Calcutt. 90. 1845. = *Eremanthe patula* (Thunb. in Murray) K.Koch, Hort. Dendrol. 65. 1853. = *Komana patula* (Thunb. in Murray) Y.Kimura ex Hisauti, Kikasyokubutsu, 179. 1950; cf. Y.Kimura, Nakai & Honda, Nova Fl. Jap. 10: 97, 99. 1951. Type: Japan, *Thunberg s.n.* (?holotype **UPS!**).

— *Hypericum uralum* sensu Hance in J. Bot. 16: 104. 1878, non. *H. uralum* Buch.-Ham. ex D.Don in Bot. Mag. 50: t. 2375. 1823. Type: Nepal, Narainhetty, *Hamilton s.n.* (lectotype **BM!**; designated by Robson in Robson *et al.* [2014]).

— *Hypericum argyi* H.Lév. & Vaniot, Bull. Soc. Bot. France 54: 591. 1908; H. Lév., Fl. Kouy-Tcheou. 198: 1914; H. Lév., Mem. Real. Acad. Ci. Barcelona 3(12): 553. 1916. Type: China, *d'Argy s.n.* (?holotype **E!**; isotype **A** [A00067732!]).

Shrubs to 3 m tall; with spreading branches, greyish-brown. *Branchlets* terete, becoming 2-lined, thick, rough, dark brown to red-orange, scarring present. *Leaves* sessile to petioled, if petioled, up to 0.5–2 mm long, in whorls at top of branch and sparse along stems; blade 1.5–6.0 × 0.5–3.0 cm, lanceolate to oblanceolate or ovate, oblong or elliptic, base cuneate, apex acuminate to obtuse, light brown to

dark red smooth, delicate, margins undulate, midrib visible and prominent on upper surface, black on both surfaces, venation $\pm$ obscure, without intramarginal veins. *Inflorescence* pedicels 0.2–0.7 cm long, 1–15-flowered. *Calyx* sepals $\pm$ free, 5–10 $\times$ 3.5–7 mm ovate to elliptic or oblong, imbricate, unequal or subequal, entire to sometimes denticulate, sometimes red. *Corolla* petals 1.2–1.8 $\times$ 1–1.4 cm, oblong to obovate, golden yellow, longitudinally striated. *Stamens* 50–70 stamens per fascicle, longest stamens 7–12 mm long; anthers bright yellow. *Ovary* ovoid; styles 4–5.5 mm long. *Fruit* ovoid. Seeds dark brown.

Thailand.— (Map 2.1.5): NORTHERN: Chiang Mai [Doi Chiang Dao, 17 Aug. 1963, *Smitinand et al.* 1055 (**BKF**); *ibid.*, 3 Mar. 1979, *Koyama et al.* 15639 (**AAU**, **BKF**); the swampy place and its' vicinity of the summit, Doi Inthanon, 4 Aug. 1988, *Tsugaru T-61869* (**A**, **AAU**, **BKF**); Doi Chiang Dao, 6 Mar. 1922, *Kerr s.n.* (**BK**)].

Distribution.— Myanmar, China, Japan, New Zealand, Sumatra, Vietnam.

Ecology and phenology.— Open ridges from 1900 to 2520 m elevation. Flowering: May–September. Fruiting: July–October.

Conservation.— IUCN Regional (Thailand) Status: Data Deficient (DD).

6. *Hypericum siamense* N. Robson, Bull. Brit. Mus. (Nat. Hist.), Bot. 12 (4): 240 1985. Type: Thailand, Chiang Mai, Doi Chiang Dao, *Kerr s.n.* (holotype **BM** [BM000617688!]; isotype **ABD** [ABDUH2/517!]).

Bushy shrubs, 0.7–3 m tall or perennial herbs. *Branchlets* terete, rigid, scars present, rough, internodes 0.5–2 cm long, brown to red. *Leaves* sessile to sessile; blade 2.3–3.6 $\times$ 0.6–1.8 cm, lanceolate to elliptic to oblong or ovate-oblong, base cuneate to tapering, apex acute or acuminate, delicate, some glaucous, few black round glands present, midrib depressed in upper surface and pronounced on lower surface, midrib narrowing towards apex but still visible, brown/red on both surfaces, secondary veins and intramarginal veins visible, intersecondary veins and tertiary veins obscure. *Inflorescence* pedicels up to 1 cm long, solitary and axillary, or 1–5-flowered and corymbiform. *Calyx* sepals free, 0.8–1.2 $\times$ 0.3–0.6 cm; triangular to ovate; imbricate or reflexed to spreading, unequal; longitudinal striations present.

Corolla petals 2–2.4 $\times$ 1.2–1.7 cm, obovate, yellow, some tinged red on dorsal side, longitudinal striations present. *Stamens* approximately 45–50 stamens per fascicle, anthers 10–11 mm long, oblong, yellow to orange. *Ovary* ovoid; styles 2.5–6 mm long. *Fruit* ovoid. *Seeds* approximately 1 mm long, orange-brown.

Distribution — Thailand (Map 2.1.6): NORTHERN: Chiang Mai [Doi Chiang Dao, 6 Jan. 1922, *Kerr s.n.* (**K**); *ibid.*, 10 July 1998, *Pongamornkul* 171 (**QBG**); *ibid.*, 8 July 1998, *Pongamornkul* 392 (**QBG**); *ibid.*, 17 Aug. 1963, *Smitinand & Sleumer* 1055 (**L**); *ibid.*, 8 July 1998, *Suksathan* 1117 (**QBG**); *ibid.*, 15 Oct. 2000, *Suksathan* 2842 (**QBG**); *ibid.*, 15 Oct. 2000, *Suksathan* 2845 (**QBG**); *ibid.*, 6 Jan. 1995, *BGO Staff* 2895 (**QBG**); *ibid.*, 7 Jan. 1995, *BGO Staff* 2919 (**QBG**); *ibid.*, 10 Nov. 1962, *Smitinand et al.* 7789 (**BKF**, **E**); *ibid.*, 27 Sept. 1971, *Murata et al.* T-15211 (**AAU**, **K**); *ibid.*, 3 Dec. 1961, *Smitinand & Anderson* 25915 (**K**); *ibid.*, 10 Nov. 1962, *Smitinand & Poore* 30328 (**L**); below the summit of Doi Chiang Dao, 14 Sept. 1967, *Shimizu et al.* T-10109 (**BKF**); Payap, Doi Chiang Dao, 7 Dec. 1965, *Hennipman* 3277 (**L**); Doi Chiang Dao, 26 Sept. 1971, *Murata et al.* T-15262 (**BKF**, **K**, **P**); higher elevation of Doi Chiang Dao, 26 Sept. 1971, *Murata et al.* T-15280 (**BKF**); Doi Chiang Dao, 13 Nov. 1922, *Kerr s.n.* (**ABD**, **BM**)].

Ecology and phenology.— Limestone ridges, exposed cliff edges from 1800 to 2200 m elevation. Flowering: July–January.

Vernacular.— Bua thong (บัวทอง) (*Pongamornkul* 392).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

2. CRATOXYLUM

Blume, Verh. Batav. Genootsch. Kunsten 9: 172, 174. 1823; Blume, Mus. Bot. 2: 17. 1852; Miq., Fl. Ned. Ind. 1(2): 515. 1859; Dyer in Hook. f., Fl. Brit. India 1: 257. 1874; Kurz, Forest Fl. Burma 1: 83. 1877; Gamble, Man. Ind. Timb.: 48. 1881; King, J. Asiat Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 145. 1890; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(6): 215. 1895; Prain, Bengal Pl. 1: 245. 1903; Brandis, Indian Trees: 47. 1907; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 287. 1910; Gamble, Fl. Madras: 70. 1915; Ridl., Fl. Malay Penins. 1: 152. 1922; Craib, Fl. Siam.

1: 111. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 251. 1943; Backer & Bakh.f., Fl. Java 1: 383. 1963; Gogelein, Blumea 15: 454. 1967; Baas, Blumea 18: 369. 1970; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; Corner, Wayside Trees of Malaya 1: 325. 1988. $\equiv$ *Hornschuchia* Blume, Cat. Gew. Buitenzorg: 15. 1823: **nom. illeg.** Type species: *Cratoxylum hornschuchii* Blume, **nom. illeg.** [$\equiv$ *Hornschuchia hypericina* Blume]

Deciduous to evergreen trees or shrubs; all glabrous except *C. formosum* subsp. *pruniflorum*; exudate yellow resinous sap turning black when dry. *Leaves* opposite, sessile to petiolate, entire, papyraceous, pellucid dots usually present, base attenuate to subcordate, apex rounded to cuspidate, venation

eucamptodromous. *Inflorescences* terminal panicles, or short terminal or axillary cymes. *Calyx* sepals 5, persistent, coriaceous, usually accrescent. *Corolla* petals 5, caducous to subpersistent, obovate, exceeding sepals, pink or white. *Stamens* 3 or 5 fascicles, adelphous, persistent, anthers dorsifixed, slender, sometimes with a brown dot on the connective. *Ovary* 3-celled, ovoid to ellipsoid; styles free; ovules 4– ∞ . *Seeds* oblong, winged all round or partly winged; embryo erect.

Distribution.—6 species in Borneo, Myanmar, Cambodia, India, Indonesia, Laos, Malaysia, South and Southwest China, Philippines, Vietnam; 5 species in Thailand.

KEY TO THE SPECIES

1. Flowers in small clusters on old leafless twigs
 2. Flowers white; leaves obovate, elliptic, lanceolate, oblanceolate or round; fruits 4–6 mm diam.; seeds 6–8 per loculus **3. *C. formosum***
 2. Flowers dark red; leaves obovate, elliptic or oblong; fruits 2–4 mm diam.; seeds 5–6 per loculus **4. *C. maingayi***
1. Flowers on leafy twigs
 3. Evergreen tree up to 45 m high; flowers in terminal pyramidal panicles; leaves obovate, oblanceolate, oblong or elliptic **1. *C. arborescens***
 3. Deciduous tree or shrub up to 30 m high; flowers in short terminal panicles or cymes; leaves oblong, elliptic or lanceolate
 4. Leaves sessile to subsessile; flowers not in the axils of mature leaves; pedicels often longer than 1–2 mm **5. *C. neriifolium***
 4. Leaves petioled; some flowers in the axils of mature leaves; pedicels 1–2 mm **2. *C. cochinchinense***

1. *Cratoxylum arborescens* (Vahl) Blume, Mus. Bot. 2: 17. 1852; Dyer in Hook.f., Fl. Brit. India 1: 258. 1874; Kurz, Forest Fl. Burma 1: 83. 1877; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 146. 1890; Ridl., Fl. Malay Penins. 1: 152. 1922; Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 2(21): 184. 1925; Corner, Gard. Bull. Straits Settlement. 10: 22, 31. 1939; Meijer, Bot. News Bull. Forest Dept., Sabah 7: 64. 1967; Gogelein, Blumea 15: 471. 1967; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; Corner, Wayside Trees of Malaya 1: 325. 1988; Phengklai & Niyomdham, Flora in peat swamp areas of Narathiwat 197. 1991. $\equiv$ *Hypericum arborescens* Vahl, Symb. Bot. 2: 86, t. 43. 1791. $\equiv$ *Vismia arborescens* (Vahl) Choisy, Prodr. Monogr. Hyperic. 36. 1821. Type: India, 1778, *König s.n.* (holotype: C [10009464 !]).

— *Hypericum coccineum* Wall., Numer. List. [Wallich] n. 4823. 1828. **nom. nud.**

— *Cratoxylum blancoi* Blume, Mus. Bot. 2: 17. 1852. Type: Philippines, Luzon, Antipolo, *Ramos s.n.* (Illustrative specimen/ neotype: Merrill 851, [US!]).

— *Ancistrolobus glaucescens* Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(1): 383. 1858. Type: *Lobb 419* (lectotype: BM [BM000624819!], designated here); isoelectotypes BM [BM000624818], KW [KW001000762!], L!).

Evergreen trees to 45 m tall; outer bark scaly, reddish/brown, red hue obvious, glabrous; exudate not recorded. *Branchlets* young shoots with continuous interpetiolar scars. *Leaves* petioled, 0.5–1.0 cm long; red to green; blade 5–16 $\times$ 2–6 cm obovate-oblong to obovate-oblanceolate or elliptic, coriaceous, base cuneate to attenuate apex acute to cuspidate, numerous faint secondary veins present. *Inflorescence* a many-flowered terminal pyramidal panicle usually borne on leafy twigs; pedicels 0.2–0.4 cm long, slender, homostylous. *Calyx* sepals 3.5–6 $\times$ 2–4.5 mm, obovate to oblong, concave. *Corolla* petals 4.5–7 $\times$ 2–5 mm, obdeltoid, usually caducous, deep red or pink or very rarely orange or white. *Stamens* 30–40 stamens per fascicle, 4–5 mm long, green-yellow. *Ovary* 1.5–2 mm long, pistil 3–5 mm. *Fruit* round to oblong; 7–9 $\times$ 4 mm. *Seeds* 10–18 per loculus; ca 5 $\times$ 0.8 mm, narrowly oblong.

Thailand.— (Map 2.2.1): PENINSULAR: Narathiwat [Tak Bai, 22 July 1984, *Niyomdham* 23 (AAU, K); To Mo, Ban Bacho, 22 Apr. 1931, *Lakshnakara* 758 (BK, BM, K); Tak Bai, 25 May 1984, *Niyomdham* 829 (A, AAU, BKF, K); Tak Bai, Ku Chum, 15 Sept. 1987, *Niyomdham & Sriboonma* 1601 (AAU, BKF, E, K, L, P); Ben Yuan Yahng, Su-ngai Padi, 7 June 1987, *Maxwell* 87-532 (A, BKF, L, PSU)].

Distribution.— India, Myanmar, Malaysia, Singapore, Borneo, Java, Sumatra.

Ecology and phenology.— Evergreen forest, peat swamp forest from near sea level to 460 m elevation. Flowering: May–September.

Uses.— The wood is used for indoor construction.

Vernacular.— Ngong ngang (ໂສ໋໋) (*Niyomdham* 23); gawng ngahng (*Maxwell* 87-532).

Conservation.— IUCN Global Status: Least Concern (LC); Regional (Thailand) Status: Critically Endangered (CR).

2. *Cratoxylum cochinchinense* (Lour.) Blume, Mus. Bot. 2: 17. 1852; Corner, Gard. Bull. Straits Settle. 10: 26–27, 34. 1939; Smythies, Comm. Sarawak Trees: 69. 1965; Gogelein, Blumea 15: 463. 1967; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; Corner, Wayside Trees of Malaya 1: 325. 1988; P.H. Hô, Ill. Fl. Vietnam 1(1): 579, f. 1604 1991; Thin, Sida 17: 742. 1997; S. Gardner *et al.*, Field Guide Forest Trees N. Thailand: 49. 2000; H.W. Li *et al.*, Fl. China 13: 36–37. 2007. ≡ *Hypericum cochinchinense* Lour., Fl. Cochinch. 2: 472. 1790. ≡ *Vismia cochinchinensis* (Lour.) Spreng., Syst. Veg. (ed. 16) 3: 350. 1826. Type: “In sylvis Cochinchinae”, *Loureiro s.n.* (not located).

— *Hypericum chinense* Retz., Observ. Bot. (Retzius) 5: 27. 1789; **nom. illeg.** ≡ *Elodes* [as *Elodea*] *chinensis* (?Retz.) Hance, London J. Bot. 7: 472. 1848. Type: China, “East China” (Hong Kong) possibly *Bladh s.n.* (isotype **LD** not seen).

— *Hypericum petiolatum* auct. non L.: Lour., Fl. Cochinch. 2: 479. 1790. ≡ *Cratoxylum petiolatum* (Lour) Blume., Mus. Bot. 2: 17. 1852. Type: China, “incultum prope Cantonem Sinarum”, *Loureiro s.n.* (not located).

— *Hypericum biflorum* Lam., Encycl. 4(1): 170. 1797; Hook & Arnott, Bot. Beechey Voy. 173. 1833. Type: China. collector unknown (**P-LAM?** not located. ?Neotype: ?Gogelin 1967, publication not located, China, *Bladh s.n.* **LD** not seen, **S!** [S-11-34218]).

— *Hypericum pulchellum* Wall., Numer. List. [Wallich] n. 4821. 1828. **nom. nud.**

— *Hypericum carneum* Wall., Numer. List. [Wallich] n. 4820. 1828. **nom. nud.**

— *Hypericum horridum* Wall., Numer. List. [Wallich] n. 4822. 1828; **nom. nud.**

— *Ancistrolobus ligustrinus* Spach., Ann. Sci. Nat., Bot. Sér. 2, 5: 352, t. 6. 1836. Type: China, circa Macao herb. *Decaisne s.n.* (not traced). ≡ *Cratoxylum ligustrinum* Blume, Mus. Bot. 2: 16. 1852; Merr., Trans. Amer. Philos. Soc. 24, 2: 268. 1935; Corner, Gard. Bull. Straits Settle. 10: 34. 1939; Meijer, Bot. News Bull. Forest Dept., Sabah 7: 64. 1967; Corner, Wayside Trees of Malaya 1: 325. 1988.

— *Ancistrolobus* sp., Wight, Ill. Ind. Bot. 1: 3. 1840; **nom. nud.**

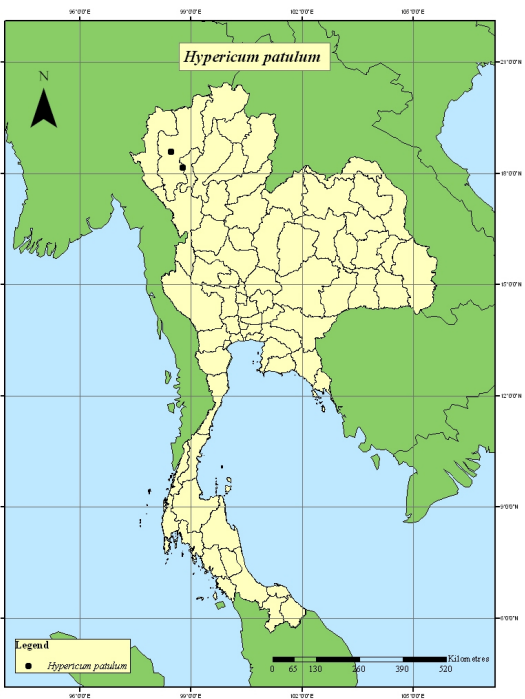
— *Cratoxylum polyanthum* Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot. 175, t. 36. 1842; Korth., Flora, 31: 579. 1848; Miq., Fl. Ned. Ind. 1(2): 515. 1859; Dyer in Hook.f., Fl. Brit. India 1: 257. 1874; Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 85. 1874; Kurz, Forest Fl. Burma 1: 83. 1877; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 145. 1890; Brandis, Indian Trees: 47. 1907; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 287. 1910; Ridl., Fl. Malay Penins. 1: 152. 1922; Craib, Fl. Siam. 1: 112. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 253. 1943. Type: Indonesia, Borneo, *Korthals s.n.* (lectotype **L** [L0012110!], designated by Gogelein [1967]; isolectotypes: **BM** [BM000624802!], **NY** [NY00084789!], **L** [L0012111!, L0012112!, L0012113!, L0012114!, L0012115!, L0012116!, L0012118!, L0012119!, L0012120!, L0012121!, L0012122!, L0012124!].

— *Cratoxylum myrtifolium* Blume, Mus. Bot. 2: 17. 1852. Type: Indonesia, Borneo, *Korthals & Müller s.n.* (syntype **L** [L0012125!]).

— *Cratoxylum wightii* Blume, Mus. Bot. 2: 18. 1852. Type: *Griffith 1104* (holotype **CGE** not seen; isotype **E** [E00438025!]). ≡ *Cratoxylum polyanthum* var.



Map 2.1.4 Distribution of *Hypericum japonicum* in Thailand.



Map 2.1.5 Distribution of *Hypericum patulum* in Thailand.



Map 2.1.6 Distribution of *Hypericum siamense* in Thailand.



Map 2.2.1 Distribution of *Cratoxylum arborescens* in Thailand.

wightii Dyer in Hook.f., Fl. Brit. India 1: 25. 1874; Corner, Gard. Bull. Straits Settle. 10: 21–36. 1939.

— *Elodes* sp., Griff., Notul. 4: 569. 1854; **nom. nud.**

— *Ancistrolobus brevipes* Turcz., Bull. Soc. Imp. Naturalistes Moscou. 31(1): 383. 1858. Type: Singapore, *Lobb 485* (isotypes **BM** [BM000624803!], **BM000624804!**), **KW** [KW001000859!], **W** not seen).

— *Cratoxylum lanceolatum* Miq., Fl. Ind. Bat. Suppl. 1: 500. 1861. Type: Indonesia, Sumatra, *Teysmann HB 3813* (holotype **U** [U0002393!]; isotypes **K!**, **L!**).— *Cratoxylum polyanthum* var. *genuinum* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 85. 1874; **nom. inval.**

— *Cratoxylum polyanthum* var. *macrocarpum* Boerl., Cat. Hort. Bog. 62. 1901. Type: Indonesia, *Boerlage s.n.* (isotypes **K!**, **L** [L0012127!],).

— *Cratoxylum hypoleuca* Elm., Leaf. Philip. Bot. 5: 1787. 1913. Type: Philippines, *Elmer 12913* (isotypes **A** [A00067463!], **BM** [BM000624805!], **E** [E00438024!], **GH** [GH00067464!], **L** [L0012126!], **K!**, **P** [P0476972!], **U** [U002394!], **US** [US00901797!], **US00114120!**, **W** not seen).

Trees or shrubs 2–30 m tall; dbh 35 cm; outer bark deeply fissured, yellow at cambium, sapwood white, heartwood brown, hard; exudate reddish-brown. *Branchlets* terete, smooth, light brown to dark brown, slender, delicate, scars present. *Leaves* petioled, 0.2–0.5 cm long; blade 2.9–12.1 × 1.0–4.7 cm, oblong to elliptic, base cuneate to attenuate, apex round, acuminate or acute, smooth and delicate to papery to coriaceous and shiny, dark tan/red to light yellow/green, some glaucous, black dots present on upper surface, density of black dots varying with each leaf, midrib faint on both surfaces, a little more pronounced on lower surface but faint, narrowing approximately ½ mm towards apex; very faint on upper surface, light green to red/brown, secondary, intersecondary, tertiary and intramarginal veins visible on both surfaces, especially obvious on lower surface, veins not arising at same points on either side of midrib. *Inflorescence* flowering stems flattened, flower on leafy twigs in axils of mature leaves (usually 2 per leaf pair), some also in terminal clusters, 1–5 flowered, pedicels 0.1–0.2 cm long. *Calyx* sepals persistent, 5–7 × 2–5 mm, oval, obovate, obtuse, dull green to dark purple. *Corolla* petals 5–10 × 2.5–5 mm, red, crimson, pink or orange, longitudinal veins present on petals. *Stamens* 4–8 mm long, 45–55

stamens present per fascicle, sometimes congested. *Ovary* 2–3 mm long; style 1–3 mm long. *Seeds* (5–)6–8 per loculus, 6–8 × 2–3 mm, oblanceolate, elliptic or oblong.

Thailand.— (Map 2.2.2): NORTHERN: Chiang Mai [Botanic Garden, Mae Rim, 30 Mar. 1998, *Sucheera 6* (**QBG**); *ibid.*, 25 Oct. 1993, *BGO Staff 63* (**QBG**); *ibid.*, 6 June 1994, *BGO Staff 600* (**QBG**); *ibid.*, 24 Mar. 1996, *BGO Staff 6109* (**QBG**); *ibid.*, 30 Mar. 1998, *Watthana 96* (**QBG**); *ibid.*, 5 Nov. 1997, *Watthana & Siriphum 22* (**QBG**); *ibid.*, 5 July 1989, *Pooma 207* (**BKF**); Huai Pan, no date, *Serm 115* (**QBG**); San Pan Si, **QBG**, Mae Rim, 9 July 2002, *Glamwaewong 241* (**QBG**); Mae Ta, 23 Apr. 1922, *Winit 714* (**ABD**, **BKF**, **K**); Doi Suthep, 4 Apr. 1910, *Kerr 1080* (**BM**, **C**, **K**, **L**, **TCD**); Doi Suthep to Ban Neh, 30 Dec. 1921, *Rock 1553* (**A**, **K**); Nov. 1960, Unknown collector 1938 (**BK**); Doi Suthep, 13 Apr. 1958, *Sørensen et al. 2682* (**BKF**, **C**, **K**); *ibid.*, 12 May 1958, *Sørensen et al. 3369* (**C**, **K**); Doi Inthanon NP, 22 July 1988, *Phengklai et al. 6746* (**BKF**, **E**, **K**); Mae Kahn, 11 Oct. 2001, *Maxwell 01-514* (**A**, **CMUB**); Doi Lahn, 13 June 2003, *Maxwell 03-130* (**A**, **CMUB**); Doi Suthep, 28 Apr. 1988, *Maxwell 88-544* (**L**); Mae Kahn (Karen Village), Doi Luang NP, east side, Mae Dtawn Nai Village Area, 19 June 1997, *Maxwell 97-679* (**CMUB**, **BKF**); along Mae Klang River, 30 July 1988, *Fukuoka T-62376* (**PSU**); Ban Mae-Hoi, Chom Thong, *Cholsuk s.n.* (**BKF**); Chiang Rai [Payapri Village (Akha), 19 May 1997, *Gardner & Sidisunthorn 2093* (**A**, **CMUB**); above Payapri Lao Mae Village, 25 Nov. 2005, *Maxwell 05-646* (**CMUB**); Doi Giah, 10 Apr. 2006, *Maxwell 06-295* (**CMUB**); Lamphun [Doi Khuntan NP, trail from Mah Meun Station to Pha Tup Falls, Mae Tha, 30 Apr. 1994, *Maxwell 94-572* (**A**, **CMUB**); Phrae [Huai Khamin, RHS of Hui, 23 Aug. 1940, *Somkid 467* (**BKF**); Sukhothai [Soke Phra Ruang Waterfall, 8 June 1972, *Maxwell 72-280* (**AAU**, **BK**); Phitsanulok [Nong Hin, 21 May 1967, *Phusomsaeng 218* (**C**, **L**); Thung Salaeng Luang, 19 July 1966, *Larsen et al. 465* (**AAU**, **BKF**, **L**, **P**); Thong Nang Tow, 3 Dec. 1966, *Prayad 561* (**BK**); Kaeng Sophi Waterfall, 10 Dec. 1966, *Sangkachand 585* (**BK**); Thung Salaeng Luang NP, ca 80 km east of Phitsanulok, 20 July 1973, *Murata et al. T-16507* (**BKF**, **L**, **P**); *ibid.*, 25 July 1973, *Murata et al. T-17058* (**C**, **K**, **L**, **P**); Kamphaeng Phet [20 June

- 1930, *Kiah* 24350 (**ABD**); NORTH-EASTERN: Loei [Si Than Forest, Wang Saphung, 8 Apr. 1926, *Din* 204 (**ABD, BK, BKF, K**); Chung Pae, 6 May 1959, *Khantchai* 1045 (**BKF, K, L**); Sakon Nakhon [26 June 1932, *Lakshnakara* 1003 (**AAU, ABD, BK, BM, E, K**); Nakhon Phanom [Tha-Uthen, 12 Aug. 1963, *Pradit* 422 (**BK**); *ibid.*, 12 Aug. 1963, *Pradit* 447 (**BK**); Khon Kaen [Kanchanapisaele Temple, Phu Wieng District, 25 Mar. 2003, *Kantachote* 168 (**KKU**); EASTERN: Nakhon Ratchasima [Khao Yai NP, 18 July 1973, *Murata et al.* T-16272 (**BKF, L, P**); Surin [Rattana, 19 May 1965, *Sakol* 286 (**BK**); Vao Yai, 9 July 1963, *Uarem?* 408 (**BK**); between Loong & Kong Bung Pru Villages, 16 Oct. 2003, *Maxwell* 03-329 (**CMUB**); Ubon Ratchathani [UR Gene Conservation Station, Ban Bahai Village, Huai Yang Subdistrict, Khong Chiam, 18 Sept. 2001, *Greijmans* 183 (**CMUB**); SOUTH-WESTERN: Uthai Thani [Nong/Prue Forest, Ban Rai, 6 July 1963, *Bunnak* 957 (**BKF**); Kanchanaburi [Saneh Pawng Village, Sangkhlaburi District, 9 May 2003, *Kansuntisukmongkol* 83 (**CMUB**); near Neeckey, near Wangka, 29 Apr. 1946, *Kwae Noi River Basin Exp.* 274 (**BK**); Huai Aek, 24 Nov. 1969, *Sangkhachand* 1598 (**BKF, C, K, L, P**); Sadong, Salag Prah Wildlife Sanctuary, 20 Nov. 1971, *van Beusekom et al.* 4037 (**BKF, C, K, L, P**); Ratchaburi [Hua Hin–Pak Ta Wan, *Ladell* 204 (**ABD, K**); Nawng Ke, Apr. 1926, *Collins* 1571 (**AAU, ABD, BK, K**); Phetchaburi [Ang Num Yen, 16 Jan. 1969, *Vachanapong* 320 (**BK**); T. Nong Ya Pong, 14 Mar. 1965, *Sakol* 545 (**BK**); Huai Sai, Cha-am, 16 Mar. 2001, *Puudjaa* 935/1 (**BKF**); Prachuap Khiri Khan [Pranburi, *Phengnaren* 141 (**BKF**); Hua Hin, 5 Aug. 1920, *Marcen* 344 (**BM, K**); Sam Roi Yot, 25 Mar. 1987, *Soejarto et al.* 5785 (**BKF, L**); Nawng Kang, 8 July 1926, *Kerr* 10911 (**AAU, ABD, BK, K**); CENTRAL: Saraburi [Pukhae, Muang District, 1947, *Dee* 81 (**BKF**); Forestry Station, Pukhae, *Thananan* 2496 (**BKF**); Sahm Lan, 1 Dec. 1973, *Maxwell* 73-697 (**AAU, BK**); Nakhon Nayok [Khao Yai NP, Muang District, along the road to Heo Suwat Falls near Lam Takhong Camping site at 43 km, 18 Aug. 2002, *Aramwith* 7 (**A, CMUB**); Pakphli District, 26 June 1991, *Parinya et al.* 36 (**BK**); Pakhli District, June 1991, *Somprasong & Sangkhachand* 49 (**BK**); *ibid.*, 27 June 1991, *Parinya et al.* 60 (**BK**); Khao Yai NP, Muang District, 25 June 2001, *Boonkongchart* 69 (**A, BKF, CMUB**); *ibid.*, 4 June 2002, *Charoenchai & Poompuang* 269 (**CMUB**); Khlong Sai Area, 9 Nov. 1997, *Charoenchai* 450 (**CMUB**); *ibid.*, 14 Mar. 1998, *Charoenchai* 527 (**BKF, CMUB**); Tu Rean Forest, 1960, *Bunpheng s.n.* (**L**); SOUTH-EASTERN: Sa Kaeo [Aran Pratet, 18 Oct. 1928, *Put* 2023 (**AAU, ABD, BK, K**); Muang, *Srisanit s.n.* (**BKF**); Prachin Buri [5 Aug. 1920, *Phengklai et al.* 3711 (**A, BKF, PSU**); Chon Buri [Khao Nang Nom, Phanus Nikhom, 9 Apr. 1976, *Vachance* 60 (**BK**); Sri Racha, no date, *Collins* 126 (**BM, K**); *ibid.*, June–Aug. 1913, *Collins* 199 (**BM, C, E, K, L, TCD**); low hill, back of Sri Racha, 16 Nov. 1926, *Collins* 1300 (**AAU, ABD, K**); Khao Chalak, near Sri Racha, 29 Aug. 1926, *Collins* 1453 (**ABD, K**); Khao Khieo Opened Zoo, 10 Dec. 2000, *Phengklai et al.* 12888 (**BKF**); Kasetsart University at Ao Udom, west side of Kow Hill, 23 Aug. 2003, *Maxwell* 03-236 (**CMUB**); Khao Khieo, Sri Racha District, 16 Feb. 1975, *Maxwell* 75-131 (**BK**); *ibid.*, 11 Apr. 1975, *Maxwell* 75-420 (**BK**); Rayong [Chak Phong, Klaeng, 17 May 2004, *Kertsawang* 293 (**QBG**); Chanthaburi [Khao Sabap, Phlieo Waterfall, 16 June 1970, *Vachanapong* 100 (**BK**); no date, *B.S.* 170 (**BKF**); Ma Kuam, 22 Nov. 1930, *Lakshnakara* 482 (**AAU, ABD, BK, E, K**); outside entrance to river on the way to the lighthouse, *Collins* 556 (**K**); Khao Sabap, Chanthabun, 5 July 1927, *Put* 890 (**AAU, ABD, BK, BM, C, E, K, L, P**); Laem Ling, 8 Apr. 1923, *Marcen* 1347 (**ABD**); Phlieo Falls, 4 Apr. 1971, *Maxwell* 71-245 (**AAU, BK, L**); Trat [23 Aug. 1954, *Sangkhachand* 179A (**L**); Ko Chang, Khlong Son, 15 Apr. 1955, *Bunnak* 418 (**A, BKF**); Makham, 17 Mar. 1956, *Sangkhachand* 629 (**C, E, K, L, P**); West slopes of Khao Sabap, 25 Feb. 1935, *Seidenfaden* 2683 (**C**); near Ban Saphan Hin, ca 60 km SE from Trat, 4 Aug. 1973, *Murata et al.* T-17628 (**BKF**); PENINSULAR: Chumphon [Pathio, 24 May 1969, *Jaray* 29 (**BK**); Tha Sae, 30 May 1969, *Jaray* 87 (**BK**); Bang Son, 9 Mar. 1928, *Put* 1469 (**AAU, ABD, BK, C, E, K, L**); Ranong [Kapoe, 18 Nov. 1965, *Sangkhachand* 1139 (**C**); Surat Thani [18 Aug. 1975, *Prapat* 47 (**BKF, C, L**); Khao Thapet, 5 June 1966, *Sakol* 1026 (**BK**); Ko Prob, 17 July 1966, *Sakol* 1387 (**BK**); Pha Phet, no date, *Smitinand* 5592 (**BKF**); Phangnga [Thung Chali, Nang Yo, 20 July 1979, *Niyomdham et al.* 356 (**BKF, C, K, L, P**); low hill along road, south of Takua Pa, 12 May 1968, *van Beusekom & Phengklai* 732 (**AAU, BKF, C, E, K, L, P**); Kopah, 14 Dec. 1907, *Haniff* 2948 (**BM,**

K)]; Phuket [on way from Ton Sai Wildlife Reserve to Pa Klok, 7 July 1979, *Niyomdham et al.* 217 (BKF, C)]; Foothills of Khao Phra Mountain, 8 July 1972, *Robson* 30761 (AAU, E, K, P); Khao Phra Mountain, 8 July 1972, *Larsen et al.* 30764 (AAU, E, K, P)]; Krabi [Nai Chong, Amphoe Muang, 14 Apr. 1969, *Chermisrivathana & Kasem* 1327 (BK); Kho Pra-Bang Khram Wildlife Sanctuary, 15 Aug. 2006, *Maxwell* 06-590 (CMUB)]; Nakhon Si Thammarat [Chawang, 10 Aug. 1956, *Sanan* 767 (AAU, BKF, L)]; Chong Khao, Thung Song District, 31 Aug. 1982, *Shimizu et al.* T-28951 (BKF)]; Phatthalung [Khaun-kha-nun, 6 Sept. 1996, *Purintavasagul* 223 (PSU)]; Trang [*Vanpruk* 602 (K); Chum Het, 15 Apr. 1928, *Kerr* 15212 (ABD, BK, K); Si Kao, 18 Apr. 1930, *Kerr* 19017 (AAU, ABD, BK, K); near Med Plant Exp. Plot, Trang Hort. Exp. Sta., Amper Sikao, 28 July 1987, *Paisooksantivatana & Sangkhachand* Y-2135-87 (BK)]; Satun [Khuan Kalong, 10 May 1967, *Unknown collector* 365 (BKF); *ibid.*, 9 May 1967, *Phengnaren* 496 (BKF, K, L, P)]; Songkhla [12 Sept. 1979, *Udomsak* 16 (PSU); Ton Nga Chang Wildlife Sanctuary, 20 km west of Hat Yai, 4 Aug. 1980, *Students* 22 (PSU); Hat Yai Municipal Park, Wat Kawn Chong, Hat Yai, no date, *Congdon & Hamilton* 22 (A, PSU); Ban Tun, Muang District, 16 Sept. 1980, *Suwit* 32 (PSU); Park, Hat Yai, 11 Sept., 1980, *Students* 36 (PSU); PSU Campus, 18 Oct. 1982, *Peechate* 37 (PSU); Tumbol Kho Sa Ba, The-Pha, 24 Nov. 1943, *K.K. et al.* 54 (PSU); Hat Yai, 16 Apr. 1960, *Pradit* 202 (BK); Khuan Mit, 29 Apr. 1979, *Congdon & Hamilton* 404 (PSU); Kho Hong Hill, Hat Yai, 23 Aug. 1979, *Srirugsa* 404 (PSU); Khlong Hae, Hat Yai, 24 Apr. 1985, *Vachanapong* 654 (BK); Rataphum, 25 May 1970, *Sutheesoan* 1733 (BK); Tapa, 23 Mar. 1928, *Kerr* 14709 (ABD, BK, BM); Kho Hong Hill, Hat Yai, 30 Oct. 1990, *Larsen et al.* 40938 (PSU); Ton Nga Chang Wildlife Sanctuary, 1 Nov. 1990, *Larsen et al.* 41030 (AAU, BKF, P, PSU); Khao Chum Sak, Hat Yai, 12 June 1992, *Larsen et al.* 42818 (AAU, P); Kho Hong Hill, Hat Yai 25 May 1985, *Maxwell* 85-537 (A, AAU, BKF, E, L, P, PSU); Khlong Hoi Khong, Hat Yai, 2 Oct. 1985, *Maxwell* 85-934 (AAU, BKF, L, PSU); near Boripath Waterfall, 12 Jan. 1978, *Srirugsa* PS21 (PSU); Tung Lung, 19 Apr. 1974, *Vitthu* V9 (PSU)]; Pattani [Banang Station, 2 July 1923, *Kerr* 7316 (AAU, ABD, BK, BM, E, K), 8 Sept. 1923, *Kerr* 7745 (AAU, ABD, BK, BM, E,

K)]; Yala [Muang, 28 July 1988, *Saephu* 8 (PSU)]; Narathiwat [Yi-ngo, 18 May 1961, *Sangkhachand* 155 (C, L, P); Tak Bai, 12 July 1983, *Niyomdham* 692 (BKF, C)]; Unknown locations [5 Dec. 1921, *Vanpruk* 298 (BKF, K); Jan.–May 1927, *Squires* 333 (E); 1862–1866, *Thorel* 1062 (E); 22 Apr. 1958, *Sørensen et al.* 3015 (C); 1862, *Pierre* 3236 (E); *Bitsenuloke & Groff* 6146 (K); *Vanpruk s.n.* (BKF, K); *Godefroy-Lebeuf s.n.* (K).

Distribution.— Myanmar, China, Indochina, Malay Peninsula, Borneo, Philippines, Sumatra.

Ecology and phenology.— Evergreen, deciduous or tropical rainforest, savannah, scrub from near sea level to 1100 m elevation. Flowering: March–June. Fruiting: August.

Vernacular.— Teo (ตั่ว) (*Ladell* 204); taew (แต้ว) (*Bunnak* 418); tiu kliang (ตั่วเกลี้ยง) (*BGO Staff* 63); tarat ki tai (ตาแรดขี้เต้) (*Sangkhachand* 179A); seu gwae joh (*Maxwell* 01-514).

Conservation.— IUCN Global & Regional (Thailand) Status: Least Concern (LC).

3. *Cratoxylum formosum* (Jack) Dyer in Hook.f., Fl. Brit. Ind. 1: 258. 1874; Kurz, Forest Fl. Burma 1: 83. 1877; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 145. 1890; Koord. & Val., Bijdr. Boomsort. Java 5: 137. 1900; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 287. 1910; Ridl., Fl. Malay Penins. 1: 152. 1922; Craib, Fl. Siam. 1: 111. 1925; Corner, Gard. Bull. Straits Settlements 10: 23, 28. 1939; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 251. 1943; Backer & Bakh.f., Fl. Java 1: 383. 1963; Meijer, Bot. News Bull. Forest Dept., Sabah 7: 64. 1967; Gogelein, Blumea 15: 467. 1967; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; Corner, Wayside Trees of Malaya 1: 325. 1988; P.H. Hô, Ill. Fl. Vietnam 1(1): 578, f. 1602. 1991; Thin, Sida 17(4): 742. 1997; H.W. Li *et al.*, Fl. China 13: 37–38. 2007. ≡ *Elodes formosa* Jack, Malay. Misc. 2(7): 24. 1822. ≡ *Tridesmis formosa* Korth., Verh. Nat. Gesch. Bot.: 179, t. 37. 1836. ≡ *Tridesmis jackii* Spach, Ann. Sci. Nat., Bot., Sér. 2, 5: 352. 1836. Type: Indonesia, Sumatra, *Jack s.n.* (holotype CAL!)

Trees to 8 m tall; dbh 10 cm; outer bark thick, scaly and flaking, inner bark with watery exudate. Branchlets larger branches armed with long stout thorns, stems spiny, brown, interpetiolar scars

interrupted. *Leaves* petioled, petiole 0.2–0.8 cm long; blade .2–10.4 × 1.3–4 cm, oval, elliptic, lanceolate, round, oblanceolate or obovate, light green, some yellow/green or brown/red, base cuneate, few being almost angustate, apex acute, round, obtuse, acuminate or cuspidate, midrib faint adaxially, obvious abaxially, narrowing towards apex, venation netted, obvious on some leaves, faint on others, secondary, intersecondary, tertiary and intramarginal veins present, veins not arising from same points on both sides of the midrib, 7–12 pairs of very obvious side veins joined in loops near margins. *Inflorescence* in

clusters of flowered cymes of 1–6 on old leafless twigs, pedicels 0.3–1(–1.5) cm long. *Calyx* sepals 5–7 × 2–3 mm, oblong to elliptic, persistent, green-grey. *Corolla* petals, 5; obovate to oblong; persistent?, flowers white. *Stamens* fused into 3 slender fascicles of 20–30 stamens, anthers round, slightly shorter than the styles. *Ovary* 2–4.5 mm long, styles 3, 2–8 mm long, green, glabrous. *Fruit* 4–6 mm, oval, oblong, obovate with pointed tip purple/deep red; pedicel 6–11 mm long, hairy; covered by persistent sepals at base. *Seeds* 6–8 per loculus, 6–7.5 × 2–4 mm, obovate, oblong or oblanceolate.

KEY TO THE SUBSPECIES OF *C. FORMOSUM*

1. All parts glabrous

1. Young twigs, pedicels, calyx and leaves pubescent

1. subsp. **formosum**

2. subsp. **pruniflorum**

1. subsp. **formosum**

— *Hypericum biflorum* (non Lamark) Choisy in DC., Prod. 1:546. 1824. Type: China, ?*König*.

— *Tridesmis ochnoides* Spach, Hist. Veg. Phan. 5: 359. 1836; Ann. Sci. Nat. Bot. 2(5): 351, t. 4a. 1836; Blume, Mus. Bot. 2:18. 1852. Type: ?holotype: **FI** [FI1005999!], possible first stage lectotype, see Gogelein, Blumea 15468-469. 1967.

— *Hypericum aegyptium* Blanco, Fl. Filip. 615. 1837. Type: Philippines, Palawan, Taytay, *Merrill Species Blancoanae* 632 (Illustrative specimen/neotype)(**S!**).

— *Cratoxylum pentadelphum* Turcz., Bull. Soc. Naturalistes Moscou 36: 580. 1863. Type: Indonesia, Java, *Horsfield s.n.* (lectotype **KW** [KW001000481!], designated here; isoelectotypes **BM!**, **CGE** not seen).

All parts glabrous; connective without glands.

Thailand.— (Map 2.2.3a): NORTHERN: Chiang Mai [Doi Suthep, 15 Apr. 1909, *Garrett* 32 (**K**)]; Sukhothai [29 Apr. 1964, *Pradit* 899 (**BK**)]; NORTH-EASTERN: Kalasin [Kalasin Morning Market, A. Muang Kalasin, 28 Jan. 1990, *Widmer* 30 (**BKF**)]; Maha Sarakham [Pa Khok Dang Khaeng, Maha Sarakham University, 10 May 1996, *BGO Staff* 3 (**QBG**)]; Khon Kaen [Nam Phong, 22 June 2003, *Chantaranothai et al. s.n.* (**KKU**)]; EASTERN: Chaiphaphum [Pa-Hin-Ngam Forest Park, 17 Mar. 1993, *Suddee* 26 (**BKF**)]; East Chaiphaphum, 18 Apr. 1971, *Chaloenphol* 85 (**L**); Pak Pang via Chaiphaphum, 30 Jan. 1931, *Kerr* 19970 (**AAU**, **ABD**, **BK**, **BM**,

C, **E**, **K**); Roi Et [Kasetwisai, Ban Nam Om, 9 June 1982, *Paisooksantivatana & Sutheesoem* Y1027-82 (**BK**)]; Si Sa Ket [Kantharalak District, 24 Mar. 1966, *Sangkhachand* 203 (**BK**); *ibid.*, 24 Mar. 1966, *Sangkhachand* 208 (**BK**); *ibid.*, 28 Mar. 1966, *Sangkhachand* 214 (**BK**); *ibid.*, 12 Apr. 1966, *Sangkhachand* 245 (**BK**)]; Ubon Ratchathani [Nam Tok Sae, NE, 26 Feb. 1967, *Phusomsaeng* 33 (**BKF**, **C**, **E**, **K**, **L**, **P**); Wormchumsak, 25 Feb. 1961, *Chirayupin* 187 (**BK**); Dong Phrauan, no date, *Niyomdham* 4598 (**AAU**)]; SOUTH-WESTERN: Kanchanaburi [Dongyai, 14 Aug. 1971, *Phengkklai et al.* 2928 (**C**, **E**, **K**, **L**); Between Kritee & Meung Chah, 7 July 1973, *Geesink & Phengkklai* 6169 (**C**, **E**, **K**, **L**, **P**); Prachuap Khiri Khan [Khlong Lah Met, 17 July 1921, *Winit* 628 (**ABD**, **BK**, **BKF**); Huai Yang Forest Reserve, 21 Apr. 1997, *Lamkay* 40-112 (**KKU**); no date, *Godefroy-Lebeuf s.n.* (**K**)]; CENTRAL: Saraburi [Sam Lan, 30 Mar. 1974, *Maxwell* 74-219 (**AAU**, **BK**, **BKF**); Sam Lan Forest, Muang District, 15 June 1974, *Maxwell* 74-590 (**AAU**, **BK**, **L**); Nakhon Nayok [Pakphli District, June 1991, *Somprasong & Sangkhachand* 53 (**BK**); Kao Sila, 25 Mar. 1975, *Sutheesoem* 3242 (**BK**)]; SOUTH-EASTERN: Sa Kao [Aran Pratet, 18 Oct. 1928, *Put* 2020 (**AAU**, **ABD**, **BK**, **BM**, **E**, **K**); Prachin Buri [Taphraya, 4 Jan. 1966, *S. & J.* 2093 (**BK**); Chon Buri [Sri Racha Forest, 16 miles inland from sea, Aug. 1913, *Collins* 159 (**AAU**, **BK**, **E**, **K**); Sri Racha Forest, *Collins* 578 (**K**); Sri Racha Forest, Khong Yai Bu, 29 Mar. 1921, *Collins* 723 (**ABD**, **E**, **K**, **TCD**); Sri Racha Forest, 4 Mar. 1920, *Kerr* 4033

(**ABD, BM, K, TCD**); Chantalen Falls, 18 Dec. 1974, *Chermsirivathana & Sangkhachand* 1969 (**BK**); Ko Khram, Sattahip, 14 Aug. 1999, *Phengkhai et al.* 11930 (**BKF**); Ang Chong Nam, Ban Bueng District, 29 Feb. 1976, *Maxwell* 76-129 (**BK, P**); Rayong [Chak Phong, Klaeng, 3 Apr. 2004, *Kertsawang* 252 (**QBG**)]; Chanthaburi [Laem Sing, 8 Apr. 1923, *Marcan* 1339 (**ABD, BM**); Makam, 8 Apr. 1959, *Smitinand* 5751 (**AAU, BKF, L**); Plain of Makam, 9 Apr. 1959, *Sørensen et al.* 7232 (**C**)]; Trat [Leam Koh, 28 Mar. 1955, *Sangkhachand* 355 (**BKF, L**); Ko Chang Noi, *Schmidt* 696 (**C, K**); Amphoe Khao Saming to Khlung, 2 Jan. 1930, *Kerr* 17923 (**AAU, ABD, BK, BM, C, K, L**)]; PENINSULAR: Chumphon [Phon, 16 Mar. 1958, *Sørensen et al.* 2142 (**C, K**)]; Surat Thani [Na Muang Falls, Ko Samui, 2 June 1960, *Chirayupin* 152 (**BK**); Ko Samui, 8 Apr. 1927, *Kerr* 12539 (**ABD, BK, BM, E, K**); Ban Na San, 13 Aug. 1927, *Kerr* 13324 (**AAU, ABD, BK, E, K**)]; Phangnga [Khao Nanghong, 9 May 1967, *Sutheeso* 2563 (**BK**)]; Krabi [Sakeo, 23 Dec. 1924, *Kerr* 9748 (**AAU, ABD, BK, BM, C, E, K, L**)]; Trang [Angtong Falls, Sikao District, 16 Oct. 1978, *Taworn* 78 (**PSU**); Amphoe Nayong, Khao Chong NP, trail from Botanic Gardens HQ to Ton Yai, 9 July 2000, *Middleton et al.* 345 (**A, E, TCD**); Khao Chong, 10 Mar. 1966, *Bunnab* 415 (**BKF**); *ibid.*, 16 June 1973, *Phusomsaeng et al.* 1594 (**BKF**); *ibid.*, 18 Mar. 1969, *Sangkhachand* 1798 (**BKF**); *ibid.*, 25 June 1969, *Sangkhachand* 1913 (**BKF**); *ibid.*, 8 Mar. 1976, *Chermsirivathana* 2203 (**BK**); Trang Forest near Chong Waterfalls, 18 Sept. 1933, *Collins* 2357 (**AAU, BM, K, P**); Chong, 20 Aug. 1935, *Smitinand* 2960 (**BKF, L**); Ko Libong, 21 Apr. 1930, *Kerr* 19056 (**AAU, ABD, BK, BM, E, K**); Khao Chong, 12 Mar. 1974, *Larsen & Larsen* 33255 (**AAU, C, K, P**); *ibid.*, 13 Aug. 1975, *Maxwell* 75-831 (**BK, L**); Satun [Khlóng Ton, 10 Mar. 1928, *Kerr* 14431 (**AAU, ABD, BK, BM, K**)]; Songkhla [near Suanisan Restaurant, Hat Yai, 16 Sept. 1991, *Pollawat* 6 (**PSU**); Hat Yai. Khuan Mit, 29 Apr. 1979, *Congdon* 404 (**AAU, BKF**); Hat Yai, Kho Hong Hill, summit ridge, 31 Mar. 1985, *Maxwell* 85-348 (**A, BKF, E, L, PSU**); *ibid.*, 10 Oct. 1985, *Maxwell* 85-946 (**A, AAU, L, PSU**)]; Narathiwat [Bacho, 18 Apr. 1961, *Sangkhachand* 65 (**C**)]; Unknown location [Apr. 1870, *Pierre* 146 (**E**)].

Distribution.— Cambodia, Laos, Vietnam, Malaysia, Indonesia, Philippines

Ecology and phenology.— Evergreen forest, deciduous forest, beach, scrub area from 20 to 900 m elevation. Flowering: March–June. Fruiting: April–October.

Vernacular.— Tao (ต้าว) (*Kerr* 14431); teo (เตอ) (*Kerr* 9748); tao-som (ต้าวส้ม) (*Sangkhachand* 355); tiu khao (ต้าวขาว) (*BGO Staff* 3).

Uses.— The wood is used in construction.

Conservation.— IUCN Global & Regional (Thailand) Status: Least Concern (LC).

2. subsp. **pruniflorum** (Kurz) Gogelein, *Blumea* 15: 469. 1967; S.Gardner *et al.*, *Field Guide Forest Trees N. Thailand*: 48. 2000. $\equiv$ *Tridesmis pruniflora* Kurz, *J. Asiat. Soc. Bengal*, Pt. 2, Nat Hist. 41(2): 293. 1872. $\equiv$ *Cratoxylum pruniflorum* (Kurz) Kurz, *J. Asiat. Soc. Bengal*, Pt. 2, Nat Hist. 43(2): 84. 1874; Kurz, *Forest Fl. Burma* 1: 84. 1877; Craib, *Fl. Siam.* 1: 113. 1925. $\equiv$ *Cratoxylum prunifolium* (Kurz) Dyer in Hook.f., *Fl. Brit. India* 1: 258. 1874; Brandis, *Indian Trees*, 47. 1907; Gagnep. in Lecomte, *Fl. Indo-Chine* 1(4): 287. 1910; Gagnep. in Humbert, *Suppl. Fl. Indo-Chine* 1(3): 251. 1943. Type: Myanmar, *Kurz s.n.* (not located, probably **CAL**).

— *Hypericum prunifolium* Wall., *Numer. List.* [Wallich] 7276. 1828; **nom. nud.**

— *Cratoxylum dasyphyllum* Hand.-Mazz., *Sinensia* 2: 4. 1931. Type: China, *Ching* 7980 (isotypes **L** [L0012128!], **NY** [NY00084786!], **W** not seen).

Young twigs, pedicels, calyx and leaves pubescent; connective with glands.

Thailand.— (Map 2.2.3b): NORTHERN: Mae Hong Son [Khun Yuam, 4 Apr. 1977, *Nimanong et al.* 1787 (**PSU**); Di Bao-hae, Mae Sariang, 23 Apr. 1973, *Sutheeso* 2379 (**BK**)]; Chiang Mai [Botanic Garden, Mae Rim, 18 Oct. 1993, *BGO Staff* 6 (**QBG**); *ibid.*, 21 Mar. 1996, *Morakot* 8 (**QBG**); *ibid.*, 30 Mar. 1998, *Watthana* 98 (**QBG**); *ibid.*, 6 Apr. 1994, *BGO Staff* 587 (**QBG**); Mae Sanam Arboretum, 17 Apr. 2000, *Sankamethawee* 110 (**CMUB**); Doi Suthep, 1 Apr. 1949, *Soradetch* 426 (**BKF**); Chom Thong, Fang, Pong Namron, 17 Aug. 1968, *Phengnaren* 579 (**BKF, L**); Doi Suthep, 27 Apr. 1909, *Kerr* 611 (**BM, K, P, TCD**); Doi Pha Dam, between Hang Dong & Bo Luang, 5 July 1968, *Larsen et al.* 2152 (**AAU, BKF, E, L, P**); Doi Suthep, *Sørensen et al.* 2910 (**C**); Mae Sa Mai, 30 Mar. 1996,

BGO Staff 6216 (QBG); Doi Inthanon NP, 4 May 1996, *BGO Staff 6389 (QBG)*; *ibid.*, 18 July 1988, *Phengklai et al. 6551 (C, K)*; Doi Suthep, east side, Huai Kao Falls Area, 4 July 1987, *Maxwell 87-604 (BKF, L)*; Muang District, Doi Suthep, east side, East side of Khonthathan Falls Area, 6 Apr. 1988, *Maxwell 88-430 (AAU, BKF, L)*; Jawn Tong, 19 July 1991, *Maxwell 91-661 (A, AAU, E, P)*; Jawn Tong, Mae Soi Valley, Mae Soi Subdistrict, without date, *Maxwell 90-525 (L)*; Muang District, east side of the Central University Library, Chiang Mai University, 11 May 1992, *Maxwell 92-213 (A, CMUB, E)*; Mae Pah Boo (Karen Village), 23 May 1995, *Maxwell 95-428 (A, CMUB)*; Doi Lahn, 18 Sept. 1996, *Maxwell 96-1204 (A, BKF, CMUB)*; Doi Bah Gluay, 3 May 1997, *Maxwell 97-434 (A, BKF, CMUB)*; Jahm Luan Subdistrict, Huay Yah Dtai (Karen) Village, slopes along Mae Jon River, 11 June 1998, *Maxwell 98-649 (A, CMUB, L)*; Doi Suthep-Pui NP, 22 Mar. 2000, *Maxwell 00-148 (A, CMUB)*; Doi Inthanon NP, 2 Dec. 1998, *Hara C533 (CMUB)*; Mae Ya Waterfall, Doi Inthanon, 29 Nov. 1999, *Hara E98 (CMUB)*; Tad Noi, Somthong, 14 Feb. 1938, *Taengsuwan s.n. (BKF)*; Me Tun, 28 Apr. 1915, *Winit 315 (BM, K)*; Chiang Rai [Khun Chae NP, 5 Apr. 1998, *Maxwell 98-397 (BKF, CMUB)*; Doi Luang NP, 29 May 1998, *Maxwell 98-604 (A, BKF, CMUB)*; Lamphun [Ban Pha Mon (Chom Thong), 31 May 1979, *Vidal et al. 6205 (BKF, E, K, L, P)*; Doi Khun Tan NP, 1 May 1994, *Maxwell 94-579 (A, CMUB)*; *ibid.*, 28 Sept. 1994, *Maxwell 94-1050 (A, CMUB)*]; Forest at Jaehomwitthaya School, 19 Apr. 2000, *Panatkool 257 (A, CMUB)*; *ibid.*, 21 May 2000, *Panatkool 309 (A, CMUB)*; *ibid.*, 25 Mar. 2001, *Panatkool 481 (A, CMUB)*; Me Kang, 29 Apr. 1925, *Winit 1403 (ABD, BK, BKF, K)*; Muang Ngao, 16 July 1931, *Put 4013 (ABD, BK, BM, E, K)*; Ngao, Pratu-pha, 2 Sept. 1996, *Phengklai & Fukuoka 10127 (BKF)*; Huai Tak, 28 May 1954, *Tharawattananon BKF 40372 (BKF)*; Doi Luang NP, 22 Apr. 1997, *Maxwell 97-386 (A, CMUB)*; Phrae [Huai Mae Sai, Padaeng District, 21 May 1949, *Sukket 3 (BKF)*; Wang Mon, 19 Feb. 1912, *Vanpruk 285 (BKF, K)*; Huai Khamin, 23 Aug. 1940, *Somkid 468 (BKF)*]; Tak [Lan Sang, 31 May 1973, *Geesink et al. 5596 (C)*; Lan Sang NP, 22 July 1973, *Murata et al. T-16683 (BKF, P)*]; Phitsanulok [Thung Salaeng Luang, 19 July 1966, *Larsen et al. 468 (AAU, BKF)*]; Nakhon Sawan [Khlong Lan, 2 km from Tr.

in southerly direction, 12 Aug., 1998, *van de Bult 79 (BKF, CMUB)*]; NORTH-EASTERN: Phetchabun [Sangkhachand 3112 (C, L)]; Loei [Namtok Tad Hueang, Na Haeo, 9 Dec. 1996, *BGO Staff 27 (QBG)*; *ibid.*, 7 Nov. 1995, *BGO Staff 120 (QBG)*; Si Tang, Wang Saphung District, 19 Mar. 1952, *Smitinand 1216 (BKF)*; Na Haeo, 28 July 1995, *BGO Staff 3976 (QBG)*; HQ-Phu Son, Phu Ruea NP, 12 Dec. 1996, *BGO Staff 8184 (QBG)*]; EASTERN: Chaiyaphum [18 Apr. 1971, *Chaloenphol 85 (BK)*; Nam Phrom, 10 Dec. 1971, *van Beusekom et al. 4100 (C)*]; Buri Ram [Lam Nong Rong, 23 Mar. 1920, *Suksakorn 892 (K)*]; Surin [3 Dec. 1976, *Phengklai et al. 3590 (PSU)*]; Si Sa Ket [Kantharalak District, 21 Apr. 1966, *Sangkhachand 296 (BK)*]; SOUTH-WESTERN: Kanchanaburi [Saneh Rawng Village, Sangklaburi, 19 May 2003, *Kansuntisukmongkol 186 (A, CMUB)*; Thung Yai Naresuan West Wildlife, Thong Pha Phum, 14 Apr. 2006, *van de Bult 885 (CMUB)*; near Kin Sayok about 120 km north west of Kanburi, 12 July 1946, *Kostermans 1090 (A, C, L)*; Dongyai, 14 Aug. 1971, *Phengklai et al. 2928 (AAU)*; Ban Kao, 17 Nov. 1961, *Larsen 8297 (C)*; 12 Mar. 1926, *Kerr 10604 (ABD, BK, BM, E, K, TCD)*; Muang Cha Area, Sangkhla Buri District, 8 July 1973, *Maxwell 73-208 (BK)*]; CENTRAL: Saraburi [Sam Lan Forest, Muang District, 19 May 1974, *Maxwell 74-528 (AAU, BK)*; *ibid.*, 8 Feb. 1975, *Maxwell 75-108 (BK, L)*]; Nakhon Nayok [Muang District, 3 May 2002, *Charoenchai & Poompuang 246 (CMUB)*]; SOUTH-EASTERN: Chon Buri [Sri Racha, 4 Mar. 1920, *Kerr 4034 (ABD, BM, K)*; Khao Khieo, Sri Racha District, 2 Feb. 1975, *Maxwell 75-102 (BK, L)*; Phra Chedi mountain, Ko Kieo, Sri Racha, 11 Apr. 1975, *Maxwell 75-419 (BK, L)*]; Chanthaburi [28 Mar. 1956, *Sangkhachand 640 (L)*; Soi Dao, Larsen 10015 (C); Khao Phra Bat, north of Chanthaburi, 27 Aug. 1972, *Larsen et al. 32141 (AAU, E, K, P)*]; PENINSULAR: Krabi [Kow Pra-Bahng Krahm Wildlife Sanctuary, 30 Mar. 2006, *Maxwell 06-240 (CMUB)*]; Unknown locations [1914, *Vanpruk 479 (P)*; Truck Lek, 25 Apr. 1922, *Marcen 737 (BM)*; Muan Jawn, 3 Apr. 1922, *Kerr s.n. (BK, P)*; *Kerr s.n. (BM)*].

Distribution.— Myanmar, Laos, Cambodia Vietnam, southern China.

Ecology and phenology.— Evergreen forest, deciduous forest, rocky dipterocarp savannah, on limestone from 20 to 950 m elevation. Flowering: March–May. Fruiting: April–November.

Vernacular.— Teaw (ต้าว) (*BGO Staff* 27); ra-gein (ราเง็ง) (*Sangkhachand* 640); tiu khon (ต้าวขน) (*BGO Staff* 6); tiu daeng (ต้าวแดง) (*Watthana* 98); tiu (ต้าว) (*BGO Staff* 8184); sah gwe jo (*Maxwell* 95-428); sih weh jo (*Maxwell* 98-604).

Uses.— The bark is used as a medicine to treat diarrhoea in domestic animals and the young leaves are used as a substitute for tea. (Li *et al.*, 2007).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

4. *Cratoxylum maingayi* Dyer in Hook.f., Fl. Brit. India 1: 258. 1874; King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 145. 1890; Gagnep., Notul. Syst. (Paris) 1: 19. 1909; Ridl., Fl. Malay Penins. 1: 152. 1922; Goegelein, Blumea 15: 470. 1967; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 4–6. 1974; Corner, Wayside Trees of Malaya 1: 325. 1988; Phengkklai & Niyomdham, Flora in peat swamp areas of Narathiwat: 197. 1991; S. Gardner *et al.*, Field Guide Forest Trees N. Thailand: 49. 2000. Type: Malaya, Malacca, Penang, *Maingay* 145 (isotypes **BM** [BM000624807!], **CAL** not seen, **CGE** not seen, **K!**, **L** [L0012144!, L0012145!]).

— *Cratoxylum harmandii* Pierre, Fl. Forest. Cochinch. 1: t. 53. 1882; Gagnep., Notul. Syst. (Paris) 1: 18. 1909. Type: Vietnam, *Harmand* 3235 (?holotype **P** [P001901062!]; isotype **L** [L0012143!]).

— *Cratoxylum formosum* var. *thorelii* Pierre ex Gagnep., Notul. Syst. 1: 19. 1909. Type: Cambodia, Grand-Lac, *Godefroy* 295 (?holotype **P** [P01901063!], P01901064!]; isotypes **L** [L0012142!], **K!**.

— *Cratoxylum cochinchinense* var. *calcareum* Ridl., Bull. Misc. Inform. Kew 1938: 115. 1938. Type: Indonesia, Borneo, *Haviland* 1463 (lectotype **SING** [SING0062298!], Designated here; isolectotypes **K!**, **L** [L0012146!]).

— *Cratoxylum acuminatum* Merr., Papers Mich. Acad. Sc. 23: 185. 1938. Type: Indonesia, Sumatra, *Rahmat Si Boeea* 7687 (lectotype **SING** [SING0062299!]), designated here; isolectotypes **A** [A000677446!], **L** [L0043274!], **MICH** [MICH1115534!], **S** [S11-34223!].

— *Cratoxylum subglaucum* Merr., Papers Mich. Acad. Sc. 23: 186. 1938. Type: Indonesia, Sumatra, *Rahmat Si Boeea* 7907 (isotypes **A** [A00067448!], **L!**, **MICH** [MICH1115536!], **S** [S-G-1700!], **SING** [SING0062300!]).

— *Cratoxylum parvifolium* Merr., J. Arnold Arbor. 19: 56. 1938. Type: Vietnam, *Clemens & Clemens* 3454 (lectotype **A** [A00067445!], designated here; isolectotypes **BM** [BM000624784!], **L!**, **MICH** [MICH1115535!], **P** [P01901058!], **U** [U226859!], **US!**, **W** not seen).

— *Cratoxylum thorelii* Pierre ex Gagnep., Suppl. Fl. Indo-Chine 1: 252. 1943. Type: Cambodia, Compon Luong, *Thorel* 2065 (?holotype **P** [P01901059!]; isotypes **L** [L0012141!], **P** [P01901060!, P01901061!]).

Deciduous shrubs or trees to 20 m tall, outer bark of many, thin flaking layers, brown, inner bark brown; exudate yellow. *Leaves* petioled, 0.5–1 cm long; blade 2–9 × 1–4.5 cm, obovate to elliptic to oblong, coriaceous, base round to cuneate, apex acute to round, midrib dark green adaxially, greyish-pale to light green adaxially, secondary veins present, raised on both surfaces. *Inflorescence* pedicels light green, 0.2–0.6 cm long, axillary cymes of 2–4 flowers on leafless twigs, flowers pink-white. *Calyx* sepals 2.5–5 × 1–3 mm, oblong, light green. *Corolla* petals 6–12 × 2–5 mm, elliptic, dark red, lateral veins present. *Stamens* numerous, anthers cream; filaments white. *Ovary* 2–3 mm long, styles as long as petals. *Fruit* 2–4 mm diam., oblong to acute. *Seeds* winged, 5–6 per loculus, oblong to ovate-oblong.

Thailand.— (Map 2.2.4): NORTHERN: Chiang Mai [Maesa Botanic Garden, 5 July 1989, *Pooma* 207 (**CMUB**); Muang Fang, 3 June 1992, *Maxwell* 92-255 (**A**, **CMUB**, **E**, **P**); Doi Suthep-Pui NP, SW side off road to Sisangwen Falls, Hang Dong District, 5 Nov. 1992, *Maxwell* 92-666 (**CMUB**, **P**); Mae Pah Boo (Karen Village), 23 May 1995, *Maxwell* 95-426 (**A**, **CMUB**); NORTH-EASTERN: Nakhon Phanom [Phu Phan NP, 14 Dec. 1982, *Koyama et al.* T-31004 (**A**, **BKF**); PENINSULAR: Ranong [Kapoe, 18 Nov. 1965, *Sangkhachand* 1139 (**BKF**, **K**, **L**); Trang [Khao Chong, 26 Oct. 1965, *Boonnab* 92 (**BKF**); Narathiwat [Pawai, Su-ngai Padi, 9 Sept. 1985, *Niyomdham et al.* 928 (**A**, **AAU**, **BKF**, **C**, **K**, **L**)].

Distribution.— Indochina, Malay Peninsula, Singapore, Sarawak, Sumatra.

Ecology and phenology.— Lowland forest, peat swamp forest from near sea level to 850 m elevation. Flowering: May–June. Fruiting: November–December.

Vernacular.— Tao (ต้าว) (*Sangkhachand* 1139); sah gwee jo (*Maxwell* 95-426).



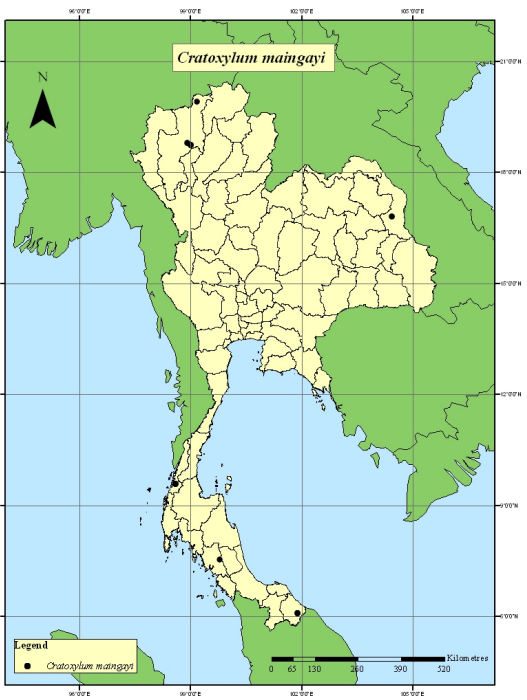
Map 2.2.2 Distribution of *Cratoxylum cochinchinense* in Thailand.



Map 2.2.3a Distribution of *Cratoxylum formosum* subsp. *formosum* in Thailand.



Map 2.2.3b Distribution of *Cratoxylum formosum* subsp. *pruniflorum* in Thailand.



Map 2.2.1 Distribution of *Cratoxylum maingayi* in Thailand.

Conservation.— IUCN Global & Regional (Thailand) Status: Least Concern (LC).

5. *Cratoxylum neriifolium* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 41(2): 293. 1872; Dyer in Hook.f., Fl. Brit. India 1: 257. 1874; Kurz, Forest Fl. Burma 1: 85. 1877; Gamble, Man. Ind. Timb.: 48. 1881; Prain, Bengal Pl. 1: 244. 1903; Brandis, Indian Trees, 47. 1907; Gagnep. in Lecomte, Fl. Indo-Chine 1(4): 291. 1910; Craib, Fl. Siam. 1: 112. 1925; Gagnep. in Humbert, Suppl. Fl. Indo-Chine 1(3): 254. 1943. $\equiv$ *Cratoxylum sumatranum* Blume subsp. *neriifolium* (Kurz) Goegein, Blumea 15: 463. 1967; S.Gardner *et al.*, Field Guide Forest Trees N. Thailand: 49. 2000. Syntypes: Myanmar, Chittagong, Pegu Myanmar, Kurz (not located).

— *Hypericum neriifolium* Wall., Numer. List. 4824 (*pro parte*). 1828, **nom. nud.**

Deciduous trees 7–20 m tall; dbh 40 cm; outer bark thick, roughly cracked and flaking, black, fissured, very rough; exudate not recorded. *Branchlets* terete to flattened, smooth, scars absent, black to black-red to green. *Leaves* sessile; blade 5.7–10.3 $\times$ 1.5–3.1 cm, lanceolate to elliptic to oblong coriaceous and tough, occasionally glaucous, base rounded to slightly cordate, apex acute to rounded to acuminate, midrib obviously depressed on upper surface and pronounced on lower surface, light yellow to red/brown on upper surface, yellow to dark red on lower surface, secondary, intersecondary and intramarginal veins present, all visible. *Inflorescence* flowering branch flattened, then spreading into many-branched terete delicate pedicels, flowers usually in groups of 3, forming an elongated inflorescence not in the axils of mature leaves but on leaf twigs, length of pedicel variable. *Calyx* sepals persistent, 6 $\times$ 3 mm, obovate; greenish-brown. *Corolla* petals twice as long as sepals, bright scarlet. *Stamens* filaments free. *Ovary* 1.5–3 mm long. *Fruit* 8–9 $\times$ 4–5 mm, covered by persistent sepals. *Seeds* 6–8 per loculus.

Thailand.— (Map 2.2.5): NORTHERN: Chiang Mai [Muang Payao, 11 July 1931, *Put* 3970 (**AAU, ABD, BK, BM, E, K**)]; Chiang Rai [Payao, 23 July 1966, *Prayad* 441 (**BK**)]; Huai Dong, at Tew Dam, 13 Aug. 1926, *Winit* 1794 (**ABD, BK, BKF, K, TCD**); Lampang [Mae Huat, Ngao, 21 May 1954, *Sabhasi* 2 (**BKF**)]; Chae Hom, 4 Feb. 1921, *Kerr* 4776 (**AAU, ABD, BK, BM, K**); Phrae [Pai Ton, 1 July 1911,

Vanpruk 270 (**BKF, K**); Huai Khamin, 24 Aug. 1940, *Somkid* 469 (**BKF**); Song, Mae Yom NP, Tao Pun Subdistrict, 10 Oct. 1991, *Maxwell* 91-872 (**AAU, CMUB, E, P**); Phitsanulok [in strip of cut out forest near rivulet (Ran Ti River), Apr.–May 1946, *Kostermans* 274 (**A, K, L**)]; NORTH-EASTERN: Udon Thani [Nong Bua, 7 Mar. 1924, *Kerr* 8619 (**ABD, BK, BM, C, E, K, P, TCD**)]; EASTERN: Nakhon Ratchasima [Pak Thong Chai, 27 May 1968, *Phengnaren* 529 (**BKF**)]; SOUTH-WESTERN: Uthai Thani [Kao Pa-sha, Nong Chang, 29 May 1974, *Sutheesoren* 3008 (**BK**)]; Kanchanaburi [Kwae Noi Basin, *Unknown collector* 143 (**L**)]; Tham Phe, 25 Dec. 1961, *Phengklai* 322 (**L**); Brangkasi, about 100 km south of Wangka, 19 June 1946, *den Hoed & Kostermans* 474 (**BK, K, L**); south of Ka Tha Lai in Pan Puang River Valley, about 40 km south east of Wangka, 13–16 June 1946, *Kostermans* 869 (**A, BK, K, L**); Tapoh, 27 Dec. 1961, *Danish Expedition* 8991 (**A, C, E**); Thung Yai Naresuan Wildlife Reserve, Lai Wa Subdistrict, Ban Saneh Pawng (Karen Village), 15 Aug. 1993, *Maxwell* 93-929 (**A, CMUB**); PENINSULAR: Trang [near Medicinal Plant Exp. Plot, Trang Hort. Exp. Station, Amper Sikao, 28 July 1987, *Paisooksantivatana & Sangkhachand* Y2133-87 (**BK**)]; Unknown locations [*Somkid* 103 (**BKF**)].



Map 2.2.5 Distribution of *Cratoxylum neriifolium* in Thailand.

Distribution.— India, Myanmar, Laos, Cambodia.

Ecology and phenology.— Deciduous and evergreen forests, on limestone from 150 to 800 m elevation. Flowering: April–August. Fruiting: (August) September–March.

Vernacular.— Tao (แต้ว) (*Kerr 8619*); khi chiu (ชีต้าว) (*Kerr 4776*); tio dam (ติวดำ) (*Winit 1794*).

Uses.— Used in construction, and for wooden utensils (e.g. handles of chisels and hammers).

Conservation.— IUCN Regional (Thailand) Status: Least Concern (LC).

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