Chapter 7

Seven new species of *Miliusa* (Annonaceae) from Thailand

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Abstract

Seven new species of the genus *Miliusa* are described from Thailand (*M. fragrans*, *M. hirsuta*, *M. intermedia*, *M. nakhonsiana*, *M. sessilis*, *M. thailandica*, and *M. umpangensis*). A key to the 19 species of *Miliusa* in Thailand is provided. In addition, the complete taxonomic nomenclature of all known species of *Miliusa* in Thailand is given, with several new proposed synonyms. The new as well as the known species of *Miliusa* in Thailand are classified into four morphological groups on the basis of a combination of flower and/or inflorescence position and inner petal morphology proposed earlier.

Introduction

Miliusa Lesch. ex A.DC. is an Asian palaeotropical genus with ca. 50 species occurring from the Indian subcontinent through Indochina, Peninsular Malaysia, the Southeast Asian islands to New Guinea and northern Australia (Mols & Keßler 2003, Chaowasku & Keßler 2006). The genus consists of shrubs or small to large trees inhabiting evergreen or drier (e.g. deciduous or Dipterocarp forests) habitats (Mols & Keßler 2003). According to the results of molecular phylogenetic analyses (Chatrou *et al*. 2012), *Miliusa* belongs to the tribe Miliuseae of the subfamily Malmeoideae. The tribe Miliuseae consists of predominantly Asian-Australasian genera, with a clade of four neotropical genera nested within (see phylogenetic trees in Saunders *et al*. 2011, Xue *et al*. 2011, Chaowasku *et al*. 2013b). In addition, *Hubera* Chaowasku, a newly described genus of the Miliuseae and a sister clade of *Miliusa*, has been found to occur in Madagascar and eastern Africa, apart from Asia, Australia and Melanesia (Chaowasku *et al*. 2012a). All members of palynologically investigated Miliuseae thus far possess cryptoaperturate or disulculate pollen (Waha & Hesse 1988, Waha & Morawetz 1988, Chaowasku *et al*. 2008, 2012a), which is considered one of the synapomorphies of this tribe.

Miliusa is circumscribed by the following characters: 1) equally-sized sepals and outer petals, both of which are much smaller than the inner petals, 2) a densely hairy torus, 3) miliusoid stamens, i.e. stamens without conspicuously dilated connective tissue covering the thecae, and 4) four-part-lamellate ruminations of the endosperm (Chaowasku & Keßler 2006). The morphology of the inner petals of *Miliusa* is very diverse. In combination with the flower and/or inflorescence position, four informal groups can be categorized (Chaowasku & Keßler 2006, Chaowasku *et al*. 2008):

1. The *Miliusa mollis* group

Flowers and/or inflorescences axillary; inner petals completely open at anthesis, with crescent-shaped to semicircular glandular structures inside at (or ± near) base (Figs. 1A, 2A), base not saccate. Included Thai species: *M. amplexicaulis* Ridl., *M. fragrans sp. nov*., *M. fusca* Pierre, *M. intermedia sp. nov.*, *M. mollis* Pierre, *M. nakhonsiana sp. nov*. and *M. sessilis sp. nov.*

2. The *Miliusa horsfieldii* group (former *Saccopetalum* Benn. species)

Flowers and/or inflorescences terminal (developing to internodal; sometimes appearing as 'axillary'); inner petals completely open at anthesis, with narrow, longitudinal (linguiform to linear) glandular structures inside along midrib (Fig. 1B; sometimes less noticeable), base (moderately to) conspicuously saccate. Included Thai species: *M. horsfieldii* (Benn.) Baill. ex Pierre and *M. sclerocarpa* (A.DC.) Kurz.

3. The *Miliusa velutina* group

Flowers and/or inflorescences terminal (developing to internodal; sometimes appearing as 'axillary'); inner petals completely open at anthesis, without pronounced glandular structures inside (Fig. 1D), base usually not to slightly saccate, rarely moderately saccate. Included Thai species: *M. parviflora* Ridl. and *M. velutina* (DC.) Hook.f. & Thomson.

4. The *Miliusa campanulata* group [*Miliusa sensu stricto sensu* Chaowasku *et al*. (2008)]

Flowers and/or inflorescences axillary in most species; inner petals usually tightly appressed from the base to ± the midpoint at anthesis (Figs. 1C, 2B–C), without pronounced glandular structures inside in most species, but (both sides) with a (± reticulate) discoloration [generally much more observable on the basal half; observed in living plants (Fig. 2B–D), often also when dry; probably representing or being a part of diffuse glandular tissue] in most species, species having such discoloration often also exhibiting ± transparent, window-like structures at base (observed only in living plants, Fig. 2D), base usually slightly to moderately saccate, rarely not saccate. Included Thai species: *M. campanulata* Pierre, *M. cuneata* Craib, *M. filipes* Ridl., *M. hirsuta sp. nov*., *M. longipes* King, *M. thailandica sp. nov*., *M. thorelii* Finet & Gagnep. and *M. umpangensis sp. nov*.

A taxonomic revision of *Miliusa* has been conducted for the species that occur in the Austro-Malesian area (Mols & Keßler 2003), leaving the majority of continental Asian species poorly understood, though several new species have recently been proposed, especially from the Indian subcontinent (Narayanan *et al*. 2010, 2012, Chaowasku 2013).

During a study of the phylogeny and taxonomy of the genus as a part of the first author's PhD study, we found seven undescribed species of *Miliusa* occurring in Thailand, belonging to group 1 or 4. Several of these species are only known from the type or a few specimens collected from the same locality; however, in comparisons with their congeners, there are enough (two or more) morphological differences to convince us that they are new to science. The aim of the present study is to describe these seven species. In addition, a key to the 19 species of *Miliusa* in Thailand is constructed and a complete taxonomic nomenclature of all known species of *Miliusa* in Thailand is provided.

Material and methods

Specimens of the following herbaria were available for this study: A, AAU, ABD, B, BK, BKF, BM, BO, BR, C, CAL, DD, E, G, HITBC, K, KYO, L, NSW, NY, P, SING, TCD, U, UC, US, WU,

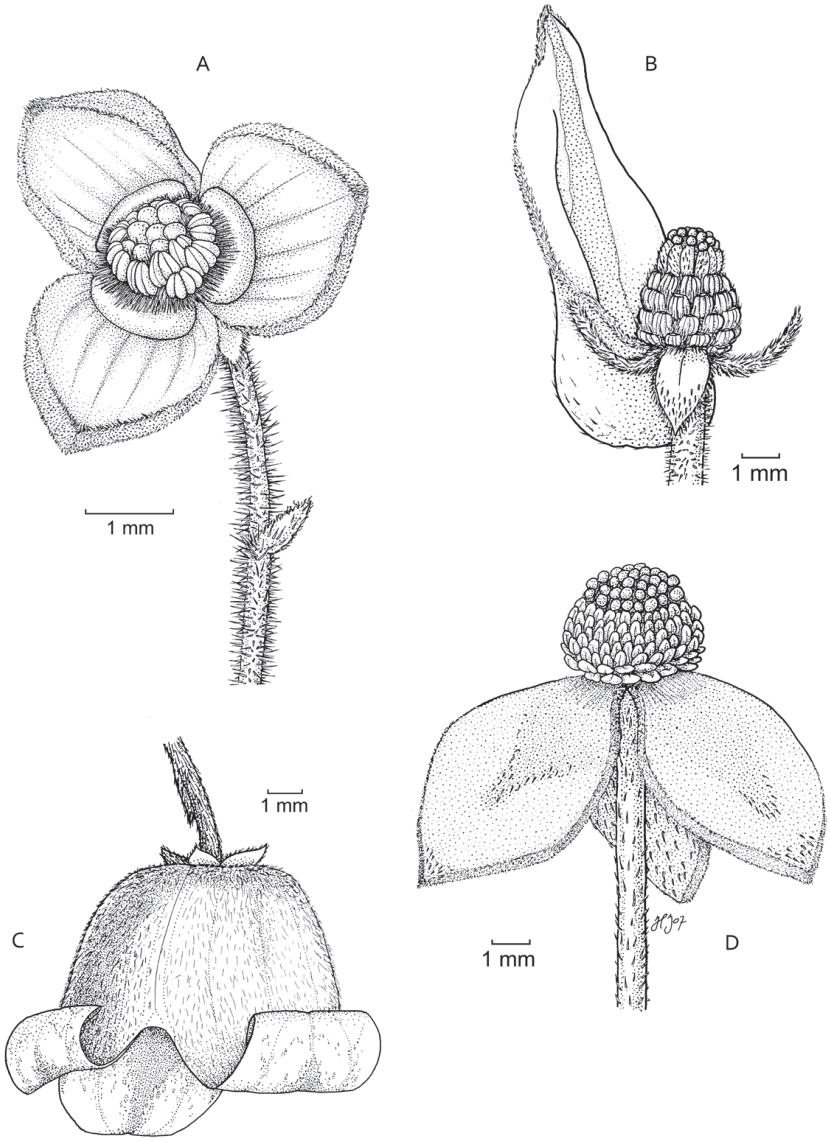

FIGURE 1. Morphology of the inner petals of *Miliusa* groups 1, 2, 3 and 4. (A) group 1: inner petals with crescent-shaped to semicircular glandular structures inside at base (*Miliusa mollis* Pierre: *Chaowasku 20*), (B) group 2: inner petals with narrow, longitudinal glandular structures inside along midrib (*Miliusa vidalii* J.Sinclair: *Curran s.n.*, Forestry Bureau no. 6403), (D) group 3: inner petals without pronounced glandular structures inside (*Miliusa macropoda* Miq.: *Ambriansyah and Arifin B 1515*), (C) group 4: inner petals tightly appressed from the base to ± the midpoint at anthesis (*Miliusa thorelii* Finet & Gagnep.: *Kerr 1162*).

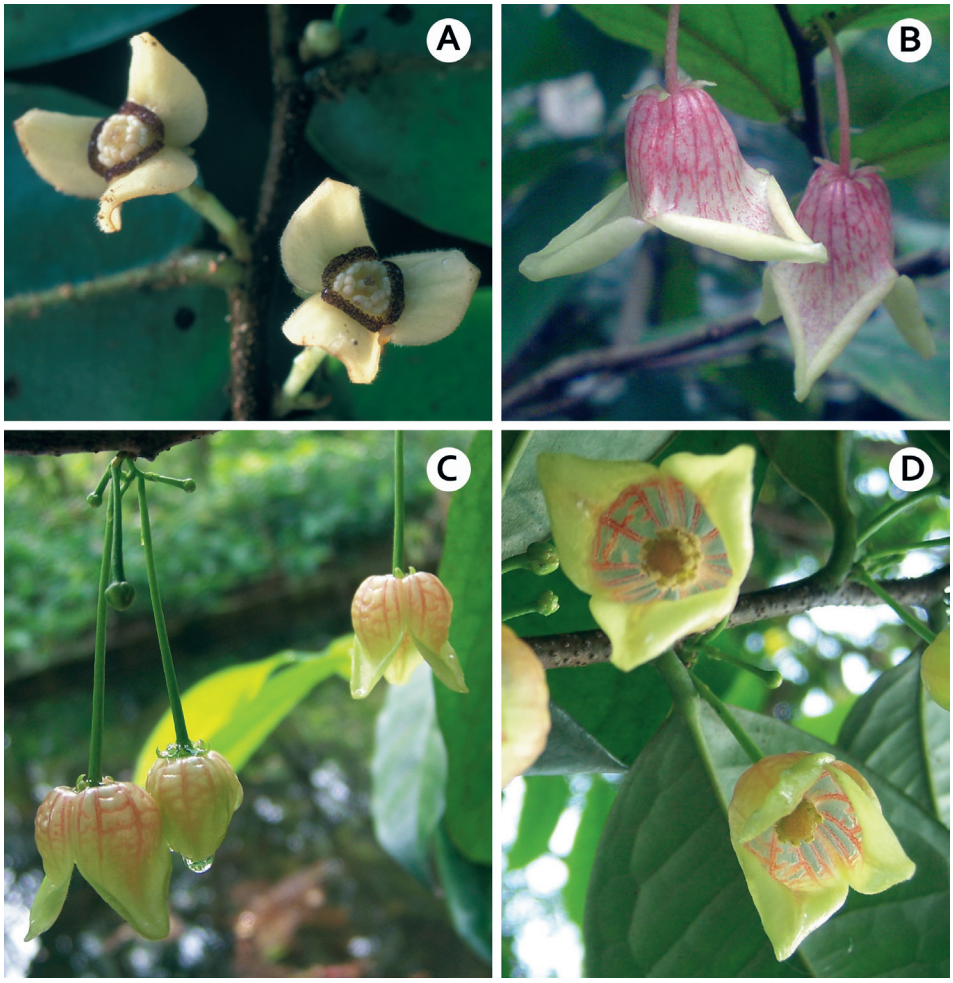

FIGURE 2. Flowers of (A) *Miliusa intermedia sp. nov*., (B) *Miliusa thailandica sp. nov*., and (C)–(D) *Miliusa campanulata* Pierre. Photographs: (A) Simon Gardner, (B) Kithisak Aongyong, (C)–(D) Charndanai Pradubpet.

Z. For the species descriptions, when only a single measurement/observation was made, the word 'circa (ca.)' was added. The indumentum terminology follows Hewson (1988). The term 'velvety' is equivalent to densely hairy/with dense hairs, whereas 'puberulous' is equivalent to sparsely hairy/with sparse hairs. Specimens of the following species of *Miliusa* already known from Thailand were studied: *M. amplexicaulis*, *M. campanulata*, *M. cuneata*, *M. filipes*, *M. fusca*, *M. horsfieldii*, *M. longipes*, *M. mollis*, *M. parviflora*, *M. sclerocarpa*, *M. thorelii*, *M. velutina* (Appendix 1). Specimens of these species collected outside Thailand, including those cited in Mols & Keßler (2003), were also examined for comparison.

Taxonomy

Key to the species of *Miliusa* in Thailand

1. Flowers bisexual; inner petals completely open and reflexed at anthesis; stamens (80–)100–200 per flower ..... *M. velutina*
– Flowers unisexual or bisexual; inner petals completely open or tightly appressed from the base to ± the midpoint, but not reflexed at anthesis; stamens ≤ 80 per bisexual flower 2
2. Inner petals with crescent-shaped to semi-circular glandular structures inside at base 3
– Inner petals without crescent-shaped to semi-circular glandular structures inside at base 9
3. Leaf base cuneate, obtuse or (slightly) rounded, generally slightly unequal, not clasping the twigs 4
– Leaf base (sub)cordate, slightly to notably unequal, not or (slightly to distinctly) clasping the twigs 5
4. Plants (semi-)deciduous; bud scales present; flowers and/or inflorescences borne on new sprouting shoots; inner petals densely hairy inside (mostly near margin and on the apical half), glandular structures inside at base ± semi-circular; stamens ca. 16 per flower; stipe 1.5–2.0 mm long ..... **1. *M. fragrans sp. nov.***
– Plants evergreen; bud scales absent; flowers and/or inflorescences not borne on new sprouting shoots; inner petals glabrous inside, glandular structures inside at base ± crescent-shaped; stamens 6–13 per flower; stipe 3.0–5.5 mm long ..... *M. fusca*
5. Leaves 9.3–26.0 × 4.0–11.0 cm; inner petals 4.0–7.0 × 4.0–7.0 mm... *M. amplexicaulis*
– Leaves 1.8–11.0 × 0.9–3.5 cm; inner petals ≤ 3.5 mm long and wide 6
6. Lower leaf surface densely hairy ..... *M. mollis*
– Lower leaf surface (almost) glabrous 7
7. Carpels ≥ 10 per flower; stipe 5.0–7.0 mm long..... **4. *M. nakhonsiana sp. nov*.**
– Carpels 3–4 per flower; stipe nearly absent to 1.5 mm long..... 8
8. Leaves usually narrowly elliptic-oblong, base always distinctly clasping the twigs; monocarps globose, nearly sessile ..... **5. *M. sessilis sp. nov*.**
– Leaves elliptic(-ovate), base often only slightly clasping the twigs; monocarps subglobose, stipe 1.0–1.5 mm long ..... **3. *M. intermedia sp. nov*.**
9. Flowers and/or inflorescences terminal (developing to internodal; sometimes appearing as 'axillary'); inner petals completely open at anthesis; ovules ≥ 3 per ovary, biseriate..... 10
– Flowers and/or inflorescences axillary; inner petals usually tightly appressed from the base to ± the midpoint at anthesis; ovule(s) 1–2 per ovary, uniseriate when there are two ovules per ovary 12
10. Inner petals 3.0–5.0 × 2.0–4.0 mm, without narrow, longitudinal glandular structures inside along midrib, base not saccate; stamens 30–40 per flower ..... *M. parviflora*
– Inner petals 17.0–40.0 × 5.0–15.0 mm, with narrow, longitudinal glandular structures inside along midrib, base (moderately to) conspicuously saccate; stamens ≥ 40 per flower 11

11. Young twigs and lower leaf surface glabrous to sparsely hairy; carpels 7–11 per flower ..... *M. sclerocarpa*
– Young twigs and lower leaf surface (sparsely to) densely hairy; carpels ≥ 17 per flower ..... *M. horsfieldii*
12. Flowers unisexual or bisexual with 2–8 stamens per flower ..... *M. thorelii*
– Flowers bisexual with > 15 stamens per flower 13
13. Inner petals with ± warty glandular structures inside the apical part (ca. 1/3 of the inner petal length) ..... **7. *M. umpangensis sp. nov*.**
– Inner petals without ± warty glandular structures inside the apical half 14
14. Leaf base slightly subcordate to cordate, slightly to moderately unequal; sepals and outer petals linguiform ..... **6. *M. thailandica sp. nov*.**
– Leaf base cuneate or obtuse, equal; sepals and outer petals (narrowly to broadly) triangular 15
15. Pedicels 0.4–0.5 cm long ..... **2. *M. hirsuta sp. nov*.**
– Pedicels ≥ (0.8–)1.5 cm long 16
16. Secondary veins ± indistinct on the lower leaf surface; outer petals 4.0–6.0 mm long; stamens 40–80 per flower ..... *M. cuneata*
– Secondary veins prominent on the lower leaf surface; outer petals ≤ 3.0 mm long; stamens ≤ 27(–36) 17
17. Young twigs moderately hairy; ovaries glabrous ..... *M. filipes*
– Young twigs (almost) glabrous; ovaries sparsely hairy 18
18. Discoloration on the basal half of the inner petals (much clearer visible inside) not (or very slightly) reticulate (much clearer observed in living plants), window-like structures at base indistinct (in living plants; sometimes absent); stipe (18.0–)20.0–35.0(–43.0) mm long ..... *M. longipes*
– Discoloration on the basal half of the inner petals (both sides) remarkably reticulate (much clearer observed in living plants), window-like structures at base conspicuous (in living plants); stipe (8.0–)10.0–15.0(–19.0) mm long ..... *M. campanulata*

1. *Miliusa fragrans* Chaowasku & Kessler *sp. nov*. (Figs. 3–4)

Type:–Thailand, Chiang Mai, Doi Chiang Dao, Feb 1958, *Bunchuai 709* [holotype: BKF! (BKF16717)], in flower.

Etymology:–The epithet refers to the fragrant flowers of this species.

Shrubs or trees, (semi-)deciduous, 4–15 m tall, 20–30 cm in diameter. Bud scales 4–5, caducous, ovate-triangular, smaller towards the basal one. Young twigs (appressed-) velvety. Petioles up to 1.5 mm long, appressed-puberulous to velvety. Leaves usually elliptic, sometimes slightly (ob)ovate, 2.7–9.0 × 1.7–3.2 cm; base cuneate, obtuse to rounded, usually slightly unequal; apex acute to slightly acuminate; lamina glabrous above, (almost) glabrous below; midrib nearly flat to slightly sunken above, almost glabrous, raised below, (appressed-)puberulous; secondary veins 12–15 pairs, angle with midrib 37°–46°. Flower solitary, axillary, borne on new sprouting shoots; pedicels 0.4–1.5 cm long, usually appressed-puberulous at base, bracts 2, (narrowly) triangular, one near sepals, another one near the midpoint of pedicels, the latter usually narrower and longer. Sepals triangular, ca. 1.2 × 1.0 mm, slightly connate at base, persistent in fruit; margin puberulous, outside glabrous. Outer petals ovate-triangular, ca. 1.9 × 1.1

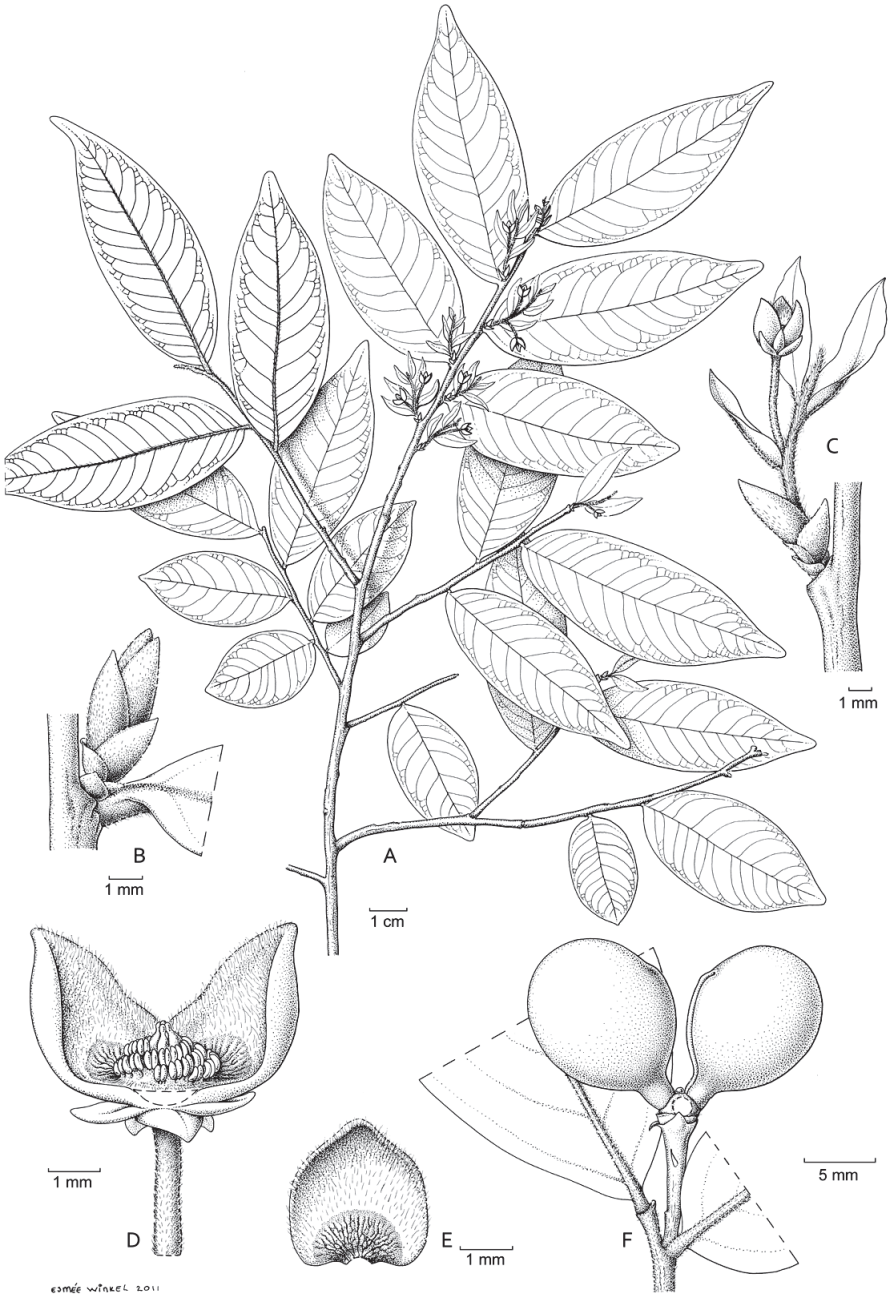

FIGURE 3. *Miliusa fragrans sp. nov*. (A) habit, (B) bud scales, (C) new axillary shoot with a flower, (D) flower with one inner petal removed, (E) inside (adaxial surface) of an inner petal, (F) fruiting twig. (A), (C)–(E) *Bunchuai 709*, (B) *Chaowasku 38*, (F) *Nakorn-Thiemchan NTC 12*.

FIGURE 4. Distribution of *Miliusa fragrans sp. nov*. (filled circle), *Miliusa sessilis sp. nov*. (filled diamond) and *Miliusa thailandica sp. nov*. (filled square).

mm, often persistent in fruit; both sides glabrous, margin velvety. Inner petals ovate-triangular, 3.0–3.4 × 2.5–3.1 mm; margin puberulous, outside glabrous, inside curly-velvety (indumentum mostly near margin and on the apical half); glandular structures present inside at base, ± semi-circular, slightly thickened, slightly irregularly warty; base not saccate. Torus ovoid-ellipsoid. Stamens ca. 16, ca. 0.8 mm long. Carpels 2–5, ca. 0.9 mm long; stigmas ellipsoid; ovaries glabrous; ovule 1, subbasal. Monocarp(s) 1–2(–3), subglobose-ellipsoid, ca. 1.0 × 0.8 cm; surface (nearly smooth to) slightly verruculose, glabrous; apex not apiculate; stipe 1.5–2.0 mm long, glabrous. Seed 1, subglobose-ellipsoid, ca. 0.9 × 0.7 cm.

Distribution, habitat and phenology:–Thailand (Chiang Mai, Lampang, Nan, Phayao Provinces), occurring in evergreen or evergreen-deciduous forests (with bamboo); on karst; on slopes of hills, near waterfalls and/or in shaded places. Elevation: 350–1000 m a.s.l. Flowering: February, fruiting: July–September.

Similar species:–*Miliusa fragrans* belongs to group 1. At present it is the only known species from this group that is (semi-)deciduous and possesses conspicuous bud scales (Fig. 3B). The other species are evergreen and lack bud scales. The (semi-)deciduous habit and bud scales are common in the species of groups 2 and 3.

Miliusa fragrans is morphologically close to *M. fusca.* The former chiefly differs in having flowers and/or inflorescences that are borne on new sprouting shoots (not borne on new sprouting shoots in *M. fusca*), inner petals that are densely hairy (glabrous in *M. fusca*) inside (mostly near margin and on the apical half) and exhibit ± semi-circular

(± crescent-shaped in *M. fusca*) glandular structures inside at base, ca. 16 (6–13 in *M. fusca*) stamens per flower, and a stipe that is 1.5–2.0 (3.0–5.5 in *M. fusca*) mm long.

Miliusa fragrans is only found in northern Thailand (Fig. 4). It is allopatric to all other species of group 1.

Field notes:–Bark grey(–brown), thin, finely cracked. Leaves dark green and glossy above, slightly paler beneath; midrib and petioles yellow–green. Flowers greenish yellow, scented. Fruits bright light green, ripening notably dark purple; fruiting pedicels brown–green. Vernacular name: Chan-Ti-Ma-Doi (Thai).

Additional specimens examined (paratypes):–*Bygrave 117* (L): Lampang, Wang Nua; *Chaowasku 38* (L), *92* (L), *Nakorn-Thiemchan NTC 1* (L), *NTC 12* (L): Chiang Mai, Chiang Dao, Chiang Dao Wildlife Sanctuary; *Kerr 3614* (BM, K): Pang Pue; *Kerr 5240* (K): Chiang Dao, Mê Poi; *Larsen et al. 43575* (BKF): Nan, Tham Pa Tok; *Maxwell 98-758* (BKF): Payao (= Phayao), Bong, Doi Pah Chang Wildlife Sanctuary.

2. *Miliusa hirsuta* Chaowasku & Kessler *sp. nov*. (Figs. 5, 10)

Type:–Thailand, Prachuab Khiri Khan, Bang Saphan, Feb 1970, *Van Beusekom and Santisuk 2815* [holotype: BKF! (BKF65232), isotypes: AAU!, E!, L!], in flower.

Etymology:–The epithet refers to the densely hairy young twigs and lower leaf surface of this species.

Shrubs, evergreen. Young twigs velvety. Petioles ca. 6.0 mm long, velvety, grooved above. Leaves elliptic, 11.0–19.0 × 4.1–8.1 cm; base cuneate; apex acute-acuminate; lamina glabrous above, velvety below; midrib (slightly) sunken above, puberulous, raised below, velvety; secondary veins ca. 16 pairs, prominent below, raised, angle with midrib 48°–57°. Flowers in 2- to 4-flowered inflorescences, axillary; peduncles 0.1–0.2 cm long, puberulous-velvety, bract not seen (absent?); pedicels 0.4–0.5 cm long, puberulous-velvety, bract(s) 1–2 for each flower, triangular. Sepals triangular, 1.5–1.6 × 0.9–1.0 mm; margin and outside puberulous-velvety. Outer petals triangular, 1.8–2.0 × 1.1–1.2 mm; margin and outside puberulous-velvety. Inner petals elliptic-oblong, ca. 14.0 × 7.0 mm, tightly appressed from the base to ± the midpoint at anthesis; apex acute-obtuse; both sides glabrous, margin (almost) glabrous; some discoloration visible inside at base (in dried material); base slightly saccate. Torus slightly ovoid. Stamens ca. 48, ca. 1.3 mm long. Carpels ca. 11, ca. 1.7 mm long; stigmas globose-capitate; ovaries puberulous; ovules 2, lateral, uniseriate. Monocarps unknown.

Distribution, habitat and phenology:–Thailand (Prachuab Khiri Khan Province), occurring in secondary forests among evergreen groves. Flowering: February.

Similar species:–*Miliusa hirsuta* belongs to group 4. It mostly resembles *M. thorelii*. The new species principally differs in having dense hairs on young twigs and the lower leaf surface while those of *M. thorelii* are usually (almost) glabrous. Additionally, *M. hirsuta* has 2-ovuled ovaries whereas they are 1-ovuled in *M. thorelii*. The type specimens are the only available collection for this species.

Miliusa hirsuta is possibly sympatric to *M. thorelii*. The latter has been extensively collected from northern Thailand, but rarely collected from southern Thailand.

Field notes:–Flowers campanulate, pale green, purple inside at base. Vernacular name: Ra-Khang-Bai-Khon (Thai).

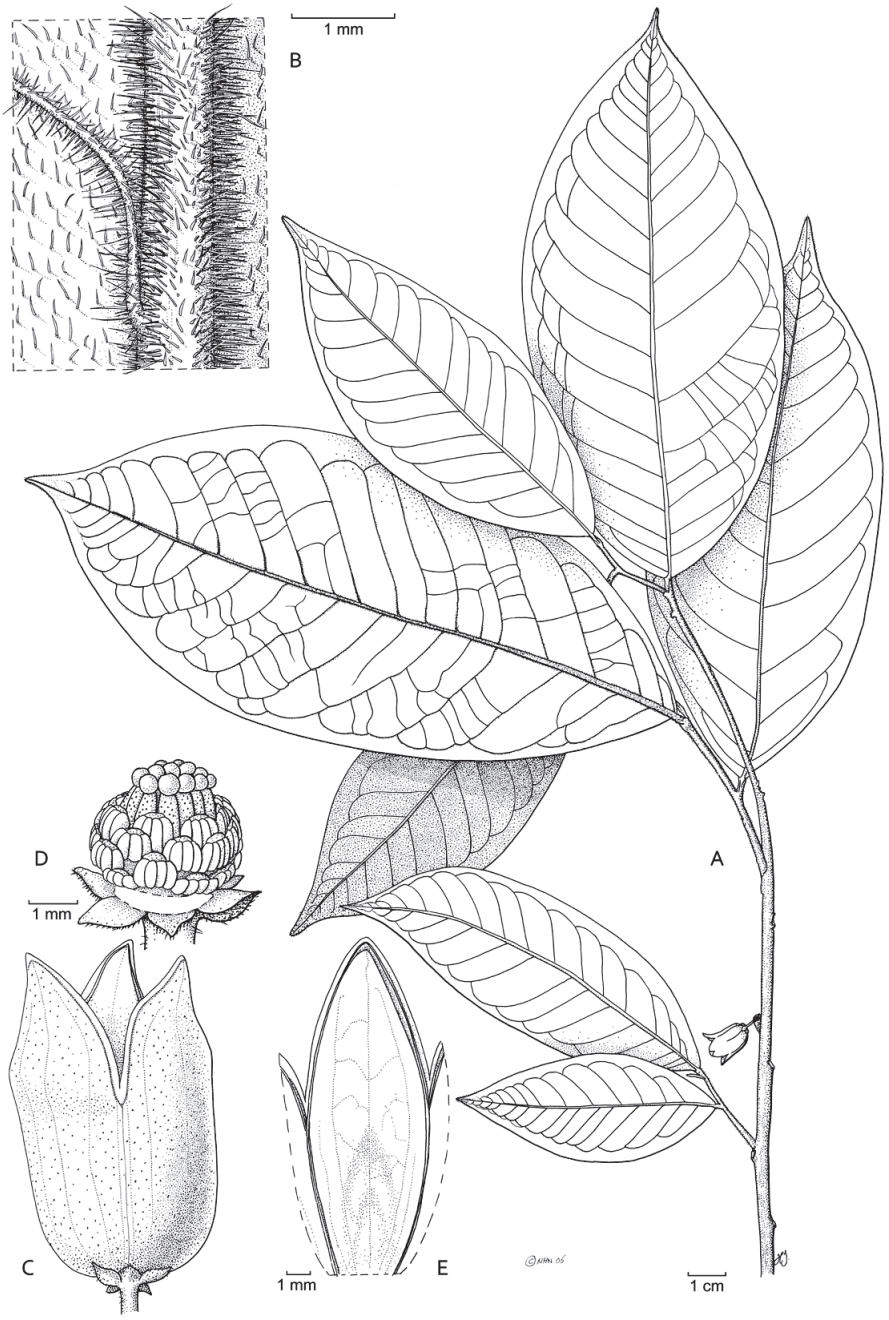

FIGURE 5. *Miliusa hirsuta sp. nov*. (A) habit, (B) lower (abaxial) leaf surface, (C) flower, (D) flower with inner petals removed, (E) inside (adaxial surface) of an inner petal. (A)–(E) *Van Beusekom and Santisuk 2815*.

3. *Miliusa intermedia* Chaowasku & Kessler *sp. nov*. (Figs. 2A, 6, 10)

Type:–Thailand, Peninsular, Takuapah-Surat Thani Rd, 20–60 km from Takuapah, 1972, *Larsen et al. 30964* (holotype: AAU!, isotypes: BKF!, L!), in flower.

Etymology:–See below.

Shrubs or trees, evergreen, 2–8 m tall, 2–10 cm in diameter. Young twigs puberulous-velvety. Petioles up to 1.0 mm long, velvety. Leaves elliptic(-ovate), 3.0–9.0 × 1.1–3.5 cm, first leaves of newly developed twigs usually notably smaller, (broadly) ovate; base (sub) cordate, moderately unequal, often slightly clasping the twigs; apex acute-acuminate; lamina glabrous above, almost glabrous below; midrib flat to slightly sunken above, puberulous, raised below, (puberulous-)velvety; secondary veins 12–16 pairs, angle with midrib 46°–62°. FIower solitary, axillary; pedicels 0.4–0.8 cm long, puberulous, bracts 2–3, triangular. Sepals triangular, ca. 1.2 × 1.2 mm, connate at base, persistent in fruit; margin puberulous, outside almost glabrous. Outer petals triangular, ca. 1.3 × 1.0 mm, persistent in fruit; outside and margin puberulous. Inner petals broadly ovate, 2.2–2.5 × 2.7–3.3 mm, both sides of margin somewhat recurved at anthesis; outside puberulous, margin curly-puberulous, inside almost glabrous; glandular structures present inside at base, between crescent-shaped and semicircular, thickened, slightly finely warty; base not saccate. Torus subglobose. Stamens 9–13, ca. 0.6 mm long. Carpels 3–4, ca. 0.7 mm long; stigmas globose; ovaries glabrous; ovule 1, basal. Monocarp 1, subglobose, ca. 0.8 × 0.6 cm, often with 1–2 underdeveloped monocarp(s); surface slightly verruculose, glabrous; apex not apiculate; stipe 1.0–1.5 mm long, glabrous. Seed 1, subglobose, ca. 0.7 × 0.5 cm.

Distribution, habitat and phenology:–Thailand (Surat Thani Province), occurring in shady understorey of relatively undisturbed evergreen forests; on rugged limestone terrain. Elevation: 100–250 m a.s.l. Flowering: June, fruiting: June, November.

Similar species:–*Miliusa intermedia* belongs to group 1. Its affinity seems to lie between *M. mollis* and *M. sessilis sp. nov*., hence its epithet. *Miliusa intermedia* mainly differs from *M. mollis* in having a (slightly) more unequal leaf base and shorter stipe (1.0–1.5 mm long in *M. intermedia* vs. 3.0–4.0 mm long in *M. mollis*). Another obvious character is the lower leaf surface that is almost glabrous, but densely hairy in *M. mollis*. The new species chiefly differs from *M. sessilis* in having elliptic(-ovate) leaves (Fig. 6A) while they are usually narrowly elliptic-oblong in *M. sessilis* (Fig. 8A). The leaf base of *M. sessilis* is notably asymmetrical and distinctly clasping the twigs (Fig. 8A) whereas that of *M. intermedia* is much less so (Fig. 6A). Table 1 compares important morphological characters of *M. intermedia* and several morphologically similar species in group 1.

Miliusa intermedia is allopatric to all other species of group 1. During a recent expedition to the localities of this species, we found a substantial number (no less than 500) of individuals of various size restricted to shaded areas among rugged limestone terrain (pers. obs. TC).

Field notes:–Bark dark brown, smooth. Leaves grey–green below, bright greenish–yellowish in young leaves. Flowers cream, stamens cream with dark brown ring around them. Fruits pale green (immature). Vernacular name: Jing-Jaab-Tai (Thai).

Additional specimens examined (paratypes):–*Chaowasku 26* (BKF, L), *Gardner and Sidisunthorn ST 0757* (BKF, L): Surat Thani, Phanom, Klong Phanom National Park.

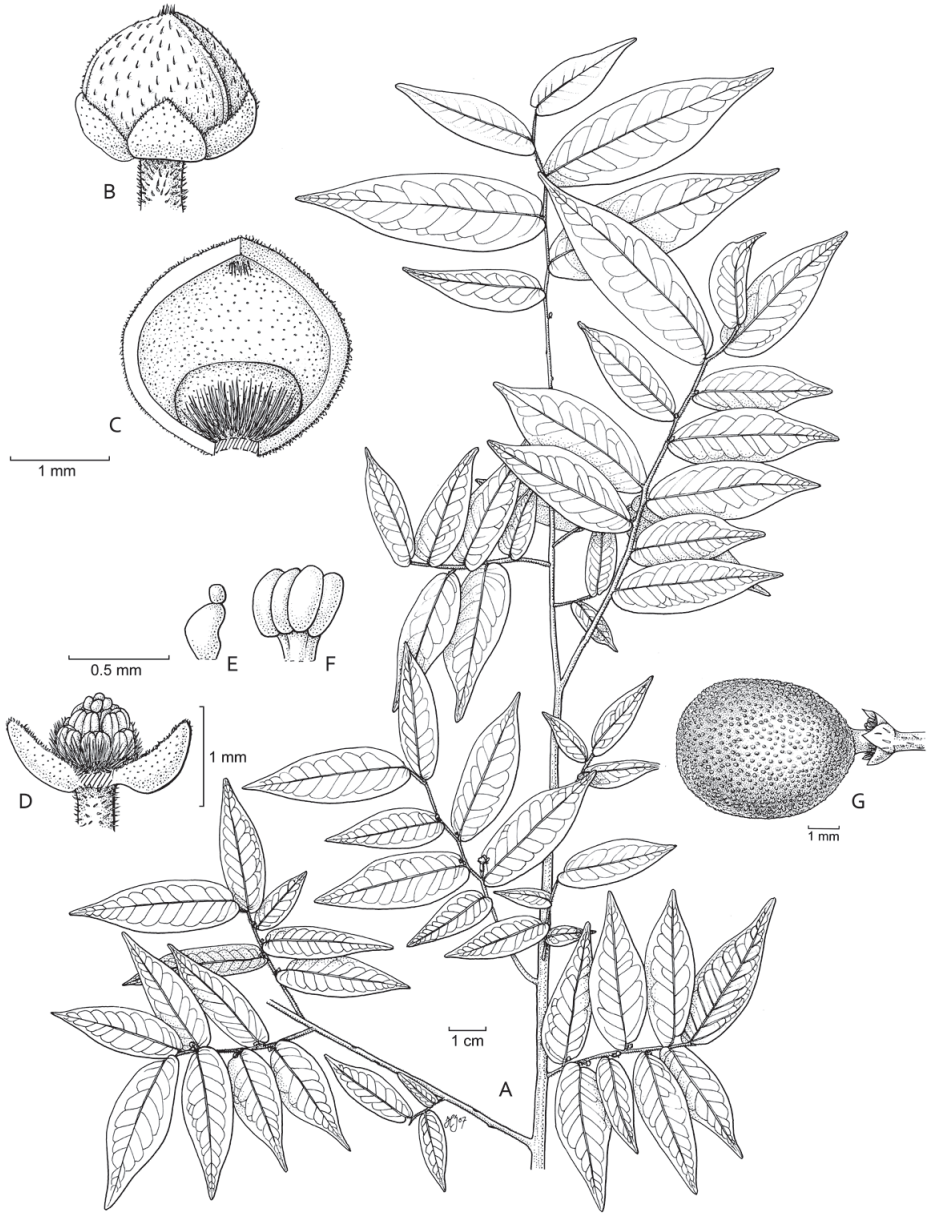

FIGURE 6. *Miliusa intermedia sp. nov*. (A) habit, (B) flower bud, (C) inside (adaxial surface) of an inner petal, (D) flower with petals removed, (E) carpel, (F) stamen, abaxial side, (G) fruit. (A)–(F) *Gardner and Sidisuthorn ST 0757*, (G) *Chaowasku 26.*

TABLE 1. Comparison of four morphologically similar species in group 1 (= *Miliusa mollis* group).

Character/species	*M. intermedia*	*M. mollis*	*M. nakhonsiana*	*M. sessilis*
- Lower leaf surface	Almost glabrous	Velvety	(Almost) glabrous	(Almost) glabrous
- Leaf shape	Elliptic(-ovate)	Elliptic to ovate	Usually (narrowly) elliptic-oblong	Usually narrowly elliptic-oblong
- Leaf base (degree of asymmetry/clasping in parentheses)	Often slightly clasping the twigs (++)	Sometimes slightly clasping the twigs (+)	Always distinctly clasping the twigs (++++)	Always distinctly clasping the twigs (++++)
- Size of inner petals (mm)	2.2–2.5 × 2.7–3.3	3.0–3.3 × 3.2–3.5	Ca. 3.0 × 3.5	2.3–2.5 × 2.6–3.7
- Number of stamens/ flower	9–13	12–18	Unknown	Ca. 13
- Number of carpels/flower	3–4	4–8	≥ 10	Ca. 4
- Length of stipe (mm)	1.0–1.5	3.0–4.0	5.0–7.0	Almost absent

4. *Miliusa nakhonsiana* Chaowasku & Kessler *sp. nov*. (Figs. 7, 10)

Type:–Thailand, Nakhon Si Thammarat, Nopphitum, Tham Lot cave, Feb 2005, *Williams 1472* [holotype: L! (barcode L0298136), isotypes: A, BKF], in flower and fruit.

Etymology:–Named after the Thai Province (Nakhon Si Thammarat, often called Nakhon or Nakhon Si for short) where this species is endemic.

Shrubs, evergreen, ca. 2 m tall. Young twigs (appressed-)puberulous. Leaves (almost) sessile, usually (narrowly) elliptic-oblong, sometimes slightly obovate, 5.5–10.1 × 1.8–3.1 cm; base cordate, notably unequal, always distinctly clasping the twigs; apex caudate-acuminate; lamina glabrous above, (almost) glabrous below; midrib (slightly) sunken above, glabrous, raised below, almost glabrous; secondary veins 12–14 pairs, angle with midrib 40°–54°. Flowers in 2-flowered inflorescences, axillary; peduncles inconspicuous, bracts ca. 2, ovate-semicircular; pedicels 1.2–1.4 cm long, almost glabrous, bract(s) 1–2 for each flower, (slightly) triangular. Sepals and outer petals ovate-triangular, not clearly observed due to limited material. Inner petals broadly ovate, ca. 3.0 × 3.5 mm; both sides glabrous, margin puberulous; glandular structures observed inside at base, between crescent-shaped and semicircular, thickened, slightly finely warty; base not saccate. Torus, stamens and carpels not observed, but carpels ≥ 10 (deduced from the number of monocarps). Monocarps ca. 10, (sub)globose, 0.6–0.7 × 0.6 cm; surface (slightly) verruculose, glabrous; apex not apiculate; stipe 5.0–7.0 mm long, glabrous. Seed 1, (sub) globose, 0.5–0.6 × 0.5 cm.

Distribution, habitat and phenology:–Thailand (Nakhon Si Thammarat Province), occurring at base of limestone mountains. Elevation: ca. 80 m a.s.l. Flowering and fruiting: February.

Similar species:–*Miliusa nakhonsiana* belongs to group 1 and is allopatric to all other species of group 1. It most resembles *M. sessilis sp. nov*. The main differences are the greater number of carpels per flower (≥ 10 in *M. nakhonsiana* vs. ca. 4 in *M. sessilis*) and the longer stipe [5.0–7.0 mm long in *M. nakhonsiana* (Fig. 7K) vs. nearly absent in *M. sessilis*, Fig. 8E]. The description was based on the holotype only; however, during

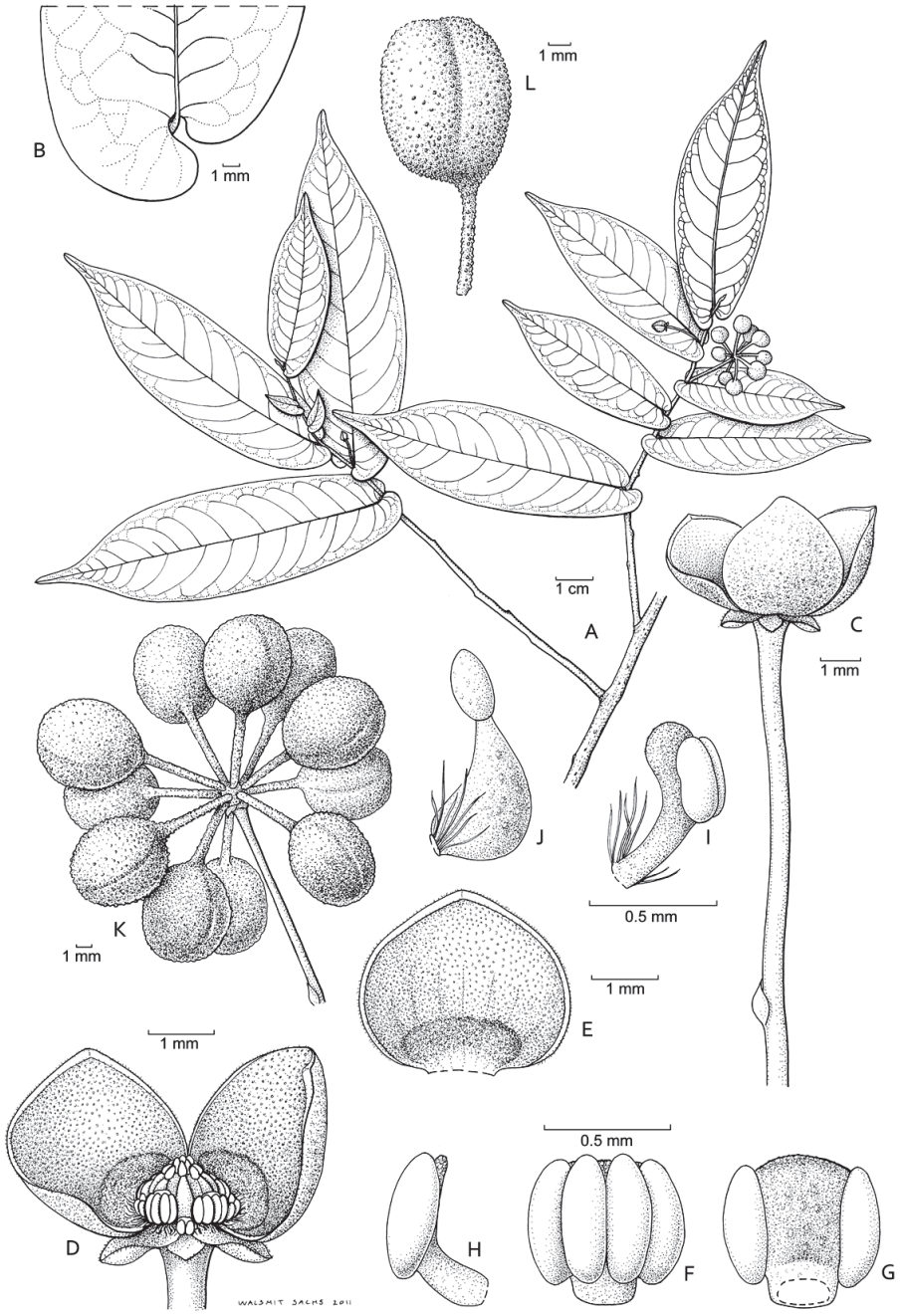

FIGURE 7. *Miliusa nakhonsiana sp. nov*. (A) habit, (B) lower (abaxial) leaf surface, (C) flower, (D) flower with one inner petal removed, (E) inside (adaxial surface) of an inner petal, (F) stamen, abaxial side, (G) stamen, adaxial side, (H) stamen, side view, (I) stamen with (just?) two smaller pollen sacs, side view, (J) carpel, (K) fruit, (L) monocarp. (A)–(L) *Williams 1472.*

a recent expedition (pers. obs. TC), several more individuals of this species were also found at the type locality. Table 1 compares important morphological characters of *M. nakhonsiana* and several morphologically similar species in group 1.

Field notes:–Fruits purple–black. Vernacular name: Bai-Biaw-Lek (Thai).

5. *Miliusa sessilis* Chaowasku & Kessler *sp. nov*. (Figs. 4, 8)

Type:–Thailand, Prachuab Khiri Khan, Bang Saphan, Feb 1970, *Van Beusekom and Santisuk 2807* (holotype: L!, isotypes[1]: AAU!, BKF, E!), in flower and fruit.

Etymology:–The epithet refers to the nearly sessile monocarps (and also sessile leaves).

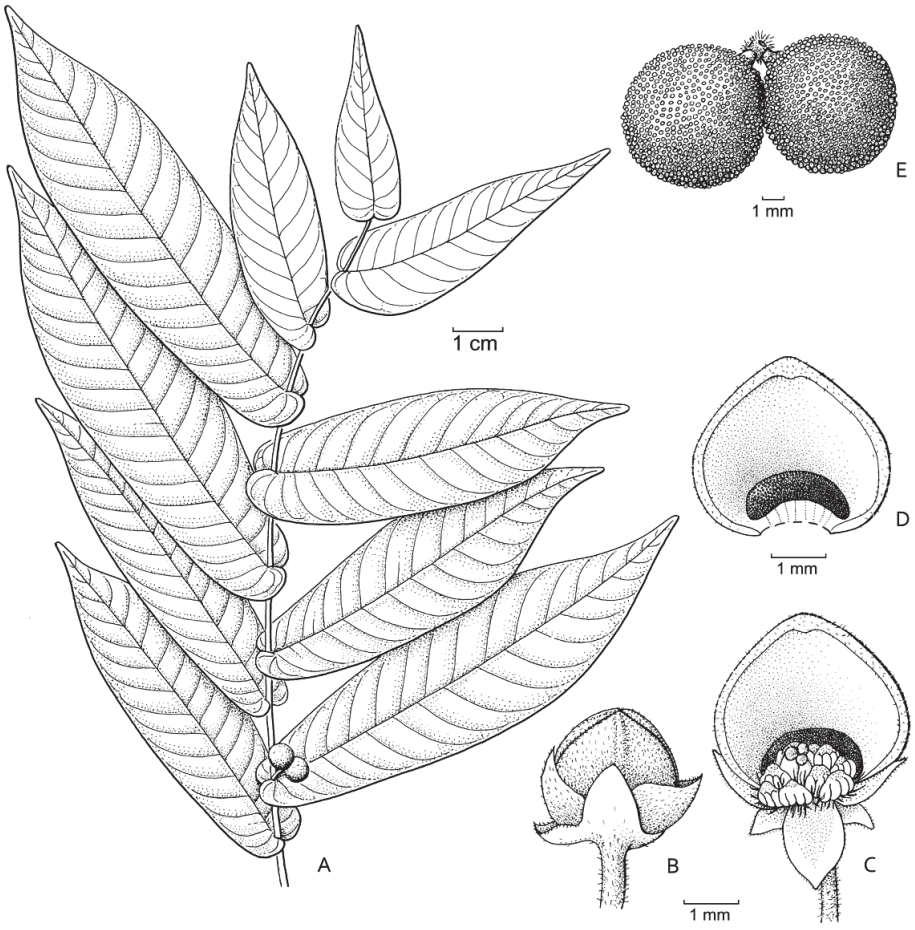

FIGURE 8. *Miliusa sessilis sp. nov*. (A) habit, (B) flower bud, (C) flower with two inner petals removed, (D) inside (adaxial surface) of an inner petal, (E) fruit. (A)–(E) *Van Beusekom and Santisuk 2807*.

[1] L! was incorrectly indicated as one of the isotypes in the original publication of this chapter.

(Understorey) shrubs, evergreen, 1–2 m tall. Young twigs puberulous(-velvety). Leaves sessile, usually narrowly elliptic-oblong, sometimes slightly obovate-oblanceolate, 4.5–11.0 × 1.2–2.9 cm; base cordate, notably unequal, always distinctly clasping the twigs; apex (slightly) acuminate; lamina glabrous above, (almost) glabrous below; midrib (slightly) sunken above, almost glabrous, raised below, puberulous; secondary veins 11–16 pairs, angle with midrib 54°–63°. Flower(s) solitary or in 2-flowered inflorescences, axillary; peduncles up to 0.2 cm long, puberulous(-velvety), bracts ca. 3, triangular; pedicels 0.6–1.3 cm long, puberulous, bract(s) 1–2 per flower, whether solitary or in 2-flowered inflorescences, triangular. Sepals triangular, ca. 1.5 × 1.5 mm, connate at base; outside (almost) glabrous, margin puberulous. Outer petals triangular, ca. 1.9 × 1.3 mm; outside and margin puberulous. Inner petals broadly ovate-triangular, 2.3–2.5 × 2.6–3.7 mm; outside puberulous, margin curly-puberulous, inside glabrous; glandular structures clearly seen inside at base, ± crescent-shaped, thickened, finely warty; base not saccate. Torus hemispheroid. Stamens ca. 13, ca. 0.7 mm long. Carpels ca. 4, ca. 0.9 mm long; stigmas globose to capitate; ovaries glabrous; ovule 1, basal. Monocarps ca. 3, nearly sessile, globose, 0.6–0.7 × 0.6–0.7 cm; surface slightly verruculose, glabrous; apex not apiculate. Seed 1, globose, ca. 0.5 × 0.5 cm.

Distribution, habitat and phenology:–Thailand (Chumphon, Prachuab Khiri Khan Provinces), occurring in moist evergreen forests or secondary forests among evergreen groves; in (very) shady areas at base of (small) limestone hills. Elevation: ca. 100 m a.s.l. Flowering and fruiting: February.

Similar species:–*Miliusa sessilis* has the shortest stipe (nearly absent, Fig. 8E) among group 1 to which it belongs, and it is allopatric to all other species of group 1. *Miliusa sessilis* and the morphologically most similar species, *M. nakhonsiana*, possess the most asymmetrical leaf base (among all species of *Miliusa* examined) that distinctly clasps the twigs (Fig. 8A: *M. sessilis*, Fig. 7A: *M. nakhonsiana*). Table 1 compares leaf base (including the degree of asymmetry/clasping) and other important morphological characters of *M. sessilis* and several morphologically similar species in group 1.

Field notes:–Fruits dark red. Vernacular name: Bai-Biaw-Dam-Kwan (Thai).

Additional specimens examined (paratypes):–*Chaowasku 44* (L): Chumphon, Sawi, Ban Tham Suai Huai Thab Thong; *Koonkhunthod et al. 311* (BKF): Chumphon, Thung Tako, Ban Khao Talu.

6. *Miliusa thailandica* Chaowasku & Kessler *sp. nov*. (Figs. 2B, 4, 9)

Type:–Thailand, Ranong, Hard Hin Dam (near the sea), Apr 1974, *Larsen and Larsen 33368* (holotype: L!, isotypes: AAU!, BKF), in flower.

Etymology:–Named after Thailand, where this species is likely endemic.

Shrubs or trees, evergreen, 2–6 m tall, 12–17 cm in diameter. Young twigs (puberulous-)velvety. Petioles up to 2.0 mm long, puberulous(-velvety). Leaves elliptic to obovate, 5.0–20.0 × 2.5–7.3 cm; base slightly subcordate to cordate, slightly to moderately unequal; apex acute to caudate-acuminate; lamina glabrous above, glabrous to puberulous below; midrib slightly sunken above, puberulous, raised below, almost glabrous to appressed-puberulous; secondary veins 8–14 pairs, angle with midrib 40°–60°. Flower(s) solitary or in 2- to 4-flowered inflorescences, axillary; peduncles up to 0.5 cm long,

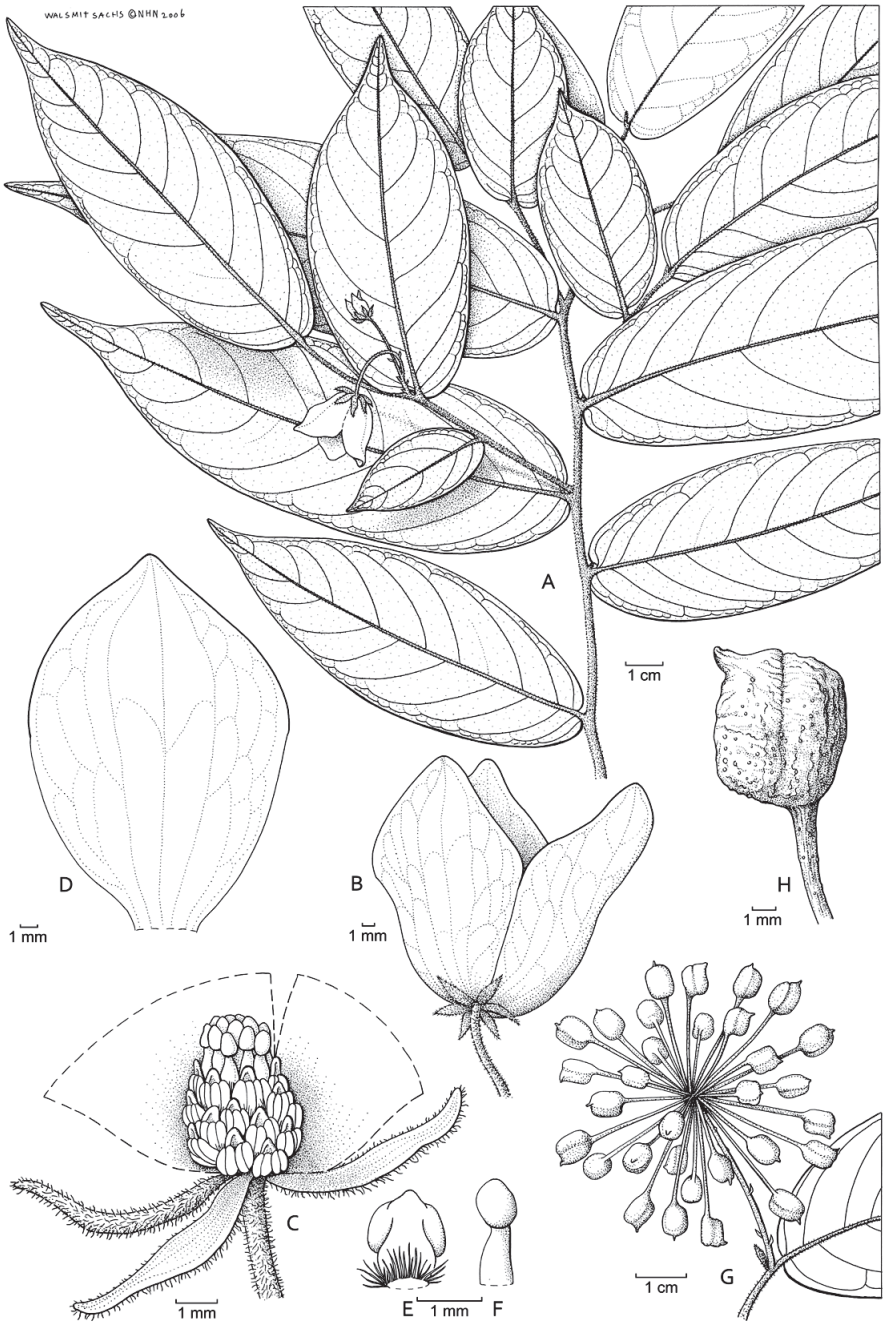

FIGURE 9. *Miliusa thailandica sp. nov*. (A) habit, (B) flower, (C) flower with stamens and carpels exposed, (D) inside (adaxial surface) of an inner petal, (E) stamen, adaxial side, (F) carpel, (G) fruiting twig, (H) monocarp. (A)–(F) *Geesink and Santisuk 5036*, (G), (H) *Fukuoka and Na Nakhon T-36095*.

FIGURE 10. Distribution of *Miliusa hirsuta sp. nov*. (filled square), *Miliusa intermedia sp. nov*. (filled upright triangle), *Miliusa nakhonsiana sp. nov*. (filled inverted triangle), and *Miliusa umpangensis sp. nov*. (filled circle).

puberulous, bracts 3–4, triangular to semicircular; pedicels 1.6–5.0 cm long, almost glabrous to puberulous, bract(s) (1–)2–3 for solitary and each flower of multi-flowered inflorescences, triangular. Sepals linguiform, 3.0–5.3 × 0.8–1.5 mm, persistent in fruit; outside and margin puberulous, inside almost glabrous to curly-puberulous. Outer petals linguiform, ca. 6.0 × 1.5 mm; outside and margin puberulous, inside almost glabrous to curly-puberulous. Inner petals elliptic, 18.0–26.0 × 11.0–15.0 mm, tightly appressed from the base to ± the midpoint at anthesis; apex acute-obtuse; margin almost glabrous to puberulous, both sides glabrous; some discoloration often observed

inside near/at base (in dried material); base moderately saccate. Torus slightly cylin drical. Stamens 27–28, 1.6–1.8 mm long. Carpels 15–50, ca. 2.0 mm long; stigmas capitate to slightly ovoid; ovaries glabrous; ovule(s) 1(–2), basi-lateral. Monocarps 7–50, ± subglobose when containing 1 seed, more irregular when containing 2 seeds, 0.7–1.1 × 0.6–0.9 cm; surface verruculose, glabrous; apex usually (notably) apiculate; stipe 15.0–35.0 mm long, glabrous, sometimes attached obliquely to monocarps. Seed(s) 1 (rarely 2), (sub)globose, 0.6–0.8 × 0.5–0.6 cm.

Distribution, habitat and phenology:–Thailand (Phang Nga, Phuket, Ranong, Satun, Trang Provinces), occurring in (dense) evergreen forests; on granitic rocks or limestone hills; on hillsides, under considerably dense canopy, along waterfalls, by streams and/or near the sea. Elevation: up to 440 m a.s.l. Flowering: February–May, fruiting: June–December.

Similar species:–*Miliusa thailandica* belongs to group 4. It is distinguishable from the other species of this group occurring in Thailand by the slightly to moderately unequal leaf base (Fig. 9A), a character that is common in species of group 1. Additionally, *M. thailandica* exhibits the largest inner petals among species of group 4 occurring in Thailand.

Among group 4, *M. thailandica* is possibly sympatric to *M. longipes*, although the latter is generally found in the eastern part of southern Thailand (pers. obs. TC) whereas the former is usually found in the western part of southern Thailand (Fig. 4).

Field notes:–Bole grey. Flowers pendulous with a penetrating (pleasant or unpleasant) smell, white to creamy yellow, nerves red, only at base. Fruits green ripening red. Vernacular name: Ra-Khang-Siam (Thai).

Additional specimens examined (paratypes):–*Bunkert 94* (BKF), *Collins 2455* (K), *Geesink et al. 7196* (BKF, K, L), *Middleton et al. 324* (E), *Nimanong and Pochanart 1605* (BKF), *Phusomsaeng and Pinnin 354* (C, KYO, L), *Pochanart 221* (BKF, KYO): Trang, Khao Chong; *Chaowasku 70* (L): Phuket, Thalang, Khao Phra Taew Non-hunting Area; *Fukuoka and Na Nakhon T-36095* (BKF, KYO, L): Phang Nga, Kuraburi, Klong Saeng Wildlife Sanctuary; *Gardner et al. ST 1116* (L): Surat Thani, Phanom, Klong Phanom National Park; *Geesink and Santisuk 5036* (AAU, C, E, KYO, L): Pangnga (= Phang Nga), Khlong Nang Yon; *Geesink and Santisuk 5200* (L): Pangnga, Takuapa, Kao Lak; *Geesink et al. 7356* (AAU, L): Satun, Koh Talutao; *Kerr 17276* (BM), *Shimizu et al. T-7848* (KYO), *T-7849* (KYO): Phang Nga; *Kerr 19123* (BM): Trang, Palien; *Larsen et al. 31157* (AAU): Peninsular; *Larsen et al. 31174* (AAU, K): Peninsular, Phang Nga, Khao Nang Hong; *Niyomdham et al. 254* (BKF, C, E, K, KYO, L, P): Puket (= Phuket), Kao Pa Ra; *Rogstad 800* (L): Trang, Khao Chong Botanic Garden.

7. *Miliusa umpangensis* Chaowasku & Kessler *sp. nov*. (Figs. 10, 11)

Type:–Thailand, Tak, Umpang, Dec 2009, *Chaowasku 88* (holotype: L!, isotypes: BKF!), in flower.

Etymology:–Named after Umpang, the mountainous district where this species was found and is likely to be endemic.

Trees, evergreen, 2–4 m tall. Young twigs (appressed-)puberulous. Petioles ca. 2.0 mm long, appressed-puberulous, usually grooved above. Leaves elliptic, 4.6–14.0 × 2.0–4.8

FIGURE 11. *Miliusa umpangensis sp. nov*. (A) habit, (B) flowering twig, (C) flower with one inner petal removed, (D) outside (abaxial surface) of an inner petal, (E) inside (adaxial surface) of an inner petal, (F) stamen, abaxial side, (G) stamen, adaxial side, (H) stamen, side view, (I) carpel, (J) fruiting twig, (K) monocarp. (A) *Chaowasku 88*, (B)–(I) *Chaowasku 87*, (J), (K) *Chaowasku 89*.

cm; base cuneate; apex usually caudate-acuminate, rarely acute; lamina glabrous above, almost glabrous below; midrib sunken above, glabrous to (appressed-)puberulous, raised below, appressed-puberulous; secondary veins 11–14 pairs, prominent below, raised, angle with midrib 48°–61°. Flower solitary, axillary; pedicels 1.3–1.9 cm long, almost glabrous, bracts 3, triangular, placed at base of the pedicels. Sepals ovate-triangular, ca. 1.5 × 1.1 mm, persistent in fruit; both sides glabrous, margin puberulous. Outer petals ovate, ca. 1.7 × 1.2 mm; both sides glabrous, margin puberulous. Inner petals ovate, 9.0–10.0 × 6.0 mm, tightly appressed at the basal part (ca. 2/3 of the inner petal length) at anthesis, the apical part (ca. 1/3 of the inner petal length) considerably recurved at anthesis; both sides glabrous, margin puberulous; inner side of the apical part (ca. 1/3 of the inner petal length) with ± warty glandular structures; base slightly saccate. Torus slightly ovoid. Stamens ca. 20, ca. 1.0 mm long. Carpels ca. 12, ca. 1.8 mm long; stigmas subglobose-ellipsoid; ovaries appressed-velvety; ovule 1, lateral. Monocarps 2–7, subglobose-ellipsoid, ca. 0.9 × 0.7 cm; surface slightly verruculose, often with larger warts in some areas, almost glabrous; apex not apiculate; stipe ca. 5.0 mm long, almost glabrous, obliquely attached to monocarps. Seed 1, subglobose-ellipsoid, ca. 0.8 × 0.6 cm.

Distribution, habitat and phenology:–Thailand (Tak Province), occurring in evergreen forests; ca. 100 m from a stream. Elevation: not less than 1000 m a.s.l. Flowering and fruiting: December.

Similar species:–*Miliusa umpangensis* is remarkable among the species of group 4 observed thus far because it is the only one to possess inner petals with ± warty glandular structures inside the apical part (ca. 1/3 of the inner petal length) (Fig. 11B, D). Other morphological characters of *M. umpangensis* seem similar to those of *M. filipes*, except the ovaries which are densely hairy in the new species while glabrous in *M. filipes*. *Miliusa umpangensis* is allopatric to all other species of group 4.

Field notes:–Flowers purplish–brown in general, the apical half somewhat purplish–greenish, fragrant like *Pandanus amaryllifolius* Roxb. leaves but fainter. Fruits half purplish half whitish green, ripening dark purple. Vernacular name: Ra-Khang-Hom (Thai).

Additional specimens examined (paratypes):–*Chaowasku 87* (BKF, L), *89* (BKF, L): both collected from the same locality as the type.

Taxonomy of species previously known from Thailand

Our study of the genus *Miliusa* in Thailand revealed that several taxa described from material collected from or outside Thailand are conspecific to species described earlier. Therefore, they are herein formally reduced into synonymy (*syn. nov*.). In addition, the complete taxonomic nomenclature (including lectotypifications, basionyms and synonyms) of all known species of *Miliusa* in Thailand is provided.

1. *Miliusa amplexicaulis* Ridl. (1910, p. 13)

Type:–Peninsular Malaysia, Langkawi, Apr 1896, *Curtis 3205* [lectotype selected by Turner (2012, p. 237): SING (barcode SING0045995), isotypes: K!, SING, UC!][2], in flower.

[2] Incorrectly indicated as "(holotype: K!, isotypes: SING, UC!)" in the original publication of this chapter.

Distribution:–Southern Thailand to Peninsular Malaysia.

2. *Miliusa campanulata* Pierre (1881, t. 41) (Fig. 2C, D)

Type:–Cambodia, in Montibus Knang Repeu, May 1870, *Pierre 602b* [lectotype selected here: P! (barcode P00160858), isotypes: B!, C!, L!], in flower.

Distribution:–Eastern/northeastern Thailand to Cambodia.

3. *Miliusa cuneata* Craib (1912, p. 145)

Type:–Thailand, Chiang Mai, Doi Sutep, May 1911, *Kerr 1837* [holotype: K!, isotypes: ABD!, B!, BK! (photograph), BM!, CAL!, E!, K!, TCD! (photograph)], in flower.

Taxonomic synonym:–*Miliusa elongata* Craib (1925, p. 12) *syn. nov*.

Type:–Thailand, Nakawn Sawan, Klawng Kung, Jun 1922, *Kerr 6050* [holotype: K!, isotypes: ABD!, B!, BK! (photograph), BM!, E!, TCD! (photograph), UC!], in flower.

Distribution:–China (Yunnan Province), Laos (Sainyabuli Province) to Thailand (Chiang Mai, Chiang Rai, Kamphaeng Phet, Kanchanaburi, Lampang, Nan, Phayao Provinces).

4. *Miliusa filipes* Ridl. (1920, p. 81)

Type:–Thailand, western coast and islands of Peninsular Siam [now Thailand], Tasan, *Kloss 6968* (holotype: K!), in flower.

Distribution:–Thailand (Chumphon Province).

5. *Miliusa fusca* Pierre (1881, t. 42)

Type:–Cambodia, Samrongtong, crescit in Montibus Kereev, Apr 1870, *Pierre 737a* [lectotype selected here: P! (barcode P00160866)], in flower and fruit.

Taxonomic synonym:–*Miliusa mollis* Pierre var. *sparsior* Craib (1931, p. 59) *syn. nov*.

Type:–Thailand, Loei, Wang Sapung, Mar 1924, *Kerr 8630* [holotype: K, isotypes: AAU!, BK! (photograph), BM!, C!, E!, L!, UC!], in fruit.

Distribution:–Thailand (Loei, Nakhon Ratchasima Provinces) to Cambodia (Kampong Thom, Koh Kong Provinces).

6. *Miliusa horsfieldii* (Benn.) Baill. ex Pierre (1881, t. 38)

Basionym: *Saccopetalum horsfieldii* Benn. (1840, p. 165).

Type:–Indonesia, Java, *Horsfield s.n.* [holotype: BM! (barcode BM000554019), isotypes: BM!, K!], in flower.

Taxonomic synonyms:–*Saccopetalum arboreum* Elmer (1913, p. 1739).

Based on the same type: *Miliusa arborea* (Elmer) J.Sinclair (1955, p. 378).

Type:–The Philippines, Islands of Palawan, Province of Palawan, Brooks Point (Addison Peak), Feb 1911, *Elmer 12677* [lectotype selected by Mols & Keßler (2003, p. 440): A! (barcode A00039668), isotypes: B!, BM!, BO!, E!, G!, L!, NSW!, NY!, P!, U!, US!, Z!], in flower.

– *Miliusa tectona* Hutch. ex C.E.Parkinson (1923, p. 75).

Based on the same type: *Saccopetalum tectonum* (Hutch. ex C.E.Parkinson) Chatterjee (1948, p. 59).

Type:–India, Andaman Islands, Middle Andaman, May 1915, *Parkinson 545* (holotype: K!, isotype: DD!), in flower and fruit.

– *Saccopetalum lineatum* Craib (1924, p. 82).

Based on the same type: *Miliusa lineata* (Craib) Ast (1938, p. 120).

Type:–Thailand, Nakawn Sawawn, Mê Wong, May 1922, *Kerr 6012* [holotype: K!, isotypes: BK! (photograph), BM!, CAL, E!, P!, UC!], in flower.

– *Saccopetalum unguiculatum* C.E.C.Fisch. (1926, p. 454).

Based on the same type: *Miliusa unguiculata* (C.E.C.Fisch.) J.Sinclair (1955, p. 378).

Type:–Myanmar, South Tenasserim, Theinkun Chaung, Naungbwa, Feb 1926, *Parkinson 1694* (holotype: K!, isotypes: ABD!, K!), in flower.

– *Alphonsea prolifica* Chun & F.C.How (1958, p. 1).

Based on the same type: *Saccopetalum prolificum* (Chun & F.C.How) Tsiang, in Tsiang and Li (1964, p. 380). – *Miliusa prolifica* (Chun & F.C.How) P.T.Li (1993, p. 315). – *Alphonsea mollis* Merr. & Chun (1935, p. 230) *nom. illeg*.

Type:–China, Hainan, Yaichow, Mar-Jul 1933, *How 70951* [holotype: NY! (barcode NY00334809), isotypes: A!, B!, K!, P!], in fruit.

Distribution:–Southern China, Laos, Thailand, southern Myanmar, Andaman/Nicobar Islands, Peninsular Malaysia through Southeast Asian islands (except three major islands: Borneo, Luzon, and Mindanao) to southern New Guinea and northeastern Australia.

7. *Miliusa longipes* King (1892, p. 124)

Type:–Peninsular Malaysia, Perak, Mar 1885, *King's collector 7352* (holotype: CAL, isotypes: BM!, BO!, G!, L!, WU!), in flower.

Taxonomic synonym:–*Miliusa smithiae* Craib (1923, p. 44).

Type:–Thailand, Khao Ram, Mar 1922, *Smith 684* [holotype: K!, isotypes: BK! (photograph), BM!], in flower.

Distribution:–Southern Thailand, Peninsular Malaysia, Singapore, Sumatra to Java.

Notes:–During the preparation of this paper, it was decided to combine this species with *M. campanulata* because of the overall similarity, although *M. longipes* generally possesses (much) longer stipe. However, during a recent expedition, several flowering living plants of *M. longipes* were seen and their flowers are quite different from those of *M. campanulata*. The discoloration on the basal half of the inner petals of *M. longipes* is not (or very slightly) reticulate (remarkably reticulate in *M. campanulata*, Fig. 2C) and the window-like structures at base of the inner petals are indistinct (sometimes absent) (conspicuous in *M. campanulata*, Fig. 2D).

Mols and Keßler (2003) cited some specimens that are *M. campanulata* as *M. longipes*. It is now becoming clear that *M. longipes* only occurs in southern Thailand and southwards to Peninsular Malaysia, Singapore, Sumatra, and Java.

8. *Miliusa mollis* Pierre (1881, t. 40) (Fig. 1A)

Based on the same type: *Orophea mollis* (Pierre) Bân (1994, p. 10).

Type:–Cambodia, Prov. Samrongtong, crescit in Montibus Kereev, Mar 1870, *Pierre 3274* [lectotype selected here: P! (barcode P00160889), isotypes: A!, BM!, L!], in flower.

Distribution:–Thailand (Chaiyaphum, Chanthaburi, Khon Kaen, Lopburi, Nakhon Ratchasima, Saraburi Provinces) to Cambodia (Kampong Thom Province).

9. *Miliusa parviflora* Ridl. (1911, p. 65)

Type:–Peninsular Malaysia. Perlis, Tebing Tinggi, Mar 1910, *Ridley 15340* [lectotype selected by Turner (2012, p. 238): SING!, isotypes: BM!, K!][3], in flower and fruit.

Taxonomic synonyms:–*Miliusa jainii* Goel & S.C.Sharma (1991, p. 629) *syn. nov*.

Type:–India, Andaman Islands, South Andamans, Tarmugli Island, Sep 1987, *Goel 16846* (holotype: CDRI, isotypes: CDRI, L!), in flower and fruit.

– *Miliusa mukerjeeana* Debika Mitra & Chakr. (1994, p. 326) *syn. nov*.

Type:–India, South Andaman Island, Alimusjid Hill Jungle, Oct 1895, *King's collector s.n.* (holotype: CAL; isotype: CAL). [The type of *M. mukerjeeana* could not be traced. Study of a drawing and description of this species in the original publication was the ground for synonymization.]

Distribution:–Andaman and Nicobar Islands, southern Thailand, Peninsular Malaysia to Sumatra.

10. *Miliusa sclerocarpa* (A.DC.) Kurz (1872, p. 291)

Basionym: *Uvaria sclerocarpa* A.DC. (1832, p. 203).

Based on the same type: *Saccopetalum sclerocarpum* (A.DC.) Hook.f. & Thomson (1872, p. 88).

Type:–Myanmar, Moalmyne, 1827, Wallich Numer. List no. 6461 [lectotype selected by Turner (2011b, p. 48): K!, isotypes: BM!, G!], in fruit.

Taxonomic synonym:–*Saccopetalum longiflorum* Hook.f. & Thomson (1855, p. 151) *syn. nov*.

Based on the same type: *Miliusa longiflora* (Hook.f. & Thomson) Baill. ex Finet & Gagnep. (1906, p. 153).

Type:–Wallich Numer. List no. 6443a [lectotype selected here: K! (photograph), isotypes: BR!, G!], in flower.

Distribution:–India (Bihar State), Myanmar (Mon State) to Thailand (Kanchanaburi?, Lampang, Lamphun, Mae Hong Son, Sukhothai Provinces).

Notes:–This species was reported to occur in Thailand for the first time under the name *M. longiflora* (Khumchompoo & Thongpukdee 2005), which is considered a synonym of *M. sclerocarpa* in this study. However, specimens collected from south-western Thailand cited in Khumchompoo & Thongpukdee (2005) were not seen by us except one collection: *Van Beusekom and Santisuk 2876*, which has somewhat smaller leaves, denser vegetative indumentum, and more carpels per flower. Hence, this collection probably represents an undescribed species.

11. *Miliusa thorelii* Finet & Gagnep. (1907, p. 89) (Fig. 1C)

Type:–Laos, Pak-Lay, 1866–1868, *Thorel 3301* [holotype: P! (barcode P00160898)], in male flower.

Taxonomic synonym:–*Miliusa bannaensis* X.L.Hou, in Hou *et al*. (2004, p. 79) *syn. nov*.

Type:–China, *Zhu and Wang 2125* (holotype: HITBC!, photograph), in flower.

Distribution:–China (Yunnan Province), Laos (Sainyabuli Province) to Thailand (Chanthaburi, Chiang Mai, Chiang Rai, Kamphaeng Phet, Kanchanaburi, Lampang, Mae Hong Son, Nan, Phang Nga, Phrae, Surat Thani, Tak Provinces) and Myanmar (Tanintharyi Division).

[3] Incorrectly indicated as "(holotype: K!, isotypes: BM!, SING!)" in the original publication of this chapter.

12. *Miliusa velutina* (DC.) Hook.f. & Thomson (1855, p. 151)

Basionym: *Uvaria velutina* DC., in Dunal (1817, p. 91).

Based on the same type: *Guatteria villosa* G.Don (1831, p. 100) *nom. illeg. superfl*. – *Uvaria villosa* Roxb. (1832, p. 664) *nom. illeg. superfl*. – *Miliusa villosa* W.Theob., in Mason (1883, p. 667) *nom. illeg. superfl*.

Type:–India Orient., Wallich Numer. List no. 6441a (holotype: G!, isotypes: A!, BM?), in flower.

Taxonomic synonym:–*Guatteria velutina* A.DC. (1832, p. 218).

Type:–Myanmar, Atran, Apr 1827, Wallich Numer. List no. 6441c [holotype: G, isotypes: BM!, K! (photograph)], in flower.

Distribution:–India (Assam, Jharkhand, Orissa, Uttar Pradesh, Uttarakhand, West Bengal States), Nepal (Central, Eastern Regions), Bangladesh (Dhaka Division) through Myanmar (Bago Division, Kachin State, Yangon Division), Thailand (Chachoengsao, Chiang Mai, Kanchanaburi, Lampang, Mae Hong Son, Nakhon Ratchasima, Nong Khai, Phetchaburi, Phrae, Prachuab Khiri Khan, Ratchaburi, Saraburi, Tak Provinces), Laos (Attapeu, Champasak Provinces), Cambodia (Kampong Thom, Kampong Speu, Kratié, Preah Vihear, Pursat, Stung Treng Provinces) to Vietnam (Ninh Thuan, Tay Ninh Provinces).

Appendix 1

Studied specimens of the *Miliusa* species previously known from Thailand

***M. amplexicaulis*:** *Bunnab 90; Chaowasku 54*.

***M. campanulata*:** *Chaowasku 23; Collins 1281; Fukuoka T-63705; Geesink et al. 6985; Gentry and Niyomdham 66500; Hardial 587; Kerr 8824, 10816; Larsen 9938; Larsen et al. 566, 3237, 31486, 31957; Maxwell 76-389; Murata et al. T-16310, T-16415; Phusomsaeng et al. 5; Plernchit 435; Pooma 1560; Sangkachand et al. 3141; Santisuk 199; Shimizu et al. T-8849; Smitinand 3820; Takahashi T-63255; Van Beusekom and Charoenpol 1807.*

***M. cuneata*:** *Bunchuai 1321; Chalermglin 420408; Kerr 1837, 5011, 6050, 10345; Keßler PK 3183, PK 3277; Kostermans 842; Koyama et al. 15600; Larsen et al. 46329; Maxwell 89-613, 90-1098, 95-407, 95-1208, 96-374, 96-600, 96-1430, 97-478, 99-282, 01-351, 02-152; Murata et al. T-15036; Parnell et al. 95-585; Phengklai et al. 2939; Pooma 1198, 1437; Shimizu and Hutoh T-10238; Tagawa et al. T-9895; Van Beusekom and Phengklai 208, 1322; Van Beusekom et al. 3700, 3848; Van de Bult 480, 682; Vidal 5182.*

***M. filipes*:** *Kloss 6968.*

***M. fusca*:** *Chaowasku 46; Kerr 8630; Murata et al. T-16322, T-16404; Van Beusekom and Phengklai 3129.*

***M. horsfieldii*:** *Chaowasku 109; Charoenchai 789, 809; Gardner and Sidisunthorn ST 0263; Kerr 6012; Larsen et al. 31294; Maxwell 02-90.*

***M. longipes*:** *Iwatsuki et al. T-8453, T-8486; Niyomdham et al. 322.*

***M. mollis*:** *Chaowasku 20, 49; Geesink et al. 6746, 6937; Kerr 8017; Keßler PK 3207;*

Koyama et al. T-33050; Lakshnakara 274; Marcan 1520; Maxwell 75-479; Phengnaren 444; Phuphathanaphong 31; Put 1095, 1870, 2417, 4365; Shimizu et al. T-23919; Smitinand 7455; Smitinand and Phengklai 8828; Smitinand & Sleumer 1313, 8375; Van Beusekom and Charoenpol 1927.

***M. parviflora*:** *Chaowasku 98*.

***M. sclerocarpa*:** *Chaowasku 19; Geesink et al. 5970; Maxwell 72-126, 94-284, 94-573, 94-1311.*

***M. thorelii*:** *Geesink et al. 6718, 8228; Kerr 1162, 1834, 5448; Keßler PK 3184, PK 3224; Kostermans 449; Koyama T-61148; Larsen et al. 2559, 2620, 3051, 30956; Maxwell 85-800, 89-427, 89-651, 89-677, 89-801, 91-765, 93-667, 94-492, 95-513, 95-944, 96-1303, 97-584, 98-797; Murata et al. 16898; Sangkachand 828; Smitinand 3983; Smitinand and Cheke 10828; Somkid 394; Sørensen et al. 3077, 4523; Van Beusekom and Phengklai 1327; Winit 862.*

***M. velutina*:** *Bjørnland and Schumacher 220; Buasawng 2; Cheeranun 5; Geesink et al. 5954; Keith 362; Kerr 1078, 5237, 10629; Keßler PK 3216; Kostermans 420; Maxwell 75-165, 88-732, 98-541; Na Nakhon and Beck 88150; Phusomsaeng 1821; Panatkool 480; Pholsena and Koonkhunthod 2842; Pooma 165, 399; Prasert 1; Put 2790; Santisuk 039, 997; Smitinand and Phengklai 8647; Soora 3; Umnat 8; Vanpruk 449; Winit 87.*