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New species and new records for the climber genus *Friesodielsia* (Annonaceae) in the flora of Thailand

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ABSTRACT

Six new species of *Friesodielsia* (Annonaceae) are described and illustrated; seven species are documented for Thailand for the first time, with a lectotype designated for the name *Oxymitra latifolia*. *Oxymitra fornicata* var. *glabra* is raised to species rank as *Friesodielsia glabra*. These additions bring the species diversity of *Friesodielsia* in Thailand to 16 species. A key to the Thai species is provided.

KEYWORDS: Plant diversity, Southeast Asia, taxonomy.

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INTRODUCTION

Friesodielsia Steenis is a genus of climbing plants with fragrant flowers distributed in tropical Asia from India to the Philippines and south to Sumatra, Java, and New Guinea. The flowers have short inner petals, vaulted and connivent to form a dome over the centre of the flower. This distinctive floral morphology is a convergent feature shared with several other genera of Asian Annonaceae, such as *Goniothalamus* (Blume) Hook.f. & Thomson (Tribe Annoneae) and *Mitrephora* (Blume) Hook.f. & Thomson (Tribe Miliuseae), but *Friesodielsia* (Tribe Uvarieae) is the only climber among them. The marginal leaf glands of *Friesodielsia*, present at the base of the leaf blade on either side of the petiole (Fig. 2A), are shared with the related genus Desmos Lour. but are otherwise unknown in the family. The fruit of *Friesodielsia*, an aggregate of many stipitate one-seeded fleshy monocarps, is a common type in the family.

Hooker & Thomson (1872) observed that the outer petals of species in the genus were either triquetrous or flat at the apex. Guo *et al.* (2017), in a molecular phylogenetic study of the genus, reported that one subclade was "characterised by flowers with three outer petals that are freely spreading and have a flat petal base, whereas the other subclade has flowers with outer petals that are connivent before anthesis and possess a distinctly concave petal base".

The name *Friesodielsia* was proposed by van Steenis (1948) as a replacement name for the illegitimate later homonym *Oxymitra* (Blume) Hook.f. & Thomson, 1855 [non Bisch. ex Lindenb., 1829 (Hepaticae)]. Das (1963) and van Steenis (1964) transferred all *Oxymitra* species names accepted at the time to the new genus, the latter also distinguishing it from *Richella* A.Gray. Guo *et al.* (2017) excluded the African species formerly included in *Friesodielsia*; the genus in its current circumscription comprises ca 37 species (Turner, 2018).

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In preparing a treatment of the genus for the Flora of Thailand we encountered unexpected diversity in the genus, particularly in Peninsular Thailand. On morphological criteria it appears that species of both subclades identified by Guo *et al.* (2017) are present in the flora. Here we describe six species, five in the group with freely spreading outer petals and one with connivent petals, and document the occurrence of seven additional species for the flora. In addition, we raise to species rank *Oxymitra fornicata* (Roxb.) Hook.f. & Thomson var. *glabra* Ridl., described from Adang Island, Satun Province, Thailand (Ridley, 1922).

TAXONOMY

NEW SPECIES

Friesodielsia brevistipitata Leerat., **sp. nov.**

Friesodielsia brevistipitata is most similar to *F. desmoides* (Craib) Steenis and *F. songkhlaensis* Leerat. It differs from *F. desmoides* in having appressed rather than erect hairs on the abaxial leaf surface, sepals 5–10 mm versus 4–5 mm long, outer petals 35–60 mm versus (19–)27–31 mm long and obtuse versus acute at the apex, and monocarp stipes 3–5 mm versus 7–10.5 mm long. From *F. songkhlaensis* it may be distinguished by the shorter sepals that are rounded to an obtuse or slightly acute apex and again by the short monocarp stipes. Type: Thailand, Songkhla, Hat Yai District, Ton Nga Chang Wildlife Sanctuary, 8 Oct. 2020, *Leeratiwong 20-1612* (holotype **PSU!**; isotypes **BKF!**, **KKU!**, **QBG!**). Figs. 1 & 2A–C.

Scandent shrub to 2 m high. *Twigs* densely brown or dark brown appressed to spreading-pubescent, eventually moderately pubescent or glabrate. *Leaves* chartaceous to subcoriaceous, glaucous abaxially, lanceolate, oblong-lanceolate, elliptic, elliptic-lanceolate or oblong, larger blades 8–18 × 2.5–8 cm; base broadly cuneate, rounded or slightly cordate; apex acuminate, acute or rarely obtuse, the acumen 0–10 mm long; glabrous to sparsely appressed hairy adaxially, denser at midrib, moderately to densely appressed hairy, with spreading hairs at midrib abaxially; midrib sunken adaxially, raised abaxially; secondary veins 10–16 per side; petiole 3–12 mm long, densely pubescent. *Inflorescences* supra-axillary, 1-flowered; pedicels 3–8 mm long, densely pubescent, with a lanceolate or broadly lanceolate bract, 2–7 mm long attached near to apex, midpoint or near to base. *Sepals* not overlapping at base, subcoriaceous, ovate or elliptic-ovate, 5–10 × 4.5–6.5 mm, obtuse to slightly acute, distinctly 5–7-veined, moderately to sparsely covered with mixed appressed and spreading hairs. *Petals* pale yellow, yellow or creamy white; outer petals separating at anthesis, sub-coriaceous, lanceolate, oblong-lanceolate or elliptic-lanceolate, 35–50(–60) × 8.5–15 mm, length:width ratio ca 4:1, apex obtuse to rarely slightly acute, flattened on base inside, moderately pubescent on both sides, except glabrous at base inside, midrib raised; inner petals forming a pyramidal cone 8–13 mm high, sometimes with pink at base, coriaceous, ovate-lanceolate to ovate, 8–13 × 4–7.5 mm, margins with protrusions at midpoint, apex obtuse to slightly acute, moderately pubescent outside, glabrous inside. *Stamens* wedge-shaped, 1.2–1.8 mm, anther connective apex peltate. *Carpels* 10–14, hairy, oblong, 1–1.8 mm long, with falcate-capitate stigmas cleft down the side, pubescent. *Fruit* of (1–)6–12 monocarps borne on a pedicel 3–6 mm long, bract and sepals persistent. *Monocarps* red, ellipsoid, ovoid, ovoid-ellipsoid or oblongoid, 10–18 × 7–12 mm, pericarp 0.5–2.5 mm thick, surface smooth to slightly verrucose in vivo, verrucose when dried, densely appressed pubescent, apiculum 0.3–1.5 mm long, stipe 3–5 × 2–3 mm. *Seeds* not examined

Thailand.— PENINSULAR: Krabi [Lam Thap, 10 July 2009, *Haman 1* (**PSU**)]; Nakhon Si Thammarat [Ban Lam Nao Village, Bang Khan District, alt. ca 150 m, 2 Jan. 2021, *Leeratiwong 21-1697* (**PSU**)]; Songkhla [Sadao District, Ban Yang Ko Village, alt. ca 100 m, 5 July 2020, *Leeratiwong 20-1611* (**PSU**); Hat Yai District, Ton Nga Chang Wildlife Sanctuary, 8 Oct. 2020, *Leeratiwong 20-1612* (**BKF**, **KKU**, **PSU**, **QBG**)].

Distribution.— Endemic.

Ecology.— Dry evergreen forest, limestone areas, Para-rubber plantation near the edge of remnant forest; 100–150 m alt. Flowering: July, September, October, December; fruiting: July, October, December.

Etymology.— Named for the short stipes of the monocarps, among the shortest in the entire genus.

Vernacular.— Sa lao (ส่าเหล้า)(Krabi).

Note.— *Friesodielsia brevistipitata* and *F. songkhlaensis* sometimes occur in the same site, but they flower at different times of the year, *F. brevistipitata* from July to December and *F. songkhlaensis* in April and May.

Friesodielsia khaoluangensis Leerat. & Aongyong, **sp. nov.**

Friesodielsia khaoluangensis resembles *F. alpina* (J.Sinclair) Steenis and *F. borneensis* (Miq.) Steenis in its narrow flowers and narrow

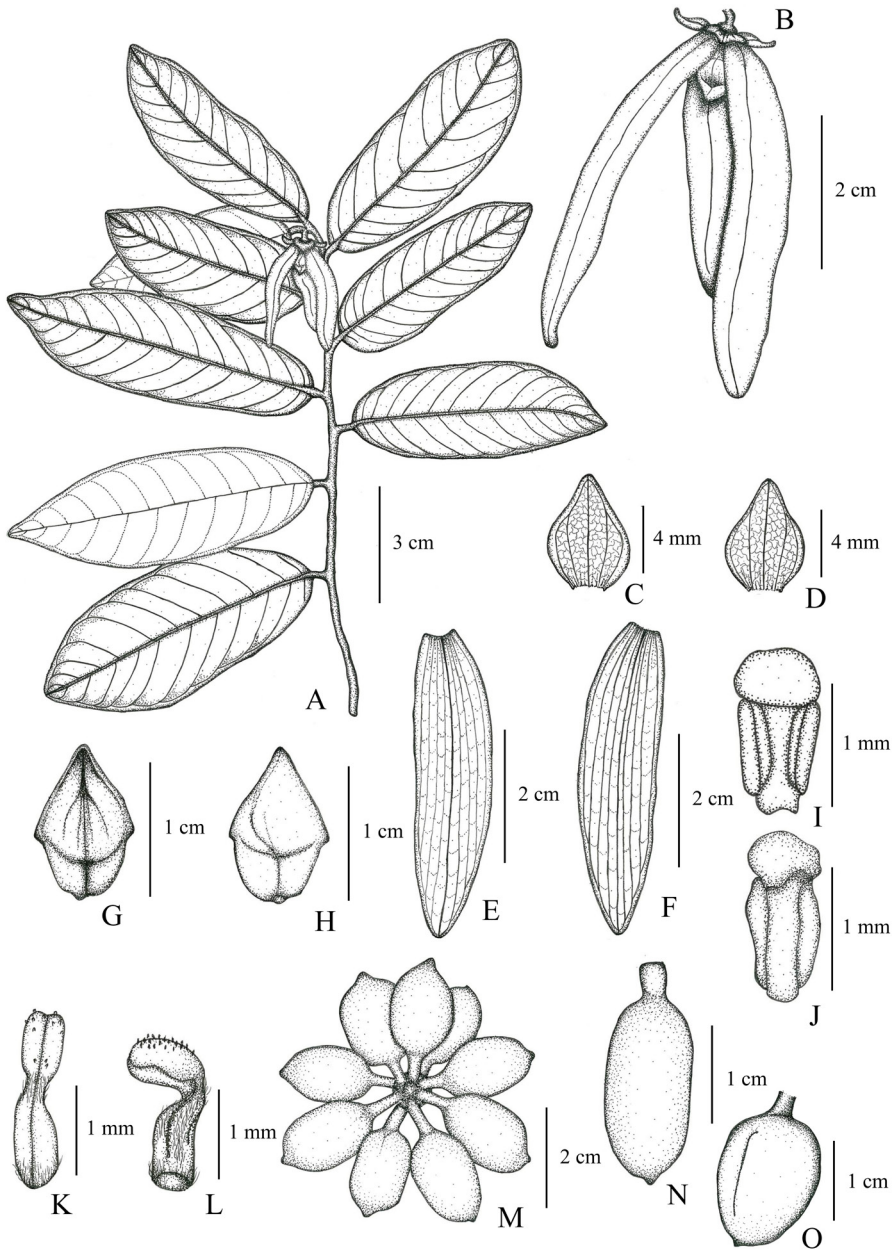

Figure 1. *Friesodielsia brevistipitata* Leerat. A. flowering branch. B. flower, side view. C. sepal, abaxial view. D. sepal, adaxial view. E. outer petal, abaxial view. F. outer petal, adaxial view. G. inner petal, abaxial view. H. inner petal, adaxial view. I. stamen, abaxial view. J. stamen, adaxial view. K–L. carpels. M. young fruit. N–O. single dried mature monocarps. Drawn by A. Somphrom.

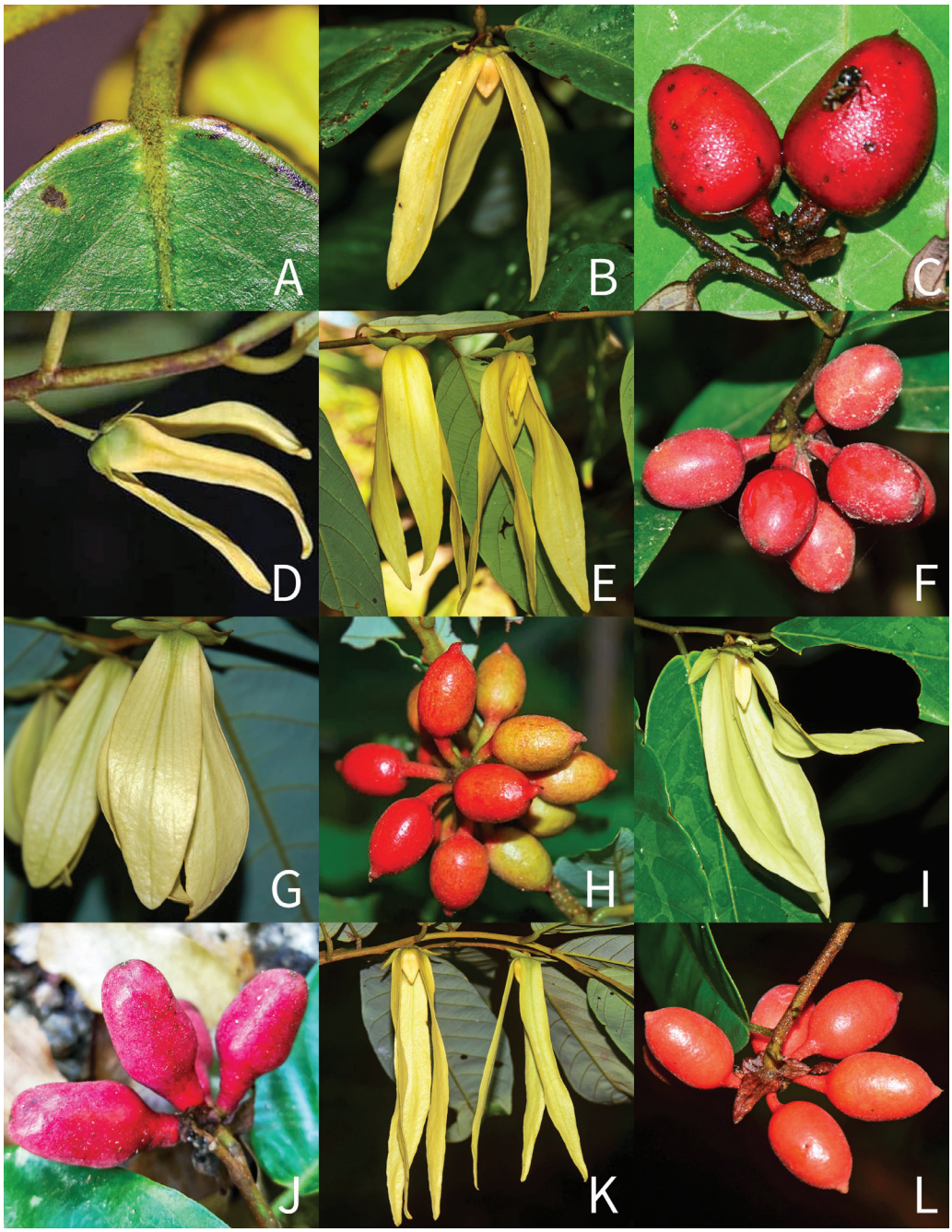

Figure 2. Photographs of new *Friesodielsia* species. A–C. *F. brevistipitata* Leerat. A. leaf base showing marginal glands. B. flower. C. monocarps. D. flower of *F. khaoluangensis* Leerat. & Aongyong. E–F. *F. longipetala* Leerat. & Chalermglin. E. flowers, F. monocarps. G–H. *F. macrosepala* Leerat. & Aongyong. G. flowers. H. monocarps. I–J. *F. phanganensis* Leerat. I. flower. J. monocarps. K–L. *F. songkhlaensis* Leerat. K. flowers. L. monocarps. Photographs by C. Leeratiwong (A–C, E–F, I &K–L), K. Aongyong (G & H) and P. Khiriwong (J).

leaves. From *F. alpina* it differs in the twigs and leaves appressed-pubescent rather than glabrous, larger leaves (13–22 × 3.8–7.5 cm versus 8.5–13 × 3–4 cm) but with only 9–12 secondary veins per side versus 12–14 per side, the pedicels ca 10 mm long versus 25–27 mm long, and the outer petals linear-lanceolate, 23–25 mm long, and appressed-pubescent versus lanceolate, ca 15 mm long, and glabrous. From *F. borneensis* it differs in the leaves not glaucous abaxially and with petioles 8–17 mm long instead of glaucous abaxially with petioles 4.5–8 mm long, the pedicellar bract lanceolate rather than linear, and petals 23–25 mm long rather than 52–59 mm long. Type: Thailand, Nakhon Si Thammarat, Nop Phitam District, Krung Ching Subdistrict, Krung Ching Waterfall, July 2018, *Aongyong 20* (holotype **PSU!**; isotype **KKU!**). Figs. 2D & 3.

Woody climber to 5 m high. *Twigs* moderately short brown pubescent, the hairs appressed, eventually glabrate. *Leaves* chartaceous, pale but not glaucous abaxially, oblong, lanceolate-oblong, oblanceolate or ovate-lanceolate, larger blades 13–22 × 3.8–7.5 cm; base broadly cuneate to rounded; apex acuminate, the narrow acumen (3–)7–20 mm long; appressed pubescent on both surfaces but denser on abaxial surface; secondary veins 9–12 per side; petiole 8–17 mm long, densely pubescent. *Inflorescences* supra-axillary or leaf-opposed, 1-flowered; pedicels ca 10 mm long, densely pubescent, with a lanceolate bract ca 2.5 mm long attached at midpoint. *Sepals* not overlapping at base, chartaceous, triangular-ovate, 5–6 mm long, acute to acuminate, moderately covered with hairs. *Petals* yellow to brown-yellow; outer petals appressed in bud, erect to slightly spreading at anthesis, subcoriaceous, lanceolate-linear, 23–25 × 6–8 mm, length:width ratio 3.1–3.8:1, acute, concave on base inside, densely appressed pubescent; inner petals forming a pyramidal cone ca 9 mm high, ovate-triangular, ca 8–9 × 4–4.5 mm, acuminate, glabrous. *Stamens* wedge-shaped, 0.9–1.2 mm long, anther connective apex irregularly depressed-globose to truncate. *Carpels* oblong, 1.5–2 mm long, hairy, stigmas recurved, bilobed and thickened at apex. *Fruits* and seeds unknown.

Thailand.— PENINSULAR: Nakhon Si Thammarat [Nop Phitam District, Krung Ching Subdistrict, Krung Ching Waterfall, July 2018, *Aongyong 20* (**PSU**, **KKU**).

Distribution.— Endemic.

Ecology.— Primary evergreen forest; ca 200 m alt. Flowering: July.

Etymology.— The species is named for the type locality.

Vernacular.— Bu nga khao luang (บุหงาเขาหลวง) (General), sao yut (สาวหยุด)(Nakhon Si Thammarat).

Note.— *Friesodielsia khaoluangensis* belongs to the group of *Friesodielsia* species with fleshy outer petals that are triquetrous at the apex and concave at the base.

Friesodielsia longipetala Leerat. & Chalermglin, **sp. nov.**

Friesodielsia longipetala is distinguished from *F. phanganensis* and *F. songkhlaensis* by its sub-coriaceous to coriaceous leaves, outer petals (50–)80–140 mm long, inner petals (11–)15–25 mm long, generally longer pedicels (up to 12 mm long), and monocarps only sparsely pubescent. Type: Thailand, Songkhla, Sadao District, Prik Subdistrict, Ban Yang Ko Village, 29 Aug. 2020, *Leeratiwong 20-1604* (holotype: **PSU!**; isotypes: **BKF!**, **KKU!**, **PSU!**). Figs. 2E–F & 4.

Woody climber or scandent shrub to 3 m high. *Twigs* densely brown pubescent, the hairs appressed to spreading, eventually moderately pubescent. *Leaves* subcoriaceous to coriaceous, glaucous abaxially, narrowly lanceolate to lanceolate, oblong-lanceolate to oblong, elliptic or broadly oblong, larger blades 5–19 × 1.5–6.5(–8.5) cm; base broadly cuneate, rounded or cordate; apex acute to acuminate, the acumen 3–18 mm long; glabrous, except with brown pubescence on midrib adaxially, moderately appressed brown-pubescent abaxially; midrib sunken above, raised beneath, secondary veins 12–16 per side; petiole 3–10 mm long, densely pubescent. *Inflorescences* supra-axillary, 1-flowered; pedicels 4.5–12 mm long, densely pubescent, with a narrowly to broadly lanceolate bract 2–8 mm long attached near to midpoint or near to base. *Sepals* not overlapping at base, subcoriaceous, ovate to triangular-ovate, 5–14 × 4–8 mm, rounded to an obtuse to acute apex, strongly 5–7-veined, moderately covered with appressed to spreading hairs. *Petals* yellow to green-yellow; outer petals spreading narrowly in bud, erect to slightly spreading at anthesis, subcoriaceous to chartaceous, oblong-lanceolate, linear-lanceolate or

lanceolate, (50–)80–140 × (12–)13–25 mm, length:width ratio (4.2)5.6–6.1:1, apex acuminate, rarely acute or slightly obtuse, flat on base inside, densely sericeous, with a slightly raised midrib; inner petals forming a pyramidal cone 11–25 mm high, lanceolate to narrowly lanceolate, (11–)15–25 × (5–)6.5–9 mm, apex acute to acuminate or rarely slightly obtuse, pubescent outside, glabrous toward base and hairy toward apex inside. *Stamens* cuneate, 1.5–1.8 mm long, anther connective apex peltate. *Carpels* 10–14, ellipsoid-oblong, 1–1.8 mm long, with falcate-capitate stigmas cleft down the side. *Fruit* of 1–10 monocarps borne on a pedicel 5–10 mm long, bract and sepals persistent in fruit. *Monocarps* red, ovoid, ellipsoid-ovoid or ellipsoid, 8–15(–18) × 6–11 mm, pericarp 1.5–3 mm thick,

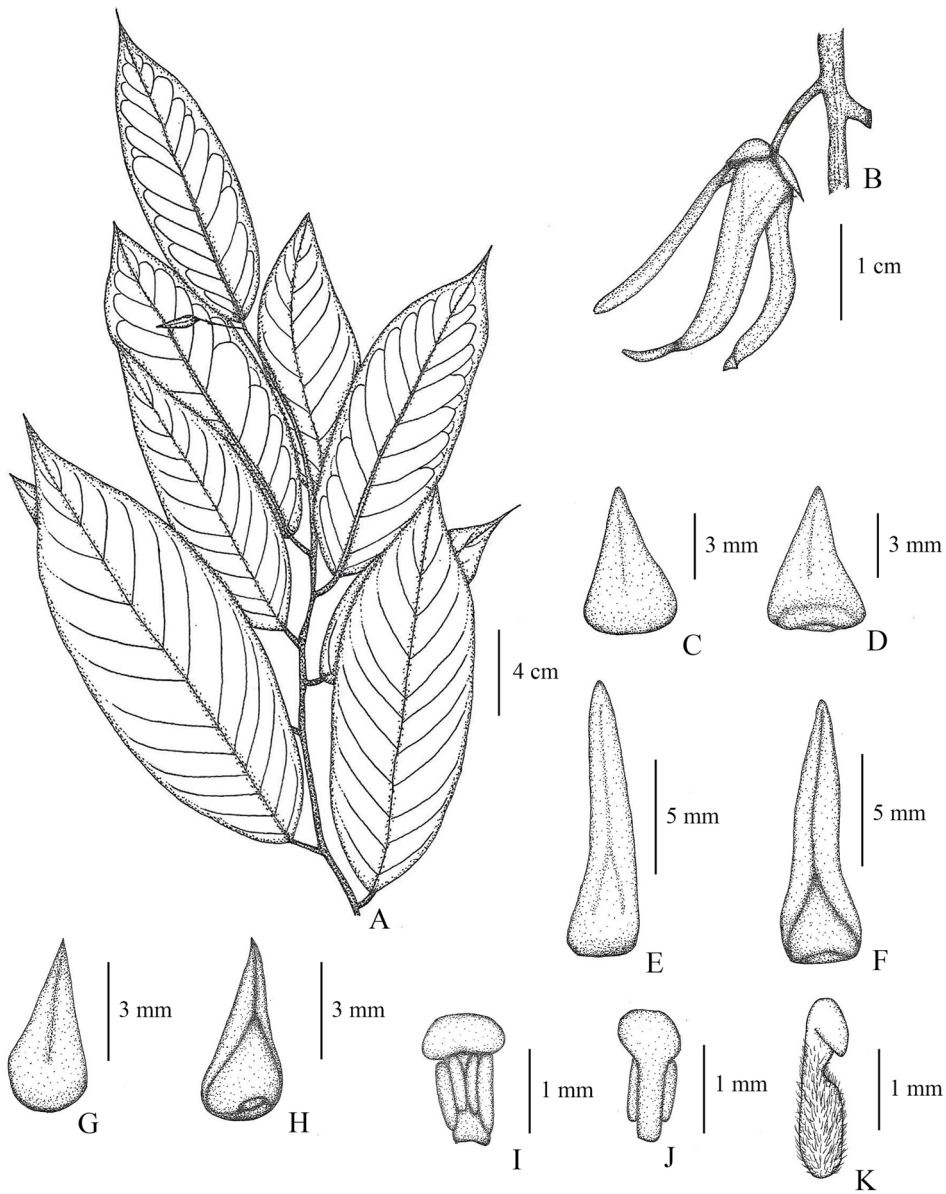

Figure 3. *Friesodielsia khaoluangensis* Leerat. & Aongyong. A. vegetative branch. B. flower, side view. C. sepal, abaxial view. D. sepal, adaxial view. E. outer petal, abaxial view. F. outer petal, adaxial view. G. inner petal, abaxial view. H. inner petal, adaxial view. I. stamen, abaxial view. J. stamen, adaxial view. K. carpel. Drawn by J. Satthaphorn.

surface smooth in vivo, verrucose when dried, sparsely appressed pubescent, apiculum to 1 mm long, or apex rounded, stipe 5–10 × 1–2 mm. *Seeds* broadly ellipsoid to ovoid, 7–15 × 6.5–7.5 mm, yellow-brown, smooth, shining.

Thailand.— PENINSULAR: Ranong [Kho Khot Kra, Kra Buri District, 18 Aug. 2020, *Chalermglin 630818-2* (**PSU**)]; Songkhla (Hat Yai District, Ton Nga Chang Wildlife Sanctuary, 28 Mar. 1998, *Puangpen et al. N381* (**QBG**); ibid., 6 Apr. 1998, *Puangpen et al. N456* (**QBG**); ibid., 28 Apr. 1998, *Puangpen et al. N496* (**QBG**); ibid., alt. 150 m, 8 June 1996, *Leeratiwong s.n.* (**PSU**); ibid., 8 Oct. 2020, *Leeratiwong 20-1613* (**PSU**); Prince of Songkla University, Ko Hong hill, alt. 80 m, 27 Dec.

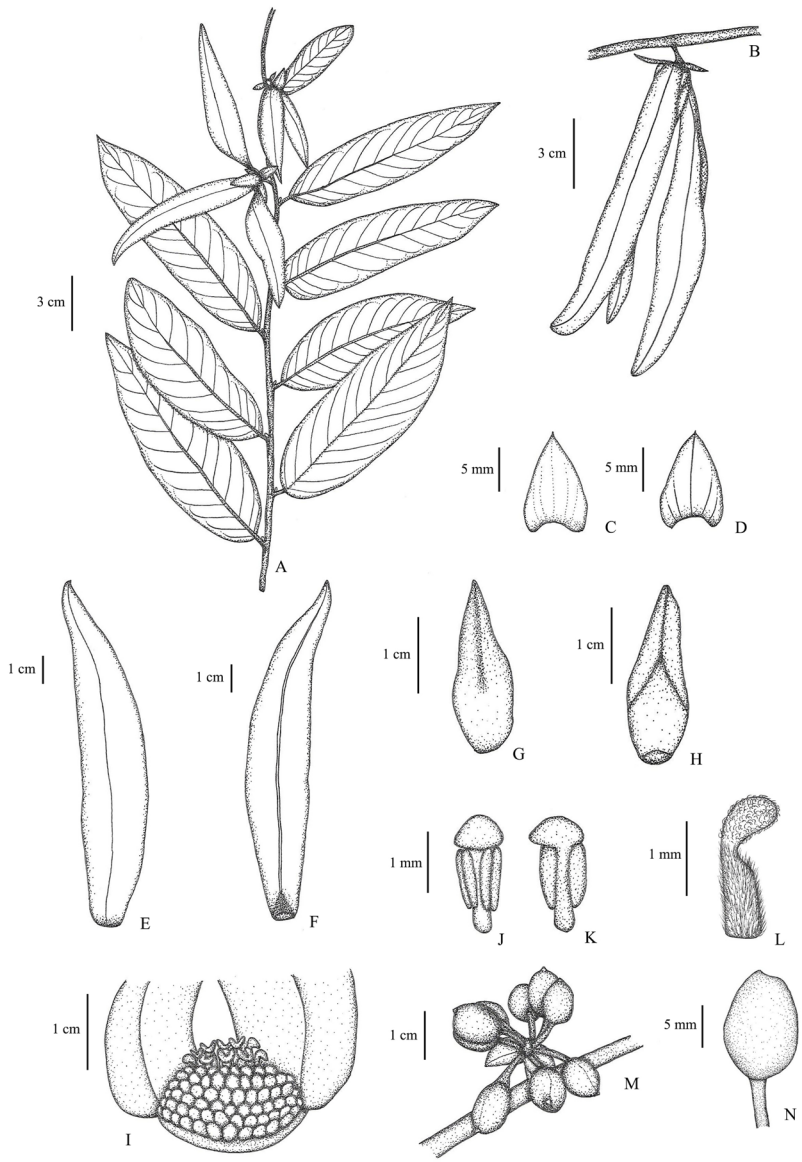

Figure 4. *Friesodielsia longipetala* Leerat. & Chalermglin. A. flowering branch. B. flower, side view. C. sepal, abaxial view. D. sepal, adaxial view. E. outer petal, abaxial view. F. outer petal, adaxial view. G. inner petal, abaxial view. H. inner petal, adaxial view. I. base of flower with some petals removed to show stamens and carpels, side view. J. stamen, abaxial view. K. stamen, adaxial view. L. carpel. M. mature fruit. N. single dried mature monocarp. Drawn by J. Satthaphorn.

2020, *Leeratiwong 20-1631* (**PSU**); ibid. 31 Mar. 2021, *Leeratiwong 21-1700* (**PSU**); Sadao District, Ban Yang Ko Village, 75 m, 5 July 2020, *Leeratiwong 20-1600* (**PSU**); ibid., 29 Aug. 2020, *Leeratiwong 20-1604* (**BKF**, **KKU**, **PSU**); ibid., 24 Nov. 2020, *Leeratiwong 20-1609* (**PSU**); ibid. 11 Nov. 2020, *Leeratiwong 20-1631* (**PSU**)]; Satun [16 Mar. 1928, *Lakshnakara 344* (**BK**, **L**); Khuan Don, Buket Yamu Village, 50 m alt., 4 Nov. 2020, *Leeratiwong 20-1618* (**PSU**); ibid., *Leeratiwong 20-1619* (**PSU**); ibid., Thaleban National Park, Ya Roi Waterfall, 90 m alt., Nov. 2020, *Leeratiwong 20-1620* (**PSU**); Khuan Kalong, Ban Ton Village, ca 50 m alt., 10 Mar. 1928, *Kerr 14425* (**BK**, **L**); ibid., 100 m alt. 4 Nov. 2020, *Leeratiwong 20-1621* (**PSU**); ibid. *Leeratiwong 20-1622* (**PSU**); 105 m alt., 7 May 1967, *Phengnaren 501* (**BKF**); ibid., ca 80 m alt., 10 May 2003, *Upho UBON 485* (**QBG**)].

Distribution.— Endemic.

Ecology.— Shaded or open areas in dry evergreen or tropical rain forest, sometimes near water, occasionally found in Para-rubber plantations; 50–100 m alt. Flowering: March, April, May, June–August, October, November; fruiting: May, June, August, October–December.

Etymology.— Named for the greater length of both the outer and inner petals compared with those of its congeners.

Vernacular.— Bu nga taeng ngan (บุหงาแต่งงาน) (General), sao yut (สาวหยุด)(Satun).

Note.— *Friesodielsia longipetala* is further distinguished from *F. phanganensis* by the outer petals widest at or below the middle and the longer monocarp stipes. From *F. songkhlaensis* it is additionally distinguished by having the bract mostly shorter than or rarely equal to the pedicel, sepals rounded to an obtuse or acute apex, and the inner petals narrowly lanceolate to lanceolate. This species is sometimes locally cultivated as an ornamental plant for the beauty and fragrance of its flowers.

Friesodielsia macrosepala Leerat. & Aongyong, **sp. nov.**

Friesodielsia macrosepala is similar to *F. unonifolia* but differs in having twigs covered by persistent mixed spreading and appressed hairs, sepals (7–)11–17 × (5–)9–11 mm, and outer petals 50–80 × 11–22 (–32) mm, with a length:width ratio of ca 4:1. *Friesodielsia unonifolia*, in contrast, has twigs initially covered with appressed hairs but soon glabrate, sepals 7–9 × 5.5–7 mm long, and outer petals 18–35 (–40) × 9.5–12 mm with a length:width ratio of ca 2.5:1. Type: Thailand, Nakhon Si Thammarat, Sichon District, 24 July 2020, *Aongyong 23* (holotype: **PSU!**; isotypes: **BKF!**, **KKU!**). Figs. 2G–H & 5.

Woody climber or scandent shrub to 6 m high. *Twigs* densely reddish brown to brown pubescent, the hairs appressed to spreading, eventually moderately pubescent. *Leaves* chartaceous to subcoriaceous, glaucous abaxially, lanceolate, oblong, oblong-lanceolate to elliptic, larger blades (7–)10–22 × 2.5–8 cm; base rounded to slightly cordate; apex acute to acuminate, the acumen 2–20 mm long; margins undulate; glabrous, except brown pubescent at midrib adaxially, moderately to sparsely appressed brown-pubescent, except with spreading hairs on midrib abaxially; midrib sunken above, raised beneath; secondary veins 10–16 per side; petiole 4–10 mm long, densely pubescent. *Inflorescences* supra-axillary, 1-flowered; pedicels 3–10 mm long, densely pubescent, with a lanceolate or broadly lanceolate bract (3.5–)7–9 mm long attached near to base or midpoint. *Sepals* not or overlapping at base, subcoriaceous, ovate to triangular-ovate, (7–)11–17 × (5–)9–11 mm, slightly obtuse to acute, strongly 5–7-veined, moderately covered with appressed to spreading hairs. *Petals* yellow to pale yellow; outer petals separating widely at anthesis, coriaceous to subcoriaceous, oblanceolate, elliptic-oblanceolate or broadly oblanceolate, 50–80 × 11–22(–32) mm, length:width ratio ca 4:1, apex mostly obtuse or rarely slightly acute, flat on base inside, densely sericeous, with a conspicuous midrib; inner petals forming a pyramidal cone 10–15 mm high, lanceolate or broadly lanceolate, 10–16 × 5–10 mm, margins with or without protrusions at midpoint, apex acute, pubescent outside, glabrous inside. *Stamens* clavate, 1.2–2 mm long, anther connective apex peltate. *Carpels* (14–)18–24, ellipsoid, 1.2–2 mm long, with falcate-capitate stigmas cleft down the side. *Fruit* of 5–12 monocarps borne on a pedicel 5–10 mm long, bract and sepals persistent in fruit. *Monocarps* ellipsoid, ovate-ellipsoid or rarely oblong, 10–14 × 6–8 mm, pericarp 0.5–1 mm thick, surface smooth to slightly verrucose in vivo, verrucose when dried, densely appressed pubescent, apiculum 1–2

mm long, stipe 5–10 × 2–3 mm. *Seeds* ellipsoid, 8–14 × 5.5–7 mm, brown, smooth, shining.

Thailand.— PENINSULAR: Surat Thani [Phanom, Khlong Phanom National Park, alt. 350 m, 20 June 2004, *Gardner & Sidisunthorn ST 0814* (**BKF**, **L**, **QBG**)]; Nakhon Si Thammarat [Khao Luang National Park, ca 800 m, 5 Apr. 1992, *Herb. T. 377* (**BCU**); Sichon District, 24 July 2020, *Aongyong 23* (**BKF**, **KKU**, **PSU**)]; Trang [Muang Trang, Nam Phut Subdistrict, 16 June 2020, *Aongyong 25* (**PSU**); Khao Chong, 1 Feb. 1969, *Phusomsaeng & Pinnin 45* (**BKF**, **K**, **L**); Yan Ta Khao, Thung Khai Botanic Gardens, 19 Dec. 1997, *Chamchumroon & Praknuk s.n.* (**BKF**)].

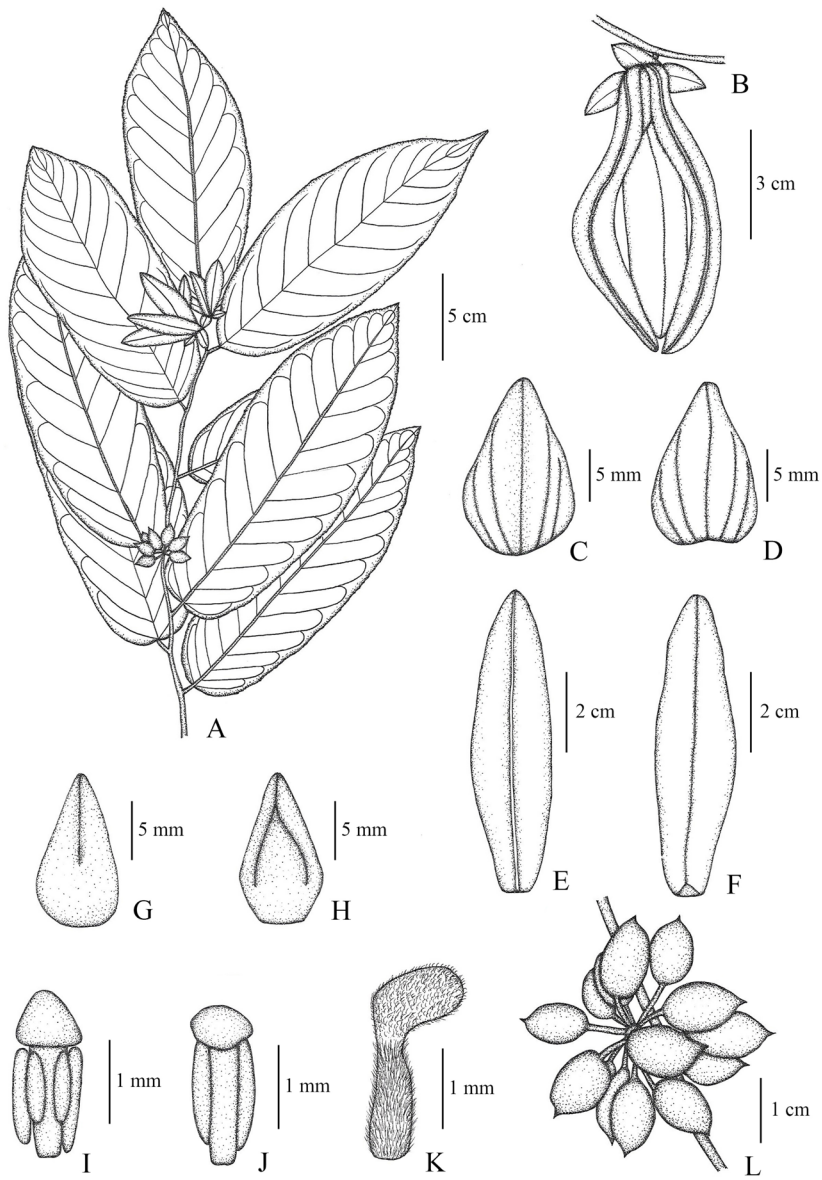

Figure 5. *Friesodielsia macrosepala* Leerat. & Aongyong. A. flowering branch. B. flower, side view. C. sepal, abaxial view. D. sepal, adaxial view. E. outer petal, abaxial view. F. outer petal, adaxial view. G. inner petal, abaxial view. H. inner petal, adaxial view. I. stamen, abaxial view. J. stamen, adaxial view. K. carpel. L. mature fruit. Drawn by J. Satthaphorn.

Distribution.— Endemic.

Ecology.— On poor granitic soil in secondary forest, on watersides in tropical rain forest, in Para-rubber plantations, tropical rain forest, dry evergreen forest at base of limestone mountain, shaded areas in tropical rain forest; 100–350 m alt. Flowering: February, April–August; Fruiting: June, July, December.

Etymology.— The sepals are among the largest in the entire genus.

Vernacular.— Bu nga sawitri (บุหงาสาวิตรี) (Nakhon Si Thammarat), sao yut (สาวหยุด)(Nakhon Si Thammarat).

Note.— The specimen *Gardner & Sidisunthorn ST 0814* was previously identified as *F. affinis*. However, *F. macrosepala* differs from *F. affinis* in having outer petals separating widely in bud and flat toward apex (rather than outer petals appressed until anthesis, then separating slightly and triquetrous [three-angled in cross-section] toward apex).

Friesodielsia phanganensis Leerat., **sp. nov.**

Friesodielsia phanganensis is distinguished from *F. longipetala* by the chartaceous leaves, oblanceolate to elliptic-oblanceolate outer petals 50–70 mm long, inner petals 11–15 mm long, and monocarps densely pubescent with shorter stipes 3–5 mm long. Type: Thailand, Surat Thani, Samui District, Phangan Island, 17 Aug. 2020, *Leeratiwong 20-1558* (holotype: **PSU!**; isotype: **BKF!**). Figs. 2I–J & 6.

Woody climber or scandent shrub to 3 m high. *Twigs* densely dark brown- to brown- pubescent, the hairs appressed to spreading, eventually moderately pubescent. *Leaves* chartaceous, glaucous abaxially, narrowly lanceolate to lanceolate, oblong-lanceolate to elliptic, larger blades 5–17 × 1.5–5.5 cm; base broadly cuneate to rounded; apex acute to acuminate, the acumen 3–18 mm long; glabrous, except brown pubescent at midrib adaxially, moderately appressed, brown-pubescent abaxially; midrib sunken above, raised beneath; secondary veins 12–16 per side; petiole 5–10 mm long, densely pubescent. *Inflorescences* supra-axillary, 1-flowered; pedicels 4–6 mm long, densely pubescent, with a lanceolate or lanceolate-linear bract 5–10 mm long attached near midpoint. *Sepals* not overlapping at base, subcoriaceous, ovate to triangular-ovate, 11–14 × 5.5–8 mm long, acuminate to obtuse, strongly 5–7-veined, moderately covered with appressed to spreading hairs. *Petals* green-yellow to pale yellow; outer petals spreading narrowly in bud, spreading at anthesis, subcoriaceous, oblanceolate to elliptic-oblanceolate, 50–70 × 15–19 mm, length: width ratio 3.6–3.8:1, apex acute, flat on base inside, moderately appressed-pubescent, with a raised midrib; inner petals forming a pyramidal cone 10–14 mm high, lanceolate to ovate-lanceolate, 11–15 × 5.5–7 mm, obtuse to slightly acute, with an appendage at margins, pubescent outside, glabrous toward base and hairy toward apex inside. *Stamens* cuneate, 1–1.5 mm long, anther connective apex peltate. *Carpels* 12–14, oblong, 1.2–1.5 mm long, with falcate-capitate stigmas cleft down the side. *Fruit* of 8–12 monocarps borne on a pedicel 3–5 mm long, bract and sepals persistent in fruit. *Monocarps* red, ellipsoid, ovoid or ellipsoid-ovoid, 9–20 × 7–10 mm, pericarp 0.5–1 mm thick, surface smooth in vivo, verrucose when dried, densely appressed pubescent, apiculum to 1.5 mm long, or apex rounded, stipe 2–5 × 0.5–1 mm. *Seeds* ellipsoid to ovoid, 7–12 × 6–8 mm, brown, smooth, shining.

Thailand.— PENINSULAR: Surat Thani [Samui District, Phangan Island, 4 Dec. 1974, *Geesink et al. 7781* (**BKF**, **L** [L0187226]); ibid; 17 Aug. 2020, *Leeratiwong 20-1558* (**BKF**, **PSU**)].

Distribution.— Endemic.

Ecology.— Tropical rain forest, shaded areas, secondary vegetation; 100–200 m alt. Flowering: August; fruiting: January, December.

Etymology.— The species is named for the type locality.

Vernacular.— Bu nga soeang phangan (บุหงาเซิงพะงัน)(General).

Friesodielsia songkhlaensis Leerat., **sp. nov.**

Friesodielsia songkhlaensis is distinguished from *F. longipetala* by the chartaceous leaves, pedicels 3–5 mm long with the bract exceeding the pedicel in length, sepals tapering to a blunt-acuminate apex, outer petals 6–12 mm wide, inner petals 8–10 mm long, and more densely pubescent monocarps. Type: Thailand, Songkhla, Sadao District, Prik Subdistrict, Ban Yang Ko, 75 m, 30 May 2020, *Leeratiwong 20-1601* (holotype: **PSU!**; isotype: **BKF!**). Figs. 2K–L & 7.

Woody climber or scandent shrub to 3 m high. *Twigs* densely brown-pubescent, the hairs appressed to spreading, eventually moderately pubescent. *Leaves* chartaceous, glaucous abaxially, lanceolate, oblong-lanceolate to elliptic, larger blades 8–20 × 3–7 cm; base broadly cuneate to rounded; apex acute to acuminate, the acumen 3–15 mm long; glabrous, except brown pubescent at midrib adaxially, moderately appressed, brown-pubescent abaxially; midrib sunken above, raised beneath; secondary veins 10–15 per side; petiole 4–10 mm long, densely pubescent. *Inflorescences* supra-axillary or leaf-opposed, 1-flowered; pedicels 3–5 mm long, densely pubescent, with a linear-lanceolate to lanceolate bract

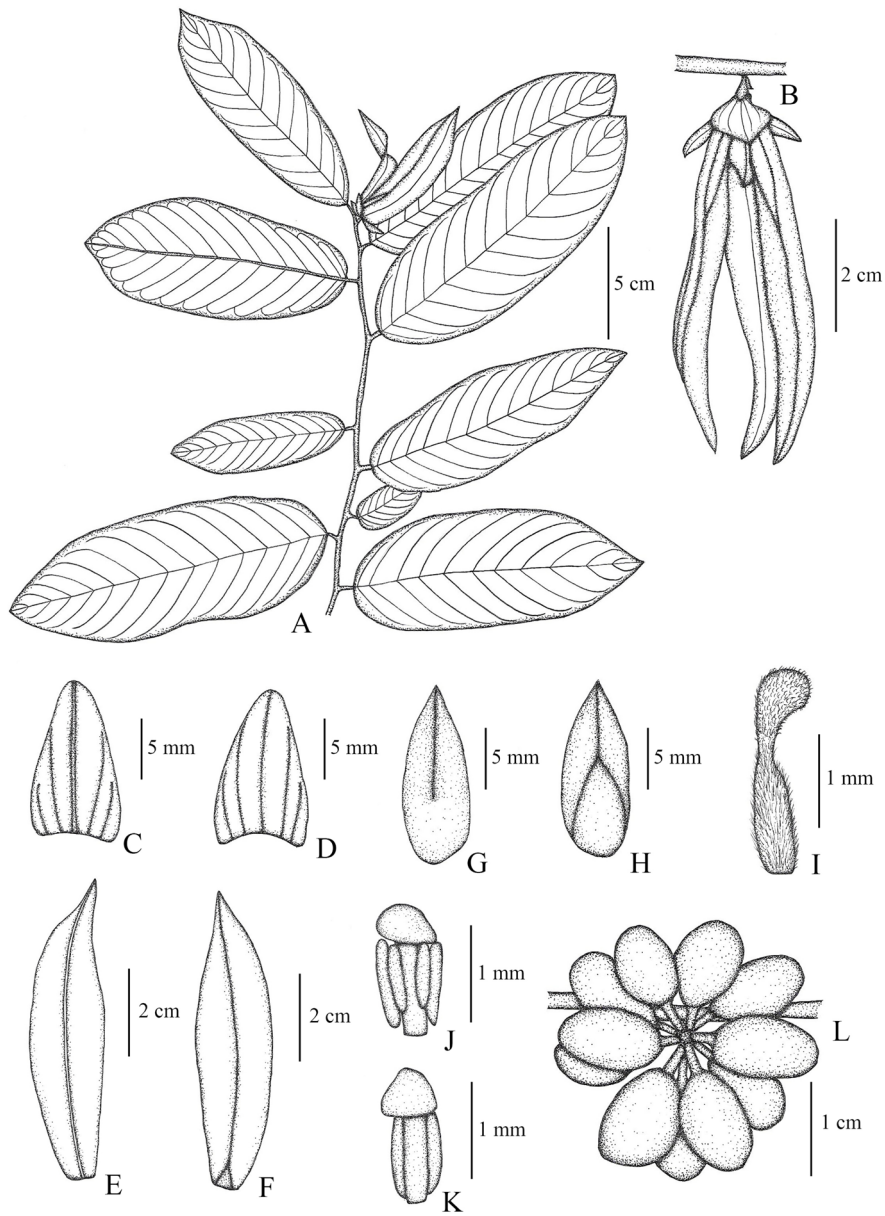

Figure 6. *Friesodielsia phanganensis* Leerat. A. flowering branch. B. flower, side view. C. sepal, abaxial view. D. sepal, adaxial view. E. outer petal, abaxial view. F. outer petal, adaxial view. G. inner petal, abaxial view. H. inner petal, adaxial view. I. carpel. J. stamen, abaxial view. K. stamen, adaxial view. L. mature fruit. Drawn by J. Satthaphorn.

6–11 mm long attached near the base to midpoint. *Sepals* not overlapping at base, chartaceous, lanceolate to ovate, 12–15 × (4–)6–8 mm, tapering to a blunt-acuminate apex, strongly 5–7-veined, moderately covered with appressed hairs. *Petals* yellow to green-yellow; outer petals separating widely in bud, chartaceous to subcoriaceous, oblong-linear or linear-oblanceolate, 50–90 × 6–12 mm, length:width ratio 7.5–8.3:1, obtuse to slightly acute, flat on base inside, densely sericeous; inner petals forming a pyramidal cone 8–10 mm high, broadly lanceolate, 8–10 × 6–7 mm, margins with protrusions at midpoint, apex obtuse to slightly acute, pubescent outside, glabrous inside. *Stamens* clavate, 1–1.2 mm long, anther connective apex peltate. *Carpels* 12–14, ellipsoid, 1–1.5 mm long, with falcate-capitate stigmas cleft down the side. *Fruit* of (5–)10–14 monocarps borne on a pedicel (5–)7–8 mm long, bract and sepals persistent in fruit. *Monocarps* red, oblong to ellipsoid-oblong, (12–)17–20 × (7–)10–12 mm, pericarp 0.5–1 mm thick, surface smooth to slightly verrucose in vivo, verrucose when dried, moderately appressed-pubescent, apiculum to 2 mm long, or apex rounded, stipe 6–10 × 1–2 mm. *Seeds* oblong, oblong-ellipsoid or ellipsoid-ovoid, 13–15 × 6–8 mm, yellow-brown or brown, smooth, shining.

Thailand.— PENINSULAR: Songkhla [Hat Yai, Ton Nga Chang Wildlife Sanctuary, 218 m alt., 5 Dec. 2020, *Leeratiwong 20-1625* (**PSU**); Nathawi, Khao Nam Khang National Park, 10 Apr. 2021, *Leeratiwong 21-1698* (**PSU**); ibid., *Leeratiwong 21-1699* (**PSU**); Sadao District, 21 Feb. 1941, *Anonymous s.n.* (**BKF**); ibid., Prik Subdistrict, Ban Yang Ko, 75 m, 30 May 2020, *Leeratiwong 20-1601* (**BKF**, **PSU**); ibid., 90 m, 14 Dec. 2020, *Leeratiwong 20-1610* (**PSU**)].

Distribution.— Endemic.

Ecology.— Edge areas in primary to secondary dry evergreen forest, often near water; 75–300 m alt. Flowering: April, May; fruiting: April, May, September, December.

Etymology.— Named for the Thai province in which it occurs.

Vernacular.— Bu nga soeng songkhla (บุหงาเซิงสงขลา)(General).

Notes.— Like *F. longipetala*, this species is sometimes locally cultivated as an ornamental plant for its flowers.

FRIESODIELSIA SPECIES NEWLY REPORTED FOR THE FLORA OF THAILAND

The following seven species are confirmed here as occurring in the Thai flora. For six of the species the Thai populations represent the northernmost extent of their distributions. Habitat and phenology data pertain only to the populations in Thailand.

Friesodielsia affinis (Hook.f. & Thomson) D.Das, Bull. Bot. Surv. India 5: 93. 1963.— *Oxymitra affinis* Hook.f. & Thomson, Fl. Brit. India 1: 70. 1872. Type: Malaysia, Malacca, 12 Apr. 1867, *Maingay 1851* [Kew distribution no. 59] (lectotype **K** [K000691787!], designated by Turner (2009)). Fig. 8A–B.

—*Fissistigma magnisepalum* [‘*magnisepala*’] Irawan, Floribunda 2(7): 184. 2005. Type: Indonesia, Borneo, East Kalimantan, Long Iram Subdistrict, Maruwai, Block Lampunut, 19 March 1999, *Kessler 2621* (holotype **BO** [sheets BO-1318961, BO-1318960, according to Turner (2018)], isotypes **E**, **K** [K000691772!], **L**, **WAN**).

Thailand.— PENINSULAR: Songkhla [Nathawi District, Khao Nam Khang National Park, 150 m, 19 Jan. 2019, *Leeratiwong 19-1444* (**PSU**); ibid., 29 Apr. 2021, *Leeratiwong 21-1746* (**PSU**)]; Narathiwat, Nikom Vang, 30 Sep. 1966, *Sangkhachand 456* (**BK**); Narathiwat, Waeng, 11 Sep. 1966, *Sangkhachand & Nimanong 1344* (**BKF**)].

Distribution.— Peninsular Malaysia, Borneo (Turner 2012).

Ecology.— Low elevation evergreen forest. Flowering and fruiting: January, September.

Vernacular.— Khruea niao (เครือเหนียว)(Surat Thani).

Notes.— Reports of this species in Chalermglin (2001) and Guo *et al.* (2017) refer instead to *Friesodielsia discolor*. Craib (1925) listed the species for Thailand but was unable to locate a voucher specimen.

Friesodielsia calycina (King) Steenis, Blumea 12: 358. 1964.— *Oxymitra calycina* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 61: 99. 1892. Type: Malaysia, Perak, Ulu Bubong, July 1886, *King’s Collector 10604* (lectotype **P** [P00602196!, designated by Turner (2018), but citing wrong barcode number; isolectotypes **CAL**, **DD**, **K** [K000691786!], **SING!**, **WU**). Fig. 8D–E.

Thailand.— PENINSULAR: Ranong [Klong Naka Wildlife Sanctuary, ca 9°30′N, 98°20′E, 100–600 m, 14 Jan. 1990, *Hoover 5620* (**A**); 30–70 km south of Ranong, 10°N, 98°35′E, 100–200 m, 26 April 1974, *Larsen & Larsen 33430* (**L**)]; Phangnga [Ton Deng Waterfall, Sri Phangnga National Park, Takuapa, 260 m, 21 Feb. 2002, *Chamchumroon et al. V.C.1300* (**BKF**)]; Narathiwat [Cha Nae District, Du Song Yo Subdistrict, Mo Tae Mountain, 7 Apr. 2020, *Leeratiwong 20-1523* (**PSU**), 10 July 2020, *Leeratiwong 20-1555* (**PSU**)].

Distribution.— Peninsular Malaysia, Singapore.

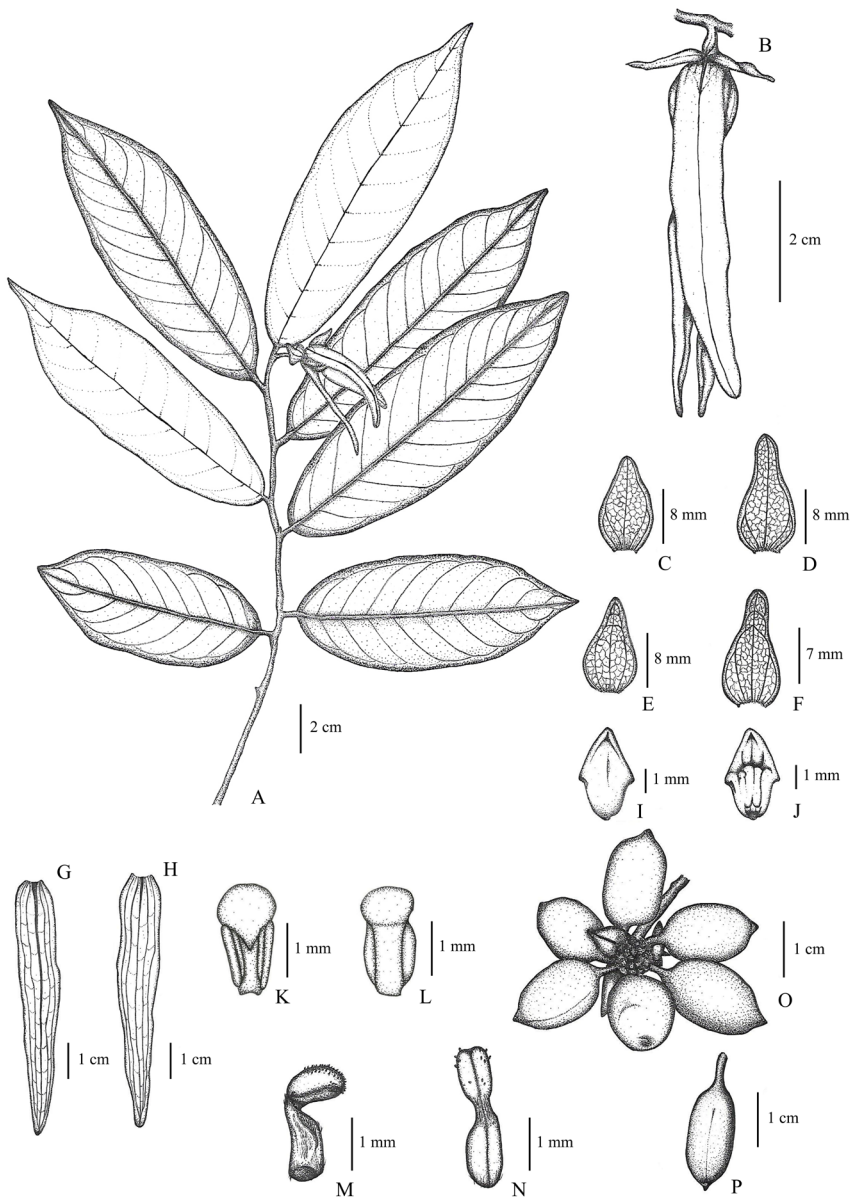

Figure 7. *Friesodielsia songkhlaensis* Leerat. A. flowering branch. B. flower, side view. C–D. sepals, abaxial view. E–F. sepals, adaxial view. G. outer petal, abaxial view. H. outer petal, adaxial view. I. inner petal, abaxial view. J. inner petal, adaxial view. K. stamen, abaxial view. L. stamen, adaxial view. M–N. carpels. O. mature fruit, P. single dried mature monocarp. Drawn by A. Somphrom.

Ecology.— Moist evergreen forest; 100–600 m alt. Flowering: January, February, April; fruiting: April, July.

Vernacular.— Bu nga darika (บุหงาดาริกา) (General).

Notes.— In its large leaves *Friesodielsia calycina* resembles *F. latifolia*, and the species have often been confused. The larger sepals (over three times as long), fewer secondary veins, shiny adaxial leaf surfaces, and short-stipitate monocarps distinguish *F. calycina* from *F. latifolia*.

Friesodielsia filipes (Hook.f. & Thomson) Steenis, Blumea 12: 359. 1964.— *Oxymitra filipes* Hook.f. & Thomson, Fl. Brit. India 1: 71 (1872). Type: Malaysia, Malacca, 31 Oct. 1867 or 1868, *Maingay 3047* [Kew distribution no. 60] (holotype **K** [K000691790!, plus one not barcoded]).

Thailand.— PENINSULAR: Narathiwat, Waeng District, Sirindhorn Waterfall, 300 m, 29 Mar. 1987, *Maxwell 87-287* (**A**, **BKF**, **CMU**); Narathiwat, Waeng, Bala-Hala, 19 Sep. 2010, *Puudjaa et al. 1619* (**BKF**).

Distribution.— Peninsular Malaysia.

Ecology.— Primary evergreen forest; 50–300 m alt. Flowering: March; fruiting: March, September.

Vernacular.— Bu nga kan dok yao (บุหงาก้านดอกยาว)(General).

Friesodielsia glauca (Hook.f. & Thomson) Steenis, Blumea 12: 359. 1964.— *Oxymitra glauca* Hook.f. & Thomson, Fl. Ind.: 146. 1855. Type: Malaysia, Prince of Wales Island [Penang], *Anonymous* [*W.E. Phillips*] *s.n.* (holotype **K** [K000691773!]). Figs. 8G–H.

Thailand.— PENINSULAR: Narathiwat [Cha Nae District, Du Song Yo Subdistrict, Mo Tae Mountain, 12 Apr. 2020, *Leeratiwong 20-1529* (**PSU**), 26 Apr. 2020, *Leeratiwong 20-1538* (**PSU**); Narathiwat, Waeng, 380 m, 13 Sep. 2003, *Promchua 53* (**A**, **CMUB**); Narathiwat, Waeng, 24 Apr. 1972, *Sangkhachand et al. 1105* (**L**)].

Distribution.— Peninsular Malaysia, Singapore, Borneo.

Ecology.— Primary seasonal evergreen hardwood forest; ca 380 m alt. Flowering: March, April; fruiting: April, May, September.

Vernacular.— Bu nga nuan paeng (บุหงานวลแป้ง) (General).

Note.— Two recent collections from Songkhla Province, *Leeratiwong 21-1732* and *21-1733*, resemble *F. glauca* in pedicel length, glaucousness of the lower leaf surface, bud shape, and indistinct sepal venation, but have more densely pubescent twigs, a longer pedicellar bract, reduplicate sepals and larger flowers. There is some resemblance as well to *F. argentea* (J.Sinclair) Steenis of Peninsular Malaysia but further study is needed.

Friesodielsia kingii (J.Sinclair) Steenis, Blumea 12: 360. 1964.— *Oxymitra kingii* J.Sinclair, Gard. Bull. Singapore 14: 453. 1955. Type: Malaysia, Perak, Larut, November 1883, *King's Collector* [=*Kunstler*] *5726* (lectotype **K** [K000691777!], designated by Turner (2018); isolectotypes **CAL**, **DD**, **SING!**). Fig. 8I–J.

Thailand.— PENINSULAR: Narathiwat [Khao Shana, 50 m alt. 14 July 1983, *Niyomdham 710* (**BKF**); Cha Nae, Du Song Yo, *Leeratiwong 20-1549* (**PSU**), *Leeratiwong 20-1602* (**PSU**); Ra Ngae, Bo Ngo, *Leeratiwong 20-1630* (**PSU**)].

Distribution.— Peninsular Malaysia.

Ecology.— Primary evergreen forest, along the streamside or shaded areas; 50–200 m alt. Flowering: April, May, July; fruiting: August, December.

Vernacular.— Bu nga klip yai (บุหงากลีบใหญ่) (General); la ro (ลาเราะ)(Narathiwat).

Friesodielsia latifolia (Hook.f. & Thomson) Steenis, Blumea 12: 360. 1964.— *Oxymitra latifolia* Hook.f. & Thomson, Fl. Ind.: 145. 1855. Type: Malaysia, Penang, *Anonymous* [*probably Phillips*] *s.n.* (lectotype, designated here, **K** [K000691793!]). Fig. 8K.

Thailand.— PENINSULAR. Phatthalung [Si Ban Phot, 12 Mar. 2005, *Gardner et al. ST 1653* (**L**), Phatthalung, Sri Ban Phot, Khao Pu-Khao Ya National Park, 07°40′N, 99°52′E, 140 m, 15 July 2000, *Middleton et al. 462* (**A**, **BKF**)]; Yala [Betong District, Bang Lang National Park, Ban Wang Sai trail to summit at 800 m, 18 July 2004, *Pooma et al. 4353* (**BKF**)]; Narathiwat [Cha Nae, Du Song Yo, 6 Mar. 2021, *Leeratiwong 21-1701* (**PSU**)].

Distribution.— Peninsular Malaysia, Singapore.

Ecology.— Evergreen forest, sometimes over limestone; 120–200 m alt. Flowering: March; fruiting: January, July.

Vernacular.— Bu nga bai kwang (บุหงาใบกว้าง) (General).

Notes.— The report of *Oxymitra latifolia* for Thailand by Craib (1925) was based on a specimen from Langkawi Island, now part of Malaysia. Several specimens from Narathiwat Province have similar flower buds on short pedicels and relatively long monocarp stipes, but the leaves are not discolorous and the blades are obovate, finely appressed-pubescent abaxially, and only 11.2–16.2 cm long.

Friesodielsia unonifolia (A.DC.) Steenis, Blumea 12: 361. 1964.— *Guatteria unonifolia* [‘*unonaefolia*’] A.DC., Mém. Soc. Phys. Genève 5: 217. 1832.— *Oxymitra unonifolia* [‘*unonaefolia*’] (A.DC.) Hook.f. & Thomson, Fl. Ind. 146. 1855. Type: Myanmar, Tavoy, *Wallich Cat. 6435* [Gomez 95] (lectotype **K-W** [K001123887!], designated by Turner (2011); isolectotypes **BM** [BM001121312!], **K-W** [K001123888!]). Fig. 8L.

Thailand.— PENINSULAR: Ranong [Kapur, 10 Apr. 2001, *Anantachote s.n.* (**BKF**)]; Surat Thani [Ban Nasan District, 13 Oct. 1955, *Snan 498* (**BKF**); Khao Sok National Park, 28 Mar. 1993, *Chantaranothai et al. 1483* (**K**); Tha Chang, 5 Mar. 1974, *Sangkachand 26* (**BKF**); Phanom, Khao Sok National Park, 10 Mar. 1996, *Sirirugsa 1304* (**PSU**); Wiphawadi, Khlong Yan Wildlife Sanctuary, 7 May 2002, *Pooma et al. 3566* (**BKF**); ibid., ca 250 m alt., 31 Aug. 2002, *Middleton et al. 1520* (**A**, **BKF**, **CMUB**)]; Phangnga [9 Mar. 2003, *Chalermglin 460309* (**OWU**); Khao Nang Hong, 8 May 1967, *Sakol 2536* (**BK**); Khao Wong, 7 May 1967, *Sakol 2527* (**BK**); Kapong, Ton Bariwat Wildlife Sanctuary, 700 m alt., 15 Nov. 2005, *Gardner et al. ST 1901* (**L**); ibid., 350 m alt., 16 Apr. 2007, *Gardner ST 2888* (**L**); Kuraburi, Bang Wan stream, 11 Mar. 2007, *Muadsub 262* (**BKF**, **PSU**-2 sheets); ibid., 30 m alt., 27 Mar. 2000, *Suksathan 2577* (**QBG**); Klong Nang Yon, ca 100 m alt., 29 Apr. 1973, *Geesink & Santisuk 5043* (**BKF**, **L**); Takua Pa, 100 m alt., 11 May 1968, *van Beusekom & Phengklai 699* (**BKF**)]; Phuket [Thalang, Khao Chaiang Khrod and Khao Sa Khu, ca 200 m alt., 7 May 1968, *van Beusekom & Phengkhlai 634* (**L**)]; Krabi [Khlong Thom District, 18 Aug. 2020, *Chalermglin 630818-3* (**PSU**)]; Trang [Wang Wiset, Khao Pra Bang Khram Wildlife Sanctuary, 16 Nov. 2012, *Chamchumroon et al. 5647* (**BKF**)].

Distribution.— Myanmar.

Ecology.— Near streams, in shaded areas of tropical rain forest, mosaic patch in hill evergreen forest; 30–900 m alt. Flowering: February–May, August, and October–December; fruiting: March, April, August.

Vernacular.— Bu nga klip na (บุหงากลีบหนา) (Phangnga).

Notes.— *Oxymitra biswasiana* Chatterjee (1940) is possibly a synonym, but we have not been able to examine the type material of that name.

NEW STATUS FOR *OXYMITRA FORNICATA* VAR. *GLABRA*

Friesodielsia glabra (Ridl.) D.M.Johnson, **comb. & stat. nov.**— *Oxymitra fornicata* (Roxb.) Hook.f. & Thomson var. *glabra* Ridl., Fl. Malay Penins. 1: 80. 1922. Type: Thailand, Satun, Pulau Adang, Apr. 1911, *Ridley 15904* (lectotype **K** [K000899615!], designated by Turner (2013); isolectotype: **SING!**). Fig. 8C.

Thailand.— PENINSULAR: Satun [Pulau Adang, Apr. 1911, *Ridley 15904* (**K**, **SING**), La Ngu, Adang Island, alt. ca 50 m, 31 Oct. 2020, *Leeratiwong 20-1624* (**PSU**), Tarutao Island, 6 Apr. 2008, *Sonsupab 3998* (**BK**)].

Distribution.— Peninsular Malaysia.

Ecology.— Dry evergreen forest near coastal forest; ca 50 m alt. Flowering: April; fruiting: October.

Vernacular.— Bu nga tarutao (บุหงาตะรุเตา) (General), sao yut (สาวหยุด)(General).

Notes.— Sinclair (1955) regarded this taxon as a taxonomic synonym of *Oxymitra discolor*; a name in *Friesodielsia* was never provided for it. As indicated in the key below, however, the two taxa are readily distinguishable and are geographically separated. *Oxymitra fornicata* var. *glabra* appears more similar to *Friesodielsia discolor* (Fig. 8F) than to *F. fornicata* var. *fornicata*. Because the taxon does

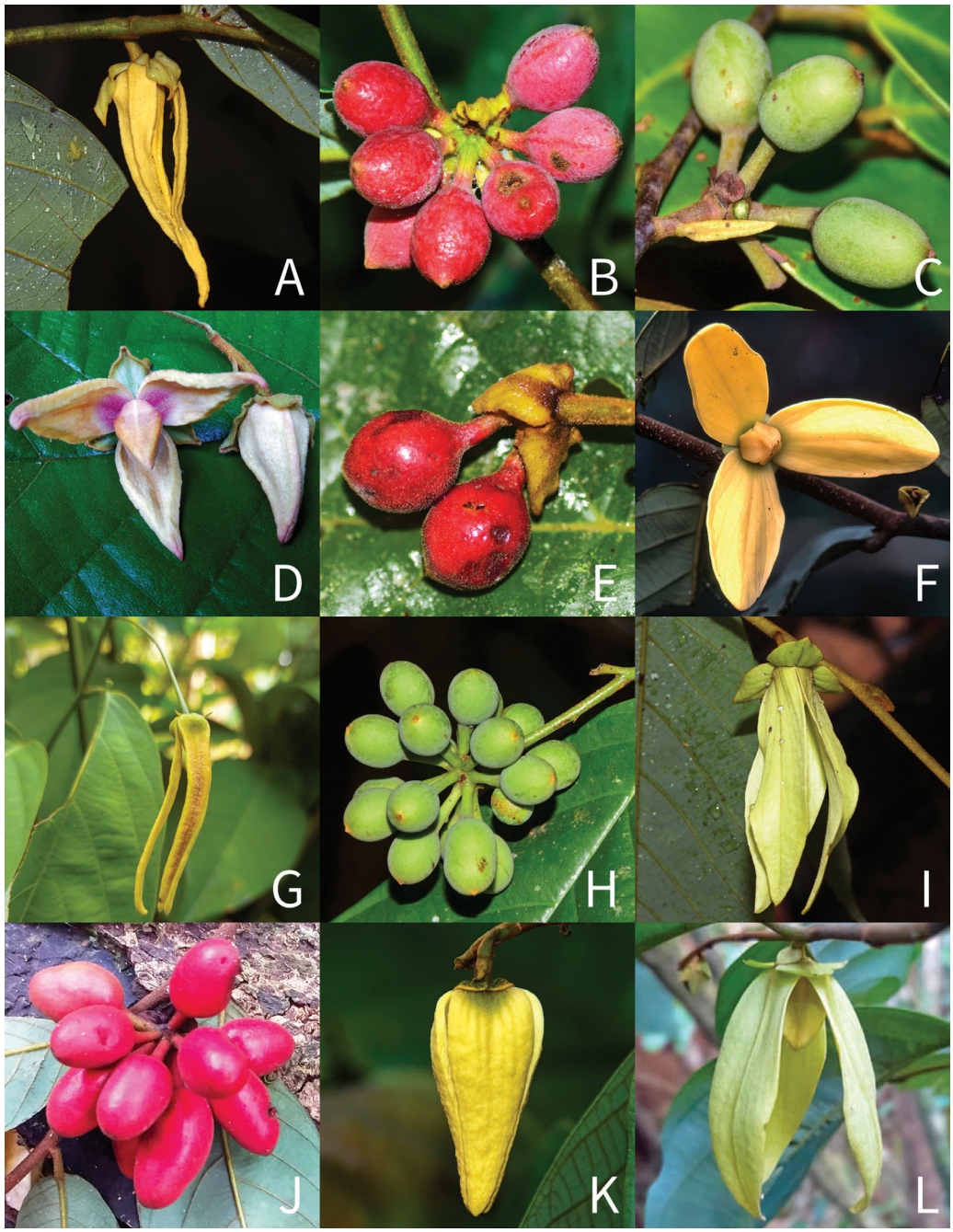

Figure 8. A–B. *Friesodielsia affinis* (Hook.f. & Thomson) D.Das. A. flowers. B. monocarps. C. immature fruit of *F. glabra* (Ridl.) D.M.Johnson. D–E. *F. calycina* (King) Steenis. D. open flower and bud. E. monocarps. F. flower of *F. discolor* (Craib) D.Das. G–H. *F. glauca* (Hook.f. & Thomson) Steenis. G. flower. H. monocarps. I–J. *F. kingii* (J.Sinclair) Steenis. I. flower. J. monocarps. K. flower of *F. latifolia* (Hook.f. & Thomson) Steenis. L. flower of *F. unonifolia* (A.DC.) Steenis. Photographs by C. Leeratiwong (A–C, E, H & K), A. Baka (D, G, I & J), P. Chalermglin (F) and A. Rungrueng (L).

not have a published name in *Friesodielsia*, and because its affinity to *F. fornicata* is dubious, we have raised it to the level of a species so that it may be treated independently of that species.

DISCUSSION

The preceding reports bring the total number of *Friesodielsia* species known from Thailand to 16. The large number of new reports for the country is probably the result of the poor knowledge of the taxonomy of the genus, as it has never been revised, and the fact that climbing species of Annonaceae in general are poorly collected, often without mature flowers or fruits.

We found that the outer petal apex character observed by Hooker & Thomson (1872) was correlated with some outer petal differences reported by Guo *et al.* (2017): Those *Friesodielsia* species with the outer petals freely spreading all have a flat petal apex (e.g., Fig. 1E–F), while those with connivent outer petals have a triquetrous petal apex (Fig. 3F). We also found, however, that in some species with freely spreading petals that there is a small concavity on the inner base (see Figs. 4F, 5G, 6F).

Six species, *Friesodielsia affinis*, *F. calycina*, *F. filipes*, *F. glauca*, *F. khaoluangensis*, and *F. latifolia*, belong to the triquetrous connivent outer petal apex group and occur no further north in Peninsular Thailand than Ranong province. The group as a whole extends eastward to New Guinea. Species of this group occurring in Thailand are readily separated, as shown in the following key.

The remaining ten species in Thailand belong to the freely spreading flat outer petal apex group, which has a more westerly overall distribution, extending to India and Vietnam. While most flat-petaled species in Thailand are concentrated in the Peninsular Region, *Friesodielsia desmoides* occurs from northern Peninsular to South-Western Thailand and *F. discolor* occurs in the South-Eastern Region. Thailand seems to represent a centre of diversity for this group, which forms a complex of similar species, separable on small quantitative differences. Several of these species co-occur at the same sites. The extent and causes of reproductive isolation are unclear. For instance, phenological separation occurs between *F. brevistipitata* and *F. songkhlaensis*, which was found to enforce reproductive isolation in two cryptic *Xylopia* species in central Africa (Johnson & Murray 2018). Many closely related species of Annonaceae co-occur in the same sites in Southeast Asia, for example in *Maasia* Mols, Kessler & Rogstad (Rogstad, 1990, 1994) and *Xylopia* L. (Johnson & Murray, 2015) in the 50-hectare plot at Pasoh in Peninsular Malaysia.

Key to the species

Notes: Measurements used in the key are based on the largest flowers and fruits present on the dried specimens examined. Outer petal measurements in particular may differ considerably between living and dried specimens. In addition, flowers of the flat-petaled group separate while in bud, i.e. the flower "opens," and are therefore sometimes collected. Because the sepals enlarge to their full size early in development, the difference in sepal and outer petal length provides a rough guide to the maturity of the flowers: as can be seen from the foregoing descriptions, the outer petals are three times or more the length of the sepals

1. Pedicels of flower or fruit 14–95 mm long
  2. Twigs glabrous to sparsely tomentose. Sepals without visible venation **F. glauca**
  2. Twigs hispid or densely tomentose. Sepals with 1–5 distinct veins
    3. Twigs hispid. Pedicels 76–95 mm long. Sepals with 1 vein. Leaf base irregularly cordate **F. filipes**
    3. Twigs densely orange to reddish brown-tomentose, eventually glabrate. Pedicels 6–14.4(–25) mm long. Sepals with ca 5 weak veins. Leaf base regularly cordate to rounded **F. calycina (in part)**
1. Pedicels of flower or fruit 14 mm long or shorter
  4. Outer petals appressed until anthesis, then separating slightly, fleshy, triquetrous (three-angled in cross-section) toward apex
    5. Sepals 3–5 mm long
      6. Outer petals linear-lanceolate, 23–25 mm long, acute. Leaf blades 3.8–7.5 cm wide, apex acuminate, the narrow acumen (3–)7–20 mm long **F. khaoluangensis**
      6. Outer petals lanceolate, 25–40 mm long, obtuse. Leaf blades 7.5–11 cm wide, apex obtuse to rounded, occasionally emarginate or mucronate **F. latifolia**
    5. Sepals 10–14 mm long

7. Pedicellar bract cordate to reniform, 5–11.2 mm long, attached at pedicel midpoint. Leaf apex acute, acuminate, or mucronate **F. affinis**
7. Pedicellar bract ovate, 4–7 mm long, subtending sepals. Leaf apex rounded or truncate-retuse, rarely with a short mucro ca 2 mm long **F. calycina (in part)**

4. Outer petals separating widely in bud, chartaceous to coriaceous, flat toward apex
8. Hairs on twigs at first appressed and remaining appressed
9. Abaxial leaf surface with slightly raised veinlets. Bracts 1.5–3.5 mm long, always shorter than pedicel. Monocarp stipes 3–5 mm long **F. discolor**
9. Abaxial leaf surface with conspicuously raised veinlets. Bracts 4–9 mm long, always longer than pedicel. Monocarp stipes 5–7 mm long **F. unonifolia**
8. Hairs on twigs at first appressed, then becoming erect to spreading
10. Leaves spreading-pubescent below
11. Monocarps ellipsoid to oblongoid, (8–)10–14 mm wide. Sepals (5–)6.5–10 mm long. Outer petals 40–70 × 13–35 mm **F. kingii**
11. Monocarps ovoid, 6.5–7 mm wide. Sepals 4–5 mm long. Outer petals (19–)27–31 × 7–9 mm **F. desmoides**
10. Leaves appressed-pubescent to glabrate below
12. Sepals > 10 mm long
13. Sepals gradually tapering to a blunt-acuminate apex. Outer petals 6–12 mm wide. Inner petals 8–10 mm long **F. songkhlaensis**
13. Sepals rounded to an obtuse to acute apex. Outer petals 11–32 mm wide. Inner petals 10–25 mm long
14. Monocarp stipes 2–5 mm long, swollen toward the apex **F. phanganensis**
14. Monocarp stipes 5–10 mm long, uniform in thickness
15. Outer petals (50–)80–140 mm long. Carpels 10–14. Monocarps sparsely pubescent **F. longipetala**
15. Outer petals 50–80 mm long. Carpels 14–24. Monocarps densely pubescent **F. macrosepala**
12. Sepals < 10 mm long
16. Twigs very soon glabrate. Pedicellar bract linear, 9–12 mm long **F. glabra**
16. Twigs persistently pubescent, rarely glabrate. Pedicellar bract lanceolate, 2–8 mm long
17. Inner petals 8–13 mm long, ovate-lanceolate to ovate, with marginal protrusions. Monocarp stipes 3–5 mm long **F. brevistipitata**
17. Inner petals (11–)15–25 mm long, narrowly lanceolate to lanceolate, lacking marginal protrusions. Monocarp stipes 5–10 mm long **F. longipetala**

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