

GENTIANACEAE

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Juss., Gen. Pl. (1789) 141, p.p.; King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(1) (1906 [‘1905’]) 86, p.p.; Ridley, Fl. Malay Penins. 2 (1923) 432, p.p.; Struwe & Pringle in Kadereit & Bittrich (ed.), Fam. Gen. Vasc. Pl. 15 (2019) 453. **Type:** *Gentiana* L.

Loganiaceae auct. p.p.: Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114; King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 598; Ridley, Fl. Malay Penins. 2 (1923) 412; Ridley, Fl. Malay Penins. 5 (1925) 322; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 293; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140; Wong & Sugau, Tree Fl. Sabah & Sarawak 2 (1996) 189.

Trees, (epiphytic or hemi-epiphytic) shrubs, or (not in Singapore) herbs, including rare mycotrophic forms without chlorophyll (drawing nutrition solely through association with mycorrhizal fungi); latex none except in some fruits of a few genera in Southeast Asia and the Pacific. **Leaves** simple, opposite (rarely whorled), typically glabrous, margins entire or (rarely) serrulate; stipules none but petiole bases sometimes elaborated into scale-like or sheath-like structures. **Inflorescences** solitary flowers or basically cymose or (not in Singapore) racemose. **Flowers** typically bisexual, actinomorphic, usually conspicuous; calyx with 4–5 (sometimes more) imbricate or valvate lobes fused at the base; corolla rotate, salverform or infundibular, tube short or long, the inner surface always glabrous, lobes 4–5 (or more), overlapping to the right in the bud; stamens inserted in the corolla tube, alternate with the corolla lobes, anthers typically dehiscent longitudinally; ovary superior, of 2 fused carpels forming 1 (rarely 2) locules, placentation parietal, rarely axile, ovules numerous, nectariferous disk or glands present at ovary base, style solitary, stigma 2-lobed. **Fruit** a septicidal capsule or (in Singapore) berry. **Seeds** typically small, endospermous.

Distribution. Some 90 genera, c. 1660 species, cosmopolitan. In Singapore 4 genera and 10 species.

Ecology. Herbaceous taxa appear to be predominantly distributed in cold temperate regions, whereas woody taxa (including trees and hemi-epiphytic forms) are mostly encountered in the tropics and subtropics.

Uses. Gentianaceae (especially genera like *Eustoma* Salisb., *Exacum* L. and *Gentiana* L.) are well known as wildflowers and decorative flowers in north temperate countries and some Pacific cultures, owing to their conspicuous and attractive, and often fragrant, flowers or inflorescences. In the tropics, some species are becoming familiar as ornamental trees. The many different gentians have also been used as ingredients in a variety of perfumes, alcoholic aperitifs, and herbal medicinal preparations (including tonics, digestives, treatment for

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Doi: 10.26492/fos13.2019-02; 19 October 2019 (online & press).

intestinal conditions, anti-malarial medicines, snakebite anecdotes, sedatives, and laxatives); some have been described as causing skin irritations. *Cyrtophyllum* timber has been exploited as some species are sizeable trees. The dye gentian violet is not derived from Gentianaceae but takes its name from the dark violet colour of some gentian flowers.

Taxonomy. The Gentianales is an order that includes the Apocynaceae, Gelsemiaceae, Gentianaceae, Loganiaceae, and Rubiaceae. Some Old World Gentianaceae have previously been treated as part of Loganiaceae (see Struwe & Albert (ed.), *Gentianaceae Systematics and Natural History*, 2002). The current classification recognises six tribes in the Gentianaceae; the Southeast Asian (including Singapore) woody taxa are all placed in the Potaliinae, a subtribe of the Potalieae. Sugumaran & Wong (*Gard. Bull. Singapore* 64 (2012) 301) and Wong & Sugumaran (*Gard. Bull. Singapore* 64 (2012) 481) have elucidated the suites of morphological characters distinguishing five molecular lineages in *Fagraea* s.l. now recognised as individual genera. These are summarised in the following key, which excludes *Picrophloeus* Blume as that is not known to occur in Singapore.

Key to genera

1. Trees with episodic stem growth, developing a wave-like sympodial branch system with successively higher orders of outwardly directed, then upturned, branch segments of indeterminate growth; inflorescences axillary **1. *Cyrtophyllum***
 Trees, shrubs, scramblers or hemi-epiphytes with continuous or episodic stem growth; branches plagiotropic or orthotropic, if developing a wave-like sympodial branch systems then the branch segments determinate; inflorescences terminal 2
2. Stem growth continuous; vegetative terminal buds not resinous; leaves arranged in two ranks (distichous) along branches; inflorescence a pendulous flowering cyme with all branches condensed along the rachis; surface of dried fruits firm and smooth, the epidermis not detaching from the pericarp **4. *Utania***
 Stem growth episodic; vegetative terminal buds covered with creamy to yellowish resin; leaves decussate on branches; inflorescence without any branching (a solitary flower) or an erect cyme with well-developed branches; surface of dried fruits wrinkled, the epidermis detaching from the pericarp 3
3. Stem/trunk with smooth bark, sometimes becoming cracked and scaly, but never prickly; branch system non-modular, developing as orthotropic complexes and not wave-like in structure; leaf margin entire; seeds ellipsoid-rounded **2. *Fagraea***
 Stem/trunk bark becoming fissured, densely set with prickles; branch system modular, developing plagiotropically by substitution to form a wave-like sympodial system; leaf margins serrulate-crenulate; seeds polygonal **3. *Limahlania***

1. CYRTOPHYLLUM Reinw.

(Greek, *cyрто-* = curved, *-phyllum* = leaf; referring to the leaf shape)

Tembusu (Malay)

in Hornschuch, Syll. Pl. Nov. 2 (1825 [‘1828’]) 8; Blume, Bijdr. Fl. Ned. Ind., pt 16 (1826–1827) 1022; Ridley, Fl. Malay Penins. 2 (1923) 421; Ridley, Fl. Malay Penins. 5 (1925) 322; Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 497; Struwe & Pringle in Kadereit & Bittrich (ed.), Fam. Gen. Vasc. Pl. 15 (2019) 492. **Synonyms:** *Fagraea* Thunb. sect. *Cyrtophyllum* (Reinw.) Blume, Rumphia 2 (1838) 34, p.p.; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 303, p.p.; Wong & Sugau, Sandakania 8 (1996) 7, p.p. – *Fagraea* Thunb. subg. *Cyrtophyllum* (Reinw.) Miq., Fl. Ned. Ind. 2, fasc. 3 (1857) 375, p.p. – *Fagraea* Thunb. sect. *Parviflorae* Benth., J. Linn. Soc. Bot. 1 (1857) 100, p.p. **Type:** *Cyrtophyllum peregrinum* Reinw. (= *Cyrtophyllum fragrans* (Roxb.) DC.).

Small to medium-sized trees, some big, reaching 25–30 m tall. **Stem** monopodial with episodic growth, developing wave-like sympodial branch systems or ‘terminalian’ branching with successively higher orders of outwardly directed, then upturned (indeterminate) branch segments; trunk bark becoming fissured in older trees. Vegetative **shoot tips** with light yellowish resin. **Leaves** decussate on branches; leaf margin entire; **petiolar sheaths** of a leaf pair fused and forming a shallow cup-like ochrea that loosely clasps the stem; petiolar base auricles absent. **Inflorescence** axillary, a few- to many-flowered and few- to multi-branched cyme, basal branches nearly as long as or longer than rachis. **Flowers** small, up to 10 mm wide at the corolla mouth; calyx lobes 5; corolla white to creamy white, corolla lobes 5; stamens 5, typically two-thirds or more exerted, anthers versatile, sagittate; ovary with axile placentation; style typically one third or more exerted; stigma capitate (knob-like). **Fruit** small, subglobose to slightly ellipsoid, to c. 10 mm diam., colour at maturity yellow-orange to bright red, with small amounts of translucent sticky latex in fruit epidermis and fruit wall; epidermis separating as a thin translucent film from pericarp (fruit surface appearing crinkled in herbarium specimens). **Seeds** numerous, polygonal.

Distribution. A genus of 5 species from Northeast India, Andaman Islands, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam and Malesia as far east as northwestern New Guinea. In Singapore 2 native species.

Taxonomy. Ridley (Fl. Malay Penins. 2 (1923) 421; Fl. Malay Penins. 5 (1925) 322) recognised Reinwardt’s genus as distinct a hundred years after its diagnosis. However, in the latter half of the twentieth century, *Cyrtophyllum* was generally considered to be a section of *Fagraea*, following the extremely broad concepts adopted by Leenhouts (Fl. Males., ser. 1, 6(2) (1962) 299).

Key to *Cyrtophyllum* species

1. Trunk bark in large adult trees coarse, reticulately-sinuously ridged and fissured; leaves with generally plane margins in fresh material, 7–9(–11) pairs of secondary veins forming distinct loops just next to the leaf margin, and which are flat or slightly raised on the upper surface in dried material; corolla tube infundibular (flared in the upper half), larger (lower narrowed part of corolla 1.5–2(–2.5) mm wide) **1. C. fragrans**

Trunk bark in large adult trees regularly and shallowly fissured; leaves with distinctively wavy margins in fresh material, 4–6 pairs of secondary veins that fork some distance from the leaf margin and do not form conspicuous marginal loops, and which are flat to frequently sunken on the upper surface in dried material; corolla tube subcylindrical (not noticeably flared in the upper part), smaller (lower narrowed part of corolla 1–1.5 mm wide) **2. C. giganteum**

1. *Cyrtophyllum fragrans* (Roxb.) DC.

(Latin, *fragrans* = fragrant; referring to flowers)

Prodr. 9 (1845) 31; Ridley, Trans. Linn. Soc. London, Bot. 3 (1893) 323; Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 501. **Basionym:** *Fagraea fragrans* Roxb. [Hort. Bengal. (1814) 84, nom. nud.], Fl. Ind. 2 (1824) 32; Don, Gen. Hist. 4 (1837) 68; Blume, Mus. Bot. 1, fasc. 11 (1850) 172; Bentham, J. Proc. Linn. Soc., Bot. 1 (1857) 100; Miquel, Fl. Ned. Ind. 2, fasc. 3 (1857) 375; Kurz, Forest Fl. Burma 2 (1877) 205; Clarke in Hooker, Fl. Brit. India 4, fasc. 10 (1883) 85; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114; Ahern, Timber Tree Sp. Philipp. Isl. (1901) 88; Koorders & Valetton, Meded. Lands Plantentuin 61 (1903) 282.; King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 611, p.p.; Ridley, J. Straits Branch Roy. Asiat. Soc. 50 (1908) 121; Elmer, Leaf. Philipp. Bot. 2 (1909) 597; Dop, Fl. Indo-Chine 4, fasc. 2 (1914) 177; Merrill, Bibliog. Enum. Born. Pl. [J. Straits Branch Roy. Asiat. Soc., Spec. No.] (1921) 492; Cammerloher, Bull. Jard. Bot. Buitenzorg, sér. 3, 5 (1923) 318; Foxworthy, Malayan Forest Rec. 3 (1927) 157; Corner, Wayside Trees Malaya (1940) 424; Kerr in Craib & Kerr, Fl. Siam. 3(1) (1951) 55; Browne, Forest Trees Sarawak & Brunei (1955) 244, t. 32; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 304, p.p.; Smythies, Common Sarawak Trees (1965) 87; Kochummen, Tree Fl. Malaya 2 (1973) 273, p.p.; Cockburn, Trees Sabah 1 [Sabah Forest Rec. 10] (1976) 211; Ashton, Manual Non-Dipt. Trees Sarawak 2 (1988) 310, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140; Wong & Sugau, Sandakania 8 (1996) 11; Coode et al. Checkl. Fl. Pl. Gymn. Brunei (1996) 174; Griffin & Parnell, Fl. Thailand 6(3) (1997) 198, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 227. **Synonym:** *Willughbeia fragrans* (Roxb.) Spreng. Syst. Veg. 4(2) (1827) 71. **Type:** *Hunter s.n.* [EIC 1597E], [Malaysia], Pullo Penang [Penang] (lectotype K [K001113556], designated here). **Fig. 1.**

Cyrtophyllum peregrinum Reinw. in Hornschuch, Syll. Pl. Nov. 2 (1825 [‘1828’]) 9; Blume, Bijdr. Fl. Ned. Ind., pt 16 (1826–1827) 1022; de Candolle, Prodr. 9 (1845) 31; Ridley, Fl. Malay Penins. 2 (1923) 421; Holtum, Gard. Bull. Straits Settlements 5(7–8) (1931) 189. **Synonym:** *Fagraea peregrina* (Reinw.) Blume, Rumphia 2 (1838) 34, t. 80; Blume, Mus. Bot. 1, fasc. 11 (1850) 172. **Type:** *Reinwardt s.n.*, [Indonesia], Java (lectotype L [L0005030], designated by Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 490).

Tree, rarely to just 3–4 m tall, more often big, to 30 m tall; trunk to c. 2 m in diam.; bark becoming deeply and ruggedly sinuous-fissured, grey-brown to dark brown. **Leaves** elliptic, (5.5–)7.5–11(–13) × (2–)3.5–4.5(–5.3) cm, base cuneate, apex short-cuspidate to caudate, (3–)5–8(–9) mm long, margin plane when fresh (in dried specimens sometimes slightly wavy), chartaceous to thin-coriaceous, upper and lower surfaces smooth, midrib prominent below, flat to slightly raised above, secondary veins (7–)9–12 pairs, forming conspicuous loops just next to the margin, upper side faint and immersed in the blade, lower side faint to very slightly prominent, tertiary veins faint to inconspicuous; petioles 1–2.3 cm long, 1–1.5 mm thick. **Inflorescence** (3.5–)4–7(–7.7) cm long, peduncle (2.8–)3–3.5 cm long, 1–1.5 mm thick, with (2–)3(–4) levels (tiers) of branching on the main axis, the branch tiers (2–)3–5(–6) mm

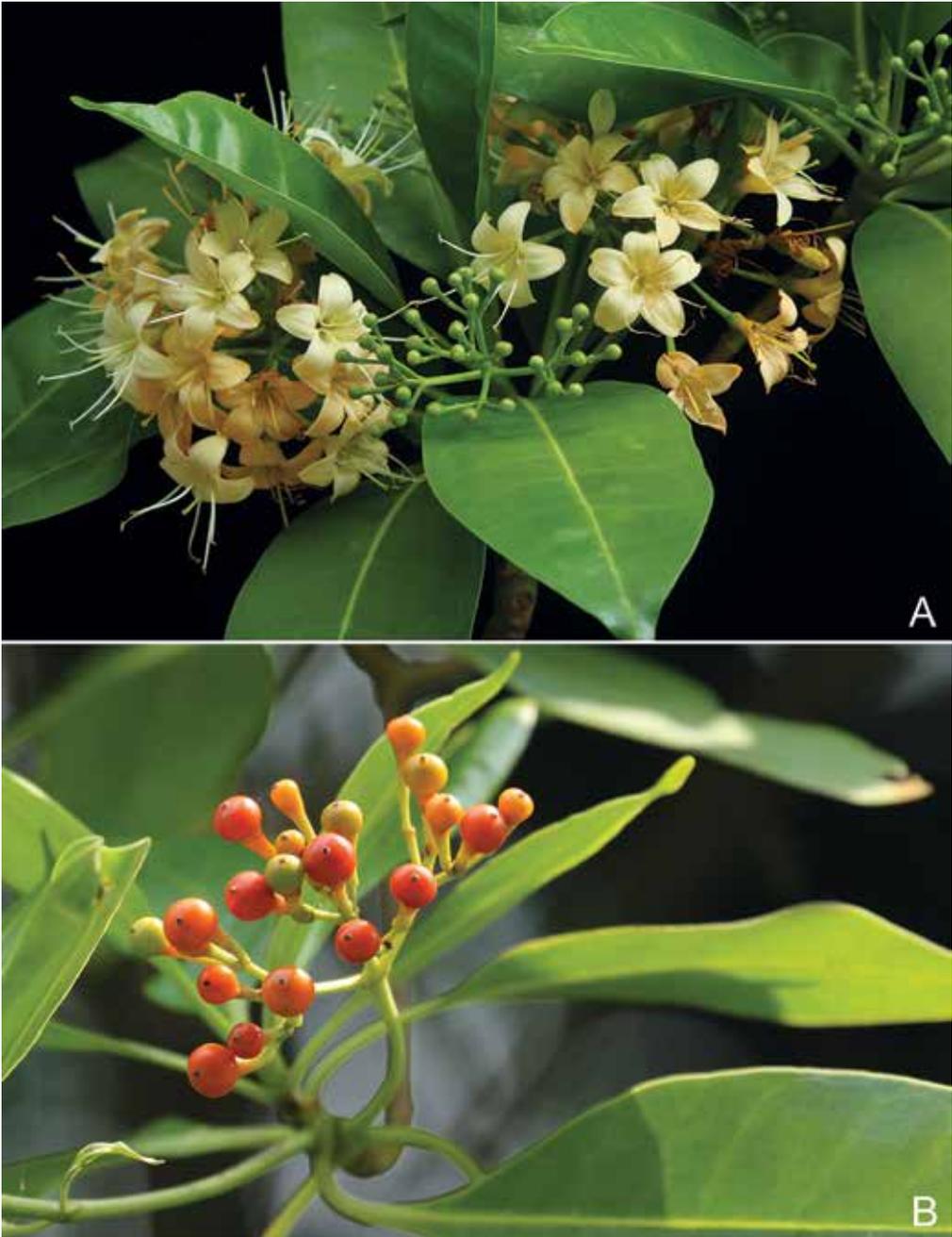


Figure 1. *Cyrtophyllum fragrans* (Roxb.) DC. **A.** Flowering leafy branch. **B.** Inflorescence. (From Singapore, A from Labrador Nature Reserve; B from St John's Island. Photos: W.F. Ang).

apart, lowest tier typically branched to 2(–3) orders; pedicel (3–)5–8(–11) mm long, 0.5(–1) mm thick. **Calyx** (from the base to the lobe apices) (1.5–)2–2.5 mm long, glabrous, calyx cup (1.5–)2–2.5(–3) mm wide, calyx lobes erect, 1–1.5(–2) mm long, 1–1.5(–2) mm wide, margins glabrous. **Corolla** tube somewhat infundibular, 5–6 mm long, lower narrowed part 2.5–3 mm wide, upper flared part 4–6 mm wide at the top, the lower narrowed tubular part nearly as long as the upper flared part, inside glabrous to minutely papillate, corolla lobes broad-ovate to subobovate, 4.5–5 mm long, 2–3 mm wide. **Stamens** inserted at the middle of the upper flared part of the corolla tube, filaments 10–14 mm long, exerted 8–11 mm in the open flower, anthers 1–1.5 mm long, 0.5–1 mm wide, each anther sac somewhat narrowly ellipsoid. **Style** 14–20 mm long, protruding 8–12 mm from the corolla mouth in the open flower; stigma c. 0.5 mm across, rounded, parting to present two slightly raised, hemispherical lobes with papillate inner surfaces when receptive, not recurving. **Infructescence** peduncle 2.5–4.5 cm long, 1–2 mm thick. **Fruit** when mature to 5–7 mm diam., the base loosely to tightly clasped by the calyx lobes. **Seeds** 0.5–1 mm across.

Distribution. Principally a continental Southeast Asian and western Malesian species: Northeast India, Andaman Islands, Myanmar, Thailand, Cambodia, Laos, Vietnam, Peninsular Malaysia, Sumatra, Java, Borneo and southwestern Philippines (the Palawan chain and Mindoro), Sulawesi. In Singapore generally common throughout, including in the Singapore Botanic Gardens (*Henderson 1329*, Nov 1921, SING [SING0060432]), the Central Catchment (*Cantley's Collector s.n.*, SING [SING0038040]), Seletar (*Turner et al. NRS 269*, 9 Apr 1992, SING [SING0038042]), Pulau Pawai (*Sidek S 99*, 8 Jun 1967, SING [SING0038038]) and Pulau Ubin (*Gwee et al. GAT 61*, 5 Nov 2002, SING [SING0042374]).

Ecology. *Cyrtophyllum fragrans* is one of the most commonly encountered trees in both Singapore and elsewhere in Southeast Asia. It is spontaneous in open sites and secondary forest, and grows easily on sandy sites, even on sandy tailings of former tin-mines in Peninsular Malaysia. Throughout the region, it is less commonly found in lowland high forest, but easily encountered in *kerangas* (tropical heath forest) vegetation and coastal or beach forest. Holttum (*Gard. Bull. Straits Settlem.* 9(1) (1935) 73) characterised the flowering of this species in Singapore as gregarious (with synchronised flowering among most or all trees in a population). It has two flowering seasons, the main one around mid-year and another towards year's end. The flowers last several days even though the stamens are spent after the first day of bloom. Corner (*Wayside Trees Malaya* 1 (1951) 424) records that the fruits take a few months to mature to an attractive yellow to red, and are probably mainly dispersed by birds or bats.

Provisional conservation assessment. Globally Least Concern (LC). In Singapore also assessed here as Least Concern (LC).

Uses. In Singapore it has been appreciated as a roadside and garden tree with good form and fragrant flowers since probably well before the mid-nineteenth century, when the Temenggong of Johor had an avenue of *tembusu* trees established leading from Napier Road to his Tyersall residence (Burkill, *Gard. Bull. Singapore* 4(2&3) (1927) 69). Ridley (*Trans. Linn. Soc. London, Bot.* 3 (1893) 267) observed that 'it is difficult to say whether the tree is more beautiful when covered with flowers or fruits.' In a 2002 Singapore poll, *tembusu* emerged

as the most favoured candidate for a national tree (Perry, Straits Times, 31 May 2002). The back of a Singapore five-dollar banknote depicts a 200-year old *tembusu* tree in the Singapore Botanic Gardens, helping to promote a ‘Garden City’ campaign. The timber is rated as a heavy hardwood, with fine and even texture, and durable, and enters the Malaysian trade with the standard name *tembusu*; this, however, is increasingly rare.

Vernacular names. *Tembusu* is the most well-known Malay name although throughout western Malesia several variations of this have been applied to this and other species of *Cyrtophyllum* as well as *Picrophloeus* spp. (the latter not in Singapore) which typically develop fissured bark in the adult tree. The preferred name used in Peninsular Malaysian forestry is *tembusu padang*, to distinguish it from the other big-tree *Cyrtophyllum*, *C. giganteum* (see below). This name (Malay: *busu*, unpleasantly odorous) probably alludes to the fermenting sweet scent that pervades as the abundant flowers fade. The use of the qualifying *padang* (Malay for field, grassland or open site) is apt because the species adapts well to quite open conditions.

The name *tembusu* is never applied to *Limahlania* (also tree), and almost never applied to *Utania* (typically small trees) or *Fagraea* s.s. (small trees, shrubs, climbers or hemi-epiphytes), despite these genera having also been placed within *Fagraea* s.l. at different periods. The only exceptions are *tembusu gajah* and *tembusu* noted but once for Bornean specimens of *Utania cuspidata* (Blume) K.M.Wong and *U. volubilis* (Wall.) Sugumaran, respectively (Wong & Sugau, Tree Fl. Sabah & Sarawak 2 (1996) 191); these were likely given in enthusiasm to indicate apparent affinity to the true *tembusu*, as all these taxa were once known under *Fagraea* names.

Taxonomy. Most of the past confusion has been whether *Cyrtophyllum giganteum* (below) should be subsumed under this species. Many consistent differences can be found between the two in adult trunk bark, leaf margin and venation, and corolla features (see Key). Besides, the two have different habitat preferences.

Notes. Inflorescence and floral size varies somewhat throughout the distributional range, including slightly larger corollas outside of Singapore. The description gives measurements applicable to known Singapore material.

2. *Cyrtophyllum giganteum* (Ridl.) Ridl.

(Greek, *gigantos* = huge; referring to the stature of many specimens)

Fl. Malay Penins. 2 (1923) 421; Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 505. **Basionym:** *Fagraea gigantea* Ridl., J. Straits Branch Roy. Asiat. Soc. 79 (1918) 98; Foxworthy, Malayan Forest Rec. 3 (1927) 157; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 995; Corner, Wayside Trees Malaya (1940) 425; Browne, Forest Trees Sarawak & Brunei (1955) 245; Kochummen, Tree Fl. Malaya 2 (1973) 273; Cockburn, Trees Sabah 1 [Sabah Forest Rec. 10] (1976) 211; Wong & Sugau, Sandakania 8 (1996) 11; Coode et al., Checkl. Fl. Pl. Gymn. Brunei (1996) 174; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 192. **Type:** *Ridley 8921*, Singapore, Gardens’ Jungle [Singapore Botanic Gardens’ Rain Forest], December 1897 (lectotype SING [SING0054758], designated by Wong & Sugau, Sandakania 8 (1996) 11; isolectotype K [K001129448]).

Fagraea sororia J.J.Sm. ex Cammerl., Bull. Jard. Bot. Buitenzorg, sér. 3, 5 (1923) 319, pl. 5; Heyne, Nutt. Pl. Ned.-Ind., ed. 2 (1927) 1270. **Type:** *Endert 44E 1P 515*, [Indonesia], Sumatra, Palembang (lectotype L [L0005023], first step designated by Wong & Sugau, Sandakania 8 (1996) 12, second step designated here; isolectotypes BO, K [K000883551], L [L0005022]).

Fagraea fragrans auct. non Roxb.: King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 611, p.p.; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 304, p.p.; Ashton, Manual Non-Dipt. Trees Sarawak 2 (1988) 310, p.p.

Fagraea speciosa auct. non Blume: Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114; Ridley, J. Straits Branch Roy. Asiat. Soc. 50 (1908) 122.

Tree, rarely to just 3–4 m tall, more often sizeable, to 30 m tall or more, trunk to over 1 m diam.; bark closely and finely fissured, grey-brown to dark brown. **Leaves** elliptic, 3.5–7.5 × 1.6–3.5 cm, base cuneate, apex short-cuspidate to caudate, 4–6 mm long, margin conspicuously wavy when fresh and in dried specimens, chartaceous, upper and lower surfaces smooth, midrib prominent below, flat to sunken above, secondary veins 4–6 pairs, forking some distance from the leaf margin and not forming conspicuous loops, upper side faint and immersed in the blade, lower side faint to very slightly prominent, tertiary veins faint to inconspicuous; petioles (0.8–)1–1.5(–2.3) cm long, 1–1.5 mm thick. **Inflorescence** 1.3–9.5 cm long, peduncle 3.5–5(–5.5) cm long, 1–1.5 mm thick, with 4–5 levels (tiers) of branching on the main axis, the branch tiers (5–)6–10(–12) mm apart, lowest tier typically branched to (2–)3 orders; pedicel 3–5 mm long, 0.3–0.5 mm thick. **Calyx** (from the base to the lobe apices) 1.5–2 mm long, glabrous, calyx cup 1.5–2 mm wide, calyx lobes erect, 0.5–1 mm long, c. 1 mm wide, margins glabrous. **Corolla** tube subcylindrical, 4–5 mm long, 1–1.5 mm wide near the base, upper part very gradually and slightly wider, inside glabrous to minutely papillate; corolla lobes broad-ovate to subobovate, 3–4.5 mm long, 2–2.5 mm wide. **Stamens** inserted at the uppermost third of the corolla tube, filaments 13–15 mm long, exerted 12–13 mm in the open flower, anthers 1–1.5 mm long, 0.5–0.8 mm wide, each anther sac somewhat narrowly ellipsoid. **Style** (12–)18–22 mm long, protruding (5–)12–14 mm from the corolla mouth in the open flower; stigma c. 0.5 mm across, lobes 2, rounded, parting to present two slightly raised, hemispherical, papillate inner surfaces when receptive, not recurving. **Infructescence** peduncle 1.5–5.5 cm long, 1–1.5 mm thick. **Fruit** when mature to 5–9 mm diam.; the base tightly clasped by the calyx lobes. **Seeds** 1–2 mm across.

Distribution. Peninsular Malaysia, Sumatra and Borneo. In Singapore previously documented only from the Singapore Botanic Gardens' Rain Forest (*Ridley 5818*, 1893, SING [SING0054759]; *Ridley 8921*, Dec 1897, SING [SING0054757, SING0054758]).

Ecology. Lowland dipterocarp forest, never establishing in open sites or on degraded soils.

Provisional conservation assessment. Globally probably Endangered on account of severe reduction and disturbance of its natural habitat in lowland forests throughout its range. Listed as Nationally Extinct in Singapore by Tan et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 2 (2008) 224) and Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 192).

Uses. Though less common, the timber is similar to that of *Cyrtophyllum fragrans* (above) and used likewise.

Vernacular name. The Malay name *tembusu hutan* has been quite consistently applied to this species.

Notes. The description gives measurements applicable to Singapore material. There is some variation from these throughout the distributional range.

2. FAGRAEA Thunb.

(Jonas Theodor Fagraeus, 1729–1797, Swedish naturalist)

Kongl. Vetensk. Acad. Nya Handl. 3 (1782) 132, t. 4; Wong & Sugumaran, Sandakania 21 (2016) 65; Struwe & Pringle in Kadereit & Bittrich (ed.), Fam. Gen. Vasc. Pl. 15 (2019) 493.

Type: *Fagraea ceilanica* Thunb.

Epiphytes, facultative hemi-epiphytes, scramblers, shrubs and small trees. **Stem** with episodic growth, developing ascending (orthotropic) branch sequences; bark smooth to lightly scaly-dimpled. Vegetative **shoot tips** with creamy yellowish resin. **Leaves** decussate on branches, leaf margin entire, **petiolar sheaths** of a leaf pair not to slightly fused at the edges, each with a scale-like ligular structure in the axillary position. **Inflorescence** terminal, of a solitary flower or a many-flowered and branched cyme with basal branches nearly as long as, or longer than, the rachis. **Flowers** small to large (to 50 mm wide or more at the mouth); calyx lobes 5; corolla white to creamy white, corolla lobes 5; stamens 5, slightly to somewhat exerted; ovary unilocular with two parietal placentas or bilocular with axile placentas; style not to slightly exerted; mature stigma peltate. **Fruit** small to big (to c. 40 mm diam.); colour at maturity often creamy, pale grey-green ranging to red; with copious creamy pale yellowish latex in fruit epidermis and fruit wall; epidermis separating as a thin translucent film from pericarp (crinkled on herbarium specimens). **Seeds** many, ellipsoid-rounded.

Distribution. Sri Lanka, India, southern China, continental Southeast Asia and Malesia to northern Australia and Polynesia. Approximately 55 species. In Singapore 3 native species.

Uses. *Fagraea* is perhaps best known in the Pacific through *F. berteriana* [‘*berteriana*’] Benth. ex Seem., the flowers of which are known to Hawai’ians as *pua keni keni* and used to make *lei*, traditional flower garlands, as well as for scenting coconut oil used to perfume hair and body lotions (Motley, Econ. Bot. 58 (2004) 396). In Malesia such parts as the bark of *Fagraea auriculata* have been used in minor medicinal treatments, but the conspicuous and highly attractive flowers in nearly all the species suggest special niches in horticulture and gardening.

Taxonomy. The concept of *Fagraea* has oscillated between narrow and broad. Here we follow the narrower concept of Sugumaran & Wong (Gard. Bull. Singapore 64 (2012) 301) and Wong & Sugumaran (Gard. Bull. Singapore 64 (2012) 481) based on molecular and morphological evidence.

Key to *Fagraea* species

1. Petiole base with narrow, rim-like to broad, rounded, auricular lateral extensions **1. *F. auriculata***
 Petiole base without auricular lateral extensions 2
2. Leaves with widely obtuse to rounded apices; secondary veins distinct and prominent on the lower surface upon drying. Flower calyx more than 15 mm long **2. *F. ridleyi***
 Leaves with pointed apices; secondary veins indistinct or, if faintly visible, immersed in the lamina and not prominent upon drying. Flower calyx shorter, 10 mm long or less **3. *F. splendens***

1. *Fagraea auriculata* Jack

(Latin, *auriculatus* = with an ear-like appendage;
 referring to the petiolar sheath)

Mal. Misc. 2(7) (1822) 82; Wallich in Roxburgh, Fl. Ind. 2 (1824) 34; Clarke in Hooker, Fl. Brit. India 4, fasc. 10 (1883) 83, p.p.; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114, p.p.; King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 605, p.p.; Ridley, Fl. Malay Penins. 2 (1923) 416, p.p.; Kerr in Craib & Kerr, Fl. Siam. 3(1) (1951) 54; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 326, p.p.; Kochummen, Tree Fl. Malaya 2 (1973) 270, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140; Griffin & Parnell, Fl. Thailand 6(3) (1997) 204; Wong & Sugau, Sandakania 8 (1996) 51, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 205; Wong & Sugumaran, Sandakania 21 (2016) 79. **Type:** *Wray 2913*, [Malaysia], Perak (neotype L [L0484087], designated by Wong & Sugau, Sandakania 8 (1996) 51). **Fig. 2.**

Small tree to large terrestrial shrub 5–18 m tall or hemi-epiphyte; stems to c. 10 cm diam.; bark smooth, grey-brown to reddish brown, smooth becoming scaly-dippled; branch internodes often with 2-several low longitudinal ridges to 1 mm broad along the inter-petiolar region. **Leaves** elliptic to oblanceolate, (12–)18–27(–31) × (4.5–)5.5–9(–11) cm, base narrowly decurrent with 1–2 mm broad wings towards the petiole base, apex obtuse-rounded and shortly pointed, margin slightly recurved in dried material, thick-coriaceous, upper and lower surfaces glabrous, midrib slightly prominent above, more prominent below with a slight median keel upon drying, secondary veins 4–6(–7) pairs, faint and immersed in the lamina on both sides, tertiary and higher-order veins faint; petioles 15–25(–35) mm long, 3–5 mm thick, petiolar sheaths not fused along the interpetiolar median, each developing a scale-like ligule (1.5–)2–5 mm high adaxially, auricles developing below the petiole base, distinct from the lamina base, typically forming broad, rounded, reflexed lobes (3–)8–15(–20) mm broad (very rarely raised lateral rims just 1–2 mm high). **Inflorescence** terminal, a 2- to few-flowered cyme, the whole about (1.5–)2–3(–4) cm long, peduncle indistinct, inflorescence rachis (1.5–)2–3(–4) cm long, 5–7 mm diam., with 1(–2) pairs of primary branches, basal primary branch pairs c. 12–22 mm long, 5–8 mm diam. and not rebranched; pedicels 3–10(–20) mm long, 8–10 mm diam.; floral bracts small, acute, 8–10(–13) mm long, inserted below the calyx; flowers fragrant. **Calyx** 27–35 mm long (from the base to the lobe apices), glabrous, not lenticellate, calyx cup 15–18 mm diam., calyx lobes 5, broad-elliptic to rounded, 20–27 mm long, 12–17 mm wide,



Figure 2. *Fagraea auriculata* Jack. **A.** Leaf bases with broad auricular extensions. **B.** Flowers. (Cultivated in Singapore, originally from Peninsular Malaysia, *Low & Ang LYW 372*. Photos: W.F. Ang).

margins glabrous. **Corolla** broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube), cream to white, lower subcylindrical part of the corolla tube 30–35(–50) mm long, 10–12(–17) mm wide basally, upper flared part of the tube slightly inflated, 30–37 mm long, 35–56(–72) mm wide at the top, corolla lobes 5, broad-obovate to suborbicular, 36–42 mm long, 23–31 mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 45–60 mm long, protruding to 15–23 mm from the corolla mouth, anthers versatile, hastate, 13–18 mm long, 6–8 mm wide, each anther sac somewhat ellipsoid. **Style** 70–90 mm long, protruding to 8–10 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole 3–4 mm diam. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, when mature (65–)80–125 mm long, 25–35(–60) mm diam., apex conspicuously attenuate, the base tightly clasped by the erect calyx lobes. **Seeds** 2–2.5 mm long, c. 1.5 mm wide, testa areolate.

Distribution. Cambodia, Vietnam, Peninsular Malaysia, Sumatra, Java and Borneo. In Singapore persisting on Pulau Ubin (*Ridley 9582*, 1898, SING [SING0011367]; *Lai SING2013-259*, 24 Oct 2013, SING [SING0215131]) and Pulau Pawai (*Sinclair SFN 38900*, 14 Mar 1950, SING [SING0011370]; *Lee et al. SING2006-53*, 5 Dec 2006, SING [SING0090252]).

Ecology. Coastal sites, including behind sea beaches, rocky outcrops; also (outside of Singapore) swamp forests and limestone and quartz outcrops in coastal lowlands.

Provisional conservation assessment. Globally, the species may be considered Vulnerable to extinction, as its predominantly coastal habitats become increasingly disturbed by development and land use transformation. Listed as Critically Endangered (CR/D) in Singapore by Tan et al. (in Davison et al. (ed.), *Singapore Red Data Book*, ed. 2 (2008) 224) and Chong et al. (*Checkl. Vasc. Pl. Fl. Singapore* (2009) 41, 137, 205).

Taxonomy. When Jack described this species, he referred to a lowland, predominantly coastal, taxon collected from Singapore and the west coast of Sumatra at Tapanuly. As there is no type material, a neotype was designated by Wong & Sugau (*Sandakania* 8 (1996) 51), which conforms to this.

Two other taxa found in Peninsular Malaysia have been confused with *Fagraea auriculata*. One is *Fagraea imperialis* Miq., also with conspicuous leaf-stalk auricles but much larger flowers (corolla tube (40–)90–100 mm long), either solitary or in small numbers in cymes, and larger rounded floral bracts (typically 20–30 mm long). This species is typified by material from Sumatra but is now adequately represented by good material from Perak, Peninsular Malaysia. *Fagraea imperialis* also develops strong, sharp keels along the interpetiolar median of the internodes, whereas in *F. auriculata* the internodes are either smooth or at most provided with low ridges without any plate-like keels developing. The other species, *Fagraea kinghamii* K.M.Wong & Sugumaran, is distinctive by the typically solitary flowers with much shorter pedicels (indistinct or to only 10 mm long), large floral bracts (typically 30 mm long) that approach the size of calyx lobes, poorly developed petiolar auricles, and a montane provenance (so far documented only from the Main Range in Peninsular Malaysia).

2. *Fagraea ridleyi* King & Gamble

(Henry Nicholas Ridley, 1855–1956, prolific botanist
and first Director of Singapore Botanic Gardens)

J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 612; Ridley, Fl. Malay Penins. 2 (1923) 417; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 320; Kochummen, Tree Fl. Malaya 2 (1973) 271; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140; Wong & Sugau, Sandakania 8 (1996) 87; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 192; Wong & Sugumaran, Sandakania 21 (2016) 119. **Type:** *Ridley 5845*, Singapore (lectotype SING [SING0051259], designated by Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 320; isolectotypes BM [BM001014299], K [K000438443]).

Small tree or hemi-epiphyte, or lianescent, usually to 6 m tall or up to 30 m high or more on trees, stems to c. 13 cm diam., bark smooth to lenticellate, dark-brown, branch internodes terete, smooth. **Leaves** broad elliptic to subobovate, (13–)17–22(–25.5) × (7.5–)9–12(–16) cm, base cuneate, not decurrent, apex widely obtuse to rounded, margin plane in dried material, thick-coriaceous, upper and lower surfaces glabrous, midrib prominent above towards the leaf base but flat to sunken nearer the leaf apex, prominent below, secondary veins (2–)4–5, upper side faint and immersed in the lamina, lower side prominent, tertiary and higher-order veins obscure; petioles (1.5–)2–3(–4.3) cm long, 3–5(–6) mm thick, petiolar sheaths not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially, petiole base without auricles. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 5–6 cm long, peduncle distinct, 2.5–3.5 cm long, 7–9 mm diam., inflorescence rachis 25–30 mm long, 5–8 mm diam., with 1–2 pairs of primary branches, basal primary branch pairs 20–30 mm long, 3–4 mm diam. and rebranched to 1(–2) orders, more distal branch pairs less so; pedicels 15–17 mm long, 3–5 mm diam., floral bracts small, acute, 3–4 mm long, located below the calyx. **Calyx** 30–35 mm long (from the base to the lobe apices, glabrous, lenticellate, calyx cup 8–15 mm diam., calyx lobes 5, broad-elliptic to rounded, 12–15 mm long, 13–15 mm wide, margins glabrous. **Corolla** broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; lower subcylindrical part of the corolla tube 18–20 mm long, 3–6 mm wide basally, upper flared part of the tube slightly inflated, 14–17 mm long, 14–18 mm wide at the top, corolla lobes 5, broad-obovate to suborbicular, 17–20 mm long, 10–15 mm wide. **Stamens** 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 25–28 mm long, protruding to c. 10 mm from the corolla mouth, anthers versatile, hastate, 6–10 mm long, 2–4 mm wide, each anther sac somewhat ellipsoid. **Style** 40–45 mm long, protruding to c. 8 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole sometimes resembling a subpeltate structure c. 2 mm diam. **Infructescence** peduncle distinct, 15–20(–35) mm long, 4–6 mm thick. **Fruit** broadly ovoid to subglobose, when mature 40–50(–55) mm long, 20–32(–42) mm diam., apex conspicuously attenuated, the base tightly clasped by the calyx lobes. **Seeds** 2–2.5 mm long, 1–1.5 mm wide, testa areolate.

Distribution. Peninsular Malaysia, Lingga Island and Borneo. In Singapore only known from one recent collection from Sentosa (*Lua et al. SING2019-019*, Tanjong Rimau, 8 Jan 2019, SING). Previously recorded from Bukit Timah (*Ridley 2767*, 1891, SING [SING0052391]);

Ridley 5845, 1894, K, SING [SING0051259]) and cultivated specimens in the Singapore Botanic Gardens (*Ridley 11363*, 1902, SING [SING0052390]; *Mhd Nur SFN 18191*, 28 Feb 1928, KEP).

Ecology. Lowland rain forest (also some *kerangas* forest sites in Borneo). In Singapore it has been collected on a rocky cliff by the sea.

Provisional conservation assessment. Globally, the species may be considered Vulnerable to extinction because of habitat reduction. Listed as Nationally Extinct in Singapore by Tan et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 2 (2008) 224) and Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 192) but after the recent rediscovery it is assessed here as Critically Endangered (CR/D) in Singapore.

Taxonomy. The non-auriculate, distinctly petiolate leaves with a very coarsely thick-coriaceous texture and prominent secondary veins on the lower surface when dried, and robust inflorescence axes and flower calyces, readily distinguish this species (see Key).

3. *Fagraea splendens* Blume

(Latin, *splendens* = shining, brilliant; referring to the fresh leaves)

Mus. Bot. 1, fasc. 11 (1850) 168; Wong & Sugau, Sandakania 8 (1996) 87; Wong & Sugumaran, Sandakania 21 (2016) 121. **Type:** *Korthals s.n.*, [Indonesia], Borneo (lectotype L [L0004984], designated here). **Fig. 3.**

Fagraea acuminatissima Merr., J. Straits Branch Roy. Asiat. Soc. 77 (1917) 232; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 319; Kochummen, Tree Fl. Malaya 2 (1973) 271; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 192. **Type:** *Native collector 686*, [Malaysia], Sarawak (lectotype K [K000883538], designated here; isolectotypes BM [BM001014298], L [L0004926, L0004927], US [US00112989]).

Fagraea heterophylla Blume, Mus. Bot. 1, fasc. 11 (1850) 168. **Type:** *Korthals s.n.*, [Indonesia], Borneo, Banjarmasin (lectotype L [L0004986], designated here).

Fagraea longicuspis Gand., Bull. Soc. Bot. France 65 (1918) 58. **Type:** *Curtis 3013*, [Malaysia], Pulau Penang, May 1893 (holotype LY n.v.; isotypes SING [SING0059728, SING0059729]).

Fagraea ceilanica auct. non Thunb.: Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 315, p.p.

Fagraea obovata auct. non Wall.: King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 606, p.p.; Ridley, Fl. Malay Penins. 2 (1923) 418, p.p.; Kerr in Craib & Kerr, Fl. Siam. 3(1) (1951) 56.

Small shrub or hemi-epiphyte, usually to 3 m tall or 10 m high or more on trees, stems to c. 10 cm diam.; bark smooth, grey to dark-brown. **Leaves** elliptic to obovate, (5.5–)10–20(–23) × (2.8–)4–8(–9.3) cm, base cuneate to rounded, not decurrent, apex short cuspidate, margin recurved in dried material, thin-coriaceous, upper and lower surfaces glabrous, midrib flat to sunken above, prominent below, secondary veins 5–7 pairs if visible, otherwise obscure on

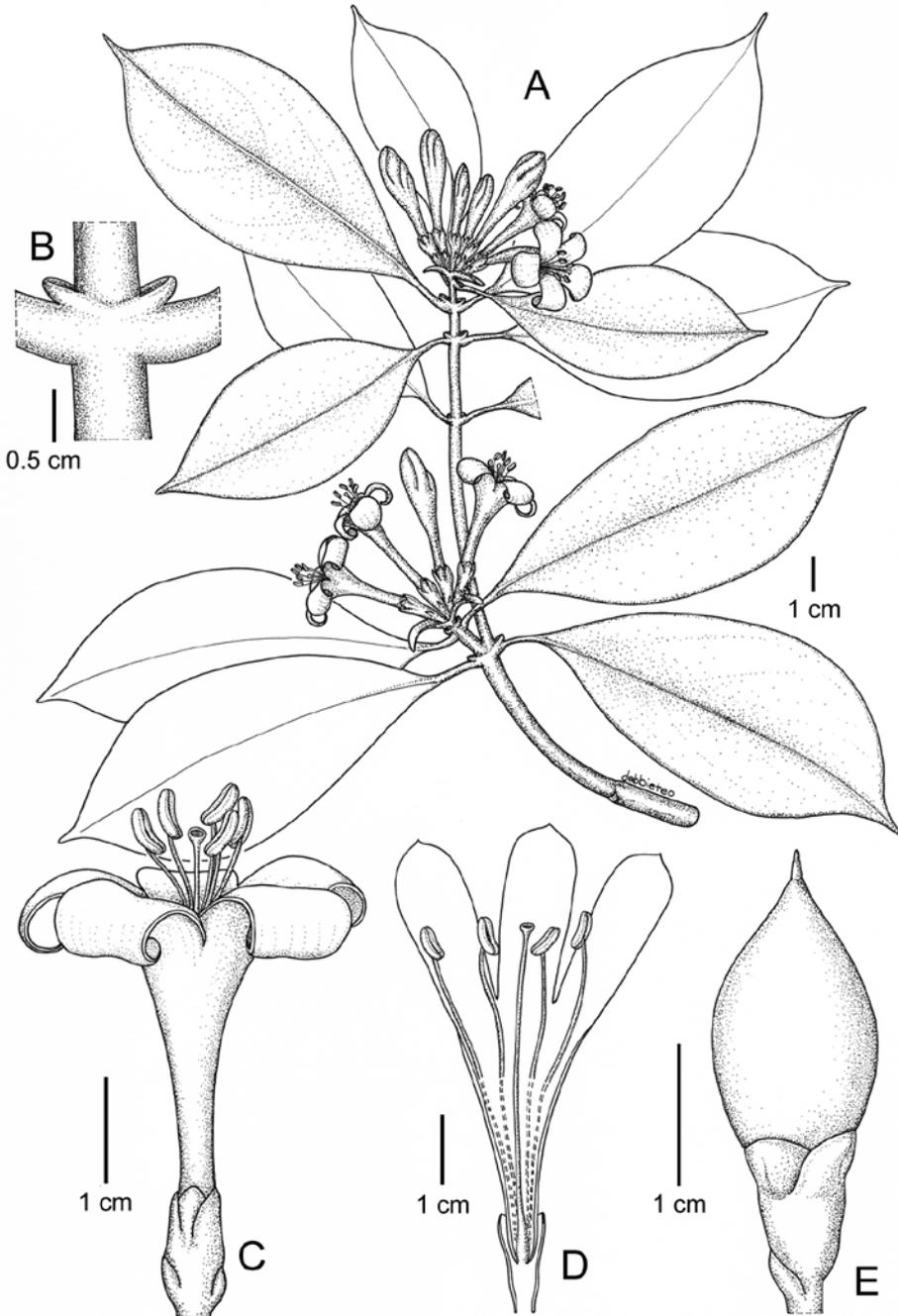


Figure 3. *Fagraea splendens* Blume. **A.** Flowering leafy branch. **B.** Detail of scale-like ligules developing adaxially on the petiole bases. **C.** Flower. **D.** Longitudinal section through flower. **E.** Fruit. (From Singapore, A–D from Nee Soon, *Ng SING2018-613*; E from Bukit Mandai, *Kiah SFN 37739*. Drawn by D. Teo).

both sides, tertiary and higher-order veins obscure; petioles (5–)20–35(–47) mm long, (1.5–)2–3(–4) mm thick, petiolar sheaths not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially, petiole base without auricles. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 5–10 mm long, peduncle indistinct or to 5 mm long, to 5 mm diam., inflorescence rachis 4–8 mm long, 2–4 mm diam., with (1–)2 pairs of primary branches, basal primary branch pairs 3–4 mm long, 2–3 mm diam. and not rebranched; pedicels 2–4 mm long, 2.5–4 mm diam., floral bracts small, acute, 2–3 mm long, inserted below the calyx. **Calyx** 6–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, calyx cup 3–6 mm diam., calyx lobes 5, broad-elliptic to rounded, 4–9 mm long, 4–8 mm wide, margins glabrous. **Corolla** broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube), cream to white, lower subcylindrical part of the corolla tube 12–18(–20) mm long, 2–4 mm wide basally, upper flared part of the tube slightly inflated, 13–17 mm long, 10–15 mm wide at the top, corolla lobes 5, broad-obovate to suborbicular, 13–20(–23) mm long, 6–15 mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 20–25 mm long, protruding to 7–8 mm from the corolla mouth, anthers versatile, hastate, 5–6 mm long, 2–2.5 mm wide, each anther sac somewhat ellipsoid. **Style** 40–45 mm long, protruding to 8–15 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–2 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 4 mm diam. **Fruit** narrowly ellipsoid, when mature to 20–30 mm long, 12–16 mm diam., apex conspicuously attenuate, the base tightly clasped by the calyx lobes. **Seeds** 2–2.5 mm long, 1–1.5 mm wide; testa areolate.

Distribution. Peninsular Malaysia, Sumatra and Borneo. In Singapore mainly recorded from swamp forest at Kranji (*Goodenough s.n.*, 12 Mar 1890, SING [SING0011365]), Mandai (*Kiah SFN 37739*, 12 Aug 1940, KEP, SING [SING0011366]) and Nee Soon (*Yeo et al. SING2012-155*, 27 Apr 2012, SING [SING0182089]; *Ng SING2018-613*, 1 Jun 2018, SING [SING0243435]).

Ecology. This species has a large altitudinal range, occurring from near sea level to lower montane forest in Peninsular Malaysia. It also occurs in peat swamp and freshwater swamp forests.

Provisional conservation assessment. Globally, this species is probably still of Least Concern (LC), being occasionally encountered during fieldwork in Peninsular Malaysia and Borneo. It was Listed as Nationally Extinct in Singapore by Tan et al. (in Davison et al. (ed.), *Singapore Red Data Book*, ed. 2 (2008) 224) and Chong et al. (*Checkl. Vasc. Pl. Fl. Singapore* (2009) 41, 137, 192, under the synonym *Fagraea acuminatissima*). However, following its recent rediscovery at Nee Soon and the likelihood that the number of mature individuals is very small, it is assessed here as Critically Endangered (CR/D) in Singapore.

Notes. Singapore specimens lack flowering or fruiting material so the above measurements are recorded from the rest of the distribution range.

3. LIM AHL ANIA K.M.Wong & Sugumaran

(Lim Ah Lan, b. 1948, former botany professor at University of Malaya)

Malabera (Malay)

Gard. Bull. Singapore 64 (2012) 491; Struwe & Pringle in Kadereit & Bittrich (ed.), *Fam. Gen. Vasc. Pl.* 15 (2019) 493. **Type:** *Limahlania crenulata* (Maingay ex C.B. Clarke) K.M. Wong & Sugumaran.

Small to medium-sized trees. **Stem** monopodial with episodic growth, developing distinct tiers of branches with wave-like sympodial extensions of successively higher orders of outwardly directed, then upturned (determinate) branch segments; trunk bark very lightly fissured, with conical prickles. Vegetative **shoot tips** with creamy yellowish resin. **Leaves** decussate on branches, margin serrulate-crenulate; **petiolar sheaths** of a leaf pair not to slightly fused at extreme edges and not forming a cup-like ochrea. **Inflorescence** terminal, a many-flowered and few- to multi-branched cyme, basal branches longest, nearly as long as rachis, mostly rebranched. **Flowers** small, c. 10 mm wide at the corolla mouth; calyx lobes 5; corolla white to creamy white, corolla lobes 5; stamens 5, typically c. half exsert, anthers versatile, hastate; ovary with axile placentation; style not to only slightly exsert; mature stigma peltate. **Fruit** medium-sized (10–15 mm diam.), narrowly ellipsoid, to c. 15 mm diam., colour at maturity pale grey-green, with small amounts of translucent sticky latex in fruit epidermis and fruit wall; epidermis separating as a thin translucent film from pericarp (fruit surface appearing crinkled in herbarium specimens). **Seeds** numerous, polygonal.

Distribution. A single species in Peninsular Malaysia, Singapore, Sumatra, Borneo (southwestern and southern Kalimantan), Cambodia and southern Vietnam.

Taxonomy. In spite of possessing some conspicuously aberrant traits (the tree architecture, prickly stem, serrulate-crenulate leaf margins) compared to all other taxa in the *Fagraea* s.l. complex, this genus had never been treated as distinct from *Fagraea*. It forms a distinct lineage in molecular phylogenetic studies (Sugumaran & Wong, Gard. Bull. Singapore 64 (2012) 301).

Limahlania crenulata (Maingay ex C.B. Clarke) K.M. Wong & Sugumaran

(Latin, *crenulatus* = crenulate, having small rounded teeth; referring to the leaf margin)

Gard. Bull. Singapore 64 (2012) 492. **Basionym:** *Fagraea crenulata* Maingay ex C.B. Clarke in Hooker, Fl. Brit. India 4, fasc. 10 (1883) 83; King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 610; Cammerloher, Bull. Jard. Bot. Buitenzorg, sér. 3, 5 (1923) 321; Ridley, Fl. Malay Penins. 2 (1923) 420; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 324; Kochummen, Tree Fl. Malaya 2 (1973) 271; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140; Wong & Sugau, Sandakania 8 (1996) 59; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 244. **Type:** *Maingay 1032*, [Malaysia], Malacca (lectotype K [K000438441, K000438442 – i.e. a single specimen over two sheets], designated here). **Fig. 4.**

Fagraea fastigiata auct. non Blume: Ridley, J. Straits Branch Roy. Asiat. Soc. 30 (1897) 167, p.p.

Tree, to 10–15(–20) m tall, trunk to c. 25 cm diam., bark with short stub-like prickles on broadly rounded bases, grey-brown. **Leaves** broadly obovate, (20–)25–40(–55) × (12–)20–40(–45) cm, base decurrent with (3–)10–20(–25) mm broad wings towards the petiole base and external to the petiolar sheath, apex rounded, thin-coriaceous, upper and lower surfaces glabrous, lower surface granular under magnification, midrib prominent to flat above, prominent below and sometimes developing a low median keel upon drying, secondary veins 5–7 pairs, prominent on both sides; tertiary and higher-order veins faint, petioles indistinct, petiolar sheaths fusing along the interpetiolar median; petiole base without auricles. **Inflorescence** terminal, a branched cyme, the whole about 7–15 cm long, peduncle indistinct, inflorescence rachis 6.5–7(–13) mm long, 5–9 mm thick, with 3–5 pairs of primary branches, basal primary branch pairs (3–)4.5–10 cm long, (4–)5–7 mm thick and rebranched to 3–4 orders, more distal branch pairs less so; pedicel 5–6 mm long, 3–4 mm thick, floral bracts small, acute, 2–3 mm long, located below the calyx; flower fragrant. **Calyx** 8–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, calyx cup 3–4 mm wide, calyx lobes 5, broad-elliptic to rounded, erect, 5–6.5 mm long, 5–6 mm wide, margins glabrous. **Corolla** slender trumpet-shaped (subcylindrical and very gradually widening towards the apex), cream to white, lower subcylindrical part of the corolla tube 10–11 mm long, 4–5 mm wide basally, upper flared part of the tube slightly inflated, 5–7 mm long, 9–10 mm wide at the top, corolla lobes broad-obovate, 10–15 mm long, 6–9 mm wide. **Stamens** 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 12–14 mm long, slightly protruding to 7–8 mm from the corolla mouth, anthers versatile, hastate, 4–5 mm long, 1–1.5 mm wide, each anther sac somewhat ellipsoid. **Style** 15–20(–33) mm long, not to slightly protruding to 5 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole resembling a somewhat peltate structure 1–1.5 mm across. **Infructescence** peduncle indistinct or to 4.5 cm long, 7–8 mm thick. **Fruit** narrowly ellipsoid, when mature to 20–24 mm long, 12–15 mm wide, apex attenuated, the base loosely surrounded by the erect to recurved calyx lobes. **Seeds** 1–1.5 mm long, 1–1.5 mm wide, testa surface areolate.

Distribution. As for the genus. In Singapore, apart from the Singapore Botanic Gardens (*Mhd Noor 1840*, 1 Mar 1918, SING), this species has only been recorded from Farrer Road (*Hardial 327*, 9 Jun 1965, SING [SING0038034, SING0038035]) and a likely cultivated tree from Labrador (*Tang & Sidek 879*, 14 Aug 1995, SING [SING0016843]). Now cultivated as a street tree in various localities around the island.

Provisional conservation assessment. Globally, probably of Least Concern, as the species readily establishes in many coastal and sandy open sites. In land-scarce Singapore, however, the situation may be different. Tan et al. (in Davison et al. (ed.), *Singapore Red Data Book*, 2008) do not list this species. Chong et al. (*Checkl. Vasc. Pl. Fl. Singapore* (2009) 41, 137, 244) list it (under *Fagraea crenulata*) as only cultivated in Singapore, however, the 1965 record is likely of a residual native tree in a secondary scrub as then the species had not yet become easily available as a cultivated tree (S.K. Ganesan, pers. comm.). *Limahlania crenulata* is reassessed here as native to Singapore but Nationally Extinct as it now exists only in cultivation.

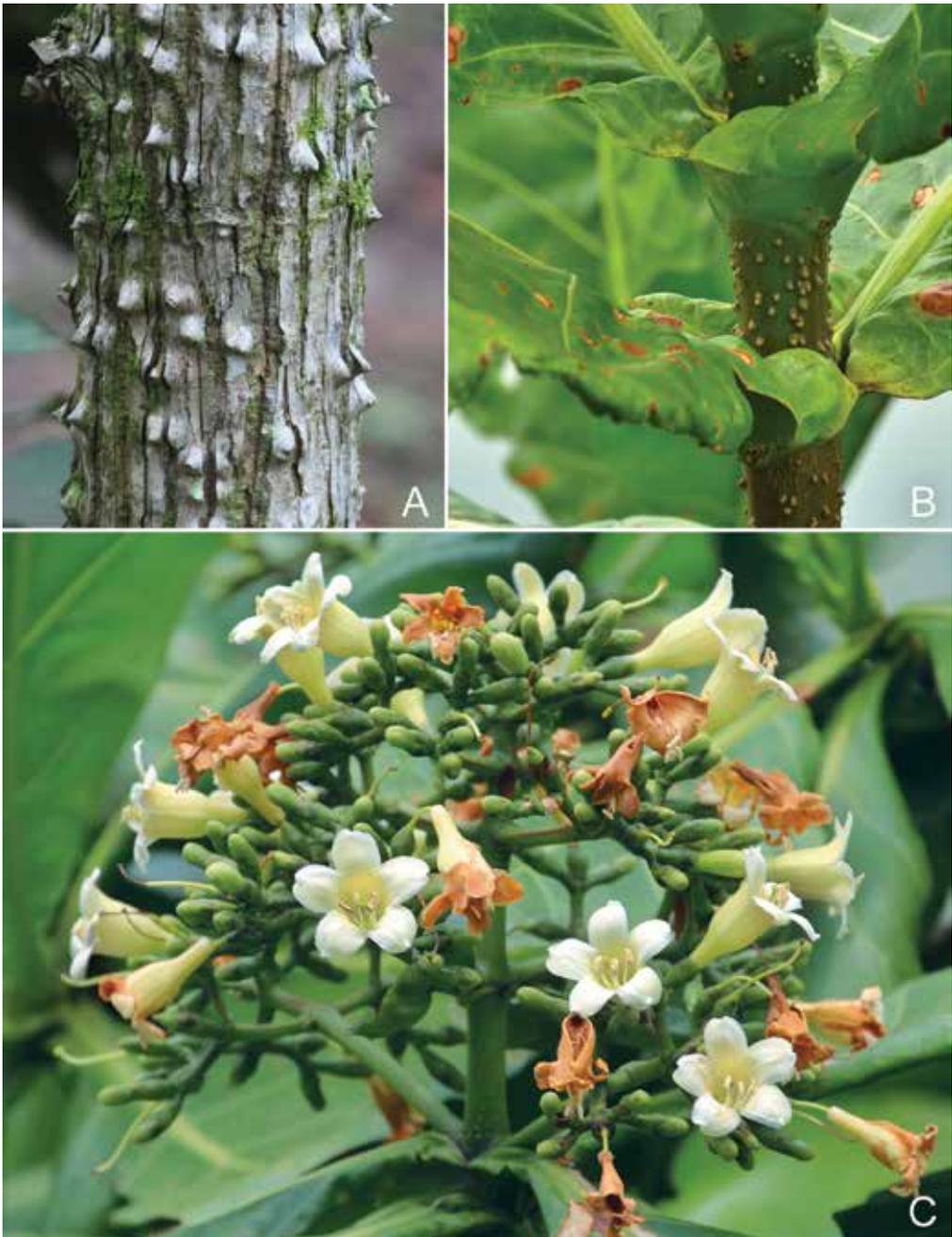


Figure 4. *Limahlania crenulata* (Maingay ex C.B.Clarke) K.M.Wong & Sugumaran. **A.** Thorny fissured trunk bark. **B.** Young leafy branch showing fused petiolar sheaths at leaf bases. **C.** Inflorescence. (Cultivated in Singapore, Gardens by the Bay. Photos: X.Y. Ng).

Uses. A tree of most immaculate form with tiers of neat, wavelike branching and clusters of big leaves, this has become available as planting material in the last two decades and is now used as a street tree in parts of Singapore.

4. UTANIA G. Don

(from the Javanese vernacular name *tjankuda-utan*, in which *utan* means forest)

Gen. Hist. 4 (1838) 663; Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 492; Sugumaran & Wong, Pl. Ecol. Evol. 147 (2014) 213; Struwe & Pringle in Kadereit & Bittrich (ed.), Fam. Gen. Vasc. Pl. 15 (2019) 492. **Type:** *Kuhlia morindifolia* Reinw. (= *Utania volubilis* (Wall.) Sugumaran).

Kuhlia Reinw., Syll. Pl. Nov. 2 (1825 [‘1828’]) 6; Blume, Bijdr. Fl. Ned. Ind., pt 14 (1826) 777, nom. illeg. non Kunth (1825). **Type:** *Kuhlia morindifolia* Reinw. (= *Utania volubilis* (Wall.) Sugumaran).

Kentia Steud., Nomencl. Bot., ed. 2, 1 (1840) 845, nom. illeg. non Adanson (1763). **Type:** *Kentia morindifolia* (Reinw.) Steud. (= *Utania volubilis* (Wall.) Sugumaran).

Small to medium-sized trees, very occasionally reaching about 30 m tall. **Stem** with continuous growth, developing plagiotropic branches; bark becoming fissured in older trees. Vegetative **shoot tips** non-resinous. **Leaves** on stem decussately arranged, those on plagiotropic branches arranged in two ranks, margin entire, petiolar sheaths of a leaf pair fused to form a shallow cup-like ochrea that loosely clasps the stem, petiolar base auricles absent. **Inflorescence** terminal, a many-flowered and branched pendulous cyme, branches much condensed. **Flowers** bisexual, small to medium-sized, up to 25 mm wide at the mouth; calyx lobes 5; corolla white to creamy white, corolla lobes 5; stamens 5, typically not to slightly exerted, anthers versatile, hastate; ovary with axile placentation, style not to slightly exerted, stigma peltate. **Fruit** small to medium-sized, ellipsoid, to 15 mm diam., colour at maturity pale to dark brown, without latex in fruit epidermis or fruit wall, epidermis not separating from pericarp (fruit surface firm and appearing smooth in herbarium specimens). **Seeds** numerous, polygonal.

Distribution. A genus of about 15 species in the Andaman and Nicobar Islands, Cambodia, southern Vietnam, Thailand, Peninsular Malaysia, Sumatra, Java, Borneo, Sulawesi, Moluccas, the Philippines and New Guinea. In Singapore 4 native species.

Taxonomy. *Utania* stands out from other genera in the former *Fagraea* s.l. alliance, with a highly distinctive plant architecture featuring branch leaves arranged in two ranks (the others all have decussate leaves even on the branches), terminal panicles with much condensed primary branches, firm fruit wall without conspicuous exudate, and non-detaching fruit epidermis in dried material.

Key to *Utania* species

1. Leaves with 10–16 pairs of secondary veins; peduncle of mature inflorescence (bearing open flowers) typically 5–7 mm diam. (although more slender, even less than 3 mm diam. when young) and 0.8–1(–2) cm long; infructescence peduncle 4–8 mm diam. **2. *U. nervosa***
 Leaves with 3–7 pairs of secondary veins; peduncle of mature inflorescence 1–3(–4) mm diam. and (1–)3–8(–10) cm long; infructescence peduncle 1–4 mm diam. 2
2. Corolla narrowly funnel-shaped (corolla mouth less than to about 3 times the diameter of the lower narrowed part of the tube); corolla lobes less than 3 mm long, only about 1/4 to 1/5 the length of the broadened upper part of the corolla tube **1. *U. austromalayensis***
 Corolla broadly funnel-shaped to campanulate (corolla mouth more than 3–4 times the diameter of the lower narrowed part of the tube); corolla lobes 5 mm long or more, more than half the length of the broadened upper part of the corolla tube 3
3. Rachis in the distal half of the flower-bearing part of the inflorescence and infructescence thinner than (or as slender as) the proximal rachis and peduncle; flowering and fruiting tiers above the basal 1–2 tiers always well-spaced, separated by clearly visible rachis lengths of 0.5 cm or more; calyx lobes spreading out from the corolla or fruit base in dried specimens **4. *U. volubilis***
 Rachis in the distal half of the flower-bearing part of the inflorescence and infructescence conspicuously thicker than the proximal rachis and peduncle; flowering and fruiting tiers above the basal 1–2 tiers typically closely spaced, without clearly visible rachis lengths between tiers; calyx lobes tightly clasping the corolla or fruit base in dried specimens **3. *U. racemosa***

1. *Utania austromalayensis* Sugumaran

(Latin, *austro-* = southern; of the southern part of Peninsular Malaysia)

Pl. Ecol. Evol. 147 (2014) 215. **Type:** *Ridley 8453*, Singapore, Bidadari, April 1897 (holotype SING [SING0013355]; isotype K [K001273390]). **Fig. 5.**

Fagraea ligustrina auct. non Blume: Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114; King & Gamble (1908) 609, p.p.; Merrill, Bibliog. Enum. Born. Pl. [J. Straits Branch Roy. Asiat. Soc., Spec. No.] (1921) 492, p.p.; Ridley, Fl. Malay Penins. 2 (1923) 420, p.p.

Fagraea racemosa auct. non Jack ex Wall.: Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 311, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 215, p.p.

Small tree, c. 2 m tall. **Leaves** elliptic-ovate to elliptic-lanceolate, (4–)8–11 × (1.2–)3–4.8 cm, base cuneate to rounded, apex acuminate to short caudate, thin coriaceous, glabrous on both surfaces, midrib prominent below, sunken above, secondary veins 4–6 pairs, upper side

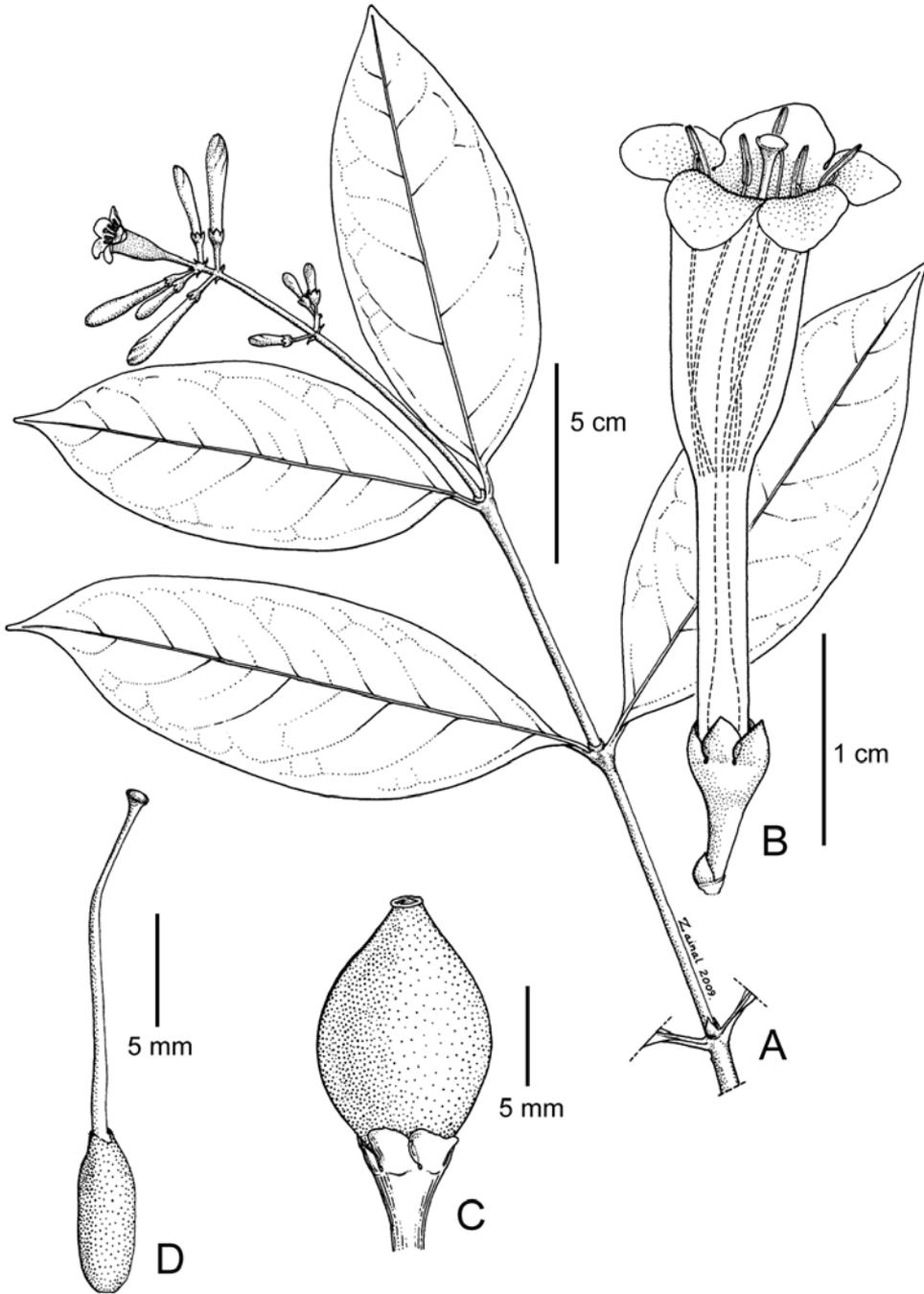


Figure 5. *Utania austromalayensis* Sugumarán. **A.** Flowering leafy branch. **B.** Flower. **C.** Fruit. **D.** Gynoecium at floral stage. (From Singapore, Bidadari, *Ridley 8453*. Drawn by Zainal Mustafa and reproduced with permission of Plant Ecology & Evolution).

faint, lower side faint to slightly prominent, tertiary veins inconspicuous; petioles 8–15 mm long, 1–2 mm diam. **Inflorescence** terminal, a many-flowered panicle, 4–9 cm long, peduncle 2.5–6 cm long, 1–1.5 mm diam., rachis in the distal half of the flower-bearing part of the inflorescence not conspicuously thicker than the proximal part and the peduncle, clearly visible, branch tiers closely spaced (except sometimes the lowest two tiers well-spaced, (0.5–)1–2(–2.5) cm apart), the basal 1–2 branch tiers most branched, typically to 1–2 orders, more distal tiers hardly so; flower with pedicel 2–4 mm long, 1–1.5 mm diam. **Calyx** (from the base to the lobe apices) 3–4 mm long, glabrous, calyx cup 3–3.5 mm diam., calyx lobes erect and tightly clasping the corolla tube, 2–3 mm long, 2–2.5 mm wide, margins glabrous to sparsely minute-ciliate or apparently lacinate (the cilia or lacinia just c. 0.1 mm long). **Corolla** narrowly infundibular (the mouth less than to about 3 times the diameter of the lower narrowed part of the tube), white, lower subcylindrical part of the corolla tube 10–13 mm long, 2–3 mm diam., upper flared part of the tube slightly inflated, 10–12 mm long, 6–7 mm diam. at the top, corolla lobes broad-obovate to suborbicular, 2–3 mm long, 2.5–3 mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 15–16 mm long, slightly protruding to 5 mm from the corolla mouth in the open flowers, anthers 1.5–2 mm long, c. 1 mm wide, each theca somewhat ellipsoid. **Style** 20–28 mm long, not to slightly protruding to 3 mm from the corolla mouth; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive (sometimes resembling a somewhat peltate structure c. 1 mm diam.). **Infructescence** peduncle 2–6 cm long, 1–1.5 mm diam., rachis in the distal half of the fruit-bearing part of the infructescence not conspicuously thicker than the proximal part and the peduncle, clearly visible. **Fruit** when mature to 10–15 mm long, 5–8 mm diam., apex beaked, the base tightly clasped by the calyx lobes. **Seeds** usually slightly elongated, 1–1.2 mm long, 0.5–1 mm diam.

Distribution. Endemic to the southern half of Peninsular Malaysia (Johor, Pahang) and Singapore, uncommon. In Singapore previously recorded from Bidadari (*Ridley 8453*, Apr 1897, SING [SING0013355]), Changi (*Ridley 2783*, 1891, K, SING [SING0013350]) and Tampines (*Ridley 5962*, Feb 1894, SING [SING0013344]; *Goodenough 1650*, 17 Jun 1890, SING [SING0013349]).

Ecology. Tropical evergreen lowland rain forest understorey, on granitic and alluvial soils.

Provisional conservation assessment. Globally, Vulnerable to extinction due to its restricted distribution and reduced habitat from land use conversion. *Utania austromalayensis* is Nationally Extinct (NE) in Singapore as its known localities have been much transformed and there have been no recent collections.

2. *Utania nervosa* K.M.Wong & Sugumaran

(Latin, *nervosus* = nerved, with conspicuous nerves or veins; referring to the leaves)

Pl. Ecol. Evol. 147 (2014) 217. **Type:** *Lai LJ157*, Singapore, Pulau Ubin, 1997 (holotype SING [SING0008241, SING0008242 – i.e. a single specimen over two sheets]). **Fig. 6, 7, 8.**

Fagraea racemosa auct. non Jack ex Wall.: Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114; Ridley, Fl. Malay Penins. 2 (1923) 418, p.p.; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 311, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 215, p.p.

Small tree, usually 1–5 m tall, trunk to c. 6 cm diam., bark smooth to slightly fissured, grey-brown to dark brown. **Leaves** elliptic to elliptic-ovate, (13–)20–31(–40) × (6–)11–15(–18) cm, wide, base cuneate to subcordate, apex acuminate-short caudate, thick-coriaceous, lamina very often strongly bullate between the secondary veins when growing in hot open sites, glabrous on both surfaces, midrib prominent below, slightly sunken above, secondary veins 10–16 pairs, upper side faint, lower side prominent, tertiary veins faint, petioles 5–12 mm long, 4–7 mm diam. **Inflorescence** terminal, a many-flowered panicle, (3.5–)4–8(–10) cm long, peduncle 0.8–1(–2) cm long, robust when mature, 5–6(–7) mm diam. (but less than 3 mm diam. in young stages), rachis in the distal half of the flower-bearing part of the inflorescence not conspicuously thicker than the proximal part and the peduncle, typically obscured from view by densely crowded flowers, branch tiers very closely spaced (except sometimes the lowest two tiers well-spaced, 0.5–1 cm apart), the basal 1–2 branch tiers most branched, typically to 3(–4) orders, more distal tiers hardly so; flower with pedicel 2–3 mm long, 2–3 mm diam. **Calyx** (from the base to the lobe apices) 5–7 mm long, glabrous, calyx cup 4–6 mm diam., calyx lobes erect and tightly clasping the corolla tube, 3–4 mm long, 3–5 mm wide, margins glabrous. **Corolla** broadly infundibular (the mouth more than 3–4 times the diameter of the lower narrowed part of the tube), creamy yellow to white, lower subcylindrical part of the corolla tube 10–15 mm long, 3–4 mm diam., upper flared part of the tube slightly inflated, 10–15 mm long, 13–18 mm diam. at the top, corolla lobes broad-obovate to suborbicular, 7–10 mm long, 5–8 mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 7–15 mm long, not protruding from the corolla mouth, anthers 3–4 mm long, 1–2 mm wide, each theca somewhat ellipsoid, style 20–25 mm long, not to slightly protruding c. 1 mm from the corolla mouth; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive (sometimes resembling a somewhat peltate structure 1–1.5 mm diam.). **Infructescence** peduncle 0.5–1.6 cm long, 4–8 mm diam.; rachis in the distal half of the fruit-bearing part of the infructescence not conspicuously thicker than the proximal part and the peduncle, typically obscured from view by the very closely spaced fruiting tiers. **Fruit** apex beaked, smooth, when mature to 14–18 mm long, 8–13 mm diam., the base tightly clasped by the calyx lobes. **Seeds** 1.5–2 mm long, 0.5–1 mm diam.

Distribution. Confined to the southern part of Peninsular Malaysia (S and SE Johor) and Singapore. In Singapore good populations are still intact on Pulau Tekong (*Gwee et al. SING2007-225*, 2 Mar 2007, SING [SING0096344]), Pulau Tekong Kechil (*Gwee et al. 23*, 29 Nov 2002, SING [SING0042795]) and Pulau Ubin (*Goodenough 1146*, 17 Jun 1890, SING [SING0013341]; *Ali Ibrahim & Lioe SING2012-316*, 12 Jun 2012, SING [SING0179374]) and more recently it has been recorded at MacRitchie (*Thomas & Niissalo DCT 1201*, 17 Aug 2015, SING).

Ecology. Tropical freshwater swamp forest and dryland tropical evergreen lowland forest, in forest understorey and fringes, on alluvial soils. The flowers are fragrant. In the rain forest,

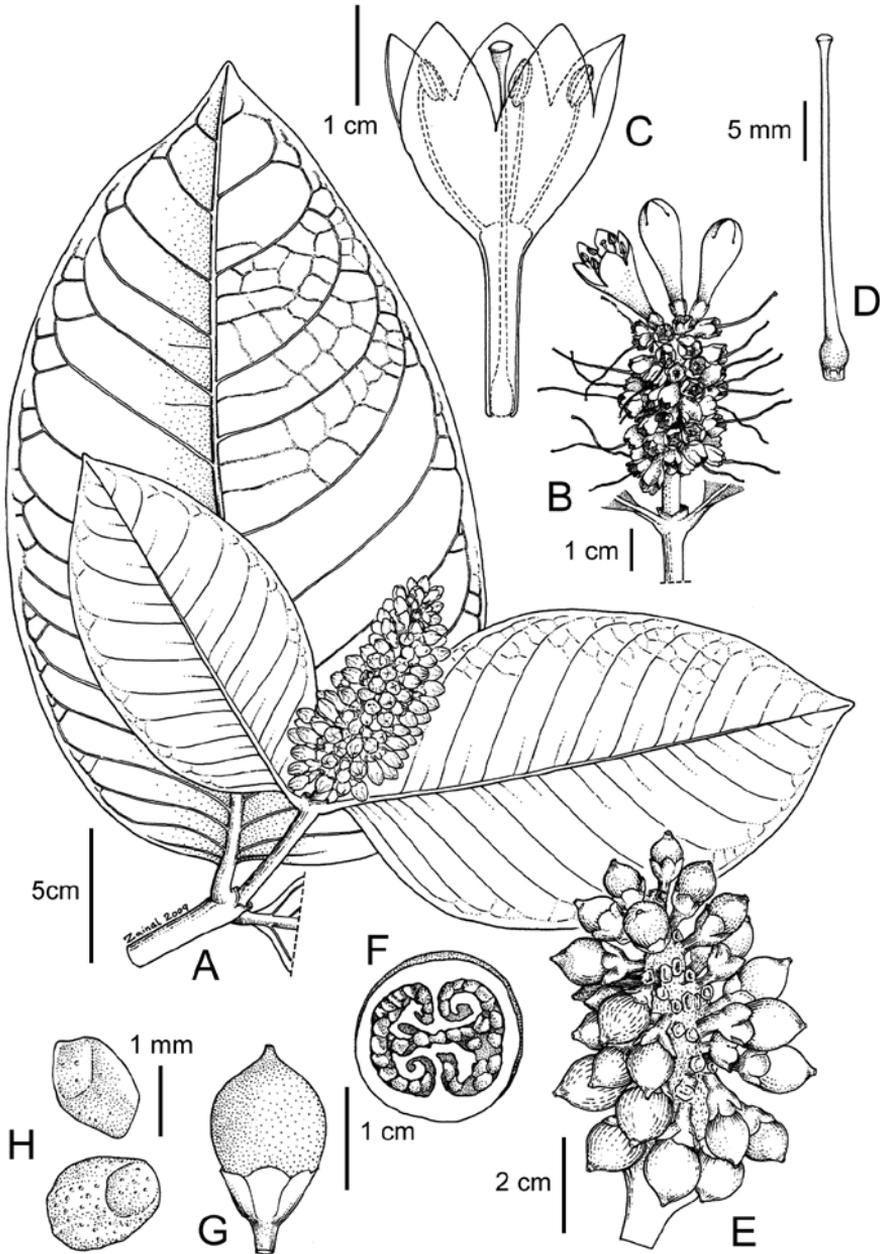


Figure 6. *Utania nervosa* K.M.Wong & Sugumaran. **A.** Leafy branch with an inflorescence. **B.** Inflorescence. **C.** Flower. **D.** Gynoecium. **E.** Inflorescence. **F.** Transverse section through mature fruit. **G.** Fruit. **H.** seeds. (A–D from Singapore, Pulau Ubin, *Lai LJ 157*; E–H from Peninsular Malaysia, *Sugumaran et al. SM 201*. Drawn by Zainal Mustafa, reproduced with permission of Plant Ecology & Evolution).



Figure 7. *Utania nervosa* K.M.Wong & Sugumaran. (From Singapore, Pulau Ubin. Photo: J. Lai)



Figure 8. *Utania nervosa* K.M.Wong & Sugumaran. **A.** Leaves arranged distichously along a branch, strongly veined. **B.** Inflorescence at bud stage. **C.** Inflorescence with open flowers. **D.** Infructescence. (From Singapore, Pulau Ubin. Photos: A, B, D, W.F. Ang; C, J. Lai).

ants visit the inflorescences and infructescences and sometimes form cartons in the tight spaces among flowers and fruits.

Provisional conservation assessment. Globally, Vulnerable to extinction, as outside of Singapore, the highly localised populations are threatened by habitat changes including agricultural development. In Singapore the population size is unknown but small. Assuming fewer than 1000 individuals it is assessed as Vulnerable (VU/D).

3. *Utania racemosa* (Jack ex Wall.) Sugumaran

(Latin, *racemosus* = racemous, with flowers in racemes; referring to the inflorescences resembling racemes)

Pl. Ecol. Evol. 147 (2014) 220. **Basionym:** *Fagraea racemosa* Jack ex Wall. in Roxburgh, Fl. Ind. 2 (1824) 35; Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 311, p.p.; Wong & Sugau, Sandakania 8 (1996) 37. **Type:** *Jack s.n.* [EIC 1601.1], [Malaysia], Penang (lectotype K-W [K001113564] designated here; isolectotypes A [A00076007], BM [BM001014304]).

Fagraea racemosa (Jack ex Wall.) Sugumaran var. *grandis* A.DC., Prodr. 9 (1845) 29. **Type:** *Porter s.n.* [EIC 1601.2], [Malaysia], Penang (lectotype K [K001113565], designated here; possible isolectotypes BM [BM001014305], G-DC [G00368220]).

Small tree, usually to 3–4 m (occasionally to 15 m) tall, trunk to c. 18 cm diam., bark smooth to slightly flaky or fissured, grey-brown to dark brown. **Leaves** elliptic-ovate to elliptic-lanceolate, (6–)13–25(–30) × (4–)6–13 (–20) cm, base cuneate to rounded, apex acuminate-short caudate, coriaceous, often bullate when growing in hot open sites, glabrous on both surfaces, midrib prominent below, sunken above, secondary veins 5–7 pairs, upper side faint, lower side prominent, tertiary and higher-order veins distinct to faint but always visible in dried specimens; petioles 5–12 mm long, 2–5 mm diam. **Inflorescence** terminal, a many-flowered panicle, 8–9 cm long, peduncle 5.5–6 cm long, 2–3 mm diam., rachis in the distal half of the flower-bearing part of the inflorescence distinctly thicker than the proximal part and the peduncle, typically obscured from view by the very closely spaced flowers, branch tiers very closely spaced (except sometimes the lowest two tiers well-spaced, 0.2–0.5 cm apart), the basal 1–2 branch tiers most branched, typically to (2–)3 orders, more distal tiers hardly so; flower with pedicel 3–4(–5) mm long, 2–2.5 mm diam. **Calyx** (from the base to the lobe apices) 4–6(–8) mm long, glabrous, calyx cup 4–6 mm diam., calyx lobes erect and tightly clasping the corolla tube, 2.5–4(–5) mm long, 2.5–4(–4.5) mm wide, margins glabrous to sparsely minute-ciliate or apparently lacinate (the cilia or lacinia just c. 0.1 mm long). **Corolla** broadly infundibular (the mouth more than 3–4 times the diameter of the lower narrowed part of the tube), cream to white, lower subcylindrical part of the corolla tube 6–9(–10) mm long, (2–)3–4(–5) mm diam., upper flared part of the tube slightly inflated, (4–)6–10(–12) mm long, 10–12(–17) mm diam. at the top, corolla lobes broad-obovate to suborbicular, 5–6(–11) mm long, 4–6(–10) mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 11–17(–20) mm long, slightly protruding to 6–8 mm from the corolla mouth, anthers 1.5–2 mm long, 0.5–1 mm wide, each theca somewhat ellipsoid. **Style** 15–20(–25)

mm long, slightly protruding to 3–5 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive (sometimes resembling a somewhat peltate structure 0.8–1.2 mm diam.). **Infructescence** peduncle (2.2–)3.5–7(–8.2) cm long, 2–3(–4) mm diam., rachis in the distal half of the fruit-bearing part of the infructescence distinctly thicker than the proximal part and the peduncle, typically obscured from view by the very closely spaced fruiting tiers above the basal 1–2 tiers. **Fruit** apex beaked, when mature to (7–)10–12(–15) mm long, (8–)9–10(–11) mm diam., the base tightly clasped by the calyx lobes. **Seeds** 1–1.2 mm long, 0.5–1 mm diam.

Distribution. Cambodia, southern Vietnam, Thailand, Peninsular Malaysia and Sumatra. In Singapore known only from a Pulau Ubin collection (*Lai SING2014-185*, 4 Jun 2014, SING [SING0205588]).

Ecology. Seasonal forest and tropical evergreen lowland rain forest, including secondary forest.

Provisional conservation assessment. Globally Least Concern (LC). In Singapore likely to be Critically Endangered (CR/D) as there are fewer than 50 mature individuals. Tan et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 2 (2008) 224) and Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 215) listed *Fagraea racemosa* as Endangered (EN/D) but were using the species concept of Leenhouts (Fl. Males., ser. 1, 6(2) (1962) 311) which was much wider, and that included a mixture of Singapore material now placed under *Utania aurtromalayensis*, *U. nervosa* and *U. volubilis* (below).

Notes. The Singapore collection has only a young inflorescence, so the above measurements are recorded from the rest of the distribution range.

4. *Utania volubilis* (Wall.) Sugumaran

(Latin, *volubilis* = twining, with climbing habit; probably owing to inference from the pendulous inflorescences that are common with climbing flowering plants)

in Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 493; Sugumaran & Wong, Pl. Ecol. Evol. 147(2) (2014) 221. **Basionym:** *Fagraea volubilis* Wall. in Roxburgh, Fl. Ind. 2 (1824) 36; Wong & Sugau, Sandakania 8 (1996) 40. **Type:** *Jack s.n.* [EIC 1600.1], [Indonesia], Sumatra, Bencoolen (lectotype K-W [K001113561], designated here). **Fig. 9.**

Kuhlia morindifolia Reinw., Syll. Pl. Nov. 2(1) (1825) 7; Bijdr. Fl. Ned. Ind., pt 14 (1826) 777. **Synonyms:** *Fagraea morindifolia* (Reinw.) Blume, Rumphia 2 (1838) 32, t. 73; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 114, as '*morindaefolia*'. – *Utania morindifolia* (Reinw.) G. Don, Gen. Hist. 4 (1838) 663, nom. inval. – *Kentia morindifolia* (Reinw.) Steud., Nomencl. Bot., ed. 2, 1 (1840) 845. **Type:** *Collector unknown s.n.* [Blume?], [Indonesia], Java (lectotype L [L0005046], designated by Wong & Sugumaran, Gard. Bull. Singapore 64 (2012) 493; isolectotypes K [K000883548], L [L0005047]).

Fagraea racemosa (Jack ex Wall.) Sugumaran var. *pauciflora* King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2) (1908) 609. **Synonym:** *Fagraea pauciflora* (King & Gamble) Ridl., Fl. Malay Penins. 2 (1923) 419, fig. 110. **Type:** *King's Collector 1926*, [Malaysia], Perak, Larut (lectotype SING [SING0052388], designated by Sugumaran & Wong, Pl. Ecol. Evol. 147 (2014) 221).

Fagraea racemosa auct. non Jack ex Wall.: Leenhouts, Fl. Males., ser. 1, 6(2) (1962) 311, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 140, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 41, 137, 215, p.p.

Small tree, usually to 2–4(–8) m tall, trunk to c. 6 cm diam., bark smooth to slightly fissured, grey-brown to dark brown. **Leaves** elliptic to elliptic-lanceolate, (8.5–)15–24(–26) × (3.8–)6–8(–10.6) cm, base cuneate to rounded, apex acuminate-short caudate, thin coriaceous, glabrous on both surfaces, midrib prominent below, sunken above, secondary veins 5–7 pairs, upper side faint, lower side prominent; tertiary veins faint; petioles 1–1.8(–2.2) cm long, (1.5–)2–3 mm diam. **Inflorescence** terminal, a many-flowered panicle, (3–)10–16(–22.8) cm long, peduncle (2–)3–5.5(–6.8) cm long, 1.5–2 mm diam., rachis in the distal half of the flower-bearing part of the inflorescence not conspicuously thicker than the proximal part and the peduncle, clearly visible, branch tiers well-spaced, (1.3–)2–2.8(–3.8) cm apart, the basal 1–2 branch tiers most branched, typically to 2(–3) orders, more distal tiers hardly so; flower with pedicel 2–4(–5) mm long, 1.5–2 mm diam. **Calyx** (from the base to the lobe apices) 4–6 mm long, glabrous, calyx cup 4–6(–7) mm diam., calyx lobes spreading out from the base of the corolla tube, 3–4 mm long, 3–4 mm wide, margins glabrous. **Corolla** broadly infundibular (the mouth more than 3–4 times the diameter of the lower narrowed part of the tube), cream to creamy-yellow, lower subcylindrical part of the corolla tube 7–10 mm long, 3.5–4 mm diam., upper flared part of the tube slightly inflated, 8–10(–15) mm long, 12–14(–16) mm diam. at the top, corolla lobes broad-obovate to suborbicular, 6–7(–10) mm long, 5–7(–8) mm wide. **Stamens** inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube, filaments 11–13 mm long, not or slightly protruding to 3 mm from the corolla mouth, anthers 1.8–2 mm long, 1–1.2 mm wide, each theca somewhat ellipsoid. **Style** 17–20 mm long, not or slightly protruding to 2 mm from the corolla mouth in the open flower; stigma shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive (sometimes resembling a somewhat peltate structure 1–1.2 mm diam.). **Infructescence** peduncle 4–6 cm long, 1.5–2 mm diam., rachis in the distal half of the fruit-bearing part of the infructescence not conspicuously thicker than the proximal part and the peduncle, clearly visible. **Fruit** apex beaked, when mature to 11–14 mm long, 9–11 mm diam., calyx lobes spread out and not clasping the base in dried materials. **Seeds** 1–1.2 mm long, 0.5–1 mm diam.

Distribution. Peninsular Malaysia (Johor, Kedah, Perak, Pahang), the Andaman and Nicobar Islands, Sumatra, Java, Borneo, Sulawesi, Moluccas, Philippines, New Guinea and the Solomon Islands, relatively common. In Singapore recorded from Bukit Mandai (*Ridley 8913*, 1897, SING [SING0013343]), Bukit Panjang (*Ridley 125471*, 1906, SING [SING0013354]), Bukit Timah (*Ridley 12434*, 1906, SING [SING0013358]), Kranji (*Ridley s.n.*, 1894, SING [SING0013357]) and Nee Soon (*Yeo et al. SING2012-189*, 12 May 2012, SING [SING0182096]).

Ecology. Tropical evergreen lowland rain forest, including secondary forest and forest fringes, on granitic, sandstone-derived, volcanic, limestone and alluvial soils.

Provisional conservation assessment. Globally, probably Vulnerable to extinction because of the reduction of habitat in lowland forest area generally. In Singapore it is likely to be

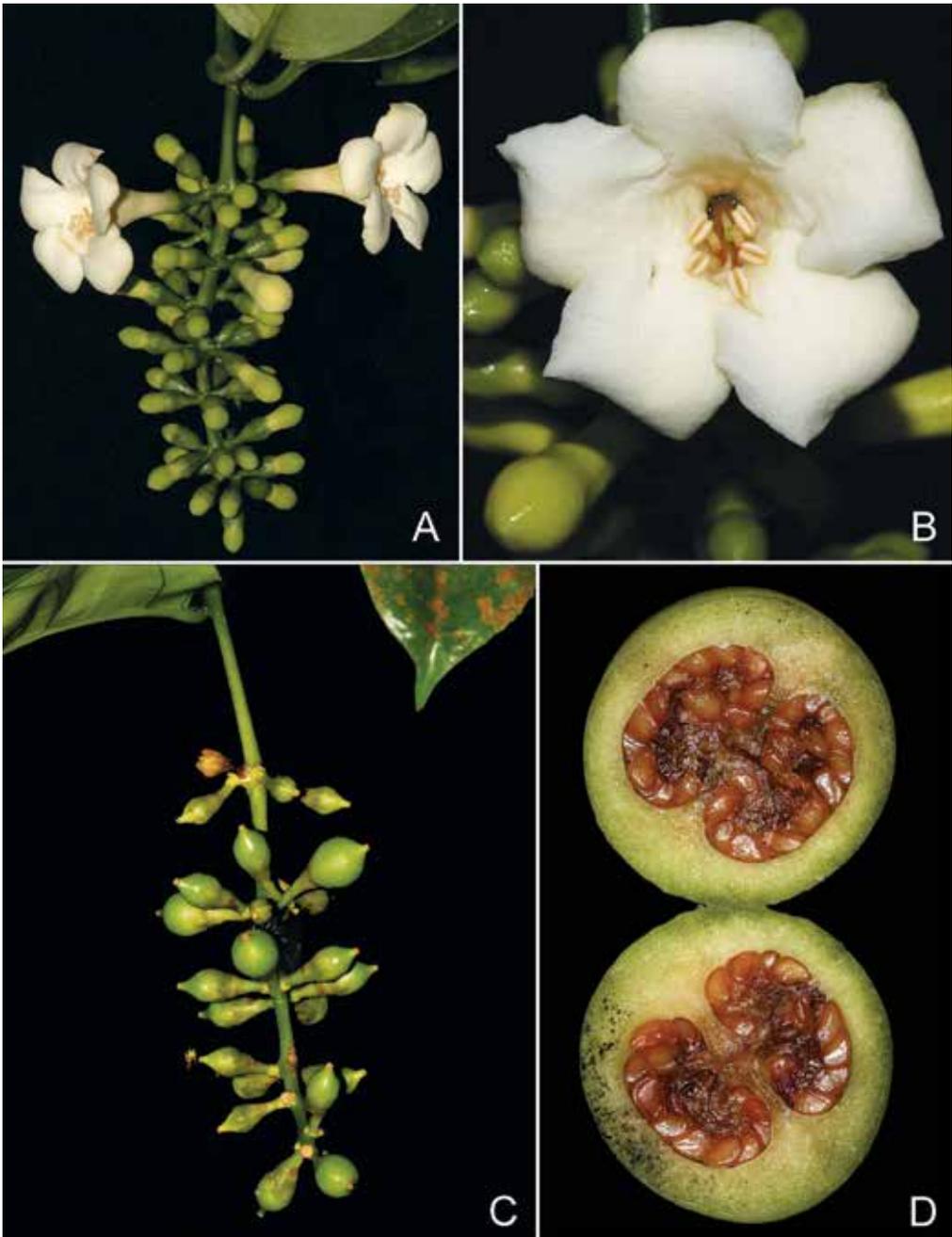


Figure 9. *Utania volubilis* (Wall.) Sugumaran. **A.** Inflorescence with open flowers. **B.** Corolla, view from above. **C.** Infructescence. **D.** Transversely sectioned fruit showing placentation and seeds. (From Singapore, Nee Soon, Ng & Teo SING2018-539. Photos: X.Y. Ng).

Endangered (EN/D) due to the historical reduction of habitat and the resulting low population of fewer than 250 individuals.

Taxonomy. *Utania volubilis* var. *microcalyx* (K.M.Wong & Sugau) K.M.Wong et al. (Wong et al., Gard. Bull. Singapore 65 (2013) 235), which can be distinguished from *U. volubilis* var. *volubilis* by its smaller calyx (4–5 mm long, 3.5–4.5 mm diam.), is only known so far from Borneo and the Moluccas. The epithet *volubilis* (Latin, twining) is somewhat unfortunate for this species, which has the habit of an erect shrub or tree; Wallich had assumed a climbing habit for this species probably because the long infructescence in Jack's Sumatran (Bencoolen) specimen resembles the pendulous blooms common in garden vines.