

ARISTOLOCHIACEAE

T.L. Yao

Juss., Gen. Pl. (1789) 72, as ‘Aristolochiae’, nom. cons.; Bentham & Hooker, Gen. Pl. 3(1) (1880) 121; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 72; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 23; Ridley, Fl. Malay Penins. 3 (1924) 14; Hutchinson, Fam. Fl. Pl., Dicot., ed. 2 (1959) 414; Backer & Bakhuizen van den Brink, Fl. Java (Spermatoph.) 1 (1964) 161; Keng, Ord. Fam. Malayan Seed Pl., ed. 3 (1983) 103; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 53; Phupathanaphong, Fl. Thailand 5(1) (1987) 1; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55; Huber in Kubitzki et al. (ed.), Fam. Gen. Vasc. Pl. 2 (1993) 129; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 5. **Type:** *Aristolochia* L.

Climbing undershrubs or shrubs, sometimes high lianas, or erect or scrambling herbs. **Stem** often slightly swollen at nodes. Hairs simple, short ones often hooked. **Stipules** absent. **Leaves** simple, alternate, petiolate, marcescent; lamina entire or lobed; venation often palmate or pinnate. **Inflorescence** cymose, racemose, rarely corymbose or flowers solitary, arising from terminal or axillary buds, or from various parts of stem; bracts present, often persistent. **Flowers** bisexual, radially (*Thottea*) or bilaterally (*Aristolochia*) symmetrical; demarcations of pedicel and ovary not distinct; perianth petaloid, with 3 (or elsewhere 6) valvate lobes, or 1(–2)-lipped. **Stamens** 6 (*Aristolochia*, fewer or more elsewhere) in one whorl or 24–42 (*Thottea*) in 1–2 whorls, with filaments or sessile; anthers free (*Thottea*) or dorsally united with style column (*Aristolochia*), each with 2 thecae with 4 pollen sacs, extrorse, longitudinally dehiscent. **Ovary** inferior, 4- (*Thottea*) or 6- (*Aristolochia*) locular, carpels free joined by styles, placentation parietal, ovules numerous, stigmatic lobes usually 6 in *Aristolochia* or 10–15 in *Thottea*. **Fruit:** capsules or siliquae, 4- or 6-valved, dehiscent from apex to base (*Thottea*) or base to apex (*Aristolochia*). **Seeds** many in each valve, horizontal or pendulous; ovoid, deltoid or flat, surface wrinkled (*Thottea*) or margin winged (*Aristolochia*); endosperm copious, oily, embryo small.

Distribution. A family of 5–12 genera (Brummitt in Heywood et al., Fl. Pl. Fam. World (2007) 44; Stevens, Angiosperm Phylogeny Website (2001 onwards)) and about 600 species in tropical and northern temperate regions. In Singapore, 2 genera and 4 species, of which 3 species are native and 1 is casual.

Ecology. In rain forests, temperate woodlands, open grassy places and dry Mediterranean-type vegetation. In Singapore, found in lowland rain forest and at forest margins. Species of both *Aristolochia* L. and *Thottea* Rottb. are food plants for larvae of birdwing butterflies (family Papilionidae). The butterflies lay their eggs on species of both genera and the larvae feed exclusively on them (Nishida et al., J. Chem. Ecol. 19 (1993) 1587), resulting in the leaves being perforated and the margins damaged. The flowers are generally adapted to fly pollination (see under each genus) and smell unpleasant. The pollination and dispersal ecology species

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of Aristolochiaceae have scarcely been studied in the Malesian region. See Yao (Fl. Penins. Malaysia, ser. 2, 5 (2015) 5–46) for more details on pollination and dispersal elsewhere.

Uses. Some *Aristolochia* species (chiefly American) with large showy flowers are planted as ornamentals. Several species in *Aristolochia* and *Thottea*, mainly the common ones, have been used in traditional medicines for various illnesses (Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 1 (1966) 189, 240; Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 2 (1966) 2195). More recent studies have confirmed that some chemical compounds, such as aristolochic acids, or their derivatives, and sesquiterpenes, are found in species of *Aristolochia* and *Thottea* (Kiew in de Padua et al. (ed.), Pl. Resources S.E. Asia 12(1) (1999) 135; Ong in van Valkenburg & Bunyaphrathasara (ed.), Pl. Resources S.E. Asia 12(2) (2001) 547). Aristolochic acids are nephrotoxic to humans and several animal species, and their strong mutagenic and carcinogenic activities are known from both in vitro and in vivo studies. Hence, restrictions are imposed on laboratory preparations containing aristolochic acids and a ban on aristolochic acids in traditional herbal preparations is also enforced in several countries.

Taxonomy. Aristolochiaceae is included in the order Piperales. Its division into two subfamilies, Aristolochioideae and Asaroideae, has been widely accepted (Brummitt in Heywood et al., Fl. Pl. Fam. World (2007) 44) although the Angiosperm Phylogeny Website (Stevens, Angiosperm Phylogeny Website (2001 onwards)) suggest that this classification needs to be revised in light of current understanding of relationships within the family. The two genera in Singapore, *Aristolochia* and *Thottea*, belong to the traditionally delimited subfamily Aristolochioideae. *Aristolochia* is placed in the tribe Aristolochieae and *Thottea* in tribe Bragantieae (Huber in Kubitzki et al. (ed.), Fam. Gen. Vasc. Pl. 2 (1993) 129).

Key to genera

1. Slender climbing or scrambling shrubs; flowers bilaterally symmetrical; stamens 6, always in 1 whorl; capsules 6-valved, oblong or sub-globose **1. *Aristolochia***
- Shrubs or undershrubs; flowers radially symmetrical; stamens 24–42 in 2 whorls; capsules 4-valved, slender **2. *Thottea***

1. ARISTOLOCHIA L.

(Greek, *aristos* = best, *locheia* = childbirth; due to its medicinal use in childbirth)

Sp. Pl. 2 (1753) 960; Duchartre in de Candolle, Prodr. 15(1) (1864) 432; Bentham & Hooker, Gen. Pl. 3(1) (1880) 123; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 74; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 29; Ridley, Fl. Malay Penins. 3 (1924) 17; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 83; Phuphathanaphong, Fl. Thailand 5(1) (1987) 1; Huber in Kubitzki et al. (ed.), Fam. Gen. Vasc. Pl. 2 (1993) 137; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 7. **Type:** *Aristolochia rotunda* L., lectotype designated by Britton & Brown, Ill. Fl. N. U.S., ed. 2, 1 (1913) 645.

Slender climbing shrub, sometimes high lianas; old stem bark corky, deeply fissured. **Leaves** with lamina entire or lobed, lower surface pubescent or glabrous. **Inflorescence** usually a few-flowered raceme (or flowers solitary but not in Singapore), produced in axils of foliage leaves and/or on bare stem, i.e. after leaves have fallen, sometimes close to base; bracts present. **Flowers** bilaterally symmetrical; perianth shape variable, usually curved (S-shaped), sometimes with a stipe between ovary and utricle, utricle globose or oblong or urn-shaped, narrowed into a slender cylindric tube topped with an oblique funnel-shaped or disc-shaped limb, often lobed; inside utricle with patches of glandular hairs; stamens 6 (rarely more elsewhere) in 1 whorl, adnate to and merged with style column to form a gynostemium; ovary 6-grooved, 6-loculed, stigmatic lobes 6. **Fruit**: capsules, 6-valved, oblong or sometimes subglobose, septicidally dehiscent from base to apex. **Seeds** horizontally arranged, flat, 3-angular in outline.

Distribution. A genus of about 400 species widely distributed in the tropics and subtropics and in some warm temperate regions. The genus is most diverse in the New World but is also found throughout Malesia. In Singapore, 2 species, 1 native and 1 casual.

Ecology. Found in primary and secondary forests, forest margins and thickets. The flowers are generally adapted to fly pollination and often smell of carrion or rotten fruit. Insects, mainly flies, are attracted to the smell and then venture further down into the utricle by the translucent window at the bottom. They get trapped within the utricle by stiff downward pointing hairs inside the perianth tube. The flowers are protogynous and the ripe stigmas are pollinated by in-coming insects carrying pollen. Secretory hairs, which form glandular bodies on the inner surface of the utricle, provide food to keep the trapped insects alive until the anthers mature and shed pollen. The hairs then wither allowing the insect to leave and, if it visits another flower, effect cross-pollination. This long-proposed pollination mechanism is supported by studies on the structure and biomechanics of *Aristolochia* trapping flower trichomes (Oelschlägel et al., New Phytol. 184 (2009) 988). The seeds are dispersed by wind. Some *Aristolochia* species are the food plants of Papilionidae butterflies (Igarashi & Fukuda, Life Histories Asian Butterflies 1 (1997) pl. 305: fig. 2 & 4).

Uses. In Southeast Asia, a decoction of the roots has been used to treat stomach and menstrual complaints, and as a febrifuge, and a poultice of the leaves is sometimes used to treat skin diseases (Kiew in de Padua et al. (ed.), Pl. Resources S.E. Asia 12(1) (1999) 133). Heinrich et al. (J. Ethnopharmacol. 125 (2009) 108–144) assessed the worldwide uses of *Aristolochia* species in local medicines over a concern about nephrotoxicity from aristolochic acids. Some tropical American species with showy flowers are planted as ornamentals, including in Singapore Botanic Gardens. They are readily distinguished from the native species by their large flowers and, in many cases, their sub-orbiculate, kidney-shaped or broadly ovate laminas.

Notes. Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 15, 113, 234) list the following species as only known in cultivation in Singapore: *Aristolochia acuminata* Lam., *A. elegans* Mast., *A. gigantea* Mart. & Zucc., *A. labiata* Willd. and *A. ringens* Vahl (but see *Aristolochia acuminata* below, now treated as casual in Singapore). *Aristolochia indica* L. has also been cultivated as a medicinal plant (*Nor s.n.*, 13 Jun 1943, SING [SING0201098]).

Key to *Aristolochia* species

1. Lamina entire, ovate; base deeply cordate and forming a pair of auricles **1. *A. acuminata***
 Lamina deeply 3-lobed, lobes widely spreading, W-shaped in outline; base truncate or cordate **2. *A. jackii***

1. *Aristolochia acuminata* Lam.

(Latin, *acuminatus* = tapered towards a narrow point; referring to the leaf apex)

Encycl. 1, fasc. 1 (1783) 254; Klotzsch, Monatsber. Königl. Preuss. Akad. Wiss. Berlin 1859 (1860) 596; Bosser, Adansonia, sér. 3, 19 (1997) 170; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 15, 113, 234; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 9, fig. 1: A, B, pl. 1: A, B; Lindsay et al., Gard. Bull. Singapore 74(Suppl. 1) (2022) 205. **Type:** *Commerson s.n.*, Isle de France [Mauritius], cultivé au Jardin de Mr Poivre (lectotype P-LA [P00381367], designated by Bosser, Adansonia, sér. 3, 19 (1997) 170; isolectotypes C [C10000296], P [P026239, P026240], P-JU [P00680187]). **Fig. 1.**

Aristolochia tagala Cham., Linnaea 7 (1832) 207, t. 5: fig. 3; Duchartre in de Candolle, Prodr. 15(1) (1864) 480; Gamble, J. Asiatic Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 30; Ridley, Fl. Malay Penins. 3 (1924) 18 (excl. fig. 136 = *A. indica*); Backer & Bakhuizen van den Brink, Fl. Java (Spermatoph.) 1 (1964) 163; Henderson, Malay. Wild Fls. Dicot., ed. 2 (1974) 421, fig. 381: A, B; Ding Hou, Blumea 29(1) (1983) 232; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 94, fig. 1: f; Phuphathanaphong, Fl. Thailand 5(1) (1987) 15, fig. 1: C, fig. 2: C, D, fig. 10, pl. 1: 1; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55, fig. 46.1: b; Kiew in de Padua et al. (ed.), Pl. Resources S.E. Asia 12(1) (1999) 138, fig. 1–3. **Type:** *Chamisso s.n.*, Romanzoff Expedition, Philippines, Luzon, Cavite Province (lectotype MPU [MPU018735], designated here).

Aristolochia roxburghiana Klotzsch, Monatsber. Königl. Preuss. Akad. Wiss. Berlin 1859 (1860) 596; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 75. **Type:** *Wallich s.n.* [EIC 2704A], Bengala inferior [India or Bangladesh] (lectotype K-W [K001116840], designated by Turner, Edinburgh J. Bot. 79-1911 (2022) 21).

Climbing shrub, sometimes climbing 20 m high to top of trees. **Stem** 2–4(–6) mm wide, surface furrowed, glabrous. **Leaves:** petiole twisted, 1.5–2.5 cm long, 1–2 mm wide, glabrous; lamina papery or sometimes membranous, ovate, not lobed, (8–)12–21 × 5–10.5 cm, base deeply cordate, auricles rounded, sinus 10–25 mm deep, 13–15 mm wide, margin entire, apex acute, lamina surface above smooth, glabrous, below pustulate, often with a scattering of black gland dots, glabrous, midrib above flat, below prominent, venation palmate-pinnate, lateral veins faint above, below distinct, palmate pairs 3, pinnate pairs 2, intercostal veins reticulate. **Inflorescences** in leaf axils or on bare nodes, solitary; peduncle once-branched, 1–1.5(–2.5) cm long, 1–1.5 mm wide, glabrous; bracts broadly ovate, 2–4 × 1–3 mm, puberulent or densely ciliate, base rounded, apex acute, venation distinct. **Flowers:** pedicel and ovary c. 15 mm long, ovary c. 1 mm wide, puberulent or pubescent, trichomes hooked; perianth dark purple-red, to 2.5 cm long, straight or curved, outer surface pubescent, with a stipe between ovary and utricle, 2–3 mm long, utricle globose, 3–5 mm diam., inner surface with 2 ellipsoid patches of woolly trichomes, tube 5–6 mm long, limb an oblique funnel, 2-lobed, front lobe obscure,

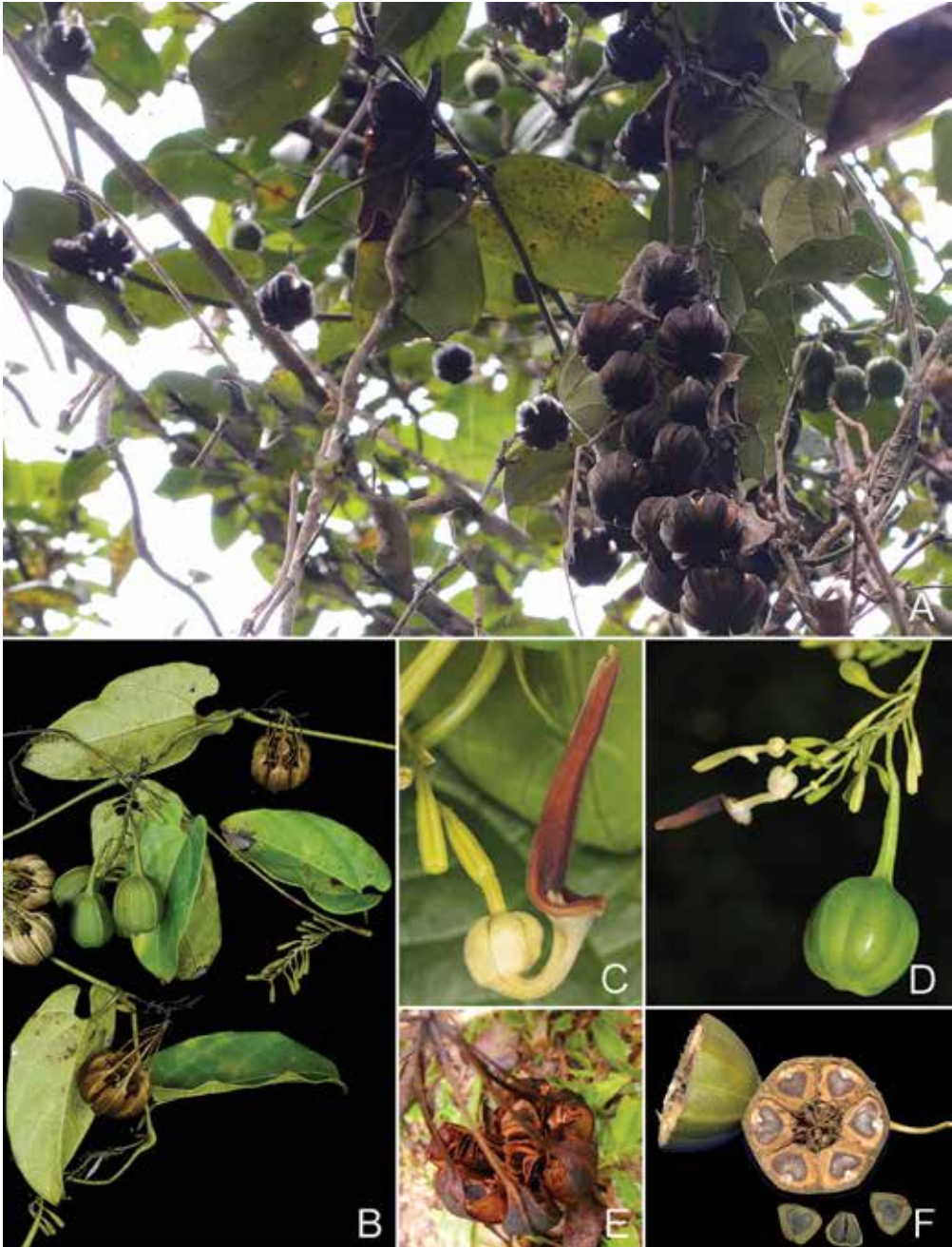


Figure 1. *Aristolochia acuminata* Lam. **A.** Habit. **B.** Portion of twig with leaves and infructescence. **C.** Flower in full bloom. **D.** Unripe capsule & flowers. **E.** Capsule septicidally dehiscent from base to apex. **F.** Unripe transversely sectioned capsule and seeds. (A–C & E, from Singapore, A, B & E, Singapore Botanic Gardens, *Leong SING2015-016*; C, HortPark; D & F from Peninsular Malaysia. Photos: A, B & E, P.K.F. Leong; C, W.F. Ang; D & F, T.L. Yao, reproduced with kind permission).

scarcely emarginate, rear lobe tongue-like, curved and sheltering the tube opening, c. 15 mm long, 3 mm wide, apex mucronate, venation distinct; gynostemium top view circular; stamens 6, anthers oblong, c. 1.2 mm long, c. 0.7 mm wide; stigmatic lobes 6, long conical, c. 2 mm long, apex blunt. **Capsules:** stalks 2.5–3.8 cm long, globose or oblong in outline, 2–2.5 cm long, 2–2.5 cm wide, surface smooth, green ripening brown. **Seeds** triangular-orbicular in outline, winged, 7–8 9–10 mm, upper surface warty, lower surface smooth.

Distribution. Madagascar, Mauritius, southern India, Sri Lanka, southern China, continental Southeast Asia, Malesia, northwestern Australia, tropical Queensland and South Pacific islands. In Singapore, this species was hitherto regarded as introduced and naturalised (Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55) or in cultivation only (Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 15, 113, 234) due to the absence of historic herbarium specimens collected from outside of Singapore Botanic Gardens. Within the Gardens it has been collected several times (*Mohd Nur s.n.*, 14 Apr 1921, SING [SING0001482; SING0001484]; *Furtado s.n.*, 10 Nov 1924, SING [SING0001483]; *Abu Kassim 119*, 17 Jan 1956, SINU [SING0351773]). A recent collection in Holland Woods (*Lua SING2018-981*, 4 Dec 2018, SING [SING0286305, SING0286306]) from a fallen starfruit tree indicates the species may be found in secondary forest regenerating from former village vegetation. Therefore, it is treated here as casual.

Ecology. At forest margins and in thickets. It is the food plant of a number of Papilionidae butterflies, such as the common rose (*Pachliopta aristolochiae asteris*), common birdwing (*Troides helena ceberus*) and Malayan birdwing (*Troides amphrysus ruficollis*) (Khew, Field Guide Butterflies Singapore (2010)).

Conservation assessment. Globally, not assessed. Not native in Singapore.

Uses. A poultice made from the leaves has been used to treat fever (Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 1 (1966) 241). It is cultivated to attract and breed birdwing butterflies.

Vernacular names. *Akar ketola hutan*, *Dutchman's pipe*, *Indian birthwort* (NParks' Flora & Fauna Web, 2026).

2. *Aristolochia jackii* Steud.

(William Jack, 1795–1822, Scottish surgeon and botanist
with the British East India Company)

Nomencl. Bot., ed. 2, 1, (1840) 132; Ding Hou, Blumea 29(1) (1983) 230; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 88, fig. 9; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55, fig. 46.1: a (as *A. unguilifolia*); Turner, Gard. Bull. Singapore 45 (1993) 42; Turner, Gard. Bull. Singapore 47 (1997 ['1995']) 136; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 15, 113, 187; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 13; Lindsay et al., Gard. Bull. Singapore 74(Suppl. 1) (2022) 205. **Synonym:** *Aristolochia hastata* Jack, Malayan Misc. 2(7) (1822) 6, nom. illeg. non Kunth (1817), nec Nuttall (1818). **Type:** *Lörzing 17293*, Indonesia, North Sumatra, Medan, 21 June 1937 (neotype L [L.1661674], designated here). **Fig. 2, 3.**

Aristolochia unguifolia Mast., J. Linn. Soc., Bot. 14 (1875) 494; Masters, Gard. Chron., n.s. 14 (1880) 116, fig. 28; Hooker, Bot. Mag. 121 [ser. 3, 51] (1895) t. 7424; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 126; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 30; Ridley, Fl. Malay Penins. 3 (1924) 18; Henderson, Malay. Wild Fls, Dicot. (1959) 422; Henderson, Malay. Wild Fls, Dicot., ed. 2 (1974) 421, fig. 381: C; Keng, Gard. Bull. Singapore 28(2) (1976) 254; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) fig. 46.1: a. **Type:** *Motley* 233, Borneo, Labuan Island (lectotype K [K000820376], designated by Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 13).

Climbing or scandent shrub. **Stem** 3–4 mm wide, surface shallowly furrowed, glabrous. **Leaves:** petiole twisted, 4–5 cm long, 1–1.5 mm wide, glabrous; lamina membranous, deeply 3-lobed, lobes widely spreading, W-shaped in outline, c. 20 × 22 cm, base truncate or cordate, sinus between lobes c. 4 cm deep, 6–7.5 cm wide, mid-lobe c. 14.5 cm long, c. 6.5 cm wide, apex acute, side lobes c. 8.5 cm long, c. 5 cm wide, apex rounded, lamina surface above smooth, below pustulate, glabrous, midrib above distinct, below prominent, venation palmate-pinnate, lateral veins above faint, below distinct, palmate pairs 3, pinnate pair 1, intercostal veins distinct, a mix of scalariform and reticulate, scalariform veinlets more pronounced. **Inflorescences** axillary, solitary; peduncle not branched, zig-zag, 3–4 cm long, c. 1.5 mm wide, glabrous; bracts broadly ovate, c. 1 × 1 mm, lax, margin ciliate, base rounded, apex blunt, venation obscure. **Flowers:** pedicel and ovary c. 15 mm long, ovary c. 1 mm wide, glabrous; perianth purple, 4–5 cm long, curved, outer surface glabrous, with a stipe between ovary and utricle, c. 2 mm long, utricle broadly oblong in outline, c. 15 mm long, c. 5 mm wide, tube c. 10 mm long, limb an oblique funnel, 2-lobed, front lobe rounded, rear lobe oblong, c. 15 mm long, c. 7 mm wide, at centre longitudinally grooved, venation obscure; stamens 6, anthers oblong; stigmatic lobes 6, conical, apex blunt. **Capsules:** stalks c. 4 cm long, capsule oblong in outline, c. 2.5 cm long, c. 2 cm wide, surface smooth. **Seeds** triangular-orbicular in outline, 4–5 × 5–7 mm, upper surface slightly ridged at the centre, lower surface smooth except for a few warts,.

Distribution. Peninsular Malaysia, Sumatra, Java, Borneo, Philippines (Palawan) and probably New Guinea. In Singapore, known only from historical collections from Jurong (*Ridley* 5563, 1893, K [K000842572]; *Ridley* 5836, 1893, SING [SING0003871]).

Ecology. In Singapore, formerly found in swamps, growing over long wet grass.

Conservation assessment. Globally, not assessed. In Singapore, assessed as Nationally Extinct (NEx) by Middleton et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 3 (2024) 472).

Notes. No fruiting specimens are known from Singapore. The description of the fruit and seeds is adapted from the *Flora of Peninsular Malaysia*.

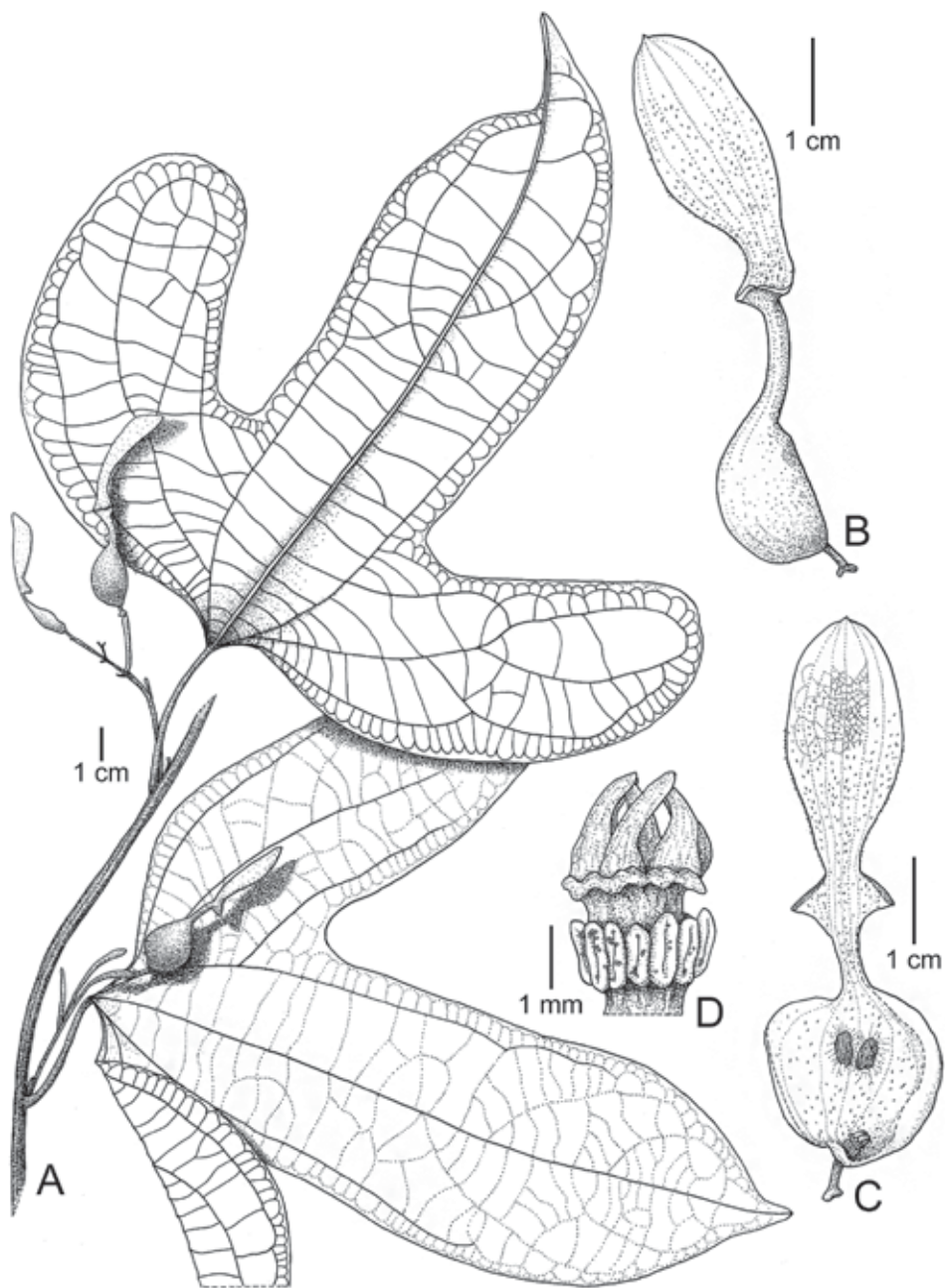


Figure 2. *Aristolochia jackii* Steud. **A.** Habit. **B.** Flower in full bloom. **C.** Flower with dissected perianth to show gynostemium and two patches of glandular hairs. **D.** Gynostemium. (A–D from Singapore, Jurong, Ridley 5836. Drawn by E. Tay-Koh).



Figure 3. *Aristolochia jackii* Steud. **A.** Portion of twig with leaves and inflorescence. **B.** Inflorescence. **C.** Flower in full bloom. (A–C from Singapore, A, Singapore Botanic Gardens, *Williams SING2015-020*; B & C, Pasir Panjang Nursery. Photos: A, P.K.F. Leong; B & C, W.F. Ang).

2. THOTTEA Rottb.

(Otto Thott, 1703–1785, Danish nobleman and patron of the University of Copenhagen)

Nye Saml. Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529; Miquel, Fl. Ned. Ind. 1(1), fasc. 7 (1858) 1068; Duchartre in de Candolle, Prodr. 15(1) (1864) 428; Bentham & Hooker, Gen. Pl. 3(1) (1880) 123; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 74; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 26; Ridley, Fl. Malay Penins. 3 (1924) 15; Henderson, Malay. Wild Fls, Dicot., ed. 2 (1974) 424; Ding Hou, Blumea 27 (1981) 303; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 65; Phupathanaphong, Fl. Thailand 5(1) (1987) 22; Huber in Kubitzki et al. (ed.), Fam. Gen. Vasc. Pl. 2 (1993) 135; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 16. **Type:** *Thottea grandiflora* Rottb.

Apama Lam., Encycl. 1, fasc. 1 (1783) 91; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 24; Ridley, Fl. Malay Penins. 3 (1924) 14; Henderson, Malay. Wild Fls, Dicot., ed. 2 (1974) 422. **Type:** *Apama siliquosa* Lam. (= *Thottea siliquosa* (Lam.) Ding Hou).

Bragantia Lour., Fl. Cochinch. 2 (1790) 528, nom. illeg. non Vand. (1771); Griffith, Trans. Linn. Soc. 19 (1845) 335; Miquel, Fl. Ned. Ind. 1(1), fasc. 7 (1858) 1067; Klotzsch, Monatsber. Königl. Preuss. Akad. Wiss. Berlin 1859 (1860) 589; Duchartre in de Candolle, Prodr. 15(1) (1864) 429; Bentham & Hooker, Gen. Pl. 3(1) (1880) 122; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 72. **Type:** *Bragantia racemosa* Lour. (= *Thottea racemosa* (Lour.) Ding Hou).

Asiphonia Griff., Proc. Linn. Soc. London 1(22) (1844) 218; Griffith, Trans. Linn. Soc. 19 (1845) 333; Huber in Kubitzki et al. (ed.), Fam. Gen. Vasc. Pl. 2 (1993) 134. **Type:** *Asiphonia piperiformis* Griff. (= *Thottea piperiformis* (Griff.) Mabb.).

Lobbia Planch., London J. Bot. 6 (1847) 144; Miquel, Fl. Ned. Ind. 1(1), fasc. 7 (1858) 1068. **Type:** *Lobbia dependens* Planch. (= *Thottea dependens* (Planch.) Klotzsch).

Strakaea C.Presl, Abh. Königl. Böhm. Ges. Wiss., ser. 5, 6 (1851) 581; Presl, Epimel. Bot. (1851 [‘1849’]) 221. **Type:** *Strakaea melastomifolia* C.Presl (= *Thottea piperiformis* (Griff.) Mabb.).

Shrubs or undershrubs, erect or scrambling, rhizomatous, stems arising in tufts; plants generally pubescent or glabrous, indumentum usually a mix of straight and hooked hairs, the latter often shorter. **Stem** not branched or sometimes sparsely branched, usually erect and the top drooping (Troll’s model), rarely much branched and scrambling. **Leaves** on lower part of stem reduced to bract-like structures, foliage leaves petiolate; petiole grooved above; lamina glabrous above, beneath puberulent, pubescent or tomentose, venation palmate-pinnate or acrodromous-pinnate. **Inflorescence** a few-flowered raceme, cyme, or corymb, flowers rarely solitary, produced at stem base close to ground level or on lower part of stem at the nodes of fallen bract-like leaves, or axillary, rarely terminal; bracts usually opposite a flower, rarely in pairs. **Flowers** radially symmetrical, in bud usually triangular in top view; perianth bell-shaped or urn-shaped, 3-lobed, the base contracted into a cup or flat, lobes valvate; stamens 24–42 in 1 or 2 whorls, sometimes with a few inserted between the whorls, free or adnate to the style column; ovary 4-grooved, 4-locular, stigmatic lobes 10–15; ovules numerous. **Fruit:** capsules, 4-valved, slender, 5–22(–35) cm long, 3–10 mm wide, usually loculicidally dehiscent from apex to base. **Seeds** pendulous, ovoid or ellipsoid, in cross section triangular, testa surface pimply or wrinkled.

Distribution. A genus of about 45 species in India, Sri Lanka, Bangladesh, China (Hainan), Myanmar, Thailand, Vietnam, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, Sulawesi and the Philippines). In Singapore, 2 native species.

Ecology. Throughout range of the genus, in lowland to hill forests, rarely above 1000 m, sometimes persisting in gaps and disturbed sites, e.g., rubber estates. Growing as scattered individuals, occasionally locally abundant. The carrion-coloured flowers without apparent scent are possibly pollinated by flies or beetles. The flowers are protogynous, possibly to avoid self-pollination though self-pollination is also possible because more than one flower is open at a time. The fully ripe capsule splits from top to bottom. The seeds embedded in the central pith are likely to attract ground foraging birds. It is the food plant of a few species of Papilionidae butterflies (Igarashi & Fukuda, Life Histories Asian Butterflies 1 (1997) pl. 305: fig. 7–9; Igarashi & Fukuda, Life Histories Asian Butterflies 2 (2000) pl. 400: fig. 1).

Uses. *Thottea* species contain essential oils that are species specific (Ong in van Valkenburg & Bunyaphratharsa (ed.), Pl. Resources S.E. Asia 12(2) (2001) 547). These are mostly a mixture of monoterpenes with sesquiterpenes and/or phenylpropanoids. Saponins, triterpenes and steroids are found in *Thottea grandiflora*. Some common species are widely used by indigenous communities as traditional medicines (Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 2 (1966) 2195). Aristolochic acids or their derivatives display a range of pharmacological activities including antimicrobial, antitumor and immunomodulatory effects. Conversely, aristolochic acids are also known for their nephrotoxicity in humans and several animal species. Strong mutagenic and carcinogenic activities induced by aristolochic acids are known from both in vitro and in vivo studies (Ong in van Valkenburg & Bunyaphratharsa (ed.), Pl. Resources S.E. Asia 12(2) (2001) 547). *Thottea tomentosa* (Blume) Ding Hou is planted as a food plant for butterfly breeding.

Key to *Thottea* species

1. Lamina ovate, oblong, broadly lanceolate or oblanceolate, 15.5–34 × 9.5–17 cm, surface beneath pubescent, hairs conspicuous to the naked eye; inflorescence axillary or on lower part of stem at the nodes of fallen bract-like leaves well above ground level; perianth bell-shaped with three lobes less than half of perianth length; capsule villose **1. *T. grandiflora***
- Lamina oblong or lanceolate, 14–15(–18.5) × 4.5–5.5(–7) cm, surface beneath puberulent, hairs hardly visible to the naked eye; inflorescence at stem base close to ground level, sometimes also with younger inflorescences well above the base; perianth saucer-shaped, 3-lobed; capsule puberulent **2. *T. praetermissa***

1. *Thottea grandiflora* Rottb.

(Latin, *grandis* = large, *flos* = flower; with large flowers)

Nye Saml. Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529, t. 2; Griffith, Trans. Linn. Soc. 19(4) (1845) 325, t. 36; Griffith, Not. Pl. Asiat. 4 (1854) 346; Griffith, Icon. Pl. Asiat. 4 (1854) pl. 530, pl. 531; Miquel, Fl. Ned. Ind. 1(1), fasc. 7 (1858) 1068; Klotzsch, Monatsber. Königl. Preuss. Akad. Wiss. Berlin 1859 (1860) 589, 623, t. 1: fig. 3; Duchartre in de Candolle, Prodr. 15(1) (1864) 428; Hooker, Fl. Brit. India 5, fasc. 13 (1886) 74; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 127; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 27; Ridley, Fl. Malay Penins. 3 (1924) 16; Henderson, Malay. Wild Fls, Dicot. (1959) 424, p.p.; Henderson, Malay. Wild Fls, Dicot., ed. 2 (1974) 424, fig. 383; Keng, Gard. Bull. Singapore 28(2) (1976) 254; Ding Hou, Blumea 27 (1981) 311, 314, fig. 8–10, fig. 62; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 69, fig. 3; Phuphathanaphong, Fl. Thailand 5(1) (1987) 26, fig. 16; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55, fig. 46.2; Turner, Gard. Bull. Singapore 45 (1993) 42; Turner et al., Gard. Bull. Singapore 46(2) (1995 [‘1994’]) 12; Turner, Gard. Bull. Singapore 47 (1997 [‘1995’]) 137; Chew et al., Gard. Bull. Singapore 49(2) (1999 [‘1997’]) 173; Ong in van Valkenburg & Bunyaphratharsa (ed.), Pl. Resources S.E. Asia 12(2) (2001) 549; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 86, 113, 224; Turner & Chua, Checkl. Vasc. Pl. Sp. Bukit Timah Nat. Res. (2011) 13; Wong et al., Checkl. Pl. Sp. Nee Soon Swamp Forest (2013) 247, 310; Neo et al., Nat. Singapore 7 (2014) 101; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 23, pl. 3: C, D, pl. 4: A, B; Ho et al., Gard. Bull. Singapore 71(Suppl. 1) (2019) 73; Lindsay et al., Gard. Bull. Singapore 74(Suppl. 1) (2022) 205. **Type:** *Koenig s.n.*, [Malaysia], Malacca [Melaka] (lectotype C [C10012834], designated here; isolectotypes C [C10012832, C10012833], BM [BM000950666]). **Fig. 4.**

Shrub, 1–2 m tall. **Stem** stout, erect, scarcely branched, drooping at top, dark dirty-green, 5.5–9 mm diam., surface shallowly furrowed, densely pubescent; nodes swollen. **Leaves:** bract-like reduced leaves 3–5, foliage leaves 4–8 on one stem; petiole stout, 4–12(–20) mm long, 2–5 mm wide, densely pubescent; lamina leathery, dark green above, green beneath, drying brown, ovate, oblong, broadly lanceolate or oblanceolate, 15.5–34 × 9.5–17 cm, first foliage lamina distinctly smaller, narrowly ovate, 5.5–10 × 1.5–3.5 cm, base truncate, rounded or cordate, sometimes slightly unequal, margin entire, apex blunt or acute, indumentum beneath densely pubescent, midrib above distinct, below prominent, venation palmate-pinnate, above obscure, below prominent, basal pairs 2, upper basal pair up to half of the lamina length, pinnate pairs (5–)7–10, intercostal veins a mix of scalariform and reticulate veinlets, scalariform ones more pronounced. **Inflorescences** axillary or on lower part of stem at the nodes of fallen bract-like leaves well above ground level, solitary; peduncle branched, 1(–2) time(s), 4–7.5(–13) cm long, (3)–5–6 mm wide, pubescent or villous; bracts green, lanceolate, narrowly oblanceolate or narrowly ovate, 10–30 × 4–12 mm, densely pubescent or villous, apex acute, venation distinct. **Flowers** pendent; pedicel and ovary 2–4 cm long, ovary 2–3 mm wide, villous; perianth dark purple-red, venation distinct, veins white on outer surface, bell-shaped, base not contracted, 3-lobed, (5–)9–11.5(–14.5) cm long, (4–)7.5–11.5(–13) cm diam., outer surface pubescent, inner surface puberulent; perianth lobes less than half of perianth length, oblong, sometimes deltoid, 15–30(–65) × 20–30(–45) mm, apex rounded, blunt or acute; stamens 28–42 in 2 whorls, upper whorl with 12–18 stamens, lower whorl with 16–24 stamens; filaments c. 0.5 mm long, glabrous; anthers almost covering the whole connective, oblong, c. 2.2 mm long, c. 0.4 mm wide; style column cylindric, c. 4 mm long, glabrous; stigmatic lobes 10–15, positioned higher than stamens, 1.5–2 mm long, glabrous. **Capsules** usually pendent, sometimes erect, ripening brown, straight or sometimes curved, 4-angled, 8–15 cm long, 4–8



Figure 4. *Thottea grandiflora* Rottb. **A.** Stem with leaves and inflorescence. Inset (top): Perianth partially removed to show gynostemium. Inset (bottom): Front view of gynostemium showing stigmatic lobes and anthers. **B.** Habit. **C.** Flowers at different stages. **D.** A fully opened flower with recurved perianth lobes. **E.** Unripe capsule. **F.** Flowers and dehiscent capsule to the right. (A, A inset (top) & B–F from Singapore, MacRitchie, Leong *et al.* SING2019-1041; A inset (bottom), from Peninsular Malaysia. Photos: A, A inset (top), B–D & F, P.K.F. Leong; A inset (bottom), M.Y. Chew, reproduced with kind permission; E, W.F. Ang).

mm wide, villose, hairs dull yellow. **Seeds** ovoid, 3-angled, slightly ridged, margin corrugated, testa surface pimply, 4–4.5 × 2–2.5 mm, apex truncate, base rounded.

Distribution. Myanmar, Peninsular Thailand and Peninsular Malaysia. In Singapore, there are historical collections from Bukit Mandai (*Ridley* 178, Apr 1889, SING [SING0003880]), Bukit Timah (*Ridley* 3355, 19 Apr 1891, SING [SING0003878]) and several other places. More recent collections are from the Central Catchment (*Samsuri* SA980, 26 Apr 1974, SING [SING0003885]; *Chen et al.* SING2020-597, 29 Jan 2020, SING [SING0340862]) and Old Upper Thomson Road (*Ng et al.* SING2024-302, 19 Aug 2024, SING [SING0400508]).

Ecology. In forest, occasionally in freshwater swamp forest.

Conservation assessment. Globally, not assessed. In Singapore, assessed as Vulnerable (VU/D) by Middleton et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 3 (2024) 472).

Vernacular names. *Bunga semubut, geroboh, kerubut, seburut, sel-wohl, telinga kelawar* (NParks' Flora & Fauna Web, 2026).

Uses. A decoction of the roots is used to treat fever and shivers, as a tonic for women after childbirth, and to treat dysentery (Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 2 (1966) 2195).

2. *Thottea praetermissa* T.L. Yao

(Latin, *praetermissus* = overlooked; not previously recognised as a distinct species)

Blumea 58 (2013) 252, fig. 6, fig. 10: f; Yao, Fl. Penins. Malaysia, ser. 2, 5 (2015) 34, fig. 7, pl. 7: A, B; Lim et al., Fl. Singapore 1 (2019) 89; Lindsay et al., Gard. Bull. Singapore 74(Suppl. 1) (2022) 206. **Type:** *Anthony'samy* SA 917, Peninsular Malaysia, Melaka, Asahan, 24 August 1987 (holotype KEP [KEP192448]; isotype SING [SING0015180]). **Fig. 5, 6.**

Lobbia dependens auct. non Planch.: Miquel, Fl. Ned. Ind. 1(1), fasc. 7 (1858) 1068, p.p.

Thottea dependens auct. non (Planch.) Klotzsch: Hooker, Fl. Brit. India 5, fasc. 13 (1886) 74; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 127; Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 28, p.p.; Ridley, Fl. Malay Penins. 3 (1924) 16, p.p.; Burkill, Dict. Econ. Prod. Malay Penins. 2 (1935) 2156, p.p.; Keng, Gard. Bull. Singapore 28(2) (1976) 254; Ding Hou, Fl. Males., ser. 1, 10(1) (1984) 75, p.p.; Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. (1990) 55; Turner, Gard. Bull. Singapore 45 (1993) 42; Turner, Gard. Bull. Singapore 47 (1997 ['1995']) 137, p.p.; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 86, 113, 199.

Shrub, 0.4–0.55 m tall. **Stem** slender, erect, scarcely branched, drooping at top, dark dirty-green, 4–5 mm diam., surface smooth, densely puberulent; nodes swollen. **Leaves:** bract-like reduced leaves 4–5, foliage leaves 5–12 on one stem; petiole slender, (2–)5–7 mm long, 1–3 mm wide, puberulent; lamina thinly leathery, green above, pale green beneath, drying

brown, oblong or lanceolate, 14–15(–18.5) × 4.5–5.5(–7) cm, first foliage lamina sometimes distinctly smaller, narrowly lanceolate, c. 12.5 × 2.5 cm, base cuneate, margin entire, apex acute or shortly mucronate, indumentum beneath sparsely puberulent, midrib above distinct or sometimes sunken, below prominent, venation palmate-pinnate, distinct above and below, basal pairs 2, upper basal pair less than half the lamina length, sometimes more than half, pinnate pairs 5–7, intercostal veins a mix of scalariform and reticulate veinlets, scalariform ones more pronounced. **Inflorescences** at stem base close to ground level, sometimes also with younger inflorescences well above the base, solitary; peduncle not branched, 4.5–6.5(–10) cm long, 1–1.5 mm wide, densely pubescent; bracts narrowly ovate, c. 4 × 2 mm, densely pubescent, apex blunt or acute, venation obscure. **Flowers** erect; pedicel and ovary c. 2.2 cm long, ovary c. 1.8 mm wide, densely pubescent; perianth dull purple-red on outer surface, paler on inner surface, venation distinct, saucer-shaped, 3-lobed, base contracted into a shallow cup, c. 7 mm long, c. 25 mm diam., outer surface sparsely pubescent, inner surface sparsely puberulent, shallow cup at base c. 5 mm deep, c. 8 mm diam., inner surface pubescent; perianth lobes deltoid, spreading to reflexed, c. 10 × 17.5 mm, apex blunt or acute; stamens 24–30 in 2 whorls, upper whorl with 9–14 stamens, lower whorl with 15–16 stamens; filaments c. 1.5 mm long, glabrous; anthers positioned at the swollen connective apex, oblong, c. 1 mm long, c. 0.3 mm wide; style column disc-shaped, c. 2.3 mm long, glabrous; stigmatic lobes 11–13, some lobes bifurcate, positioned higher than stamens, c. 2.6 mm long, glabrous. **Capsules** pendent, ripening brown, twisted, 4-angled, c. 15 cm long, c. 4 mm wide, densely puberulent. **Seeds** ovoid, 3-angled, slightly ridged, margin corrugated, testa surface pimply, 2.3–2.6 × 4–4.3 mm, apex acute, base acute or rounded.

Distribution. Southern Peninsular Malaysia. In Singapore, known only with certainty from a few localities in the Western Catchment such as Sungei Morai [Murai Reservoir] (*Goodenough* 5570, 28 Mar 1893, SING [SING0003872]) and Pergam Marsh (*Lee et al.* SING2007-343, 25 Jun 2007, SING [SING0106386]; *Leong et al.* SING2007-367, 24 Jul 2007, KEP [KEP140012], SING [SING0093668]; *Gwee* SING2010-831, 22 Sep 2010, KEP, SING [SING0153571]). Ridley's record of *Thottea dependens* from Sungei Buloh (Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 127) is much more likely to be a record of *T. praetermissa* but no specimen of *Thottea dependens* or *T. praetermissa* from Sungei Buloh have been found.

Ecology. In Singapore, in lowland forest in heavily shaded undergrowth, on damp soil close to a freshwater swamp. The leaf size is variable: 'plants on higher slope tend to have smaller leaves than those on lower slope closer to the water body' (*Gwee* SING2010-831).

Conservation assessment. Globally, not assessed. In Singapore, assessed as Critically Endangered (CR/D) by Middleton et al. (in Davison et al. (ed.), Singapore Red Data Book, ed. 3 (2024) 472).

Notes. The first specimen of *Thottea praetermissa* was collected in Singapore by Goodenough (*Goodenough* 5570) in 1893 and it was included in *T. dependens* by Ridley (Fl. Malay Penins. 3 (1924) 16). Subsequent authors continued to recognise it as this species until *Thottea praetermissa* was described (Yao, *Blumea* 58 (2013) 252). True *Thottea dependens* does not occur in Singapore.

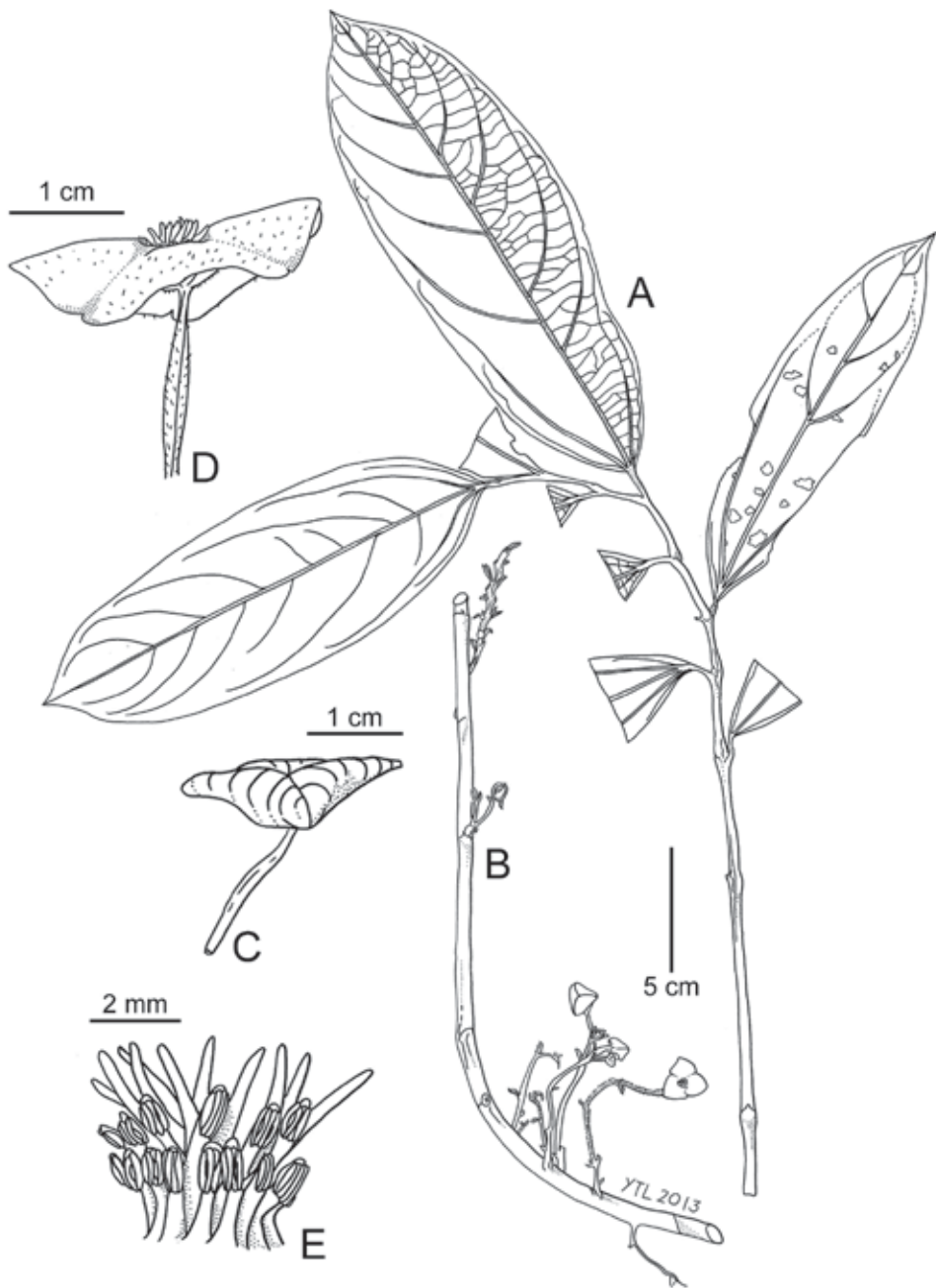


Figure 5. *Thottea praetermissa* T.L. Yao. **A.** Habit. **B.** Procumbent stem with mature inflorescences close to the base and younger inflorescences well above the base. **C.** Flower bud (side view). **D.** Flower (side view). **E.** Gynostemium. (A & B from Peninsular Malaysia, *Anthony samy SA917*; C–E from Singapore, Western Catchment, *Gwee et al. SING-MS 20*. Drawn by T.L. Yao, reproduced with permission from *Flora of Peninsular Malaysia*, ser. 2, 5 (2015) 35.



Figure 6. *Thottea praetermissa* T.L.Yao. **A.** Habit. **B.** Whole plant showing inflorescences at stem base. **C.** Flower (side view). **D.** Flower bud. **E.** Flower in full bloom. **F.** Capsule. (A–F, from Singapore, Western Catchment, *Leong et al. SING2009-348*. Photos: A, W.F. Ang; B–F, P.K.F. Leong).

The record of *Thottea dependens* from Singapore as cited by Hooker (Fl. Brit. India 5, fasc. 13 (1886) 74) and followed by subsequent authors (e.g., Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 75(1) (1912) 28) was based on two specimens: *Wallich s.n.* [EIC 6648B] (K [K000575918]) and *Lobb 289* (BM [BM000950665], E [E00317719, E00317720], K [K000575922, K000575923, K000575924]). *Wallich s.n.* [EIC 6648B] was actually collected from Penang. The locality of Lobb's specimens is dubious (van Steenis-Kruseman, Fl. Males., ser. 1, 1 (1950) 325; Middleton & Turner, Fl. Singapore 1 (2019) 32). Ridley (Fl. Malay Penins. 1 (1922) xvi) pointed out that some of Lobb's specimens '...labelled 'Singapore' were undoubtedly obtained in the Himalayas, but most are Penang plants'. *Lobb 289* was most probably collected from Penang where *Thottea dependens* is common.

Thottea praetermissa is now only known in Singapore from one extant colony in Pergam Marsh estimated to consist of fewer than 50 mature plants. Plants from this population have, however, been brought into cultivation to increase the number of individuals and have also been transplanted to another site to mitigate the chances of catastrophic loss.