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Towards a field guide to the trees of the Nee Soon Swamp Forest (III): Myristicaceae

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Abstract. This paper is the third instalment of a continuing series on the tree species of the floristically diverse Nee Soon Swamp Forest, Singapore's last substantial tract of intact freshwater swamp forest. Here, for the Myristicaceae, we provide a key and descriptions, based on characters easily observed in the field and when dried of *Gymnacranthera* (three species), *Horsfieldia* (seven species, with two varieties for *Horsfieldia polyspherula*), *Knema* (10 species, with two varieties for *Knema curtisii*), and *Myristica* (five species). *Horsfieldia tomentosa* is unlikely to occur in Singapore based on recent accounts. *Horsfieldia grandis* and *Horsfieldia superba* are new records for the Nee Soon Swamp Forest.

Key words. Myristicaceae, Nee Soon Swamp Forest, trees, field identification, new records

INTRODUCTION

The nutmeg family or Myristicaceae, which was named after the genus *Myristica*, has its Malay indigenous names derived from the word 'blood' or 'darah' (pendarah, chendarah, penarah, darahan, chendarahan, pendarahan, penarahan) because of its characteristic red sap, which is found generally in all species worldwide (Sinclair, 1958a). The Myristicaceae is a pantropical family with approximately 370 species worldwide and 19 genera with each being restricted to a single continent (Utteridge & Miliken, 2014). There are five genera in Asia, viz., *Endocomia*, *Gymnacranthera*, *Horsfieldia*, *Myristica*, and *Knema*, and all are found in Singapore. Family members range from being shrubs to large trees but most are understorey trees (Whitmore, 1972). The four genera—*Gymnacranthera*, *Horsfieldia*, *Myristica*, and *Knema*—found in Nee Soon Swamp Forest (NSSF) are dioecious, while *Endocomia*, which has only been recorded in the Bukit Timah Nature Reserve (BTNR), is monoecious.

Buttresses or stilt-roots are often found in species that grow in swampy areas. Branching is whorled and typically arranged horizontally around the trunk in tiers, like the spokes of wagon-wheels (Fig. 1). The crown is often pyramidal, with dense and dark green leaves (Whitmore, 1972; de Wilde, 2000a). The bark of Myristicaceae can be smooth, scaly, or fissured (Whitmore, 1972). Young twigs and leaves are generally hairy, becoming glabrous or remaining persistently hairy. Hairiness is good for species identification. The leaf arrangement is alternate and distichous but *Horsfieldia sucosa* has spirally arranged leaves. The leaves are exstipulate and the lamina is entire, and when fresh, its lower surface is waxy-white or pale green but that for *Horsfieldia crassifolia* is brownish, while that for *Myristica cinnamomea* is coppery. When dried, *Gymnacranthera*, *Knema* and some *Myristica* species generally have lower lamina surfaces that are waxy-white, while those for *Horsfieldia* and other *Myristica* species are brown. Within *Horsfieldia*, markings or dots on the lower lamina surface are characteristic of certain species, e.g., *Horsfieldia crassifolia*, *Horsfieldia punctatifolia*, *Horsfieldia sucosa* and *Horsfieldia wallichii*. The midrib and secondary veins of a dried lamina can be raised, flat, or sunken on the upper surface, but are always raised below. The tertiary venation of a dried lamina consists usually of widely spaced veins that are distinct or indistinct in family members, except for that of *Knema*, for which it is densely arranged and distinct on both lamina surfaces. Watery, spicy-smelling, red or pink sap is produced from bark incisions or cut surfaces of branches immediately or several minutes after the cuts are made (Figs. 2A, B). The flowers and fruits are similar across the four genera, consisting of either branching panicles or thick, short, woody knobs (*Knema*) bearing exclusively male or female flowers (LaFrankie. 2005). Female flowers then go on to form a single-seeded capsules. The fruit has a leathery, orange, yellow, or rusty-brown pericarp which splits into two halves to reveal a seed covered by a spicy-smelling, brightly coloured aril that is entire or divided to various depths (Figs. 3A, B). The endosperm of the seed is oily and ruminate (Fig. 3C). Characteristics of families with similar morphology and how to distinguish them from Myristicaceae members are shown in Table 1.

The most recent comprehensive revision of the Myristicaceae of Malesia was by de Wilde (2000a). Our identifications and descriptions, especially of tree height, bark, flowers, and fruits which we have not observed for all species, are therefore based on this account, supplemented by earlier regional family accounts (Sinclair, 1958a; Whitmore 1972; de Wilde 2000b) or Sinclair's generic accounts (1958b; 1961; 1968; 1975) for other missing characters.

Fig. 1. Wagon wheel spokes-like branching of a mature *Knema malayana* tree. This branching pattern may also be seen in saplings of most Myristicaceae species.

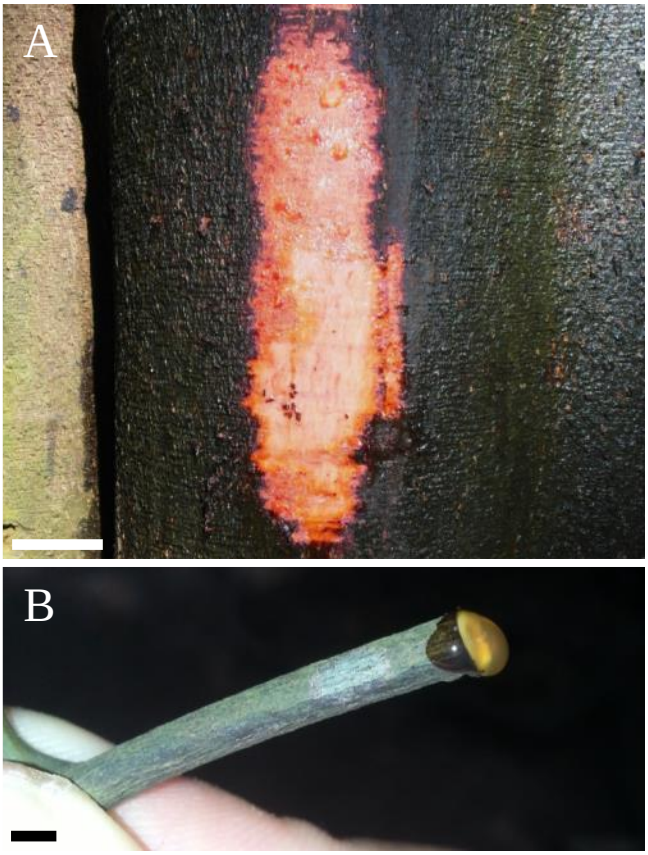

Fig. 2. Red sap from incisions or cuts. A, Scraped bark of *Knema malayana*. Scale bar = 2 cm. B, Sap flowing from cut of leafy twig of *Myristica cinnamomea.* Scale bar = 2 mm.

Fig. 3. Fruits and seeds of various Myristicaceae. A, Seeds, yellow divided aril covering seeds and pericarp of *Gymnacranthera farquhariana*. Scale bar = 1 cm. B, Open fruit and undivided aril covering seed of *Horsfieldia superba.* Scale bar = 2 cm. C, Cut seed showing ruminate endosperm of *Myristica elliptica.* Scale bar = 1 cm.

Table 1. Characteristics to distinguish families that are similar to the Myristicaceae (LaFrankie, 2010; Utteridge & Miliken, 2014).

Families with Similar Morphology to the Myristicaceae	Characters to Distinguish
Annonaceae	Red sap rarely present, twig bark with fishnet venation, flowers bisexual
Lauraceae	No red sap, base of petiole thickened, no wagon wheel branching
Clusiaceae	Latex yellow, red or orange; leaves opposite, fruit many-seeded
Ebenaceae	No red sap, leaf blades usually with glands, cross section not showing rays, fruit many-seeded
Magnoliaceae	No red sap, stipules present, flowers large with numerous tepals

Thirty-nine species from five genera have been recorded from Singapore, of which 36 species are native (Chong et al., 2009). Twenty-four species from four genera have been previously recorded from the Nee Soon catchment, including the former Chan Chu Kang Forest Reserve (Wong et al., 2013). One species that is listed to be found in the NSSF—*Horsfieldia tomentosa*—is not likely to be native to Singapore based on accounts by Sinclair (1975) and de Wilde (2000a). The single specimen of this species, collected from the NSSF in the Singapore Botanic Gardens Herbarium (SING)—*A. Samsuri NES33*—has been determined as *Horsfieldia grandis*, instead. *Horsfieldia grandis* and *Horsfieldia superba* have been collected in the course of surveying vegetation plots, hence these two species are new records for the NSSF, bringing the total number of Myristicaceae species here to 25. Most taxon names are those that are listed as accepted in The Plant List (2013), and where they are unresolved, the taxon name from de Wilde (2000a) was used as is indicated in the species description.

De Wilde (2000a) noted that "the genera of Myristicaceae can be told apart on vegetative characters only with experience, and flower, inflorescence, and fruit characters are necessary for a definite identification". The Myristicaceae are indeed difficult to identify in the field even to genus in many cases. A key to the genera and species based on sterile and dried specimens, and a separate key for dried fruit characters, are provided here. For fertile characters of all genera and species, de Wilde (2000a) provided a good key for Peninsular Malaysia and Singapore species. Measurements provided here are for dried characteristics, unless otherwise stated. Photographs of specimens collected from the NSSF when fresh are presented for most of the species, while SING specimens are shown for certain dried characters.

KEYS TO THE GENERA OF THE MYRISTICACEAE OF THE NEE SOON SWAMP FOREST

Key to genera based on dried, sterile characters

1. Lamina with dense and prominent tertiary venation, sometimes distinct only below. . ..... *Knema*
– Lamina with loosely spaced or indistinct tertiary venation, usually distinct only below. 2

2. Lamina waxy-white below, midrib never raised above. Twigs terete or flattened with two lines on each side running along length of the twig. Bark faintly striate or not at all, not lenticellate. ..... *Gymnacranthera*
– Lamina waxy-white or brownish below, midrib raised, flat or sunken above. Twigs terete, rarely flattened. Bark striate or rugose, rarely distinctly lenticellate. 3

3. Lamina brown below, with secondary veins never sunken above. ..... *Horsfieldia*
– Lamina waxy-white, coppery or brown below, if brown, with secondary veins sunken above. ..... *Myristica*

Key to genera based on dried, fruit characters

1. Aril divided to or almost to the proximal end. 2
– Aril entire or shallowly divided at the distal end. 3

2. Fruit 1.5–3 cm long; pericarp ≤5 mm thick. Seed ≤1 cm long. ..... *Gymnacranthera*
– Fruit 1.5–8 cm long; pericarp usually ≥1 cm thick. Seed ≥1 cm long. . ..... *Myristica*

3. Pericarp distinctly hairy. ..... *Knema*
– Pericarp mostly glabrous. . ..... *Horsfieldia*

GYMNACRANTHERA (A.DC.) Warb

(Greek *gumnos*, exposed; *akron*, apical; *anther*, stamen; for the exposed stamens of the distal end of the flowers)

Key references: de Wilde (2000a: 40), de Wilde (2000b: 343–344)

Trees. **Twigs** when mature sometimes flattened, lenticellate, with *faintly striate or flaky bark*. **Leaves** each with a lamina that is *glaucous below*, without dots, with *midrib never raised above*, *tertiary venation loosely spaced* and faint, apex acute-acuminate. **Inflorescence** paniculate. **Flowers** with hairy perianths, when fresh yellow on the outside and

never red on the inside; males have more flowers than females. **Fruit** c. 3 cm long. **Seed** with *aril divided to the proximal end*.

Key to species based on dried sterile characters

1. Lamina 18–42 cm long, with distinct, dense, rusty hairs, always glossy above, usually coriaceous. .... *Gymnacranthera bancana*
– Lamina ≤20 cm long, with short appressed hairs below, visible with a hand lens, sometimes glossy above, coriaceous or not. 2

2. Lamina usually ≥15 cm long, with secondary veins below usually distinctly darker than the lamina, usually subcoriaceous. Twigs at apex usually ≥2 mm across, 10 cm down ≤4 mm across. .... *Gymnacranthera forbesii* var. *forbesii*
– Lamina usually ≤15 cm long, with secondary veins below of a similar colour to the lamina, usually chartaceous. Twigs at apex c. 1 mm across, 10 cm down ≤2.5 mm across. ..... *Gymnacranthera farquhariana*

1. ***Gymnacranthera bancana*** (Miq.) J.Sinclair
(Latin for of Pulau Banca, now Bangka Island, Sumatra)

Key references: Whitmore (1972: 319–320), de Wilde (2000a: 41–43)

Tree to 40 m tall. **Bark** reddish-brown, smooth or finely cracked; inner bark dark red; sap dark red, not copious. **Twigs** greyish-brown, pustular, densely lenticellate, rusty woolly-tomentose, becoming glabrous with time. **Leaves** each with a lamina elliptic to lanceolate, *18–42 × 7.5–19 cm*, coriaceous, with 1–2-mm wide midrib that is flat or sunken above, 15–23 pairs of secondary veins that are prominent below, and tertiary veins that are indistinct above and below, when young *distinctly rusty brown* and covered with soft stellate hairs below, when older and fresh, duller above and becoming glabrous and glaucous-green below, when older and dried, *often glossy above*, *becoming glabrous with patches of dense, rusty hairs below*, margin often revolute, base short-attenuate to rounded; petiole late glabrescent. **Inflorescence** male 6–10 cm long, up to 6 cm wide, many-flowered; female 2–5 cm long, fewer-flowered. **Fruit** ellipsoid to oblong, 2.2–3.5 ×1.5–2.2 cm, rusty hairy, apex acute, sometimes hooked, 2–8 per infructescence; pericarp 3 mm thick. **Seed** yellowish brown, shiny. — Figs. 4–6.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also collected previously from the Central Catchment Nature Reserve (CCNR) (*J. Sinclair SF 40045)*, Sungei Bajau, and Murai Reservoir.

Habitats: Primary and degraded dryland forest, also swamp forest and on hillsides and ridges, on granite, sand

Conservation: Nationally Critically Endangered (Tan et al., 2008)

Suggested common name: Bangka gymnacranthera

Similar species: Its flowers resemble those of *Horsfieldia superba*, but the edges of the anthers are separate in *Gymnacranthera bancana* (Sinclair, 1958a). The leaves also resemble those of *Horsfieldia superba*, but that species has a harsh, persistent tomentum below, and the midrib is more raised above the lamina surface (Whitmore, 1972).

Fig. 4. *Gymnacranthera bancana*. A, Lower and upper surface of freshly fallen leaves collected from the NSSF. Scale bar = 2 cm. B, Patches of dense, rusty hairs on the lower surface of a dried lamina. Scale bar = 2 mm.

Fig. 5. *Gymnacranthera bancana*. A, The habit of a mature tree, with distinctly brown lower leaf surfaces. B, Intact and scraped bark. Note the lichens (left) and ants (mostly on the right).

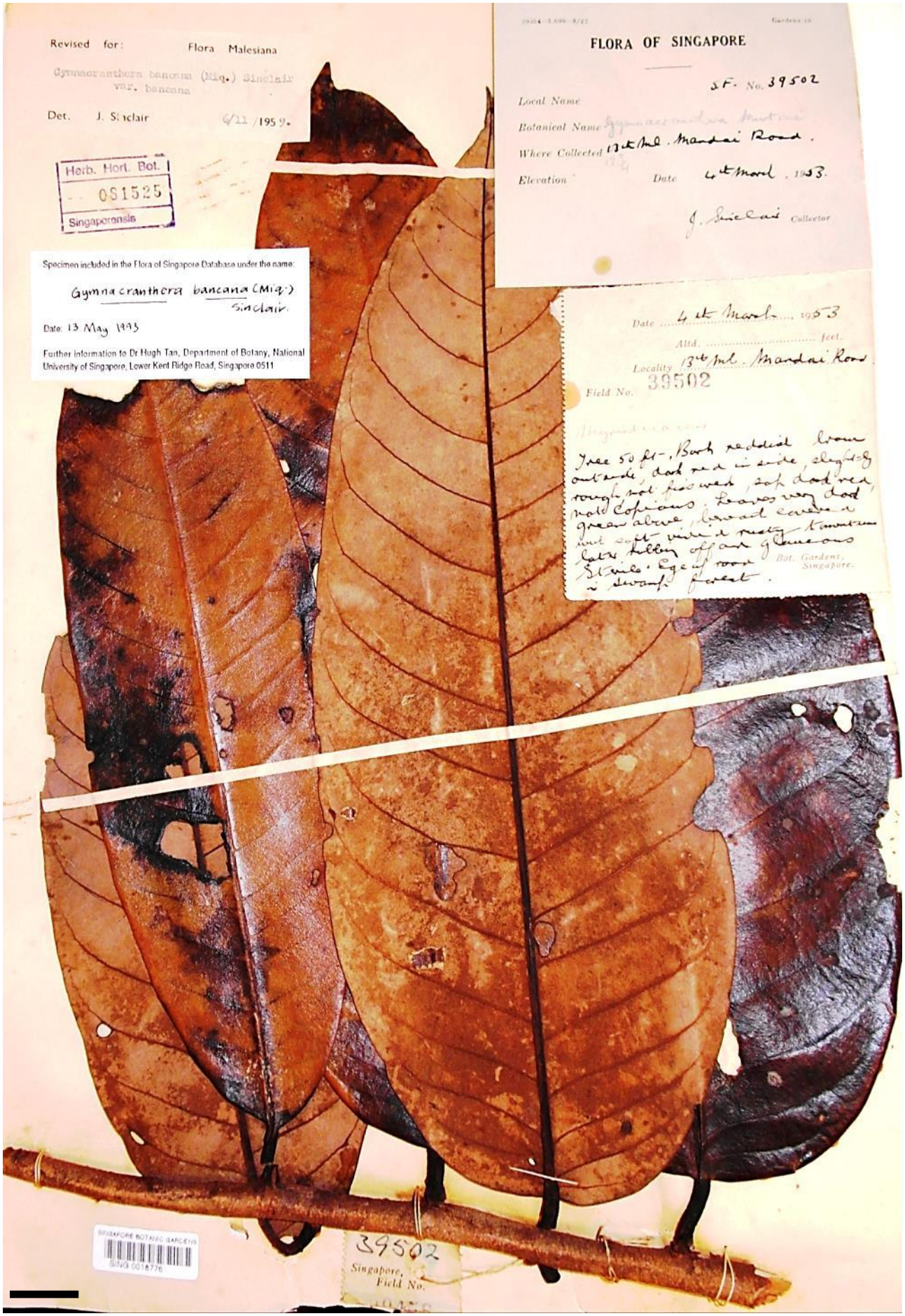

Fig. 5. *Gymnacranthera bancana*. Herbarium sheet specimen of a leafy twig, *J. Sinclair 39502*, Mandai Road, SING barcode no. 0018776. Scale bar = 2 cm.

2. ***Gymnacranthera farquhariana*** (Hook.f. & Thoms.) Warb.
(After William Farquhar, 1770–1839, a major in the British army, the first colonial resident of Singapore)

Key references: de Wilde (2000a: 44–45), de Wilde (2000b: 348)

Tree to 45 m tall. **Bark** brown or grey, slightly fissured and finely flaky or scaly; inner bark dark brown. **Twigs** grey-brown, *faintly angular, sometimes slightly ridged or lined when young*, about 1 mm across, later lenticellate, early glabrescent. **Leaves** each with a lamina drying *pale brown to grey-purplish below*, elliptic to lanceolate, *5–17 × 1.5–6 cm*, sometimes glossy above, sparse, appressed hairy below, becoming glabrous, with midrib 1 mm wide, above flat or sunken, below when fresh green or yellow, 7–15 pairs of secondary veins that flat or raised above, *of a similar colour to the lamina below*, and tertiary veins are indistinct on both surfaces, margin revolute when the lamina is coriaceous, base attenuate; petiole early glabrescent. **Inflorescence** male 2.5–12 cm long, up to 8 cm wide; female up to 4 cm long. **Fruit** subglobose to elliptic-oblong, 1.8–2.8 × 1.1–1.9 cm, becoming glabrous or remaining slightly pubescent, up to 13 per infructescence; pericarp 1 mm thick. **Seed** brown with light brown markings, shiny. — Figs. 3A, 7–8.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also collected previously from the BTNR, the CCNR, the Singapore Botanic Gardens, Sungei Bajau (*I. Ngadiman SF 36491*), and Woodlands.

Habitats: Primary and degraded forest, on dry land, hillsides, and ridges as well as in periodically wet places, near streams and rivers, found on limestone and on sandy soils. In the NSSF, this species was usually collected from wet forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as common in Peninsular Malaysia.

Suggested common name: Farquhar's gymnacranthera

Four varieties were recognized by de Wilde (2000a). Three varieties occur in the NSSF, viz., varieties *farquhariana*, *eugeniifolia*, and *zippeliana*. However, the varieties are very similar morphologically to each other, and not easily distinguished on the character states provided, so for this treatment we shall not provide their descriptions.

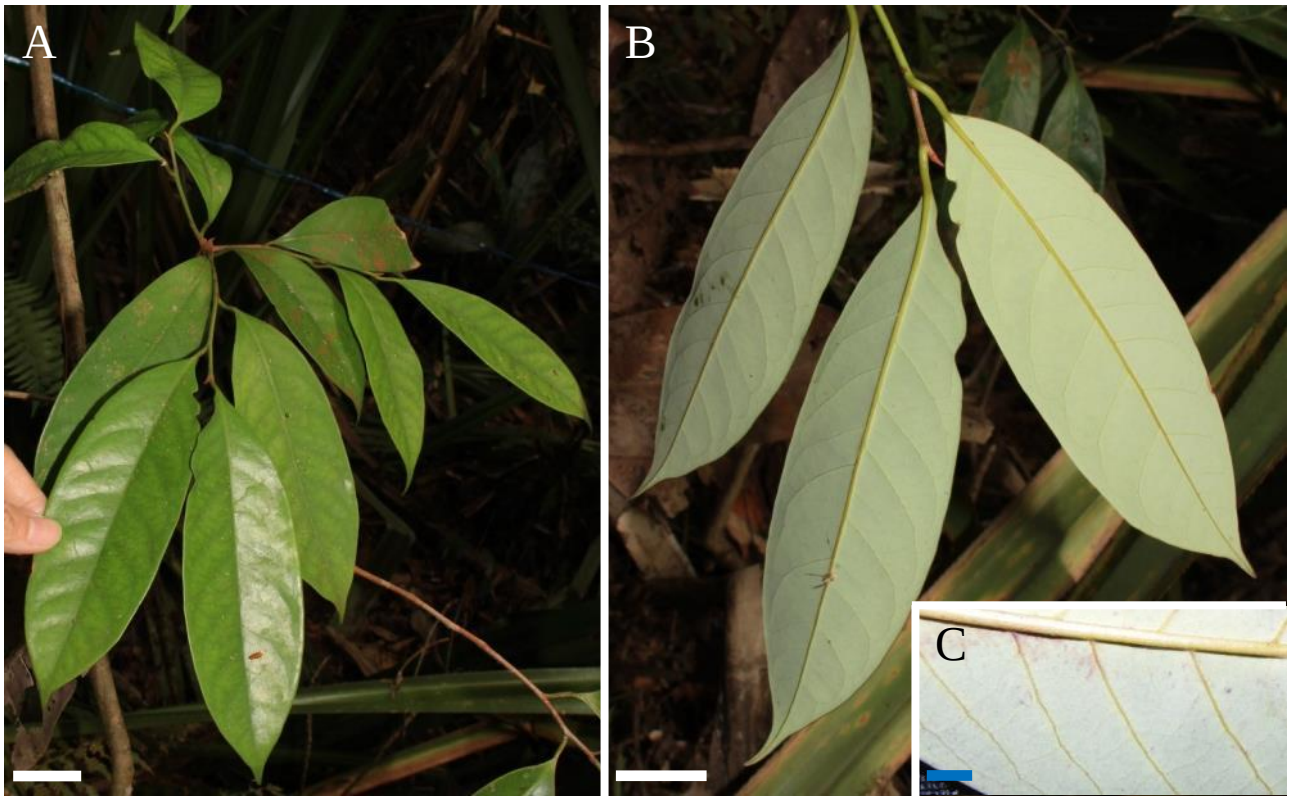

Fig. 7. *Gymnacranthera farquhariana.* A, Leafy twig showing upper leaf surface. Scale bar = 2 cm. B, Leafy twig showing lower leaf surface. Scale bar = 2 cm. C, Closeup of lower lamina surface with sparse, appressed hairs. Scale bar = 1 cm.

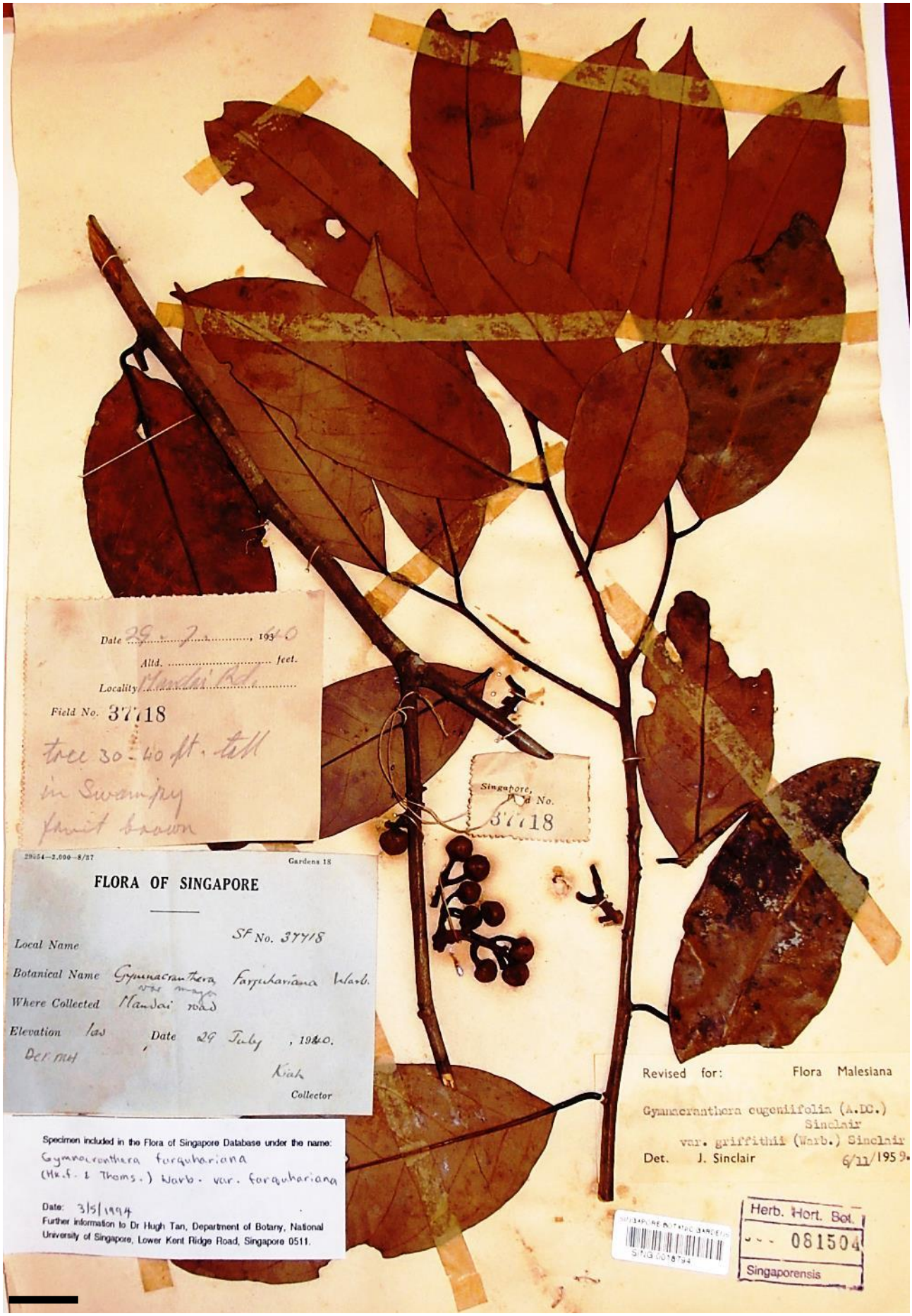

Fig. 8. *Gymnacranthera farquhariana*. Herbarium sheet specimen of fruiting and leafy twigs, *Kiah 37718*, Mandai Road, SING barcode no. 00187794. Scale bar = 2 cm.

3. ***Gymnacranthera forbesii*** (King) Warb. var. ***forbesii***
(After Henry Ogg Forbes, 1851–1932, a Scottish botanist)

Key references: Whitmore (1972: 320), de Wilde (2000a: 48–50)

Tree to 40 m tall. **Bark** greyish-brown, with large bumps, smooth or finely fissured; inner bark pink to red-brown, laminated, sometimes fibrous; slash wood white to pale yellow. **Twigs** *subterete to angular or ridged*, 2–5 mm across, finely cracked, lenticellate. **Leaves** each with a lamina drying greenish to brown above, grey purplish to brownish below, elliptic to oblong-lanceolate, broadest at or below the middle, 14–28 × 5.5–13 cm, *usually more than 20 cm long*, *usually subcoriaceous*, *coarsely undulate on drying*, sometimes glossy above, with midrib 1.5 mm wide, somewhat sunken above, *dark below green or brown below when fresh*, 10–18 pairs of secondary veins that are distinct below, with scattered, appressed, minute hairs, becoming glabrous with time, base short attenuate to broadly rounded. **Inflorescence** male 4–12 × 8 cm; female 1–4 × 1–3 cm. **Fruit** ripening brown green turning orange, ellipsoid, 2.5 × 1.5 cm, scurfy, 4–10 per infructescence. — Figs. 9–10.

Singapore localities: Nee Soon, Seletar Forest (*J. Sinclair SF 39539*) and "Selitar" (*H. N. Ridley 6270*). This species was also collected previously from the BTNR, other parts of the CCNR, and the Singapore Botanic Gardens.

Habitats: Primary and degraded forest; hillsides and riverbanks, alluvial forest; on sandy and limestone-derived soils. In the NSSF, this species was usually collected from wet forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as common throughout Peninsular Malaysia.

Suggested common name: Forbes' gymnacranthera

Remarks: Two varieties of *Gymnacranthera forbesii* are recognized by de Wilde (2000a), but only *Gymnacranthera forbesii* var. *forbesii* is recorded to occur in Singapore.

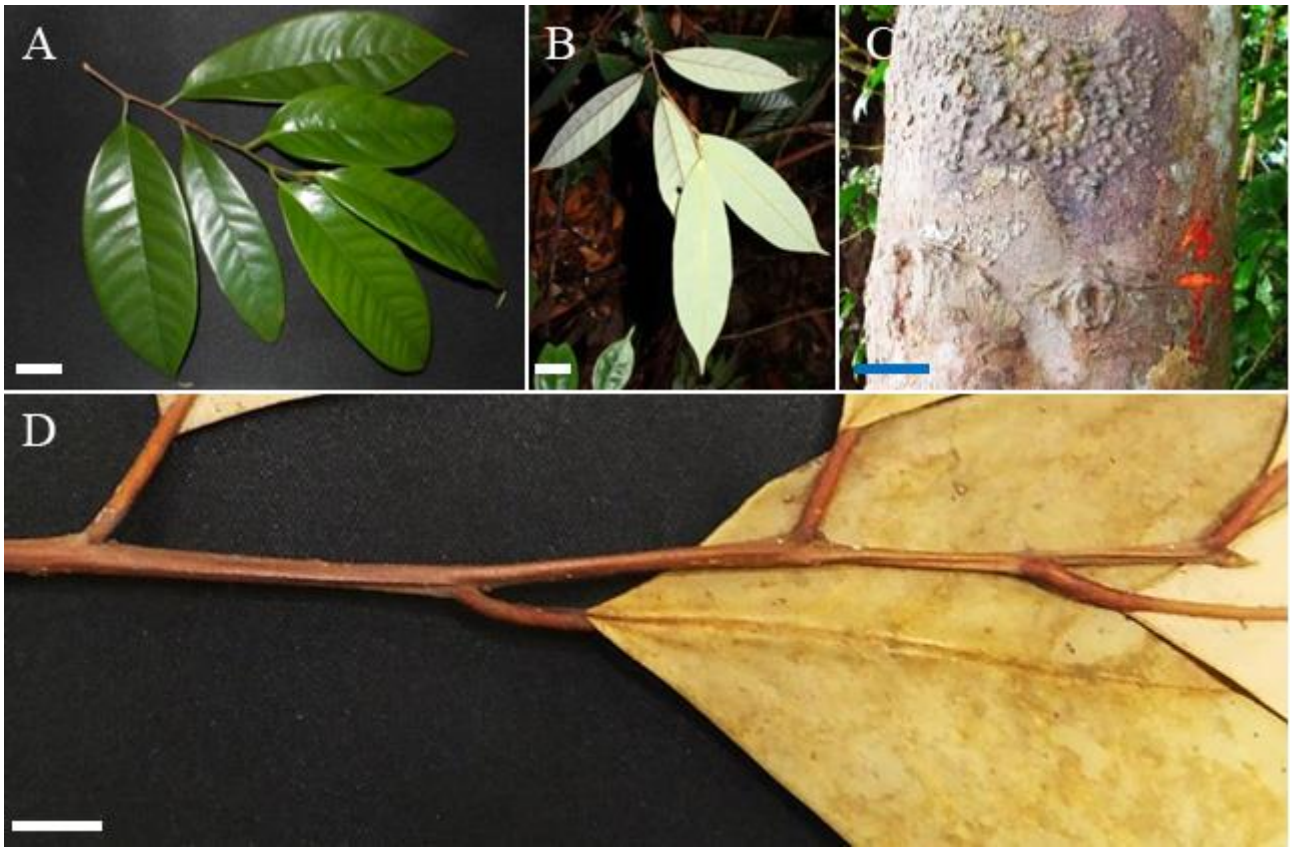

Fig. 9. *Gymnacranthera forbesii.* A, Leafy twig showing upper leaf surface. Scale bar = 2 cm. B, Leafy twig showing lower leaf surface. Note the brown midribs of more mature leaves. Scale bar = 2 cm. C, Trunk of mature individual with scraped bark to reveal the inner bark, on the right. Scale bar = 5 cm. D, Twig which is flattened and ridged, showing characteristics that are uncommon. Scale bar = 2 cm.

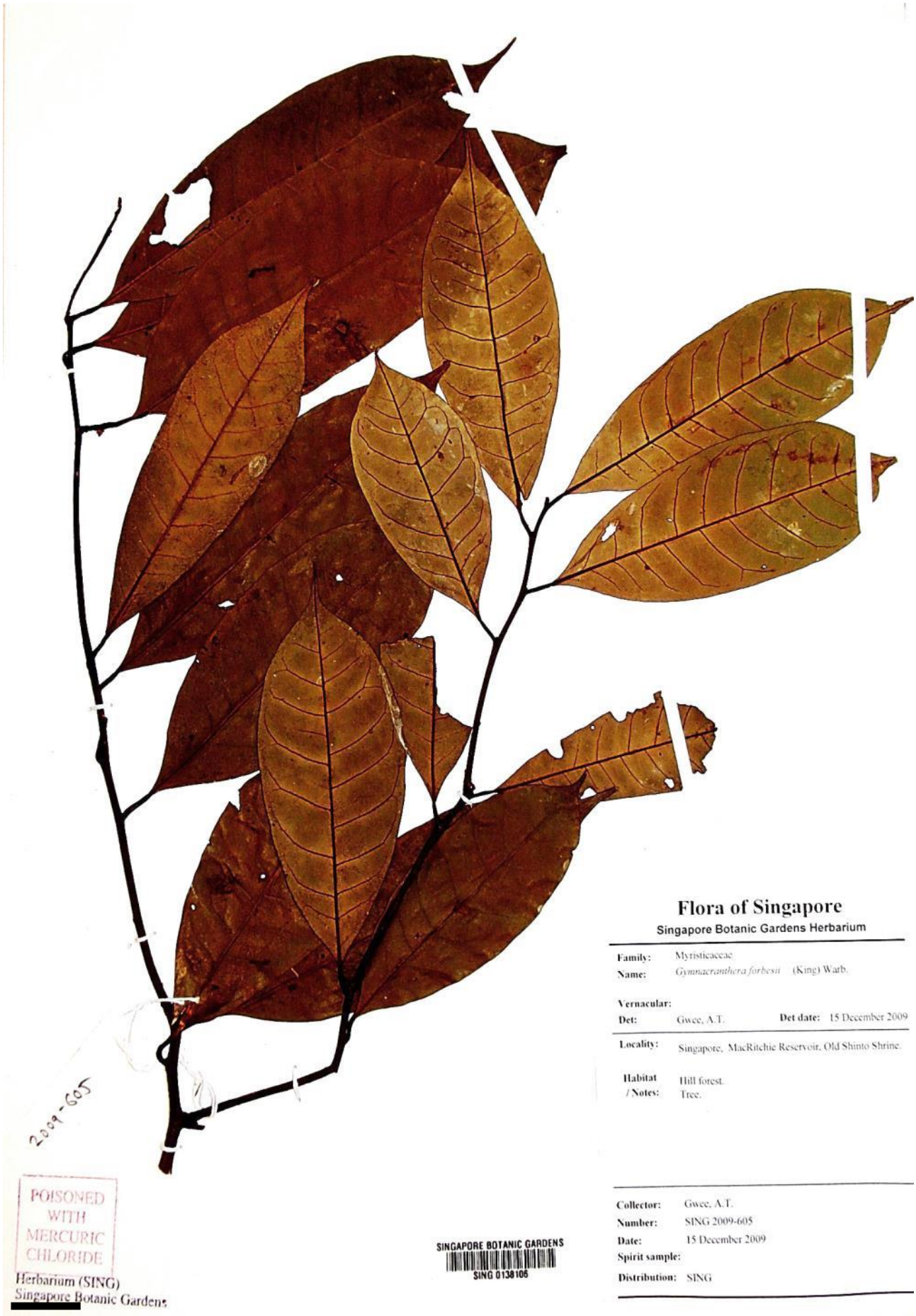

Fig. 10. *Gymnacranthera forbesii*. Herbarium sheet specimen of leafy twigs, *A. T. Gwee 2009-605*, MacRitchie Reservoir, SING barcode no. 0138106. Scale bar = 2 cm.

***HORSFIELDIA* Willd.**

(Named after Thomas Horsfield, 1773–1859, an American medical doctor and naturalist who worked in Java)

Key references: de Wilde (2000a: 54–55), de Wilde (2000b: 352–353)

Tree to 20–40 m tall. **Bark** reddish brown, smooth or more often striate, or rough with circular or irregular dents, sometimes flaking off but mostly not. **Twigs** sometimes angular or with two raised lines, lenticellate, not flaky, glabrescent. **Leaves** each with a lamina *that is pale green, drying brown below*, with dots present or absent, midrib flat or raised above, *never sunken* (as in *Gymnacranthera*), with *tertiary venation loosely spaced, and never forming a dense and distinct network* (as in *Knema*). **Inflorescence** paniculate, usually branched several times; many-flowered. **Flowers** small, perianth when fresh yellowish, never red, leathery, inside glabrous, lobes 2–4; mostly short-pedicelled; male perianth globose or cup-shaped; female perianth globose to ovoid-ellipsoid, slightly larger than that of the male; ovary glabrous or hairy. **Infructescence** branched, few to many-fruited. **Fruit** globose or ellipsoid, drying 1–8 cm long; pericarp leathery or somewhat fleshy, with or without lenticel-like tubercles, glabrous or hairy. **Seed** rarely globose, seed coat not variegated; *aril entire or only shallowly lobed at the distal end*; oily.

Key to species based on dried, sterile characters:

1. Lamina hairy below, with tertiary venation somewhat distinct on both surfaces. 2
– Lamina glabrous, or with a very sparse layer of appressed hairs below, tertiary venation indistinct above. 3

2. Lamina woolly below, with tertiary venation usually distinct on both surfaces. ..... *Horsfieldia grandis*
– Lamina thinly hairy below, rubbing off, with tertiary venation usually only distinct below nearer to the margin. .. .. *Horsfieldia superba*

3. Lamina without dots, dashes, or dark markings below visible observed by the naked eye or with a hand lens. .... *Horsfieldia polyspherula*
– Lamina with dots, dashes, or dark markings below visible observed by the naked eye or under hand lens. 4

4. Lamina below with clear dots and dashes that are visible to the naked eye. 5
– Lamina below with mostly dots and few dashes that are visible to the naked eye or under hand lens. 6

5. Lamina when fresh slightly rust-brown below, 10–20 × 3.5–7 cm. Mature twigs dry with less than a quarter of the total diameter hollow or not. Perianth 2-lobed. ..... *Horsfieldia crassifolia*
– Lamina when fresh light green below, 19–40 × 4.5–12 cm. Mature twigs dry with about half the diameter hollow or not. Perianth 3- or 4-lobed. ..... *Horsfieldia wallichii*

6. Twigs usually drying straw-brown with blackened petioles. Lamina below glabrous with dots usually visible only using a hand lens. ..... *Horsfieldia sucosa*
– Twigs and petioles usually drying dark brown. Lamina below floccose glabrescent with mostly dots and few dashes visible to the naked eye. ..... *Horsfieldia punctatifolia*

1. ***Horsfieldia crasssifolia*** (Hook.f. & Thoms.) Warb.

(Latin *crassus*, thick or fleshy, *folium*, leaves; referring the leathery laminas of this species)

Key references: Sinclair (1975: 23–26), de Wilde (2000a: 107–108)

Tree to 25 m tall; occasionally with stilt-roots or buttresses. **Bark** greyish, fissured, flaking off in small rectangular scales. **Twigs** 2–8 mm across, coarsely striate, not flaking off, *mature twigs usually drying with a small hollow not larger than a quarter of the twig's diameter*, lenticels sparse to dense, early glabrescent, hairs rust- or yellow-brown. **Leaves** each with a lamina drying dull brown to dark brown above, with *scattered dark dots and dashes below*, elliptic to oblong, 10–20 × 3.5–10 cm, coriaceous, with midrib above flattish, 11–16 pairs of secondary veins that are thin and flat above, and tertiary veins that are faint on both surfaces, *when fresh below slightly rust-brown, covered with subpersistent stellate hairs then hair scars*, *apex rounded to subacute or rarely emarginated*, base rounded to attenuate; petiole 9–30 × 1.5–4.5 mm. **Inflorescence** late glabrescent or with persistent, dense, woolly dendroid hairs; male 3–5-times branched, broadly paniculate, 6–20 × 4–15 cm, many-flowered in loose clusters of 2–7; female 3–14 cm long; bracts elliptic-lanceolate, hairy, caducous. **Flowers:** male *perianth 2-lobed; female perianth persistent*. **Fruit** drying dark brown, ovoid to obovoid, 1.5–2.2 × 1.2–1.8 cm, with at most a few lenticel-like tubercles, glabrous, 1–10 per infructescence; pericarp 1.5–2 mm thick. — Figs. 11–12.

Singapore localities: NSSF (*Mohd. Shah & Ali Ibrahim MS 4110*), "Selitar" (*H. N. Ridley s.n.* SING barcode 0018822), "Mandai Road 11½ mile" (now Mandai Lake Road, see remarks) (*J. Sinclair SF 40256*). This species was also previously collected from different parts of the CCNR, Choa Chu Kang, and Upper Seletar Forest.

Habitats: Mostly in marshy forest, freshwater and peat-swamp forest and on sandy soils. In the NSSF, this species was only collected from wet forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Near Threatened (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Horsfield's fleshy-leaved nutmeg

Similar species: This species closely resembles *Horsfieldia wallichii*, as these two species are the most difficult to distinguish when dry as many of their characteristics overlap or are not typically present. The best way to distinguish them would be from the slightly rust-brown lower surface of the fresh lamina of *Horsfieldia crassifolia* but which is absent in that of *Horsefieldia wallichii* as described by Sinclair (1975). *Horsfieldia crassifolia* also has a smaller lamina size (10–20 × 3.5–10) compared to that of *Horsfieldia wallichii* (19–40 × 4.5–12 cm).

Remarks: J. Sinclair made two collection trips for this species at Mandai Road 11½ mile, which is presently Mandai Lake Road (O'Dempsey & Chew, 2013). He likely collected two fruiting specimens from the same individual in March 1953 and April 1954.

Fig. 11. *Horsfieldia crassifolia.* A, Leafy twig showing rust-brown lower leaf surfaces. B, Scraped bark producing thick, red sap. C, Closeup of the lower lamina surface with dots and dashes when dried. Scale bar = 1 cm.

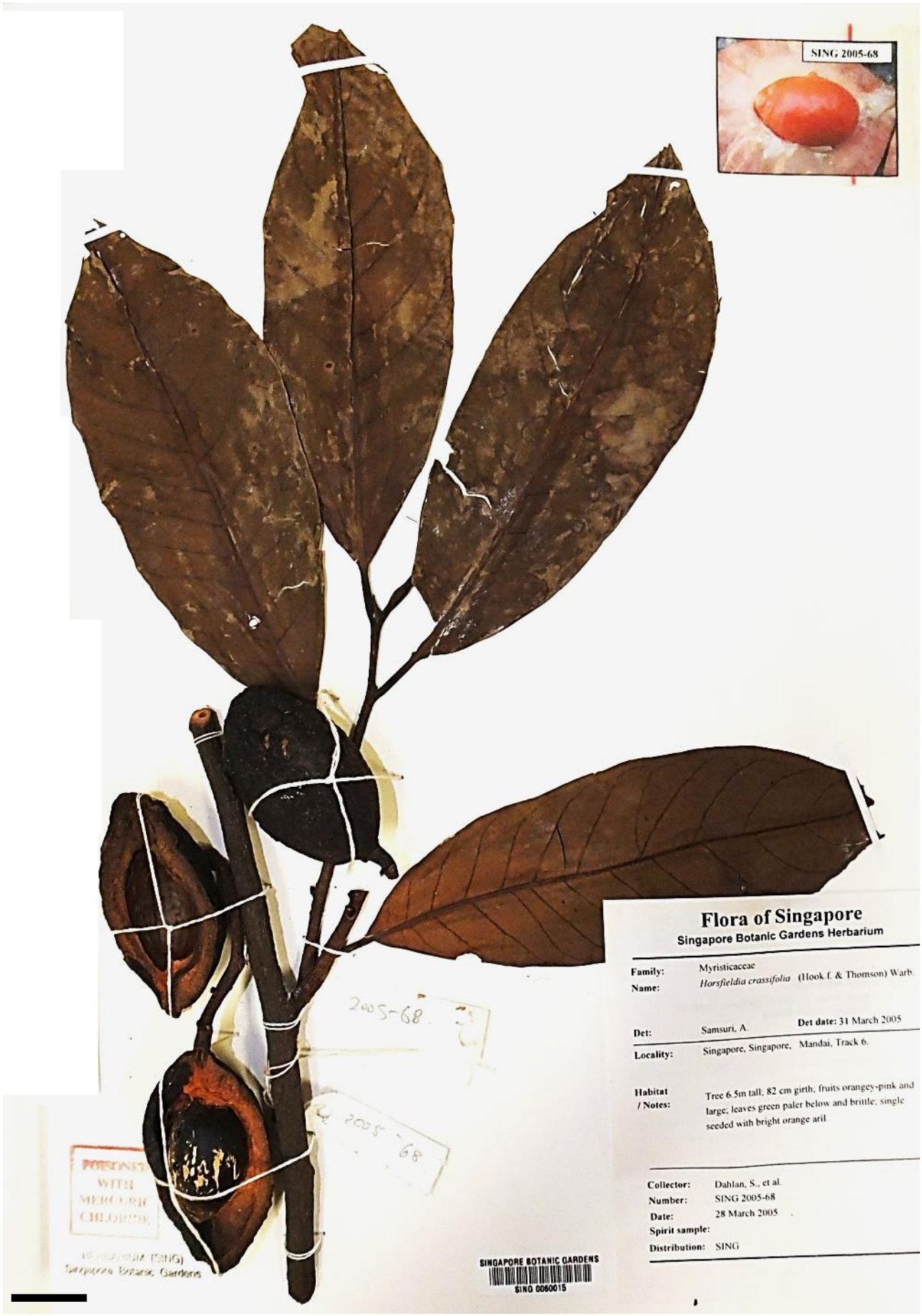

Fig. 12. *Horsfieldia crassifolia*. Herbarium sheet specimen of a fruiting twig, *S. Dahlan 2005-68*, Mandai Track 6, SING barcode no. 0060015. Scale bar = 2 cm.

2. ***Horsfieldia grandis*** (Hook.f.) Warb.
(Latin *grandis*, large; referring to the large leaves of this species)

Key reference: de Wilde (2000a: 123)

Tree to 25 m tall. **Bark** usually longitudinally fissured, scaly, flaky or cracked to strips, sometimes smooth, not flaking off; inner bark red-brown; sapwood whitish to yellowish pink; sap reddish, watery. **Twigs** 3–10 mm across, coarsely striate, sometimes slightly cracking or flaking off, often lenticellate, late glabrescent, the *hairs dense and harsh*; leaf bud 7–15 mm long, densely hairy. **Leaves** each with a lamina drying greenish brown, elliptic-oblong to oblong-oblanceolate, 12–40 × 5–20 cm, membranous or chartaceous, minutely pustulate, somewhat bullate, with midrib somewhat raised above, harsh-pubescent, 8–19 pairs of secondary veins that are flattish or usually sunken above, and tertiary veins that are loosely spaced, *scalariform*, distinct on both surfaces, particularly below, above with harsh, persistent sparse hairs, sometimes becoming glabrous but *always scabrous by harsh hair bases, below with persistent dense to sparse harsh-woolly hairs*, apex acute or acute-acuminate, base attenuate to subcordate; petiole 6–15 × 2.5–6 mm, hairy. **Inflorescence** with dense, yellow-rusty hairs; male 3–4-times branched, widely spaced, 6–25 × 2.5–15 cm, many-flowered; female 1.5–5 cm long, the buds often of different ages. **Flowers** solitary or usually in loose clusters in males, often aggregated into compound clusters; perianth 3–4-lobed, glabrous. **Fruit** clustered, ripening yellow or orange, obovoid-ellipsoid, 1–1.4 × 0.8–1.1 cm, glabrous, apex rounded; pericarp when fresh inside pink, drying dark brown or reddish brown, 1.5 mm thick, without lenticels or warts. **Seed** grey, almost globose, 8–10 mm across. — Figs. 13–14.

Singapore localities: Seletar Reservoir (*A. T. Gwee, Ahmad Samsuri, S. Lee & P. Leong SING 2005-26*). This species was also previously collected from different parts of the CCNR.

Habitats: Understorey or middlestorey tree of primary or degraded forest or ridge forest; on clayey soil and sandstone

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Horsfield's large-leaved nutmeg

Fig. 13. *Horsfieldia grandis.* Closeup of the lower lamina surface with dense, wooly hairs, when dried. Note the distinct reticulations on both sides. Scale bar = 1 cm.

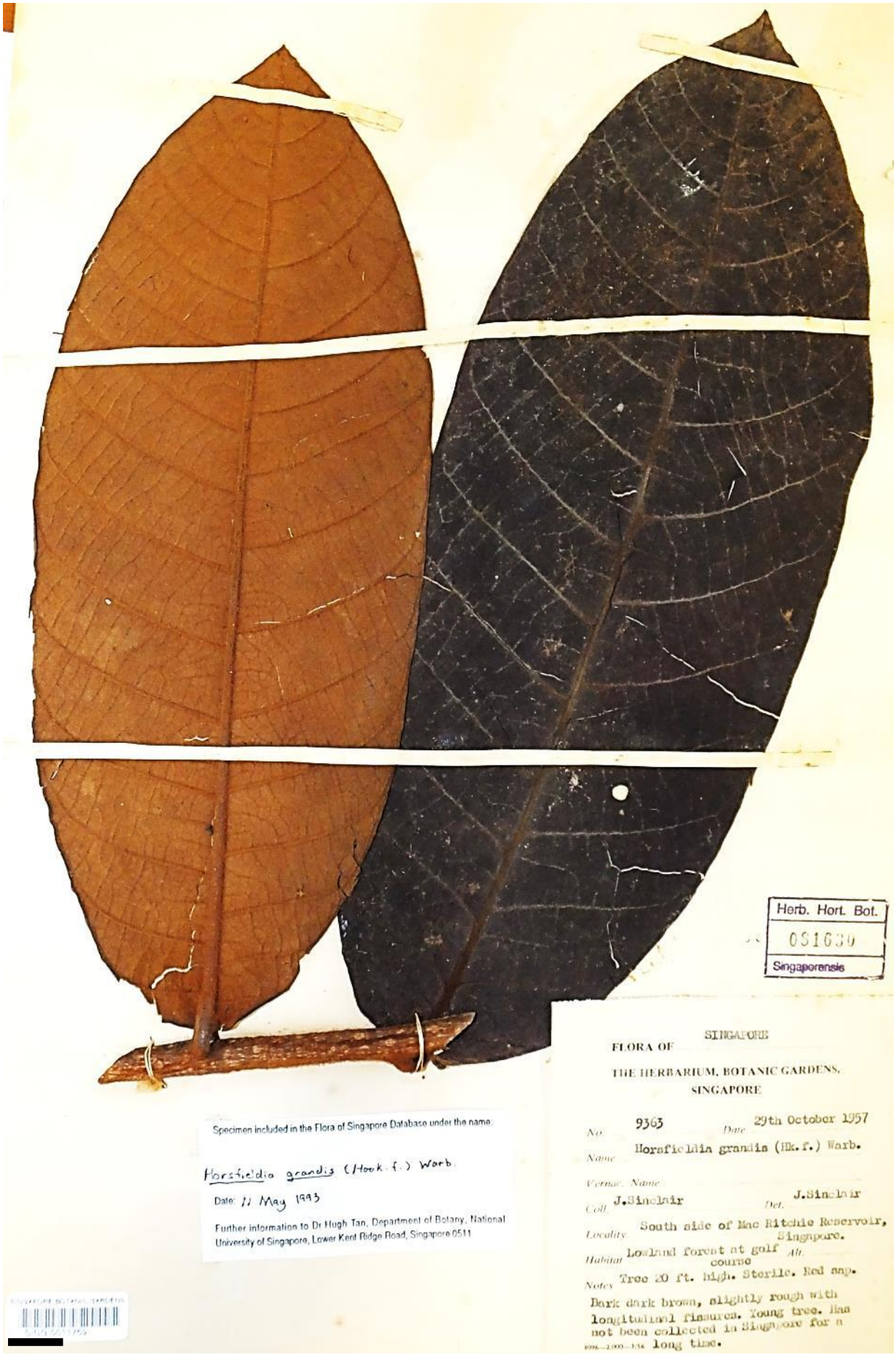

Fig. 14. *Horsfieldia grandis*. Herbarium sheet specimen of a leafy twig, *J. Sinclair 9363*, MacRitchie Reservoir, SING barcode no. 0011759. Scale bar = 1 cm.

3. ***Horsfieldia polyspherula*** (Hook.f. emend. King) J.Sinclair
(Latin *poly*, many; *sphaera*, globe or ball; referring to the flowers resembling many small balls)

Key reference: de Wilde (2000a: 167–171), variety names from de Wilde (2000a)

Tree to 40 m tall. **Bark** finely or coarsely striate, neither cracking nor flaking off, lenticels distinct or not. **Twigs** terete or subterete, never lined or ridged, 2–5 mm across, early or late glabrescent, hairs rusty brown; *buds with rusty dendroid hairs*. **Leaves** each with a lamina drying light brown or brown, *elliptic-ovate-oblong to oblong-lanceolate*, usually narrowly obovate when young, 7–28 × 2.5–9 cm, drying membranous when young, becoming chartaceous, sometimes bullate, with midrib often late glabrescent, *6–15 pairs of secondary veins that are distinctly raised above*, and tertiary veins that are loosely spaced and faint, *early glabrescent*, apex acute-acuminate, base rounded or usually attenuate; petiole 6–15 × 1.5–3 mm, sometimes late glabrescent. **Inflorescence** with sparse to dense woolly hairs, sometimes becoming glabrous; males 3–5-times branched, 4–20 × 3–12 cm, many-flowered; female few- to many-flowered, up to 8 cm long. **Flowers** in clusters of up to 8 each, perianth 3-lobed; glabrous or glabrescent. **Fruit** subglobose or ellipsoid, 1.9–6 × 1.4–5 cm, apex rounded, base rounded or slightly attenuate, not lenticel-like tuberculate, glabrous, 1–6 per infructescence; pericarp 2–15 mm thick.

Suggested common name: Horsfield's ball-flowered nutmeg

There are two varieties of *Horsfieldia polyspherula* in the NSSF. These can be distinguished on the basis of mainly fruit characters (de Wilde, 2000a). A key for distinguishing the two varieties is provided below.

Key to varieties based on dried characters

1. Fruit 1.7–2.8 cm long. Male flower buds 1.0–1.5 mm long, thecae 6–14. Lamina 7–19 cm long, secondary veins 6–15 pairs. .....*Horsfieldia polyspherula* var. *polyspherula*
– Fruit 2.5–3.5 cm long. Male flower buds 1.2–1.8 mm long, thecae 12 or 14. Lamina 13–28 cm long, secondary veins 11–20 pairs. ..... *Horsfieldia polyspherula* var. *sumatrana*

a. ***Horsfieldia polyspherula*** var. ***polyspherula***

Twigs 2–3 mm across. **Leaves** each with a lamina *7–19 × 2.5–6 cm*, with secondary veins 6–15 pairs. **Flowers:** male buds 1–1.5 mm long; thecae 6–14; female perianth 2–2.5 mm long. **Fruit** 1.7–2.8 × 1.4–2 cm; pericarp 2–4 mm thick. — Figs. 15–16.

Singapore localities: NSSF (*A. T. Gwee SING 2005-87*). This variety was also previously collected from other parts of the CCNR (*A. T. Gwee SING 2009-739*) and the Singapore Botanic Gardens (*J. Sinclair SF 40681*).

Habitats: Lowland forest, usually on sandy soils; fresh-water swamp forest and ridge-top forest. In the NSSF, this variety was usually collected from dry forest.

Conservation: Nationally Vulnerable (Tan et al., 2008)

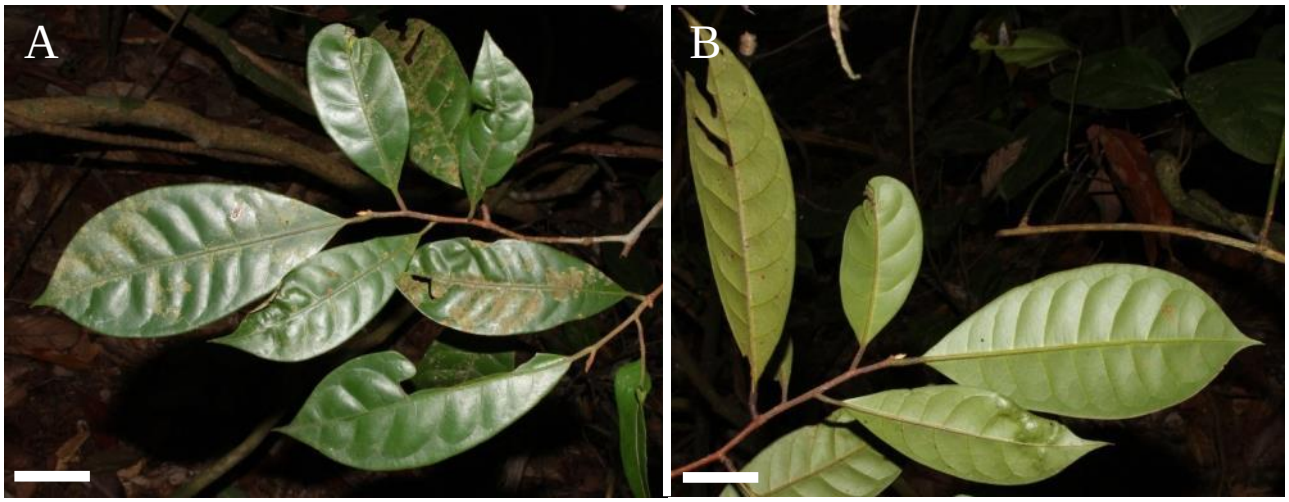

Fig. 15. *Horsfieldia polyspherula* var. *polyspherula.* A, Leafy twigs showing upper leaf surfaces. B, Leafy twig showing lower leaf surfaces. Scale bar = 2 cm.

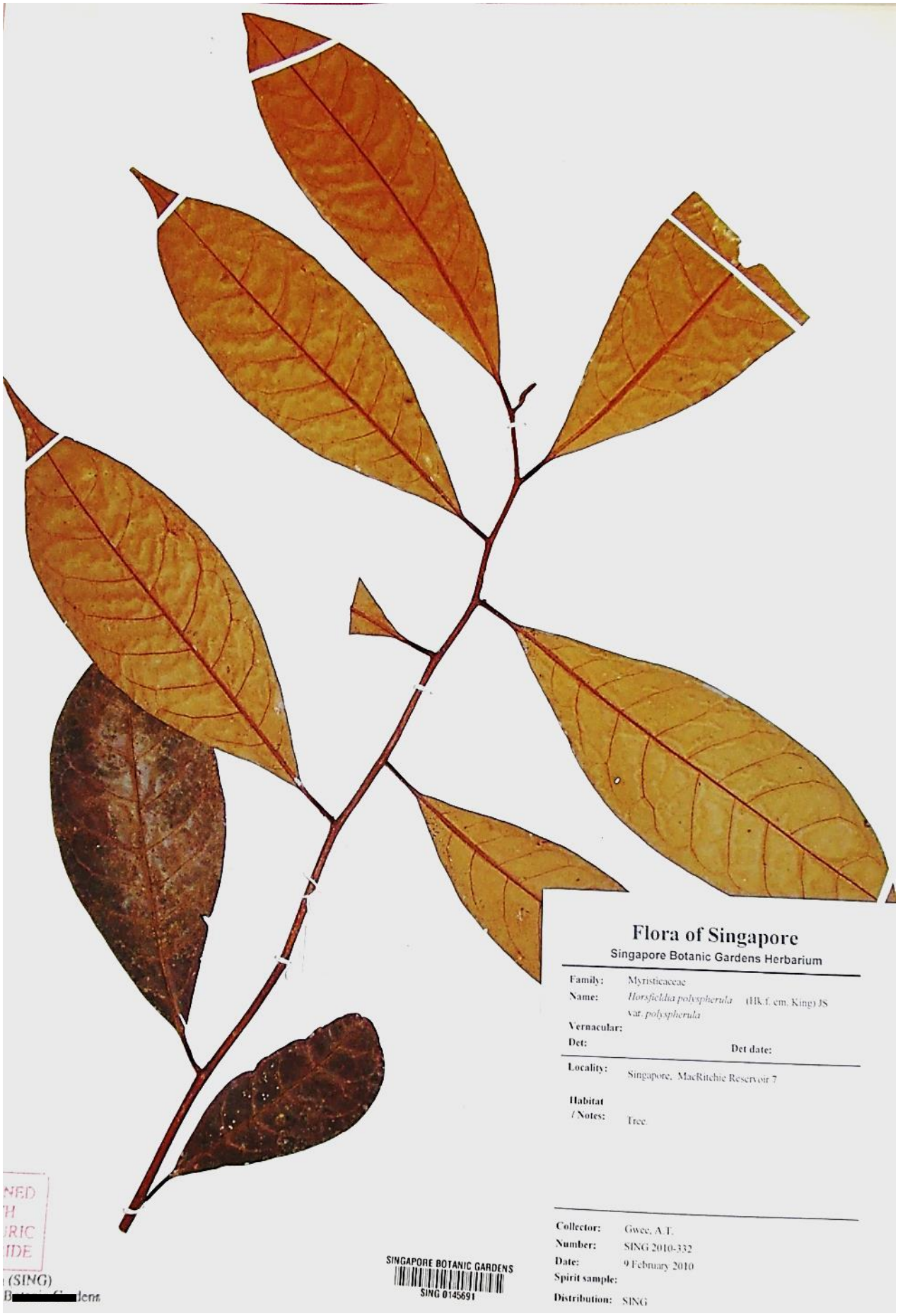

Fig. 16. *Horsfieldia polyspherula* var. *polyspherula*. Herbarium sheet specimen of a leafy twig, *A. T. Gwee SING 2010-332*, MacRitchie Reservoir, SING barcode no. 0145691. Scale bar = 2 cm.

b. ***Horsfieldia polyspherula*** var. ***sumatrana*** (Miq.) W.J. de Wilde
(Latin for of Sumatra)

Tree to 30 m tall. **Bark** brown-grey, finely fissured, with small scales; wood white to pale brown. **Leaves** each with a lamina *oblong-lanceolate, broadest at or below the middle, 13-28 x 4.5-9 cm*, chartaceous, with secondary veins 11-20 pairs, *below not or hardly raised*, usually of the same colour as the lamina, and slightly raised, margin usually not revolute. **Fruit** ripening green turning golden yellow to orange, subglobose, 2.5-3.5 x 2.2 x 2.7 cm, l–5 per infructescence; aril very spicy. — Figs. 17–18.

Singapore localities: NSSF (*Ahmad Samsuri, S. Lee, P. Leong, A. T. Gwee, Mohd. Noor, Ali Ibrahim, S. Saiffudin & K. S. Lioe NES 406*), Lower and Upper Peirce Reservoir (*A. T. Gwee SING 2008-60, SING 2009-668*). This variety was also previously collected from the BTNR, other parts of the CCNR, Singapore Botanic Gardens, and Woodlands.

Habitats: Primary and degraded forest; on dry land such hillsides and ridges as well as in periodically wet places, near streams and rivers; found on limestone and on sandy soils. In the NSSF, this variety was usually collected from wet and dry forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008)

Fig. 17. *Horsfieldia polyspherula* var. *sumatrana*. A, Scraped bark with several droplets of red sap produced. B, Seedling showing distinctly obovate leaves of a seedling. C, Stilt roots of a mature individual in swampy conditions.

Fig. 18. *Horsfieldia polyspherula* var. *sumatrana*. Herbarium sheet specimen of leafy twigs, *A. Samsuri, NES 406*, Nee Soon Pipeline, SING barcode no. 0055066. Scale bar = 2 cm.

4. ***Horsfieldia punctatifolia*** J.Sinclair
(Latin *punctatus*, dotted; *folium*, leaf; for punctate or dotted laminas of this species)

Key reference: de Wilde (2000a: 175–176)

Tree to 30 m tall; may have low-rounded or steep, thick buttresses. **Bark** smooth, shallowly fissured or cracked, or brittle scaly; inner bark pinkish to red, inner wood white, yellowish, or pinkish; sap red, watery. **Twigs** 2.5–4 mm across, finely to coarsely striate, not flaking off, lenticels conspicuous or inconspicuous, early glabrescent, hairs grey-brown; *buds with dense grey-brown hairs*. **Leaves** each with a lamina *above drying dull greenish or dark brown, scattered dots present below*, elliptic-oblong, 9–21 × 3–9 cm, membranous, with midrib mostly flat above, 11–16 pairs of secondary veins, and tertiary veins that are loosely spaced and hardly visible on both surfaces, *floccose glabrescent below*, apex acute-acuminate, base attenuate; petiole 10–17 × 1.5–3 mm, glabrous. **Inflorescence** sparsely hairy or glabrescent; males about 3-times branched, rather many-flowered, 4–10 × 2–8 cm; females about twice-branched, fewer-flowered than males, 3–6 × 1.5–4 cm. **Flowers:** male in loose clusters of 2–5; perianth 3–4-lobed, glabrous. **Fruit** ripening yellow to red, drying blackish brown, broadly ellipsoid, 4.5–8 × 3–4.5 cm, without or with few small warts, glabrous, 1–3 per infructescence; pericarp pink inside, 10–20 mm thick. — Figs. 19–20.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also previously collected from other parts of the CCNR and Singapore Botanic Gardens (*J. Sinclair SF 40211*).

Habitats: Primary forest, including hillsides, ridge-tops, and pole marshy forest; on a variety of soil types including grey and brown soil, sandy clay, tertiary sandstone, and dacite hill. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as uncommon in Peninsular Malaysia. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Horsfield's dotted-leaved nutmeg

Similar species: Whitmore (1972) stated that this species may be confused with *Horsfieldia sucosa* as both may have straw-coloured twigs with blackened petioles when dry. *Horsfieldia sucosa*'s lamina is glabrous, while that of *Horsfieldia punctatifolia* is floccose.

Fig. 19. *Horsfieldia punctatifolia*. A, Scraped bark showing reddish inner bark. B, Copious clear sap from a cut twig. C, Closeup of the lower lamina surface with dots most distinct when dried. Scale bar = 5 mm. D, Stilt roots of a mature individual in swampy conditions.

Fig. 20. *Horsfieldia punctatifolia*. Herbarium sheet specimen of fruiting and leafy twigs, *D. Liew, SING 2009-416*, Mandai Road, SING barcode no. 0131724.

5. ***Horsfieldia sucosa*** (King) Warb. ssp. ***sucosa***
(Latin *succosus*, juicy; referring to the sappy twigs of this species)

Key reference: de Wilde (2000a: 201–202). This name is listed as unresolved in The Plant List (2013).

Tree to 20 m tall. **Bark** smooth, shallowly fissured, or thin-scaly; inner bark reddish; inner wood yellowish or pink; sap reddish, sticky. **Twigs** *straw-coloured,* 2–10 mm across, coarsely striate or not, with a tendency to flake off, lenticels conspicuous only on the very young parts, early glabrescent, at first with rusty or greyish hairs; buds with rusty to greyish brown hairs. **Leaves** distichous or *spiral in 2 or 3 rows*; lamina *drying greenish to blackish brown above, light brown below, with scattered smaller dots often present below, usually clearly visible with a microscope*, elliptic-oblong to oblong-oblanceolate, 14–28 × 4.5–8.5 cm, membranous to thin-chartaceous, with midrib quite flat above, 13–17 pairs of secondary veins, and tertiary veins that are loosely spaced, faint or sometimes prominent, *glabrous above, below early glabrescent,* apex acute-acuminate; base attenuate; *petiole drying blackish*, 10–20 × 2–3 mm. **Inflorescence** on the leafless parts of twigs, thinly hairy or late glabrescent; male 3–4-times branched, 7–19 × 5–16 cm long, with flowers in clusters of 3–7. **Flowers** glabrous, contrasting with the hairy branches of the inflorescence; perianth mostly 3-lobed. **Fruit** when fresh glossy green ripening yellow or pink, drying blackish, broadly ovoid-ellipsoid, 2.3–3.5 × 2–2.5 cm, finely granulate, sometimes tuberculate, glabrous, apex narrowly rounded, 1–4 per infructescence; pericarp pink inside, 4 mm thick. — Figs. 21–24.

Singapore localities: NSSF (*A. Samsuri, S. Lee, A. T. Gwee, Md. Noor, P. Leong & S. K. Ganesan NES 45*; *A. Samsuri, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 239*; *A. Samsuri, S. K. Ganesan, S. Lee et al. NES 353*); Lower Peirce Reservoir (*A. T. Gwee SING 2008-59*). This species was also previously collected from Mandai Road and the Singapore Botanic Gardens.

Habitats: Primary or disturbed dry land and seasonal swamp forest; sandy soils or sandstone

Conservation: Nationally Endangered (Tan et al., 2008). Whitmore (1972) listed it as common in Peninsular Malaysia.

Suggested common name: Horsfield's sappy nutmeg

Similar species: Whitmore (1972) stated that this species may be confused with *Horsfieldia punctatifolia* as both may have straw-coloured twigs with blackened petioles when dry. The lamina of *Horsfieldia sucosa* is glabrous, while that of *Horsfieldia punctatifolia* is floccose.

Remarks: There are two subspecies of *Horsfieldia sucosa*, but only *Horsfieldia sucosa* ssp. *sucosa* occurs in Singapore.

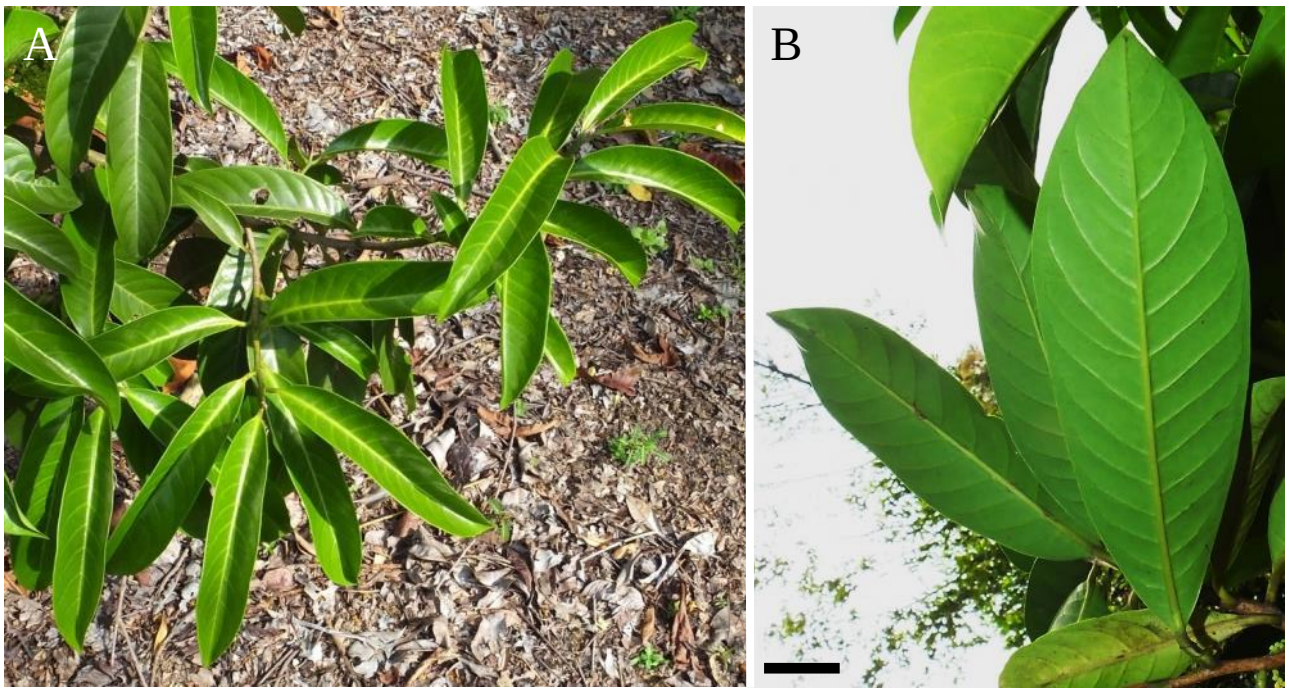

Fig. 21. *Horsfieldia sucosa.* A, Leafy twigs. B, Lower leaf surfaces. Scale bar = 2 cm.

Fig. 22. *Horsfieldia sucosa*. A, Young tree in the Singapore Botanic Gardens. B, Female inflorescence. C, Closeup of an individual female flowers. Scale bar = 1 mm. D, The shallowly fissured bark.

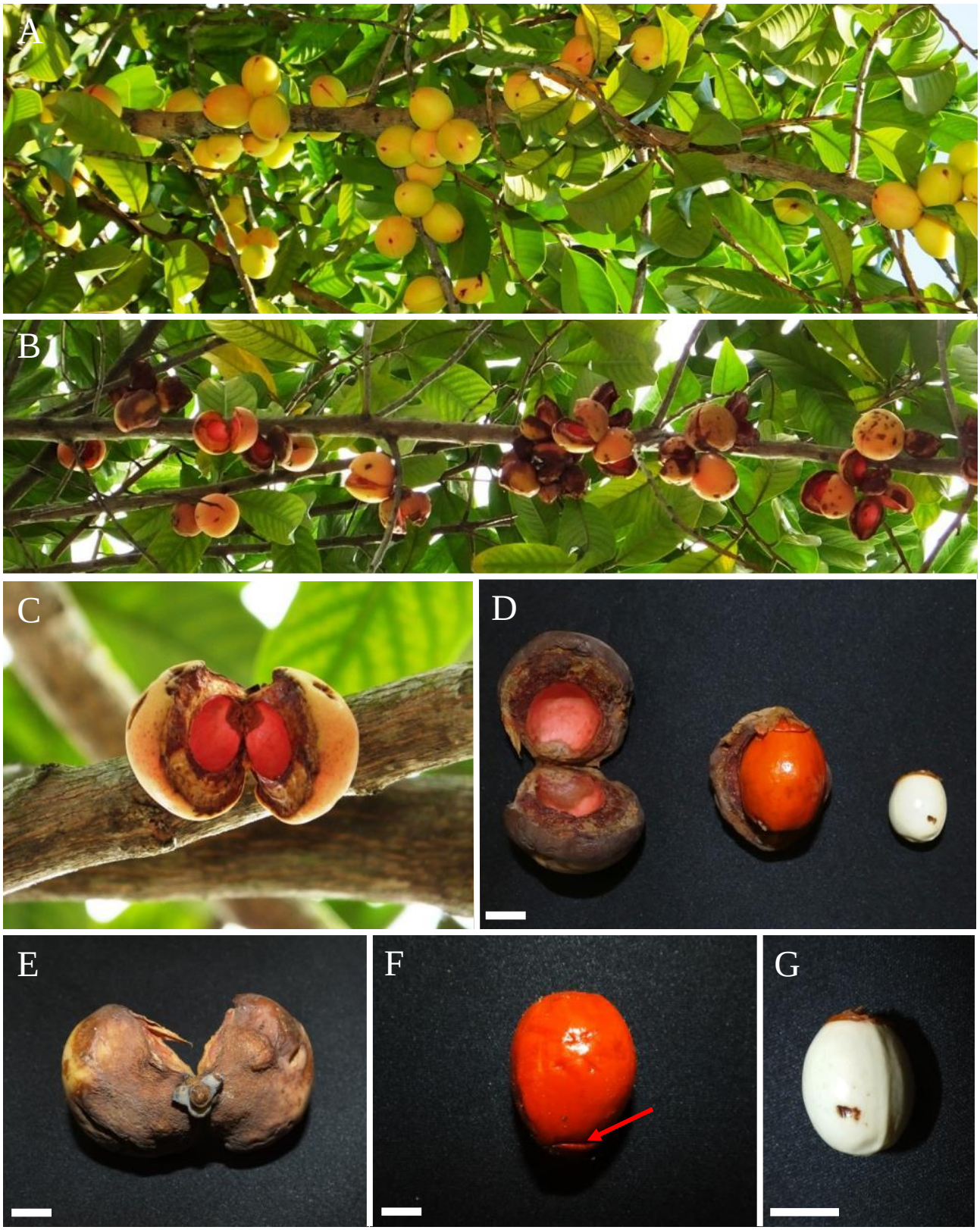

Fig. 23. *Horsfieldia sucosa*. A, Yellow, pinkish ripe fruits just before splitting. B, Open fruits, with only the pericarp remaining on the tree. C, Closeup of an individual open fruit. D, Fallen fruit, with the pericarp, aril and exposed seed. Scale bar = 1 cm. E, Persistent 3-lobed perianth at the base of a fallen fruit. Scale bar = 1 cm. F, Aril shallowly divided at the apex, seen here as a fold (red arrow). Scale bar = 1 cm. G, Seed ridged where the suture lines are. Scale bar = 1 cm.

Fig. 24. *Horsfieldia sucosa*. A, Herbarium sheet specimen of flowering twigs, *A. Samsuri* et al., *NES 45*, Nee Soon, SING barcode no. 0045754. Note the straw-brown twigs with blackened petioles. Scale bar = 2 cm. B, Lamina underside showing minute black spots. Scale bar = 1 mm.

6. ***Horsfieldia superba*** (Hook.f. & Thoms.) Warb.
(Latin *superbus*, magnificent or superb)

Key Reference: de Wilde (2000a: 203–204). This name is listed as unresolved in The Plant List (2013).

Tree to 30 m tall. **Bark** longitudinally fissured, dippled or cracked; brittle, gritty; slash wood soft, whitish or yellowish. **Twigs** dark grey, 5–8 mm across, sometimes faintly angular, striate, sometimes slightly cracking and flaking off, lenticels usually many and conspicuous, late glabrescent, at first with dense, rusty, dendroid hairs; buds 20–30 × 5–10 mm, densely hairy. **Leaves** usually distichous or *spiral in 2 or 3 rows*; lamina drying dull greenish brown above, elliptic-oblong, 25–40 × 10–22 cm, coriaceous, *becoming glabrous with time above except at the midrib*, late glabrescent, *below when fresh with yellowish brown rather sparse to dense mealy indumentum of floccose, dendroid hairs*, with midrib rather broad, flat above, persistently hairy, 15–30 pairs of secondary veins that are flat or sunken above, and tertiary veins that are faint on both surfaces, *sometimes distinct closer to margin*, apex blunt to acute-acuminate, base narrowly subcordate to short-attenuate; petiole 6–15 × 5–7 mm. **Inflorescence** developing on the leafless parts of twigs, with dense, woolly yellowish brown dendroid hairs; male 2–3-times branched, 7–15 × 2.5–10 cm, rather many flowered; female somewhat branched, 2–5 cm long, few-flowered. **Flowers:** male up to 5 in a cluster, glabrous; perianth 3–4-lobed, drying often with a grey-bluish tinge. **Fruit** ripening greenish yellow to orange, broadly ovoid-ellipsoid, 3.8–5.5 × 2.8–4.5 cm, coarsely warty and wrinkled, glabrous, 1–3 per infructescence; pericarp 8–12 mm thick. — Figs. 3B, 25–26.

Specimens examined: No specimens from the NSSF were found in SING at the time of writing. This species was also previously collected from the BTNR, "Mandai Road 11 ½ mile" (now Mandai Lake Road) (*J. Sinclair SF 39538*) and Tanjong Pasir Laba (*J. Sinclair SF 40174*).

Habitats: Forest on alluvial soils, undulating country, and in swampy forest

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as common throughout Peninsular Malaya. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Near Threatened (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Horsfield's superb nutmeg

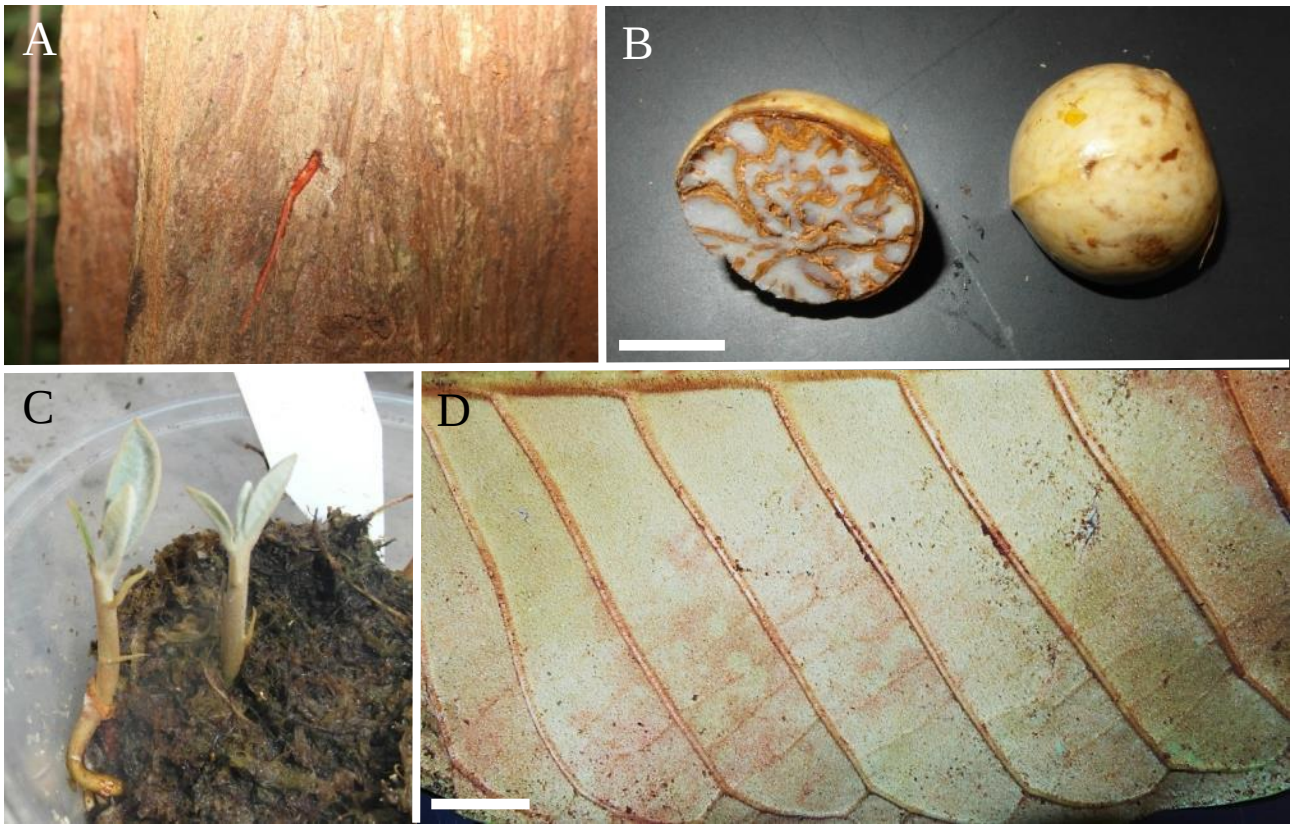

Fig. 25. *Horsfieldia superba*. A, Scraped bark. B, Seed cut laterally showing the ruminate endosperm. Scale bar = 1 cm. C, Seedlings with leaves a distinctive blue-green colour. D, The reticulations on the fresh lamina that are more distinct closer to the margin. Scale bar = 2 cm.

Fig. 26. *Horsfieldia superba*. Herbarium sheet specimen of flowering and leafy twigs, *E. J. H. Corner, SF 36134*, CCNR, SING barcode no. 0018879. Scale bar = 2 cm.

7. ***Horsfieldia wallichii*** (Hook.f. & Thoms.) Warb.
(After Nathaniel Wallich, 1786–1854, a Danish botanist
who was instrumental in founding the forerunner of the Singapore Botanic Gardens)

Key reference: de Wilde (2000a: 219–220). This name is listed as unresolved in The Plant List (2013).

Tree to 30 m tall. **Bark** dark grey, 1 cm thick, shallowly or deeply longitudinally fissured, not flaking off; inner bark bright to deep red, pink, or reddish brown; slash wood whitish to red-brown. **Twigs** dark brown or blackish, sometimes drying somewhat flattened, 3–6 mm across, coarsely striate, later on fissured, sometimes flaking off, lenticels inconspicuous, early to late glabrescent, *mature twigs drying with large hollow*; buds 20–30 × 4–6 mm, densely hairy. **Leaves** each with a lamina drying greenish to blackish brown above, *with dark dots and or dashes present below*, ovate-oblong to oblong-lanceolate, 19–40 × 4.5–12 cm, coriaceous, glabrous above, below early or late glabrescent, with hairs sparse or dense, with midrib slightly raised above and late glabrescent, 15–28 pairs of secondary veins, and tertiary veins indistinct, apex subobtuse to acute-acuminate, base rounded to short-attenuate; petiole 15–35 × 2.5-4.5 mm. **Inflorescence** usually developing on the leafless parts of twigs, with sparse or dense stellate-dendroid hairs; male 3–4-times branched, 10–33 × 6–22 cm, many-flowered; female rather stout, 3–7 cm long, fewer-flowered. **Flowers:** male in clusters of 5–12; perianth 3–4-lobed, glabrous; female becoming glabrous with time. **Fruit** ripening yellow to red, ovoid-ellipsoid, 4–7 × 3–4.5 cm, smooth or wrinkled, not or only faintly warted, glabrous, 2–9 per infructescence; pericarp 10–15 mm thick. — Figs. 27–28.

Singapore localities: Upper Peirce Reservoir (*A. T. Gwee SING 2009-476*). This species was also previously collected from the BTNR and the Singapore Botanic Gardens (*J. Sinclair SK 39487*).

Habitats: Lowland and ridge-top forest; on red soil, granitic sand, loam soil with coral limestone. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as common in Peninsular Malaysia, Sumatra and Borneo. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Wallich's nutmeg

Similar species: This species closely resembles *Horsfieldia crassifolia*, as these two species are the most difficult to distinguish as dried specimens as many of their characteristics overlap or are not typically present. The best way to distinguish them would be from the slightly rust-brown lower surface of the fresh lamina of *Horsfieldia crassifolia* but which is absent in *Horsefieldia wallichii* as described by Sinclair (1975). *Horsfieldia crassifolia* also has a smaller lamina size (10–20 × 3.5–10) compared to that of *Horsfieldia wallichii* (19–40 × 4.5–12 cm).

Fig. 27. *Horsfieldia wallichii.* A, Leafy twigs showing green underside of leaves. B, Closeup of the lower lamina surface with dots and dashes when dried. Scale bar = 5 mm.

Fig. 28. *Horsfieldia wallichii*. Herbarium sheet specimen of flowering and leafy twigs, *S. Kiah, SK 709*, Bukit Kallang, SING barcode no. 0018891. Scale bar = 2 cm.

KNEMA Lour.

(Greek *knema*, the spoke of a wheel; referring to the stamens in the androecium)

Key references: Whitmore (1972:330–331), de Wilde (2000a: 222–223)

Tree, with stilt-roots sometimes present. **Bark** brown, often reddish or greenish, occasionally black, brittle, smooth to scaly. **Twigs** lenticellate, flaky or not; leaf buds hairy. **Leaves** each with a lamina *drying waxy-white below*, with the midrib usually flat or raised, rarely sunken, and *tertiary veins dense, forming a closed raised network that is distinct on both surfaces or only below*, hairy or becoming glabrous leaving hair scars. **Inflorescence** subumbellate, many-flowered in the male; fewer-flowered in the female. **Flowers** without a distinct scent, small; mostly stalked. **Infructescence** sessile, single- to few-fruited. **Fruit** ellipsoid, 2–5 cm long, tomentose or early glabrescent; pericarp leathery. **Seed** ellipsoid, not variegated; *aril entire or only divided at the proximal end*, oily.

Key to species based on dried, sterile characters:

1. Lamina below covered with dense hairs that are distinct to the touch. 2
– Lamina below with minute hairs indistinct to the touch, sometimes visibly hairy only on the midrib bases and petioles of young leaves. 4

2. Long, brown, woolly hairs on the young twigs and leaves, tertiary venation and twig striations are much obscured by the hairs. ..... *Knema hookeriana*
– Short, grey or brown stellate hairs on the young twigs and leaves, tertiary venation and twig striations are distinct. 3

3. Lamina widest at the middle, secondary veins above raised or flat, with brownish black dots present on tertiary veins visible under a hand lens. ..... *Knema conferta*
– Lamina widest above the middle, secondary veins above sunken or flat, with no brownish black dots on tertiary veins. ..... *Knema laurina*

4. Midrib on both lamina surfaces golden-brown to reddish. 5
– Midrib on both lamina surfaces straw-coloured, dull, or dark brown. 7

5. Lamina widest above the middle, sometimes slightly fiddle-shaped, above yellowish or greyish brown; petioles darkened. ..... *Knema intermedia*
– Lamina widest at the middle or not, not fiddle-shaped, above yellowish or dark brown; petioles not darkened. .. 6

6. Lamina widest above the middle, above dark brown or not, base attenuate to rounded, midrib and secondary veins reddish above and below. Mature twigs cracking and flaking off. ..... *Knema latericia* ssp. *ridleyi*
– Lamina widest at the middle, above yellowish brown, base truncate to cordate, midrib and secondary veins golden brown below. Mature twigs not cracking and flaking off. ..... *Knema furfuracea*

7. Lamina above glossy, dark brown, contrasting with the straw-brown midrib above or not, ≤10 cm long. Twigs straw-brown. ..... *Knema curtisii*
– Lamina above glossy or dull, light or dark brown, not contrasting with the midrib above, ≥15 cm long or larger. Twigs dark brown. 8

8. Lamina above yellowish brown, mature laminas ≥20 cm long, base usually rounded or obtuse, areoles less than 0.5 mm across, sometimes faint. ..... *Knema glaucescens*
– Lamina above grey or dark brown, mature laminas between 15–20 cm long, base usually cuneate or attenuate, areoles larger or smaller than 0.5 mm across, always distinct. 9

9. Lamina usually blackish above in some parts and brown in others, midrib above usually flattish, usually light brown, chartaceous, areoles more than 0.5 mm across. ..... *Knema malayana*
– Lamina usually uniformly brown or olivaceous above, midrib above usually raised, usually of the same colour as above, subcoriaceous, areoles less than 0.5 mm across. ..... *Knema communis*

1. *Knema communis* J.Sinclair

(Latin *communis*, common; perhaps referring to the frequency of occurrence of this species)

Key reference: de Wilde (2000a: 250–251). This name is listed as unresolved in The Plant List (2013).

Tree to 20 m tall; bole basally fluted. **Bark** smooth or nearly so, or sparingly flaky; inner bark pink or red; sapwood white or yellowish. **Twigs** often blackish, 1.5–2 mm across, finely striate, sometimes finely cracking, *not flaking off*, at first with rust-brown or greyish hairs, glabrescent. **Leaves** each with a lamina *drying* yellow-brown, *grey or brown above*, grey-glaucous below, oblong-lanceolate to lanceolate, 6–25 × 2–5 cm, *chartaceous or subcoriaceous*, subpersistent or late glabrescent with dense rust-brown to greyish hairs below forming distinct hair scars, with the *midrib usually raised above*, 15–22 pairs of secondary veins that are slightly raised above, and tertiary veins very fine, with *areoles less than 0.5 mm across*, apex acute-acuminate, *base cuneate;* petiole 7–20 × 1–3 mm. **Inflorescence** sessile; male 3–10-flowered; female 1–3-flowered. **Flowers** with a 3-lobed perianth that is pink or reddish inside, with persistent rusty hairs outside; male 2.5–3 mm across; female 4 × 3 mm across. **Infructescence** 1–2-fruited. **Fruit** ripening greenish yellow or orange, ellipsoid to obovoid, 1.5–1.8 × 1–1.3 cm, with rust-brown hairs; pericarp 1 mm thick. — Figs. 29–30.

Singapore localities: NSSF (*J. Sinclair SF 40280*; *SF 40368*; *SF 40717)*; Chan Chu Kang (*H. N. Ridley 1833*). This species was also collected previously from Bukit Timah, other parts of the CCNR, Jalan Jambul, and the Singapore Botanic Gardens.

Habitats: Lowland forest. In the NSSF, this species was usually collected from wet and dry forest areas.

Conservation: Nationally Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Vulnerable A1c (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: common knema

Similar species: Although easily confused with *Knema malayana*, the laminas of *Knema communis* dry slightly thicker and have smaller areoles. The midrib is usually prominently raised above, whereas *Knema malayana* has a flattish midrib. The leaves above also dry grey or dark brown, while those of *Knema malayana* usually dries dark brown above with secondary veins being a lighter brown.

Fig. 29. *Knema communis.* A, Leafy twig showing upper leaf surfaces. B, Leafy twig showing lower leaf surfaces. C, Young twigs and midrib below are usually grey-green with light brown hairs. Scale bar = 1 cm. D, Scraped bark with copious red sap produced.

Fig. 30. *Knema communis*. Holotype specimen of leafy twigs, *J. Sinclair*, *SF 40522*, Singapore Botanic Gardens, SING barcode no. 0046033. Scale bar = 2 cm.

2. ***Knema conferta*** (King) Warb.
(Latin *confertus*, pressed together; referring to the male flowers being densely clustered)

Key references: de Wilde (2000a: 251–252; 2000b: 406)

Tree to 25 m tall; bole straight with buttresses to 3 m high. **Bark** smooth, sometimes slightly rough, or often peeling off in narrow strips; inner bark light red or brownish red inside; sapwood whitish, yellowish, or reddish brown; heartwood reddish brown. **Twigs** 2–5 mm across, coarsely striate, not tending to crack or flake off; at first with dense rusty hairs, becoming glabrous with time. **Leaves** each with a lamina drying glossy greenish brown above, greyish or waxy-white below, oblong to lanceolate, *widest at the middle*, 10–30 × 3–12 cm, chartaceous to coriaceous, finely papillate, with distinct hair scars above or not, with *persistent indumentum of mixed sessile and stalked stellate-dendroid hairs on both surfaces when young, mature laminas remaining persistently hairy only below*, with the *midrib raised above*, 12–28 raised pairs of secondary veins, and tertiary veins distinct, fine, and have *scattered minute brownish black dots visible under hand lens*, apex subobtuse or acute-acuminate, base subcordate to cuneate; petiole 5–15 × 1.5–5 mm, late glabrescent. **Inflorescence** in the male up to 40-flowered; in the female up to 10-flowered. **Flowers** each with a 3-lobed perianth that is, when fresh, greenish or yellowish inside, with a brown-pink blotch at the base of lobes, covered with dull rust-brown hairs. **Infructescence** 1–5-fruited. **Fruit** when fresh rust-brown or orange, subglobose, ellipsoid, or obovoid, 1.5–4 × l–3 cm, glabrescent; pericarp 2–5 mm thick. **Seed** grey; aril red. — Figs. 31–33.

Singapore localities: NSSF (*C. M. Boo SING 2007-335*; *A. T. Gwee, P. T. Chew, I. Hassan, H. K. Lua SING 2009-209*; *T. O'Dempsey SING 2011-189*; *C. K. Yeo SING 2012-359*). This species was also previously collected from the BTNR and other parts of the CCNR.

Habitats: Forest, including inundated and swamp forest. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Endangered (Tan et al., 2008). Whitmore (1972) listed it as uncommon and scattered throughout Peninsular Malaysia. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: dense-flowered knema

Similar species: The lamina has hairs and a texture similar to that of *Knema laurina*, but the lamina shape of *Knema conferta* is consistently widest at the middle, and the secondary veins are not sunken above. The presence of brownish black dots along the tertiary veins is distinctive of this species, but is only visible with a hand lens when dried.

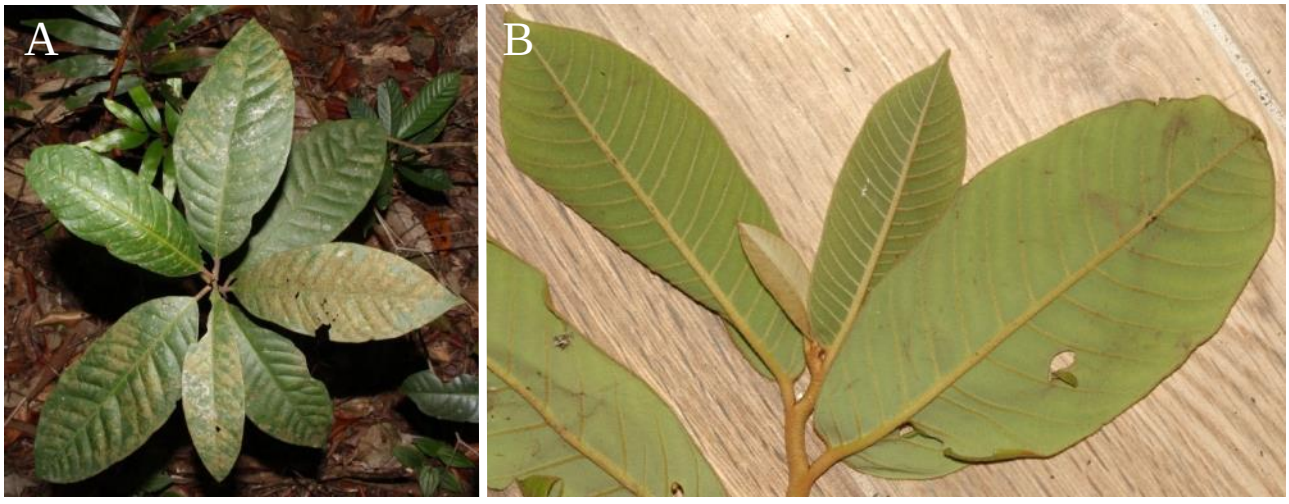

Fig. 31. *Knema conferta*. A, Young individual in the understorey. B, Leafy twig showing dense hairs on the twig and lower leaf surfaces.

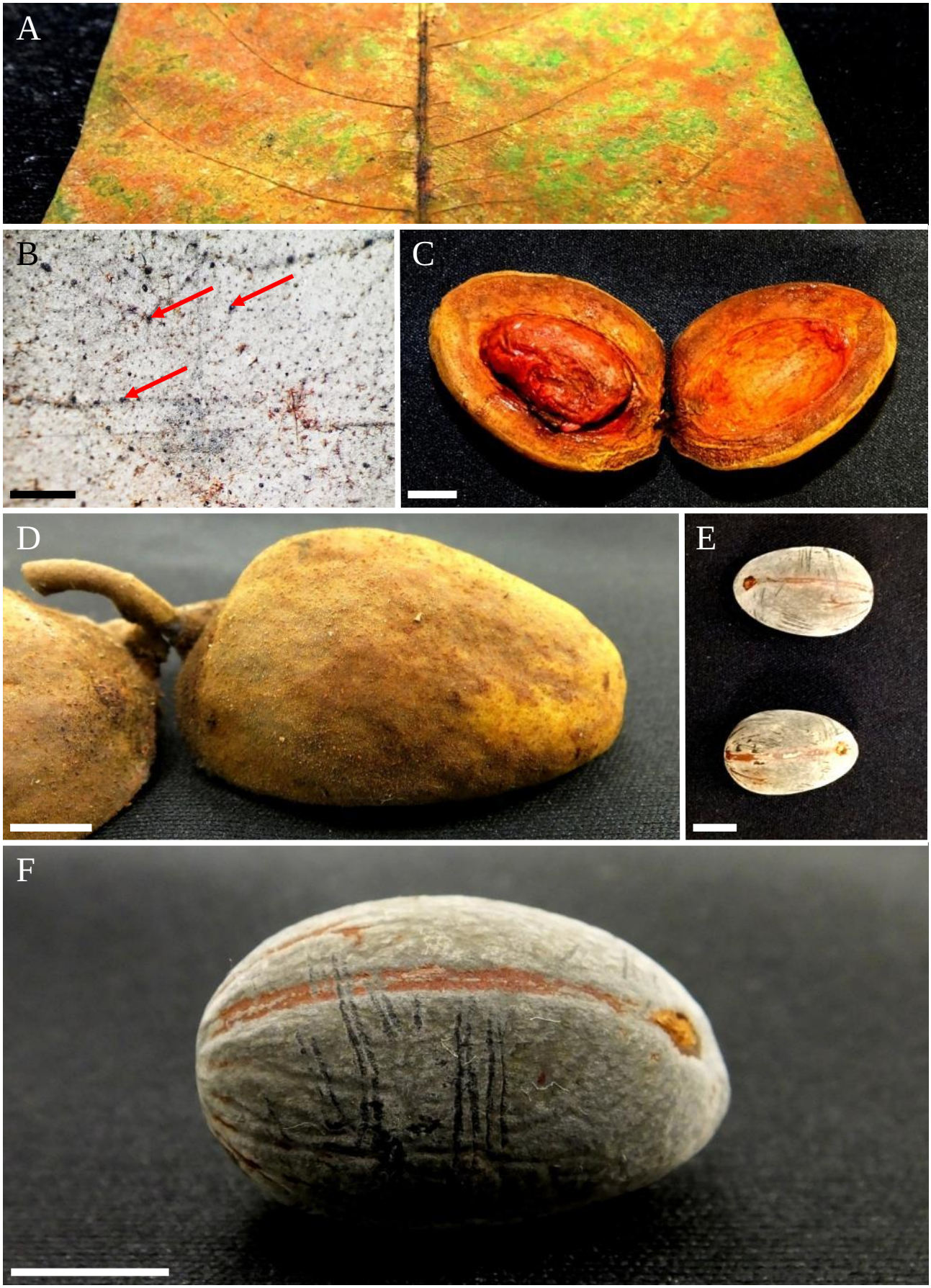

Fig. 32. *Knema conferta*. A, Dried lamina showing raised secondary veins. B, Lower leaf surface with scattered minute brownish black dots (red arrows) along the tertiary veins. Scale bar = 1 mm. C, Fallen fruit with pericarp and aril covering the seed. D, The scurfy hairs on the pericarp of a fallen fruit. E, Exposed seeds with the suture line forming a ridge running from the base to the apex of the seed. F, Closeup of an individual seed. Scale bars = 1 cm.

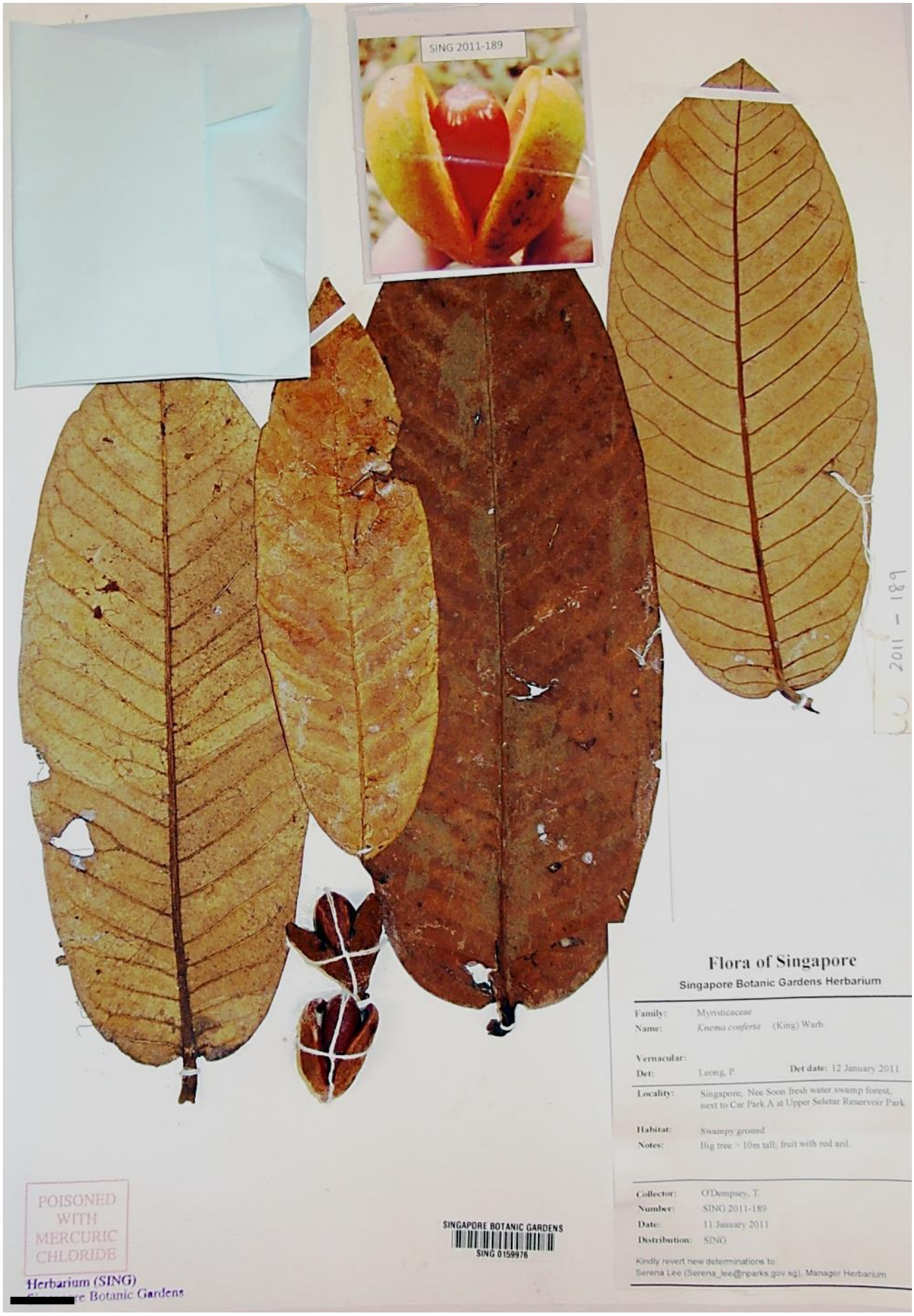

Fig. 33. *Knema conferta*. Herbarium sheet specimen of leaves and fruits, *T. O'Dempsey*, *SING 2011-189*, NSSF, SING barcode no. 0159976. Scale bar = 2 cm.

3. ***Knema curtisii*** (King) Warb.

(After Charles Curtis, 1852–1928, plant collector, former superintendent of the Penang Botanic Gardens)

Key references: de Wilde (2000a: 252–256; 2000b: 406–407). This name is listed as unresolved in The Plant List (2013).

Shrub or tree to 35 m tall. **Bark** finely striate, not cracking or flaking off. **Twigs** *straw-brown*, l–2 mm across, sometimes faintly 2–3-angled, at first covered with greyish hairs but early glabrescent. **Leaves** each with a lamina greenish or dark brown above, *glossy* or not, greyish below, *elliptic or ovate*, *3.5–10 × 1.2–5 cm*, membranous or chartaceous, very *finely papillate below*, at first with dense hairs but early glabrescent, with the midrib raised above, 6–20 pairs of secondary veins that are flat to slightly raised above, and tertiary veins that are very fine and distinct above or not, apex acute-acuminate, sometimes blunt or rounded, base cuneate to attenuate, rarely rounded; petiole 5–20 × 0.7–1.5 mm. **Inflorescence** in male 2–15-flowered; in female l–5 flowered. **Flowers** with a perianth that is 3–4-lobed, cream to pink inside, with persistent or partially caducous grey or rust-brown hairs. **Infructescence** 1–2-flowered. **Fruit** somewhat ellipsoid, ridged, 2–5 × 1.5–3 cm, with greyish to rusty hairs, becoming glabrous with time, apex acute, base obtuse, or often up to 5 mm narrowed (beaked) at both ends; pericarp 1–2.5 mm thick.

Suggested common name: Curtis' knema

There are four varieties recognized by de Wilde (2000a), but only two varieties occur in the NSSF. A key for distinguishing the two varieties is provided below.

Key to varieties:

1. Lamina usually ≤10 cm long, broadly elliptic, with secondary and tertiary veins prominent on both sides, apex acuminate or bluntly acute. ..... *Knema curtisii* var. *curtisii*
– Lamina usually ≤5 cm long, elliptic, with secondary and tertiary veins faint on both sides, apex obtuse or rounded. ..... *Knema curtisii* var. *paludosa*

a. ***Knema curtisii*** var. ***curtisii***

Bole sometimes with buttresses. **Bark** smooth, with scattered small dents, or slightly fissured; inner bark red-brown or yellow; sapwood white; sap light red. **Leaves** each with a lamina when fresh glossy dark green above, glaucous, drying greenish to *dark brown above*, *usually glossy*, *elliptic* or elliptic-lanceolate, 5–12 cm long, *membranous*, with the midrib when fresh yellowish green below, 8–18 pairs of secondary veins, and *secondary and tertiary veins distinct on both surfaces*, *apex blunt to acute, or acuminate with blunt or acute tip*, base cuneate or attenuate. **Flowers** when fresh with a perianth that is pinkish or red inside; male buds in cross section with sharp angles, 2.5–4 mm across, with mixed stellate and dendroid hairs outside, partly tending to be shed. **Fruit** ripening yellow, brown, orange-brown or red, 2–4.5 cm long, ridged, scurfy. **Seed** grey-white. — Figs. 34–36.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This variety was also previously collected from Changi and St. John's Island (Pulau Sakijang Bendera).

Habitats: Primary and degraded forest, hill slopes; on a variety of soil types: clay, loam, sandy clay, sandstone, lime-containing soils. In the NSSF, this variety was usually collected from wet and dry forest.

Conservation: This variety was not assessed by Tan et al. (2008).

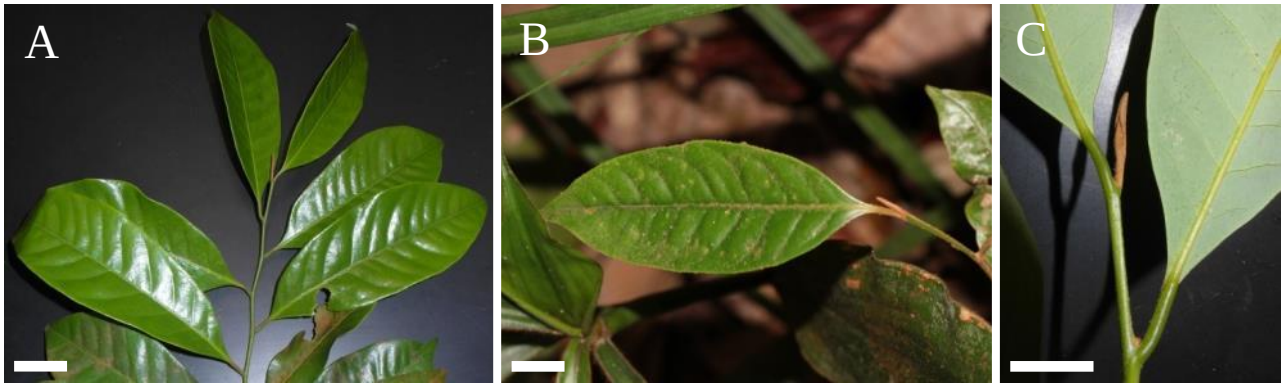

Fig. 34. *Knema curtisii* var. *curtisii*. A, Leafy twig with glossy leaves. Scale bar = 2 cm. B, Young leaf with brown hairs. Scale bar = 1 cm. C, Young stem with sparse brown hairs becoming glabrous with time. Scale bar = 1 cm.

Fig. 35. *Knema curtisii* var. *curtisii.* A, Stilt-roots formed in swampy ground. B, Scraped bark showing copious red sap.

Fig. 36. *Knema curtisii* var. *curtisii*. Herbarium sheet specimen of a leafy twig, *A. T. Gwee, SING 2010-227*, Mandai, SING barcode no. 0145743. Scale bar = 2 cm.

b. ***Knema curtisii*** var. ***paludosa*** J.Sinclair

Bole with stilt-roots usually present. **Leaves** each with a lamina drying brown, elliptic or obovate, widest at or above the middle, 3–7 cm long, membranous or *chartaceous*, with the secondary veins in 6–16 pairs and *secondary and tertiary veins faint on both surfaces*, *apex* subacute or sometimes faintly acuminate with a blunt tip, *obtuse, or rounded*, base cuneate or attenuate. **Flowers** with male buds sharply angled, 3–5 mm across, covered with sessile-stellate and dendroid hairs, and partially tending to become glabrous. **Fruit** ridged on the line of suture, 4–5 cm long. — Fig. 37–38.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This variety was also previously collected from Jurong and Mandai.

Habitats: Primary lowland forest, clearings, preferably marshy forest, and then with stilt-roots

Conservation: Nationally Endangered (Tan et al., 2008)

Fig. 37. *Knema curtisii* var. *paludosa*. A, Habit of a mature tree. B, Scraped bark.

Fig. 38. *Knema curtisii* var. *paludosa*. Holotype specimen of leafy twigs, *E. J. H Corner*, *SF 26155*, Jurong, SING barcode no. 0045041. Scale bar = 2 cm.

4. ***Knema furfuracea*** (Hook.f. & Thoms.) Warb.
(Latin *furfuraceus*, like bran; referring to the persistent, short scales on the leaves)

Key reference: de Wilde (2000a: 258–259)

Tree to 25 m tall; bole sometimes with buttresses. **Bark** smooth with longitudinal flakes or scale-like hairs, or fissured; inner bark white, laminated or fibrous; sapwood whitish; heartwood light red to dark brown. **Twigs** brown turning blackish, 4–10 mm across, conspicuously longitudinally cracking and flaking off, striate or not, sometimes faintly angular, *at first with dense furfuraceous scales* that are soon rubbed off, becoming glabrous. **Leaves** each with a lamina drying *greenish or yellow brown*, glossy or dull above, *oblong or oblanceolate*, *widest at the middle*, *10–50 × 3–21 cm*, coriaceous, finely papillate below, early glabrescent below, with the midrib stout, raised above, *golden brown above and below*, 20–50 pairs of secondary veins that are raised above and *golden brown below*, and tertiary veins raised or sunken above, apex acute acuminate, sometimes rather blunt, *base narrowly to broadly cordate*; petiole 5–25 × 4–8 mm, late glabrescent. **Inflorescence** sessile; in the male 3–30-flowered; in the female up to 20-flowered. **Flowers** with a perianth that is 3 or 4-lobed, yellow, pink, red, or deep red inside, with furfuraceous scales that are dense and subpersistent, or becoming glabrous. **Infructescence** 1–4-fruited. **Fruit** ovoid, subglobose, or obovoid, 2.5–3.5 × 2–2.8 cm, with rust-brown hairs; pericarp 3–5 mm thick. — Figs. 39–40.

Singapore localities: NSSF (*A. Samsuri, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 70*). This species was also previously collected from Dalvey Road and the Singapore Botanic Gardens.

Habitats: Primary and degraded rain forest, hillsides, ridges, ridge-tops over granite, limestone, on clayey and black soil

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) listed it as common thoughout Peninsular Malaysia. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: bran-scaled knema

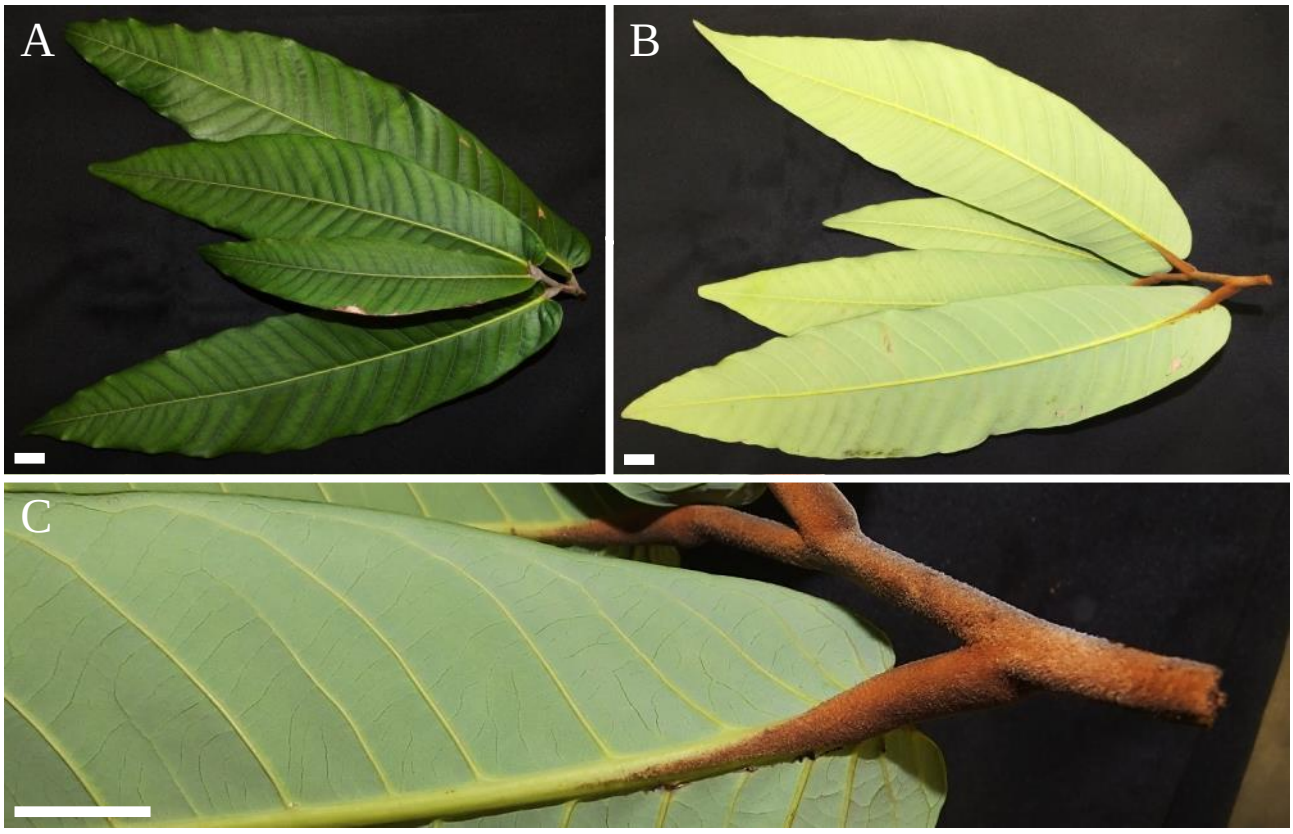

Fig. 39. *Knema furfuracea.* A, Leafy twig showing upper leaf surfaces with raised, yellow midrib. Scale bar = 2 cm. B, Leafy twig showing lower leaf surfaces. Scale bar = 2 cm. C, Young twig with dense, furfuraceous hairs extending to the midrib below, becoming glabrous with time. Scale bar = 1 cm.

Fig. 40. *Knema furfuracea*. Herbarium sheet specimen of a leaf, *A. Samsuri et al., NES 70*, NSSF, SING barcode no. 0045779. Scale bar = 2 cm.

5. ***Knema glaucescens*** Jack

(Latin *glaucescens*, becoming somewhat sea-green; referring to the lower surface of the fresh lamina)

Key references: de Wilde (2000a: 264–265; 2000b: 411–412). This name is listed as unresolved in The Plant List (2013).

Tree to 15 m tall. **Bark** ochre-brown, nearly smooth, only slightly flaking off or not; inner wood white. **Twigs** l–3 mm across, finely striate, not tending to crack or flake off, at first with very fine rust-brown, scurfy hairs, becoming glabrous with time. **Leaves** each with a lamina when fresh glossy dark green above, waxy-white, drying *yellow brown above*, greyish below, ovate-oblong to lanceolate, *6–23 × 2–7.5 cm*, when fresh coriaceous, drying chartaceous or thinly coriaceous, with *subpersistent dense stellate hairs, mixed with larger stellate-dendroid hairs, when shed leaving minute hair scars*, with the midrib when fresh whitish green above, brownish below, flat or raised above, 13–20 pairs of secondary veins that are raised above, and tertiary veins not visible when fresh but drying distinct above, apex acute-acuminate, *base rounded or subattenuate*; petiole 5–15 × 1–2 mm. **Inflorescence** in the male 5–20-flowered; in the female 1–10-flowered. **Flowers** with perianth that is 3-lobed, creamy or yellowish inside, with persistent grey to rust-brown hairs. **Infructescence** 1–2-fruited. **Fruit** ellipsoid or broadly obovoid, sometimes ridged, 1.8–2.2 × 1.2–1.8 cm, with rust-brown, mealy hairs; pericarp l–2 mm thick; aril spicy, tasting like cloves and nutmeg. — Figs. 41–42.

Singapore localities: NSSF (*A. T. Gwee, P. T. Chew, I. Hassan & H. K. Lua SING 2009-225*). This species was also previously collected from other parts of the CCNR, Lornie Road, Mandai Road and the Seletar Firing Range.

Habitats: Forest, including swamp forest; sand, granitic sand, and clayey soil

Conservation: Rediscovered (Chong et al., 2012). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: sea-green knema

Fig. 41. *Knema glaucescens.* A, Leafy twig showing lower leaf surfaces with the distinctive sea-green colour and young shoots covered with fine, brown hairs. B, Leafy twig showing upper leaf surfaces.

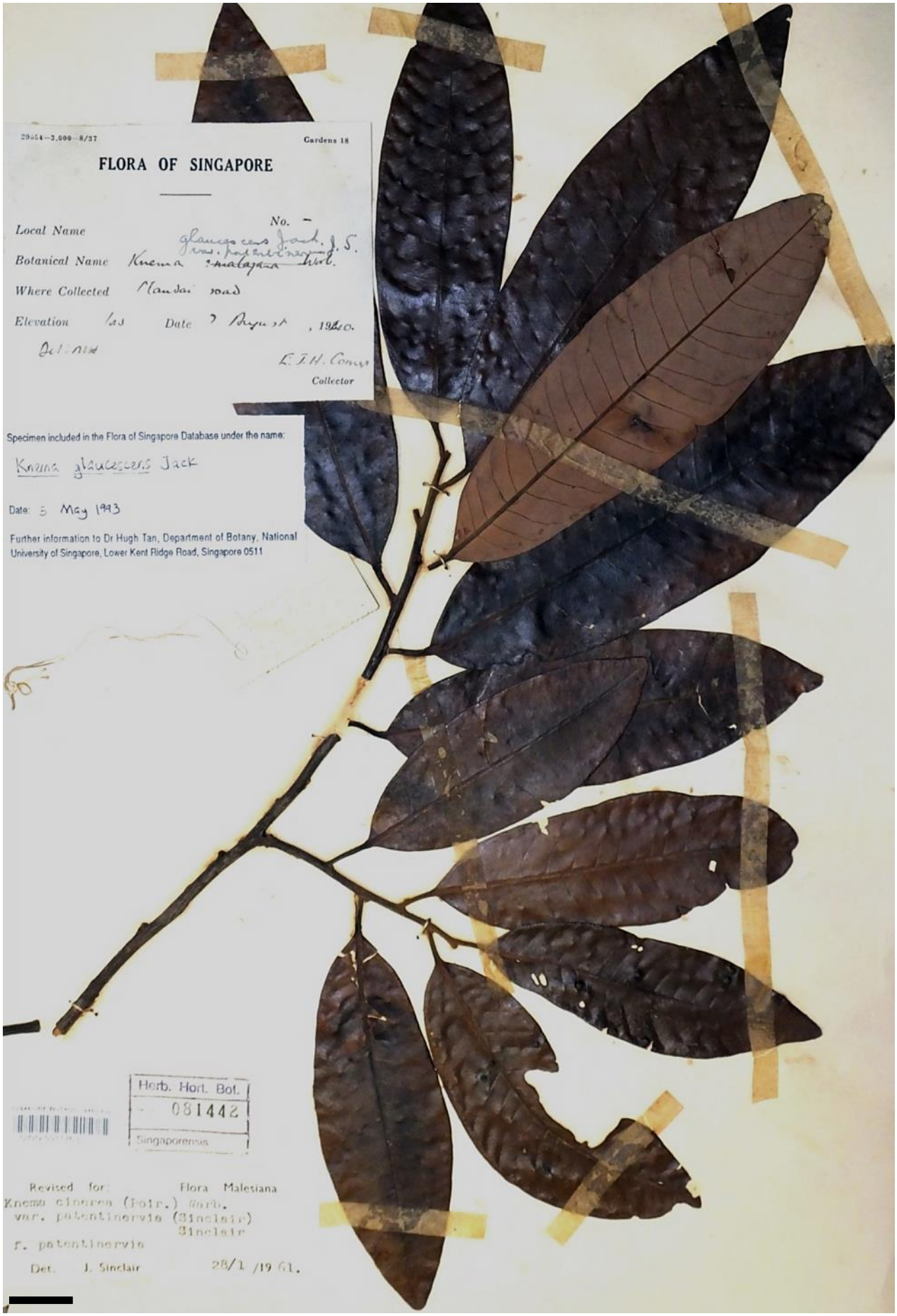

Fig. 42. *Knema glaucescens*. Herbarium sheet specimen of a leafy twig, *E. J. H. Corner*, Mandai Road, SING barcode no. 0011763. Scale bar = 2 cm.

6. ***Knema hookeriana*** (Wall. ex Hook.f. & Thoms.) Warb.
(After Sir William Jackson Hooker, 1785–1865, English botanist and former Director of the Royal Botanic Gardens, Kew)

Key reference: de Wilde (2000a: 270). This name is listed as unresolved in The Plant List (2013).

Tree to 30 m tall. **Bark** smooth but scaly by several layers of thin, brittle, blackish, adherent flakes, rectangular or elongate. **Twigs** brown, 5–10 mm across, longitudinally cracking and flaking off, with *dense, light brown, woolly hairs 5–8 mm long*, late glabrescent, the *indumentum shed in compact rags*. **Leaves** each with a lamina when fresh mature leaves glossy dark green above, waxy-white below, drying greenish, yellow to dark brown above, greyish below, oblong-lanceolate, slightly narrowed towards the base, *25–60 × 5–22 cm*, coriaceous, faintly papillate or not, when *immature with light brown hairs 5–8 mm long*, with the midrib raised above, 25–33 pairs of secondary veins that are somewhat raised above and sometimes reddish to yellowish brown, and tertiary veins distinct, apex subobtuse, acute, or acuminate, base subattenuate, rounded, or subcordate; petiole 10–30 × 8–12 mm, late glabrescent. **Inflorescence** sessile, up to 20 mm across; in the male 5–20-flowered; in the female 4–10-flowered. **Infructescence** 1–3-fruited. **Flowers** with a perianth that is 3–4-lobed, red inside, with dense woolly hairs 1–3 mm long. **Infructescence** 1–3-fruited. **Fruit** ellipsoid, 4.5–8 × 3–4.5 cm, with thick, light brown hairs 5–13 mm long, not easily rubbed off; pericarp 3–8 mm thick. — Figs. 43–45.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also previously collected from other parts of the CCNR, Jalan Jambul, and the Singapore Botanic Gardens.

Habitats: Primary and degraded forest; ridge tops and hill sides

Conservation: Nationally Critically Endangered (Tan et al., 2008). Whitmore (1972) lists it as very common throughout Peninsular Malaysia, saying it is probably the commonest species of Myristicaceae there. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Vulnerable A1c (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Hooker's knema

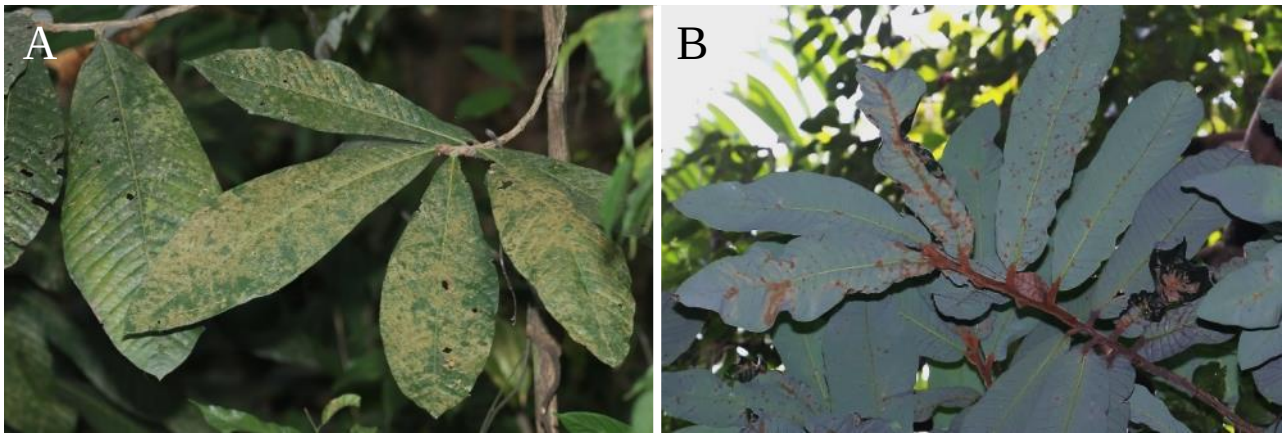

Fig. 43. *Knema hookeriana.* A, Leafy twig showing upper leaf surfaces. B, Leafy twig showing lower leaf surfaces, with densely hairy young twigs.

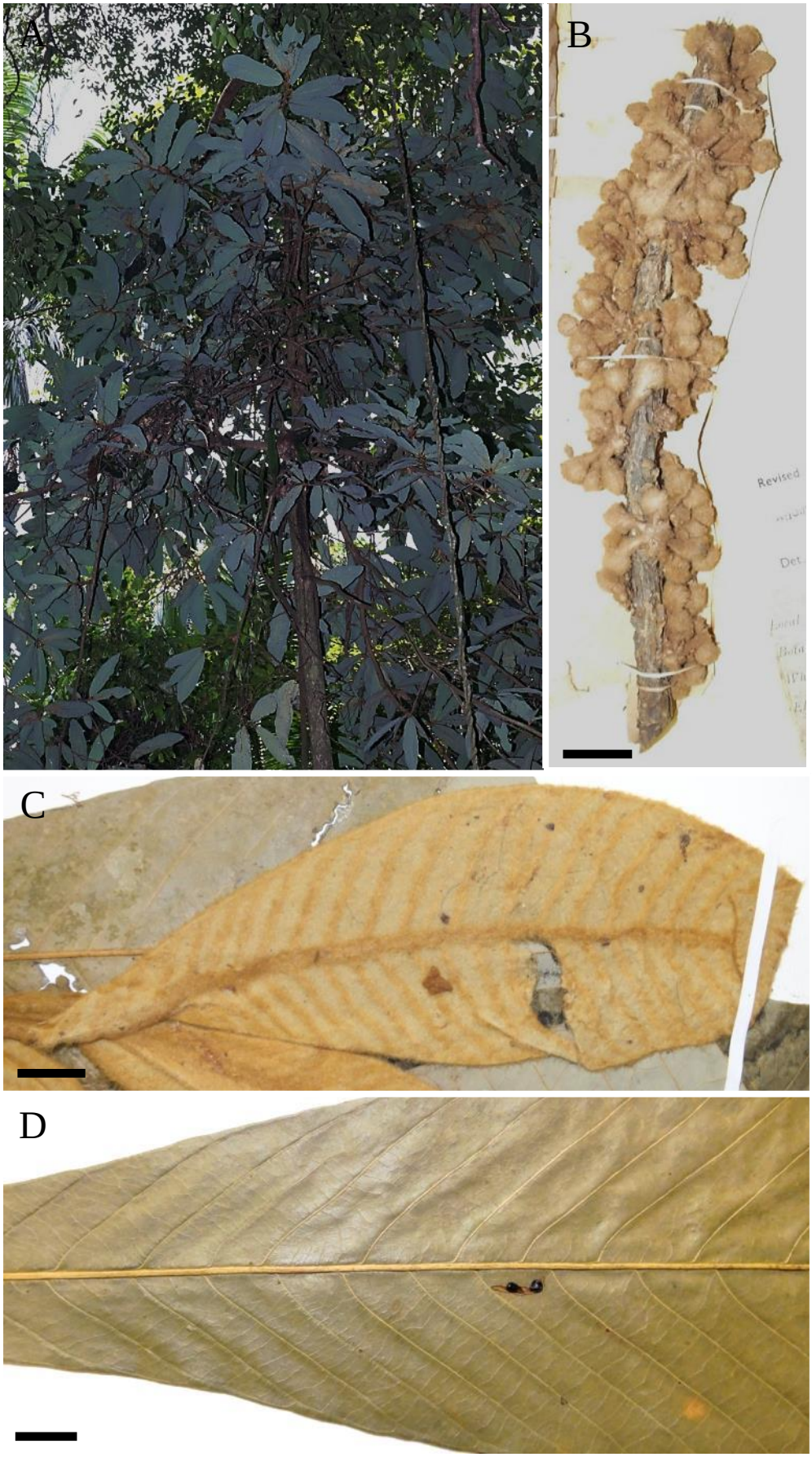

Fig. 45. *Knema hookeriana.* A, Habit of a sapling. B, A young developing leaf with very long, dense hairs. Scale bar = 2 cm. C, Flower buds with long, dense hairs. Scale bar = 2 cm. D, Upper surface of the lamina with prominent tertiary veins when dried. Scale bar = 1 cm.

Fig. 46. *Knema hookeriana*. Herbarium sheet specimen of fruiting and leafy twigs, *H. N. Ridley, No. 3701*, Bukit Timah, SING barcode no. 0018951. Scale bar = 2 cm.

7. ***Knema intermedia*** (Blume) Warb.
(Latin *intermedius*, in between; inference unknown)

Key references: de Wilde (2000a: 271–272; 2000b: 414–415). This name is listed as unresolved in The Plant List (2013).

Tree to 30 m tall; bole frequently with stilt-roots. **Bark** smooth, scaly, or flaky, wood white or somewhat reddish. **Twigs** slender or stout, subterete, slightly angled, or flattened, 1.5–5 mm across, *smooth or finely striate, not tending to crack or flake off*, at first with rust-brown hairs, becoming glabrous with time. **Leaves** each with a lamina when fresh bright dark green, glossy, waxy-white or light blue-green or whitish below, *drying light brown above*, grey-brown below, oblong to lanceolate, usually *slightly pandurate*, 7–35 × 1.3–8 cm, chartaceous or coriaceous, newly emerged leaves with velvety golden indumentum on both sides, early glabrescent, with the midrib raised above, *pale yellow when fresh, drying reddish*, 12–25, pairs of secondary veins that are much raised and *tertiary veins distinct*, apex acute-acuminate, base rounded, cuneate, or attenuate; petiole 10–25 × 2–3 mm, becoming glabrous with time. **Inflorescence** in male 5–25-flowered; in female 1–10-flowered. **Flowers** with a perianth that is 3-lobed, creamy or pinkish inside, with woolly or mealy rust-brown hairs; buds yellowish brown, cream-coloured inside; stamens and disc pink. **Infructescence** 1–4-fruited. **Fruits** ripening often yellow or orange with rust-brown or red indumentum, ellipsoid, 2.5–4 × 1.5–2.3 cm, often ridged, with easily rubbed off hairs; pericarp 2–3 mm thick. — Figs. 47–48.

Singapore localities: Seletar Reservoir (*J. Sinclair SF 38564*), Upper Peirce Reservoir (*A. T. Gwee SING 2009-695*). This species was also previously collected from the BTNR, other parts of the CCNR, Jurong, and the Singapore Botanic Gardens.

Habitats: Mixed lowland forest, peat forest; once from granitic sand. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Endangered (Tan et al., 2008). Whitmore (1972) lists it as common throughout Peninsular Malaysia. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Near Threatened (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: intermediate knema

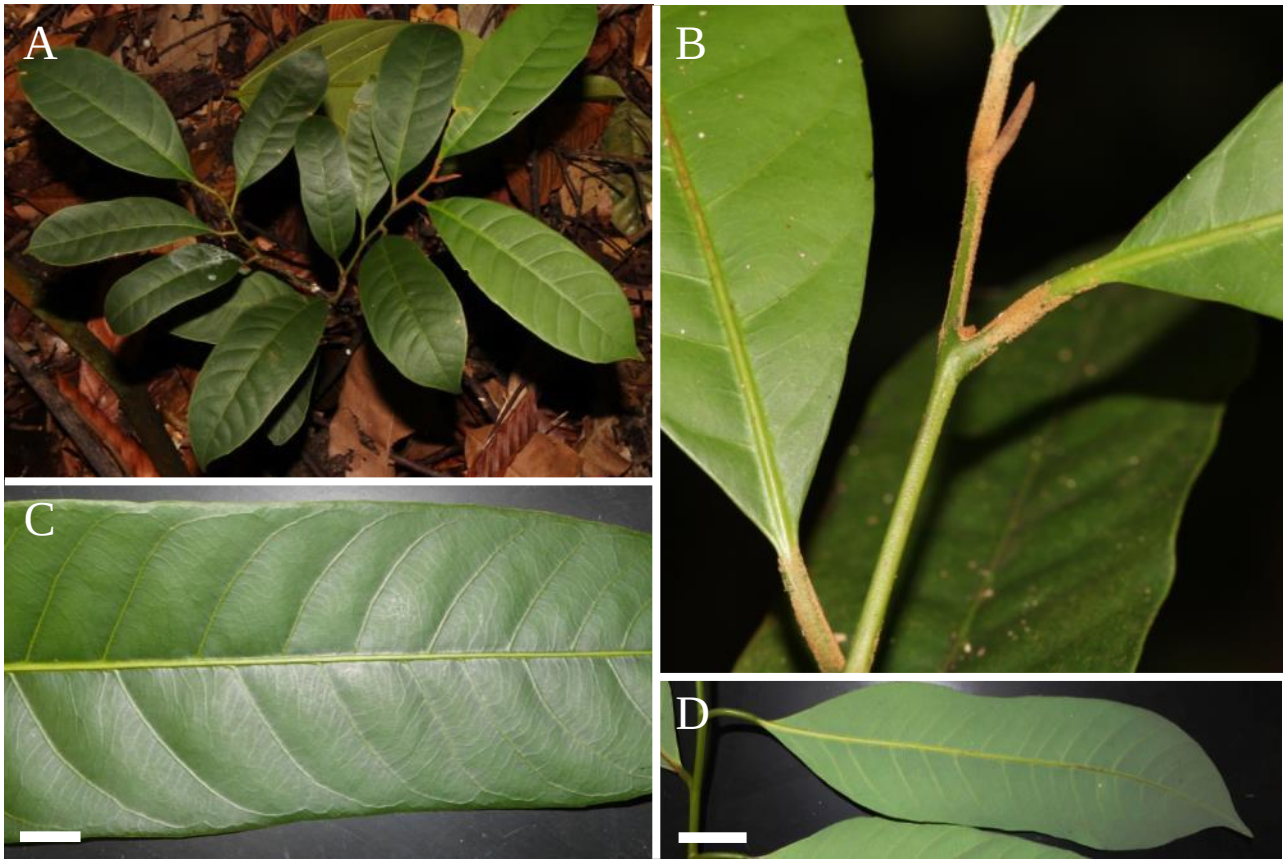

Fig. 47. *Knema intermedia*. A, A young individual in the understorey. B, Young twig becoming glabrous with time. C, Upper lamina surface with prominent tertiary veins. Scale bar = 1 cm. D, The fiddle shaped lamina characteristic of mature leaves. Scale bar = 2 cm.

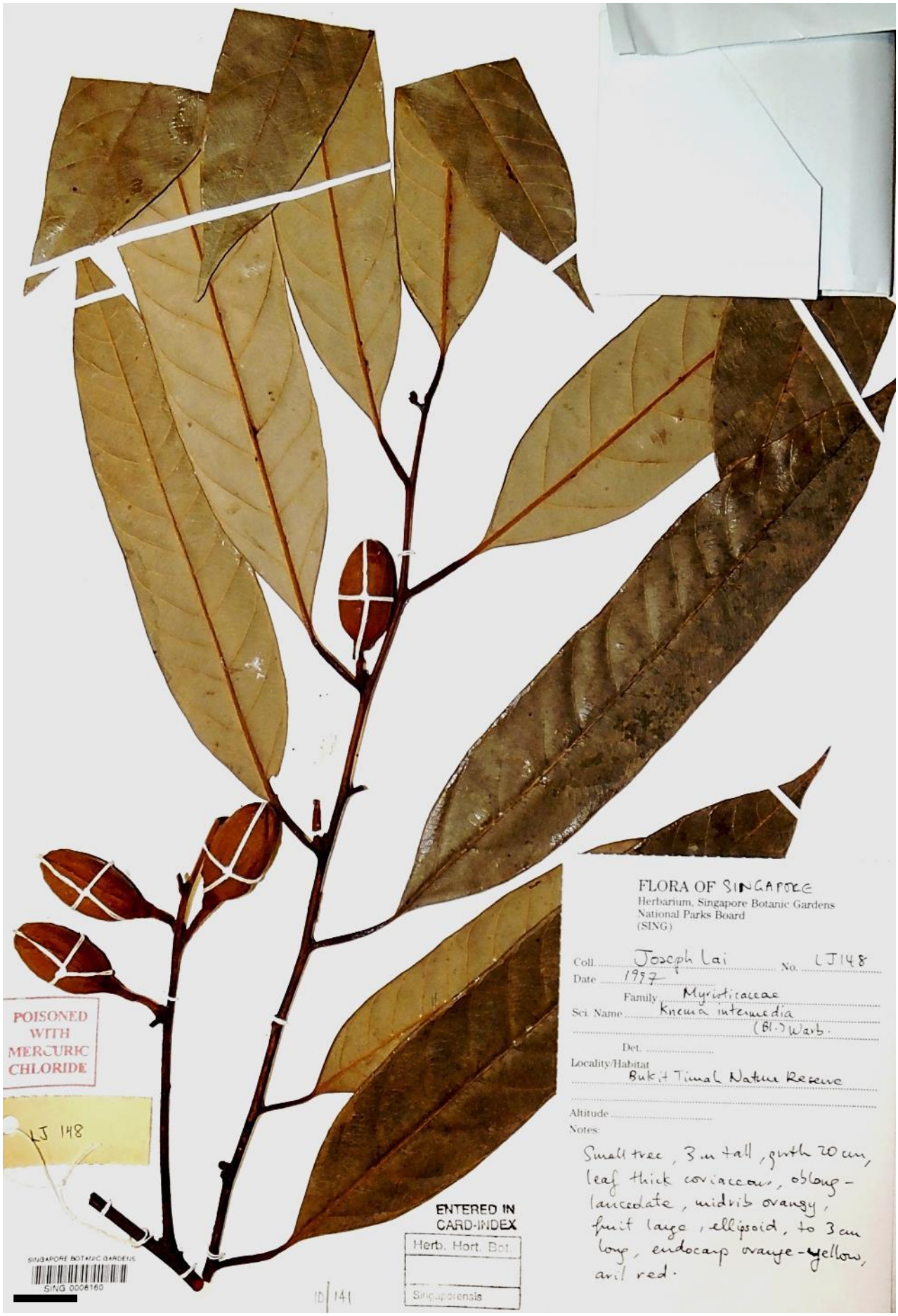

Fig. 48. *Knema intermedia*. Herbarium sheet specimen of fruiting and leafy twigs, *J. Lai, LJ 148*, BTNR, SING barcode no. 0008160. Scale bar = 2 cm.

8. ***Knema latericia*** Elm. ssp. ***ridleyi*** (Gandoger) de Wilde forma ***ridleyi***
(Latin *latericius*, brick-red; referring to the inside of the perianth;
after H. N. Ridley [1855–1956], former Director, Singapore Botanic Gardens)

Key references: de Wilde (2000a: 284–290; 2000b:419–420). This name is listed as unresolved in The Plant List (2013).

Erect shrub or tree to 20 m tall. **Bark** reddish brown or chocolate, scaly or flaking off in fairly large elongate portions, not furrowed; inner bark pink or reddish; sapwood white, pale yellow, or pale brown, sometimes with streaks. **Twigs** l–4 mm across, striate or fissured, *cracking, when mature coarsely or finely flaking off*, or not, sometimes somewhat angular, at first with rough, rust or grey-brown, or yellowish brown hairs, glabrescent when fresh. **Leaves** each with a lamina when fresh dark green above, waxy-white, grey-brown or whitish below, *drying dark brown or greenish above*, oblong to oblanceolate, *usually widest above the middle*, 8–30 × 1.5–9 cm, membranous or thinly coriaceous, not obviously papillate, becoming glabrous with time, with the midrib when fresh whitish green, *when dry reddish on both sides*, raised above, *rust-brown hairs on the base*, 9–30 raised, pairs of secondary veins, and tertiary veins faint or distinct, apex acute-acuminate, base attenuate to rounded; petiole 5–18 × 1.5–3.5 mm, with rust-brown hairs. **Inflorescence** sessile; in the male 3–20-flowered; in the female 2–10-flowered. **Flowers** with a perianth that is 3–4-lobed, outside yellow brown or rust-brown, red inside, with pale brown to rusty hairs; disc pink. **Infructescence** 1–4-fruited. **Fruit** yellow brown or dark rusty, broadly ellipsoid to obovoid, sometimes subglobose, 1–3 × 1–2.5 cm, apex rounded, with rough hairs; pericarp 1–3 mm thick. — Figs. 49–51.

Singapore localities: There have been more than 10 specimens collected from the NSSF. Notable ones are: *J. F. Maxwell 82-77*; *A. Samsuri, S. Lee, A. T. Gwee, Md Noor, P. Leong & S. K. Ganesan NES 8*; *A. Samsuri, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 80*; *NES 198*; *A. Samsuri, S. Lee, Mohd. Noor, Y. K. Chua & P. Leong NES 377*; *T. O'Dempsey SING 2012-036*; *W. F. Ang & C. K. Yeo SING 2012-065*; *C. K. Yeo, D. Austin & X. Y Ng SING 2012-120*; *C. K. Yeo SING 2012-171*; *C. K. Yeo, W. F. Ang, J. Gan & Y. F. Chung SING 2012-193*. This species was also collected previously from other parts of the CCNR and the Singapore Botanic Gardens.

Habitats: Primary and degraded forest, on hill sides, ridges, dipterocarp forest, also in kerangas; found on a variety of soils: sand, loam, clay, black and brown soils, limestone, sandstone, basalt hills, well-drained soils, and leached soils. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Endangered (Tan et al., 2008)

Suggested common name: brick-red knema

Remarks: There are three subspecies of *Knema latericia* recognized by de Wilde (2000a), but only *Knema latericia* ssp. *ridleyi* forma *ridleyi* occurs in Singapore.

Fig. 49. *Knema latericia* ssp. *ridleyi.* A leafy twig showing the upper leaf surfaces with whitish raised midribs.

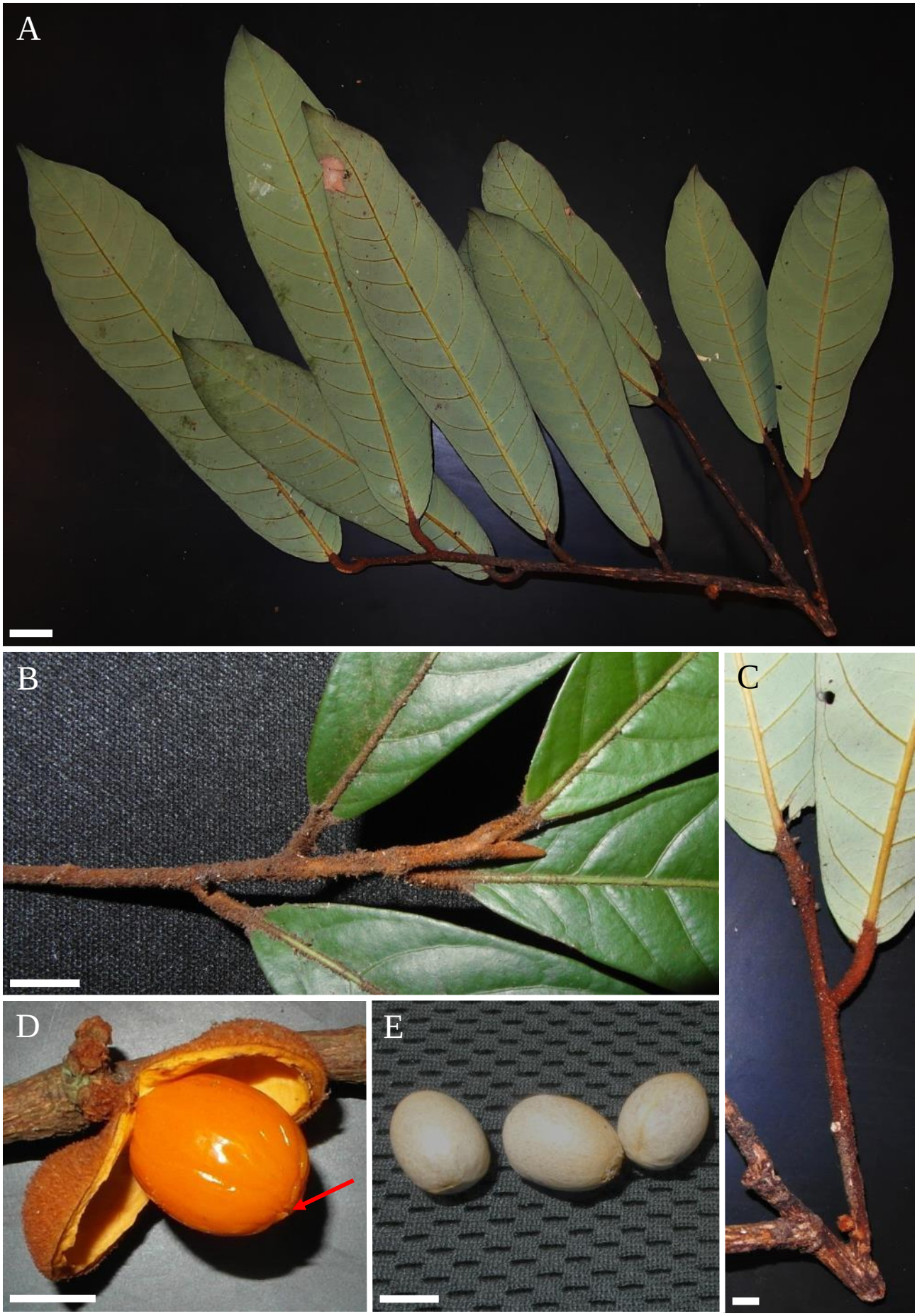

Fig. 50. *Knema latericia* ssp. *ridleyi.* A, A leafy twig showing lower leaf surfaces with a yellowish midrib. Scale bar = 2 cm. B, Young twig with hairs sometimes covering up to the midribs. C, Young twig becoming glabrous and cracking when mature. D, Open fruit with orange aril divided at the apex (red arrow). E, Speckled seeds. Scale bars = 1 cm.

Fig. 51. *Knema latericia* ssp. *ridleyi*. Herbarium sheet specimen of a fruiting and leafy twig, *A. T. Gwee, SING 2012-171*, NSSF, SING barcode no. 0174262. Scale bar = 2 cm.

9. ***Knema laurina*** (Blume) Warb. var. ***laurina***
(Latin *laurinus*, laurel-like; resembling the laurel tree)

Key reference: de Wilde (2000a: 293–295). This name is listed as unresolved in The Plant List (2013).

Shrub or tree to 30 m tall. **Bark** grey or reddish brown, essentially smooth but fine scaly or slightly cracked, sometimes furrowed; inner bark reddish; sapwood white, yellowish, red with brown rays, light brown, or yellow with brown stripes. **Twigs** 2–5 mm across, smooth or striate, not tending to crack or flake off, at first with *dense, rough, rust-brown hairs, late glabrescent*. **Leaves** each with a lamina when fresh glossy above, waxy-white below, drying brown above, obovate-elliptic to oblong-lanceolate, *widest above the middle*, 9–30 × 2.5–10.5 cm, membranous or coriaceous, below finely papillate, with *persistent and equally long-stalked dendroid hairs*, with the midrib somewhat raised above, late glabrescent, secondary veins when fresh yellowish, in 12–28 pairs, and flat or *sunken above*, and tertiary veins raised, and clearly visible above, apex subobtuse to acute-acuminate, base attenuate, rounded, obtuse, rarely subcordate; petiole 10–20 ×1.5–3.5 mm, late glabrescent. **Inflorescence** sessile or stalked up to 0.5 mm; in the male 5–20-flowered; in the female 3–8-flowered. **Flowers** with a perianth that is 3-lobed, pink or red inside, with dense rust-brown hairs. **Infructescence** 1–5-fruited. **Fruit** ripening yellow, golden brown, or red-brown, ovoid or ellipsoid-oblong, when fresh up to 3.5 × 3 cm, drying 1.5–3 × 1–2 cm apex obtuse to subacute, with rusty hairs; pericarp 1.5–2 mm thick. — Figs. 52–53.

Singapore localities: NSSF (*S. Dahlan et al. SING 2005-47*); Seletar Firing Range (*A. T. Gwee, P. T. Chew, et al. SING 2009-116*). This species was also collected previously from the BTNR, other parts of the CCNR, Pulau Ubin, and the Singapore Botanic Gardens.

Habitats: Primary and degraded rain forest and mixed dipterocarp forest; found on a variety of soils: sand, sandstone, sandy ridges, granitic sand, basalt-derived soils, black soil, yellow clayey soil, and shales. In the NSSF, this species was usually collected from wet and dry forest.

Conservation: Nationally Endangered (Tan et al., 2008). Whitmore (1972) lists it as very common throughout Peninsular Malaysia.

Suggested common name: laurel-like knema

Similar Species: The lamina has hairs and a texture similar to that of *Knema conferta*, but the lamina shape of *Knema laurina* is consistently widest above the middle, and its secondary veins are sunken above. This species also does not have the characteristic brownish black dots along the tertiary veins found in the lamina of *Knema conferta*.

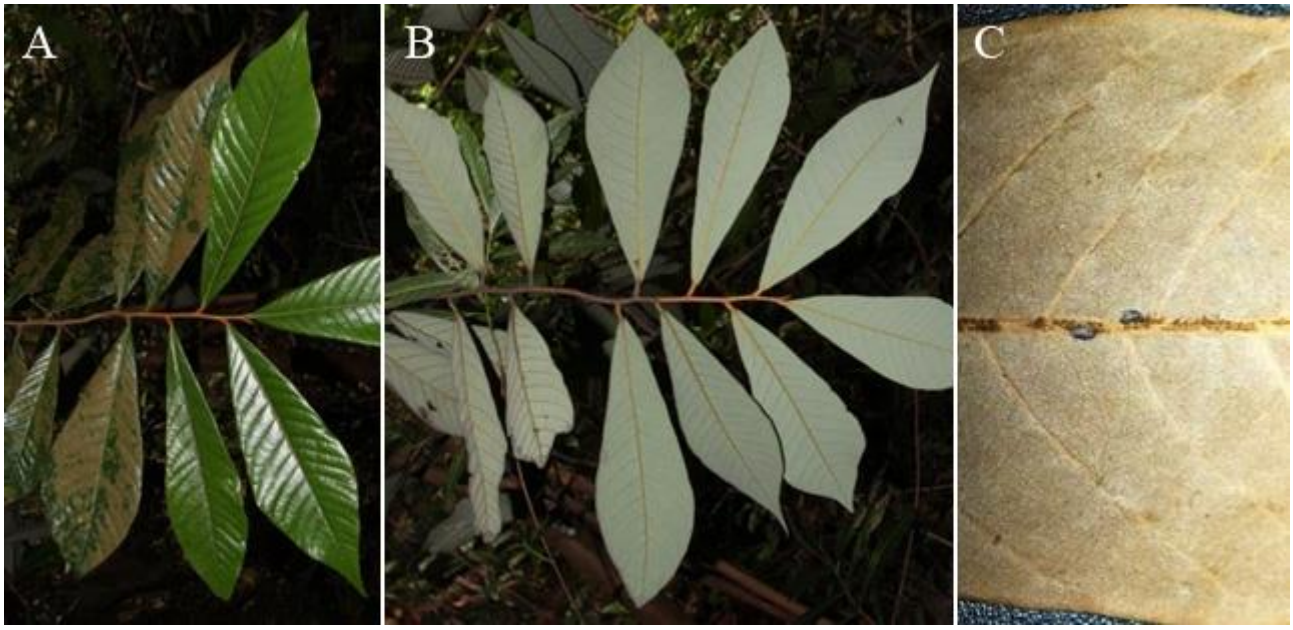

Fig. 52. *Knema laurina.* A, A leafy twig showing the leaf upper surfaces. B, A leafy twig showing the lower leaf surfaces. C, Secondary veins are sunken when dried. Scale bar = 1 cm.

Fig. 53. *Knema laurina.* A, Lower leaf surface without scattered minute brownish black dots along the tertiary veins. Scale bar = 1 mm. B, Herbarium sheet specimen of a flowering and leafy twigs, *J. Lai et al., SING 2012-317*, Pulau Ubin, SING barcode no. 0179375. Scale bar = 2 cm.

10. ***Knema malayana*** Warb.
(Latin *malayanus*, of Malaya or present-day Peninsular Malaysia)

Key reference: de Wilde (2000a: 302–303). This name is listed as unresolved in The Plant List (2013).

Tree to 20 m tall. **Bark** nearly smooth, slightly flaky or not; inner bark pinkish, orange, or brownish, granular, sapwood white. **Twigs** *1–2 mm across*, finely striate, not tending to crack or flake off, at first with rust-brown stellate hairs, glabrescent. **Leaves** each with a lamina drying *unevenly blackish brown above*, grey-waxy-white glaucous below, elliptic to oblong-lanceolate, 7–21 × 2–7 cm, *when fresh slightly chartaceous, drying membranous*, at first with sparse, greyish, early glabrescent, with the midrib raised above, secondary veins usually drying brown, in 14–20 pairs that are raised above, and tertiary veins that are very fine, with *areoles at least 0.5 mm or larger* and prominent and distinct above, apex acute-acuminate, up to 2.5 cm long, base cuneate-attenuate to rounded; petiole 7–15 × 1.5–2.5 mm. **Inflorescence** sessile; in the male 3–15-flowered; in the female 1–6-flowered. **Flowers** with a perianth that is 3–4-lobed, light-yellow outside, cream-coloured inside, with persistent grey or rust-brown hairs; stigma green. **Infructescence** 1–3-fruited. **Fruit** ripening light or dark brown, or yellow, ellipsoid or obovoid, 1.2–1.6 × 0.8–1 cm, apex subobtuse, base often narrowed, with mealy hairs; pericarp 1–1.5 mm thick. — Figs. 1, 2A, 54–55.

Singapore localities: NSSF (*J. Lai LJ 239; A. Samsuri, S. K. Ganesan, P. Leong, A. T. Gwee & Mohd. Noor NES 165; A. T. Gwee SING 2010-467; K. Y. Chong s.n.* SING barcode 0158548; *C. K. Yeo SING 2012-169*); Mandai Track 7 (*C. K. Yeo SING 2012-127*); Upper Seletar (*A. T. Gwee SING 2011-252*; *T. O'Dempsey SING 2012-069*). This species was also collected previously from Chestnut Avenue and the Singapore Botanic Gardens.

Habitats: Lowland and hill forest, old bamboo forest, and ridges. In the NSSF, this species was usually collected from dry forest.

Conservation: Nationally Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Malayan knema

Similar Species: Although easily confused with *Knema communis*, the lamina of *Knema malayana* dries slightly thinner and has larger areoles. The midrib is usually flattish, whereas *Knema communis* has a raised midrib. The lamina of *Knema malayana* usually dries dark brown with the secondary veins a lighter brown above, while the lamina of *Knema communis* usually dries yellow brown, grey or dark brown.

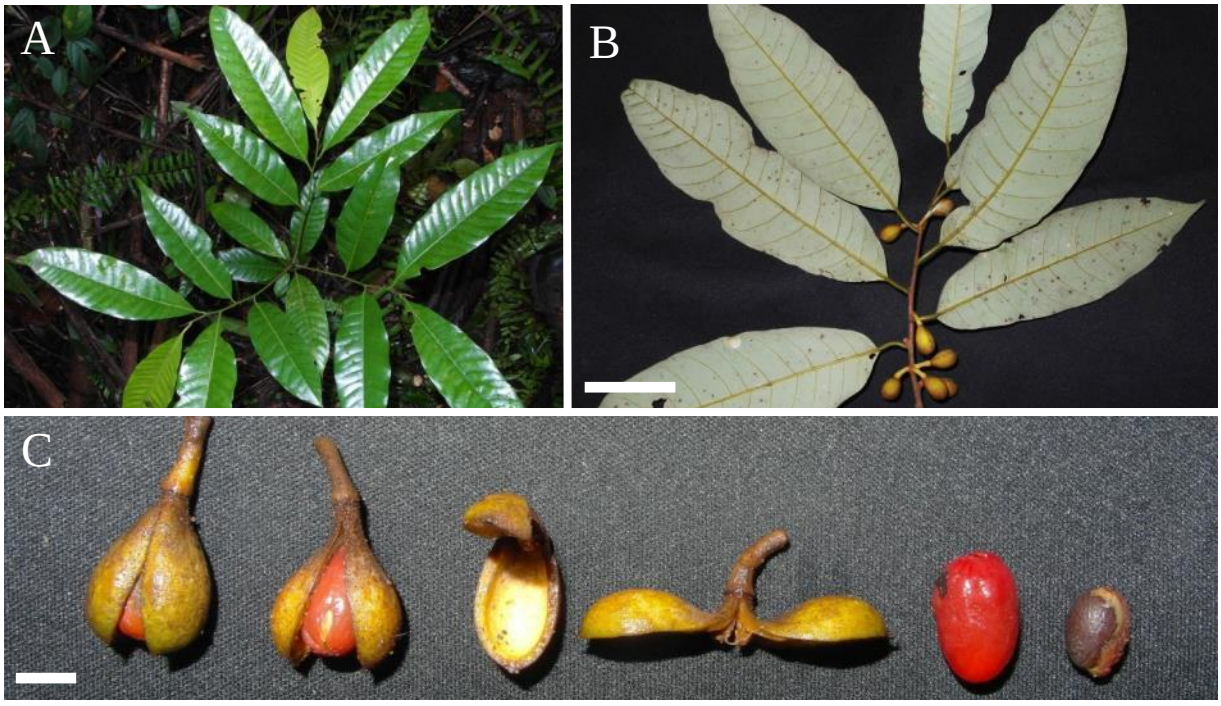

Fig. 54. *Knema malayana*. A, A seedling in the understorey. B, A fruiting twig showing the lower leaf surfaces with unopened fruits. Scale bar = 5 cm. C, Open fruits showing pericarp, aril and seed. Scale bar = 1 cm.

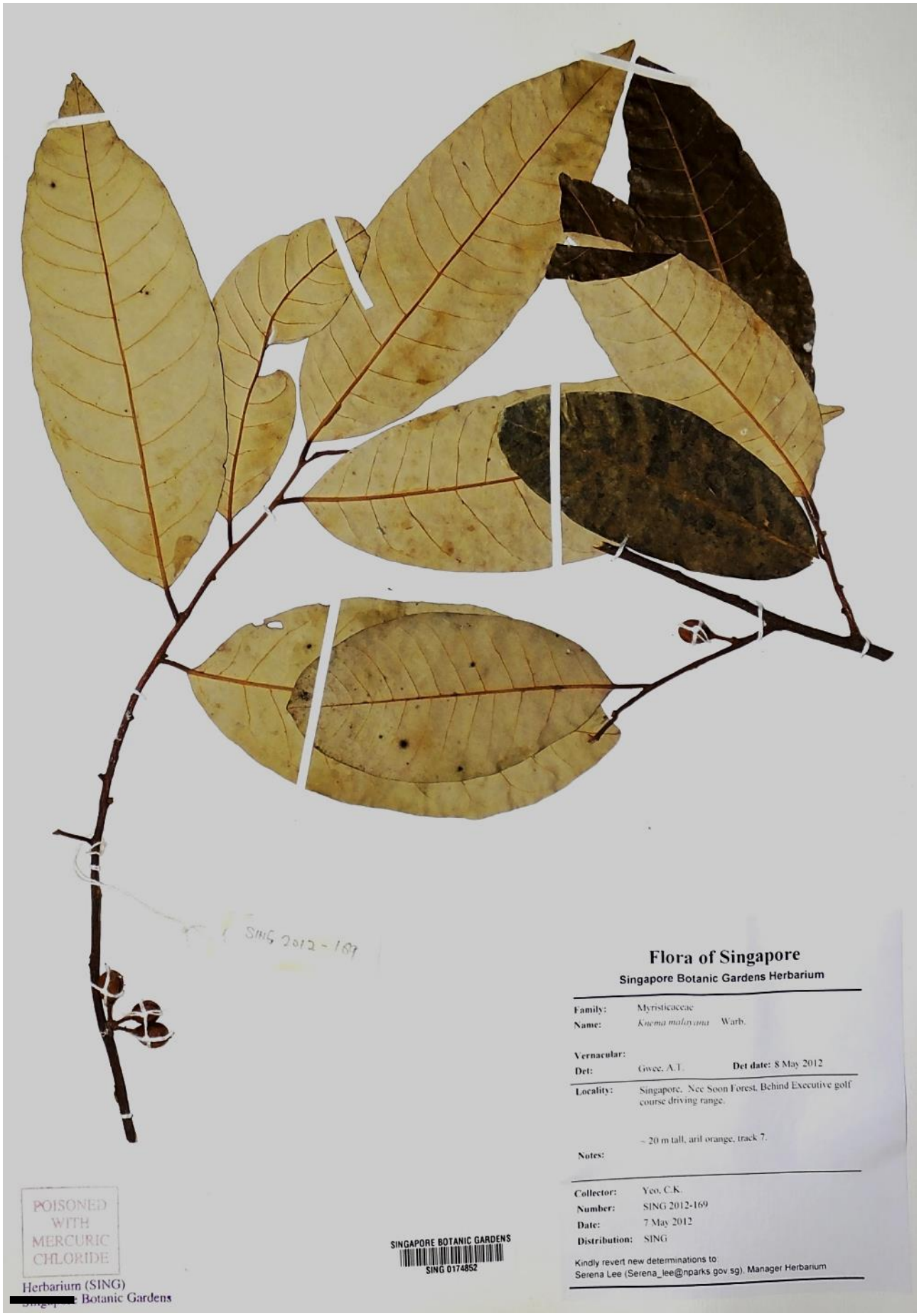

Fig. 55. *Knema malayana*. Herbarium sheet specimen of fruiting twigs, *C. K. Yeo*, *SING 2012-169*, NSSF, SING barcode no. 0174852. Scale bar = 2 cm.

***MYRISTICA* Willd.**

(Greek *muron*; a fragrant vegetable ointment; referring to the nutmeg tree)

Key references: de Wilde (2000a: 359–360), de Wilde (2000b: 449–451)

Trees. **Bark** grey-brown to coal black, rough, sometimes longitudinally fissured; sap watery, red or pink. **Twigs** *striate*, older bark tending to crack or flake off, lenticellate. **Leaves** each with a lamina *drying waxy-white glaucous or brown below, reticulation loosely spaced, never forming a close raised network as in Knema*. **Inflorescence** axillary branched panicles. **Flowers** fragrant, 2- to 4-lobed; rust-brown or cream coloured, small, outside hairy, inside glabrous; females more swollen than males. **Infructescence** simple or branched, few to many-fruited. **Fruit** ripening orange, yellow or rust-brown, ovoid or oblong, 1–10 cm long; pericarp glabrous or pubescent, leathery or somewhat fleshy. **Seed** shiny; *aril divided to or nearly to the base*, oily.

Key to species based on dried, sterile characters

1. Lamina below when fresh and dry slightly shiny, coppery brown. ..... *Myristica cinnamomea*
– Lamina below when fresh light green, drying waxy-white or brown. 2

2. Lamina below waxy-white, secondary veins above raised or flat. 3
– Lamina below brown, secondary veins above sunken. 4

3. Twigs and lamina above yellowish, lamina margin, midrib or secondary veins undulate, lamina not bullate. ..... *Myristica elliptica*
– Twigs and lamina above brown, lamina margin, midrib or secondary veins not undulate, lamina bullate. ..... *Myristica maxima*

4. Lamina usually <10 cm, 11–16 pairs of secondary veins. ..... *Myristica iners*
– Lamina usually ≥15 cm, 15–22 pairs of secondary veins. . ..... *Myristica lowiana*

1. ***Myristica cinnamomea*** King

(Latin *cinnamomeus*, yellow-brown; referring to the colour of the lamina below)

Key reference: de Wilde (2000a: 431–432). This name is listed as unresolved in The Plant List (2013).

Tree to 30 m; bole trunk at base often fluted or with low buttresses or small stilt roots. **Bark** blackish brown, with fine close vertical fissures, sometimes with fine horizontal cracks, sometimes thinly flaking off with appressed flakes; inner bark brown to pinkish, soft; sap red, watery; sapwood pale yellowish to brownish, often speckled reddish. **Twigs** *dark grey-brown to blackish* when mature, 1.5–4 mm across, glabrescent. **Leaves** each with a lamina *greenish brown above when fresh, somewhat glossy, drying brown, below coppery or silvery-brown when fresh, remaining so when dry*, elliptic-oblong to oblong-lanceolate, 8–22 × 2–8 cm, chartaceous or thinly coriaceous, not obviously papillose, sometimes late glabrescent, hairs inconspicuous, with midrib above flat or somewhat raised, in a groove, 10–17 pairs of secondary veins that are *faint below*, and *tertiary veins indistinct*, apex acute-acuminate, base broadly acute or attenuate; petiole 12–22 by 1.5–3 mm. **Inflorescence** among the leaves, pedunculate, 1–2.5 cm long, with mealy hairs; male lateral branches up to 5 mm, central axis to 10 mm or absent or reduced to one flower, with subumbels of 5–10 flowers, buds of various sizes; female with a pedunculate wart, with 2–4-flowered subumbel. **Infructescence** solitary or up to 3 fruits. **Fruit** ripening yellow to brown, broadly ellipsoid or oblong, 5–9 × 2.5–5 cm, hairs rust-brown, dense, mealy; pericarp 5–15 mm thick. **Seed** blackish, ellipsoid, 3.5–5.5 cm long; aril bright or dark red. — Figs. 51–52.

Singapore localities: NSSF (*J. Sinclair SF 40374*; *P. Wilkie, A. T. Gwee, M. Ragupathy & A. Ali PW 540*). This species was also previously collected from the BTNR and the Singapore Botanic Gardens.

Habitats: Locally common or scattered in various types of primary forest such as lowland and hill mixed dipterocarp forest, ridge forest, wet ground, sandstone; on hillsides, crests, undulating land; also in peat swamp forest

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: cinnamon-leafed nutmeg

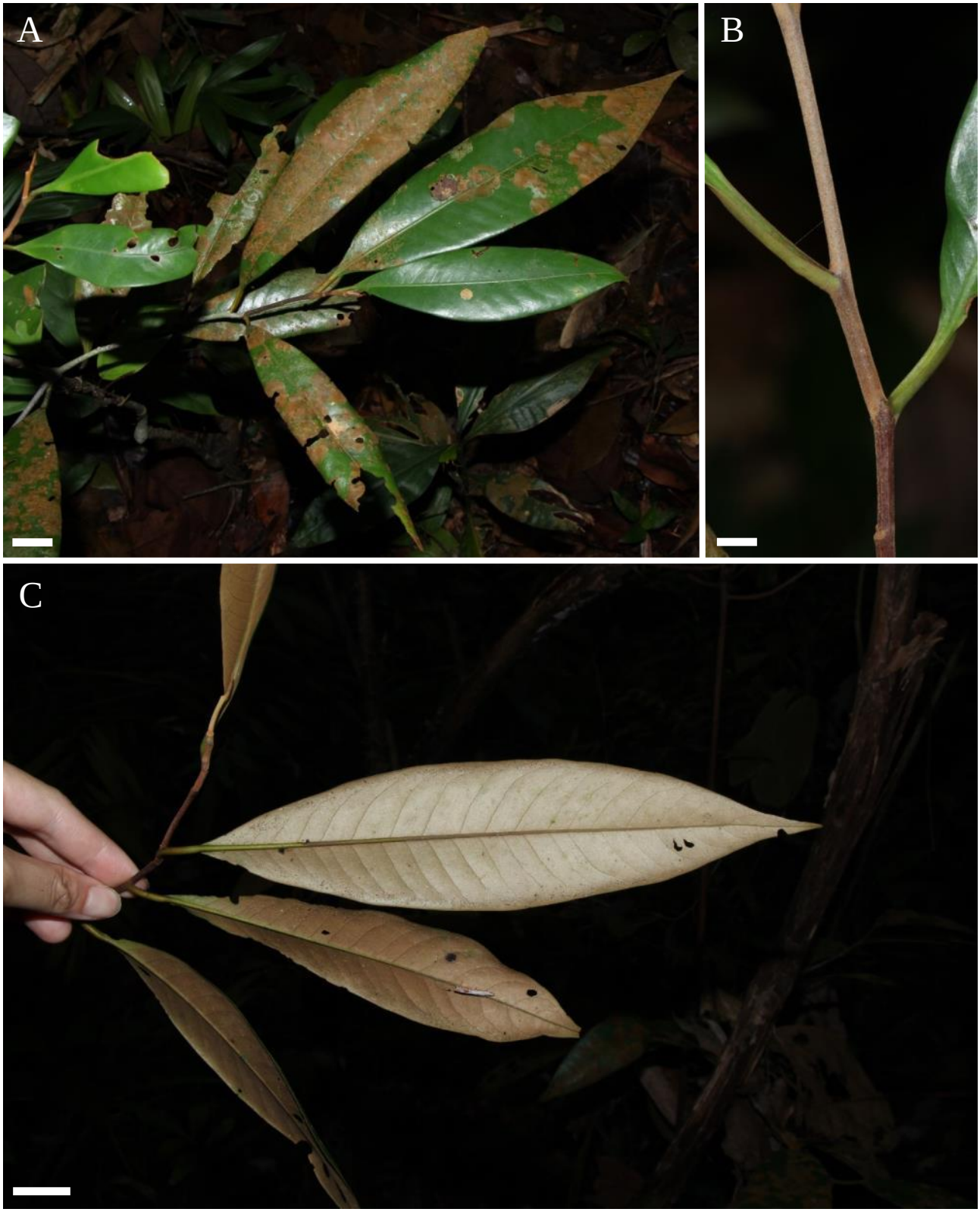

Fig. 51. *Myristica cinnamomea.* A, Leafy twigs. Scale bar = 1 cm. B, Young twig. Scale bar = 5 mm. C, Lower leaf surface, with the distinctive coppery scales. Scale bar = 1 cm.

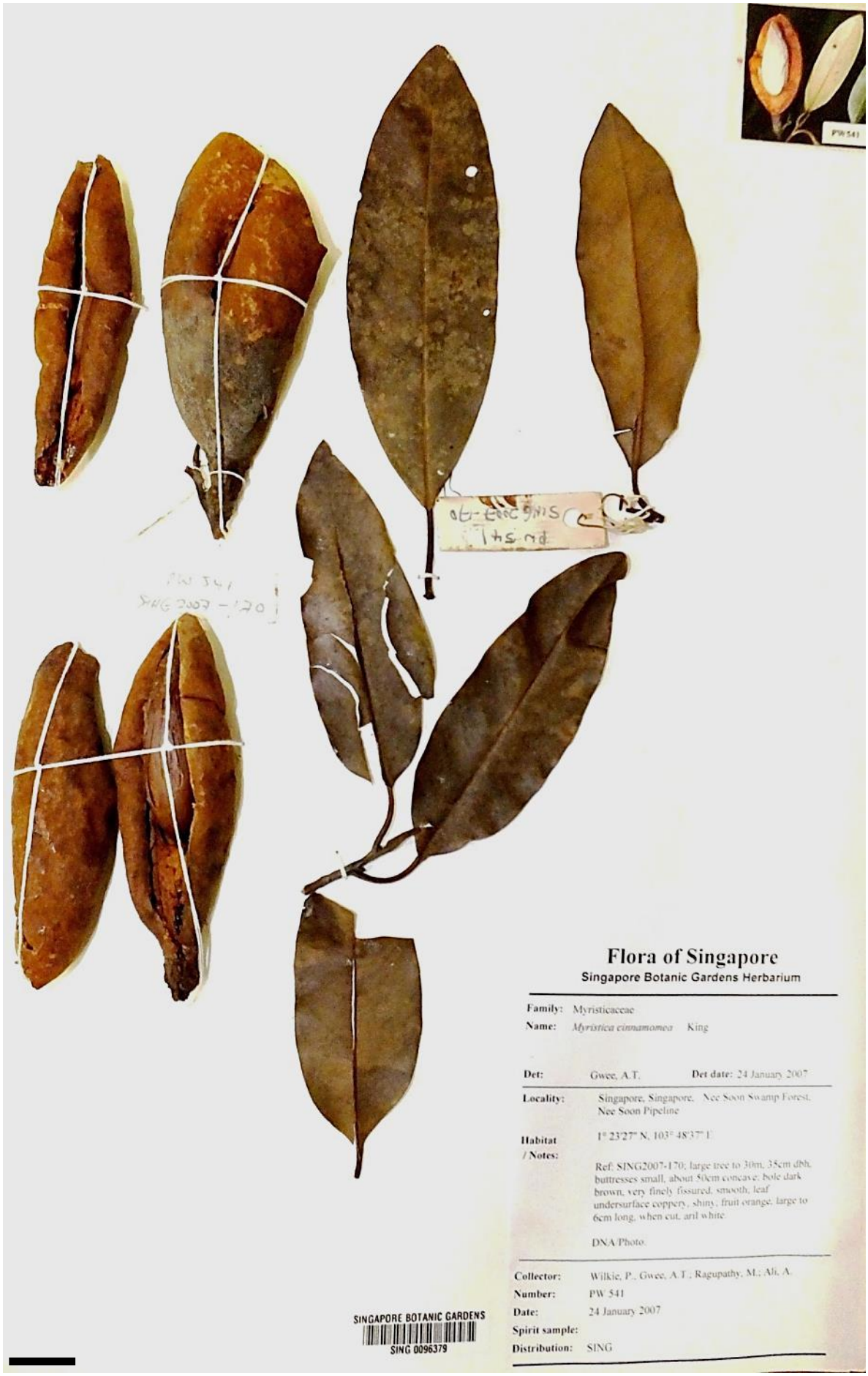

Fig. 52. *Myristica cinnamomea*. Herbarium sheet specimen of leaves and fruits, *P. Wilkie et al., PW 541*, NSSF, SING barcode no. 0096379. Scale bar = 2 cm.

2. ***Myristica elliptica*** Wall. ex Hook.f. & Thoms.
(Latin *ellipticus*, shaped like an ellipse; referring to the leaf shape)

Key reference: de Wilde (2000a: 454–457). This name is listed as unresolved in The Plant List (2013).

Tree to 40 m tall; bole trunk sometimes fluted or buttressed up to 1 m high, in marshy forest with spreading stilt-roots. **Bark** grey to dark brown to blackish, smooth or finely fissured or scaly, sometimes lenticellate; inner bark red-brown to pink; sapwood white to pale yellow; sap watery, pink or red. **Twigs** *pale, grey or yellowish, older twigs straw or yellowish*, 2–4 mm across, not longitudinally cracking, sometimes with a few pale brown lenticels; early glabrescent, hairs grayish. **Leaves** each with a lamina above drying *yellowish or greenish brown, below greyish or yellowish*, elliptic or oblong, 9–32 × 3–12 cm, chartaceous, *drying somewhat undulate*, minutely pustulate, papillae not obvious, dots sometimes present, scattered, early glabrescent, hairs greyish or pale brown, scattered, appressed, with midrib above flat or slightly raised, 8–15 pairs of secondary veins that are faint, flat or slightly raised above, distinct below, and tertiary veins faint on both surfaces, apex acute-acuminate, base narrowly rounded or acute; petiole 10–30 × 1.5–2.5 mm. **Inflorescence** among the leaves, loose subumbels of 3–5; glabrescent, hairs pale, sparse, appressed; males 1–2.5 × 1–1.5 cm, few-flowered, branches simple, up to 5 mm. **Flowers** with buds of various sizes; females like males, 1–3, angled, hairs pale, sparse, appressed. **Infructescence** often conspicuously lenticellate, 1 or 2 fruits. **Fruit** ripening from greenish yellow to orange ovoid or ellipsoid, 4.5–7.5 × 2–4 cm, early glabrescent, apex rounded or bluntly narrowed or somewhat beaked, base often narrowed into 4–12 mm long pseudostalk; pericarp dull dark brown, 5–10 mm thick. **Seed** greenish-brown, ellipsoid, 4–5 cm. — Figs. 3C, 53–55.

Singapore localities: NSSF (*A. Samsuri, S. Lee, A. T. Gwee, Md. Noor, P. Leong & S. K. Ganesan NES 31*; *W. F. Ang SING 2012-277*; *D. Austin SING 2012-282*). This species was also previously collected from the BTNR and other parts of the CCNR.

Habitats: Primarily in swamp and peat swamp forest; also in disturbed forest and belukar; alluvial forest; degraded forest, along rivers; clayey or poor sandy soils, also on red soil; rocky streamsides. In the NSSF, this species was collected only from wet forest.

Conservation: Nationally Endangered (Tan et al., 2008). Whitmore (1972) lists it as common throughout Peninsular Malaysia. The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: swamp nutmeg

Fig. 53. *Myristica elliptica*. A, Leafy twig showing upper leaf surfaces. Scale bar = 2 cm. B, Leafy twig showing lower leaf surfaces. Scale bar = 1 cm

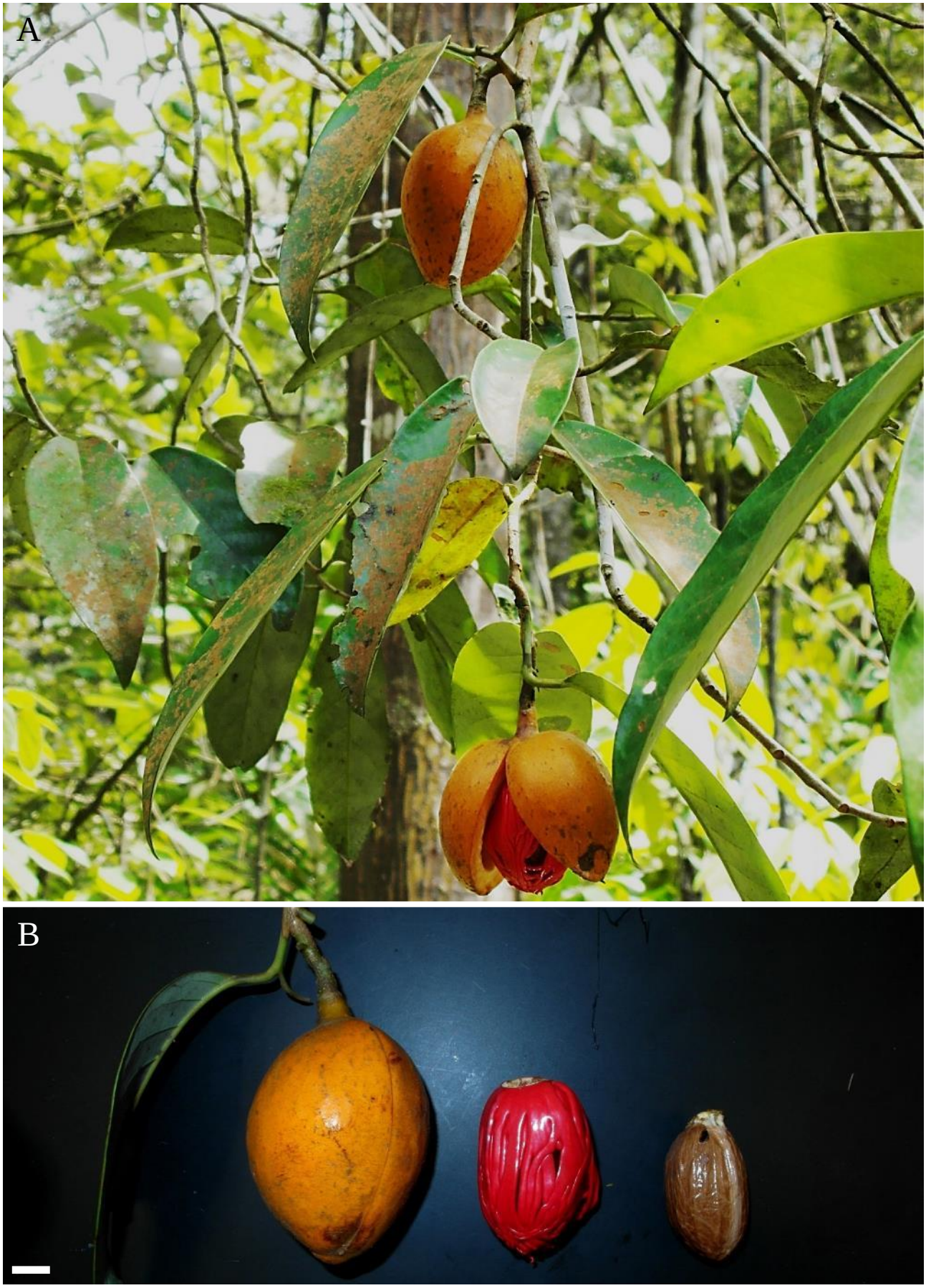

Fig. 54. *Myristica elliptica*. A, Fruiting twigs with an open fruit. B, Unopen fruit, red divided aril covering seed and seed. Scale bar = 1 cm.

Fig. 55. *Myristica elliptica*. Herbarium sheet specimen of fruiting twigs, *D. Austin, SING 2012-282*, NSSF, SING barcode no. 0178896. Scale bar = 2 cm.

3. ***Myristica iners*** Blume
(Latin *iners*, inert or sluggish; referring to the absence of an aroma of the seed)

Key reference: de Wilde (2000a: 493–495)

Tree to 40 m tall; with buttresses or stilt-roots, or without stilt-roots. **Bark** dark brown, grey, and blackish, rough, deeply fissured and flaky; inner bark pinkish or brown, soft, laminated; inner wood white or pale, sometimes red streaked; sap clear, reddish, sometimes copious. **Twigs** blackish brown, 1.5–3 mm across, flaking off, sporadically with a few lenticels, early glabrescent, hairs greyish. **Leaves** each with a lamina above drying *brown-grey*, *below brown*, elliptic-oblong to oblong-lanceolate, *7–24 × 1.5–10 cm*, membranous or *chartaceous*, *below early glabrescent*, hairs scale-like, with midrib slightly raised above, 11–16 pairs of secondary veins that are flat to sunken above, and tertiary veins indistinct, apex acute-acuminate, base rounded or attenuate; petiole 11–25 × 0.5–2 mm. **Inflorescence** between the leaves or below, paniculate, glabrescent; male with 1 or 2 subumbels of 5–15 flowers, buds of various sizes, 2–8 cm long, branches to 20 mm, central axis absent or up to 40 mm; females reduced, 1–6 flowered, sometimes sessile. **Flowers** glabrescent, hairs woolly. **Fruit** usually single, ripening yellow, ellipsoid or ovoid-ellipsoid, 3.5–8 × 2.5–4.5 cm, glabrescent, hairs grey-brown, dense, mealy; pericarp 4–10 mm thick. **Seed** glossy brown or black, ellipsoid, 2–5 × l–2.3 cm; aril orange to red. — Figs. 56–57.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also collected previously from Mandai Road (*E. J. H. Corner SFN 36282*) and Tanjung Gul (*J. Sinclair 10664*).

Habitats: Forest on flats, slopes and ridges; evergreen forest; peat swamp forest; on sandstone and sandy-loam soils or tuff soil

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: inert nutmeg

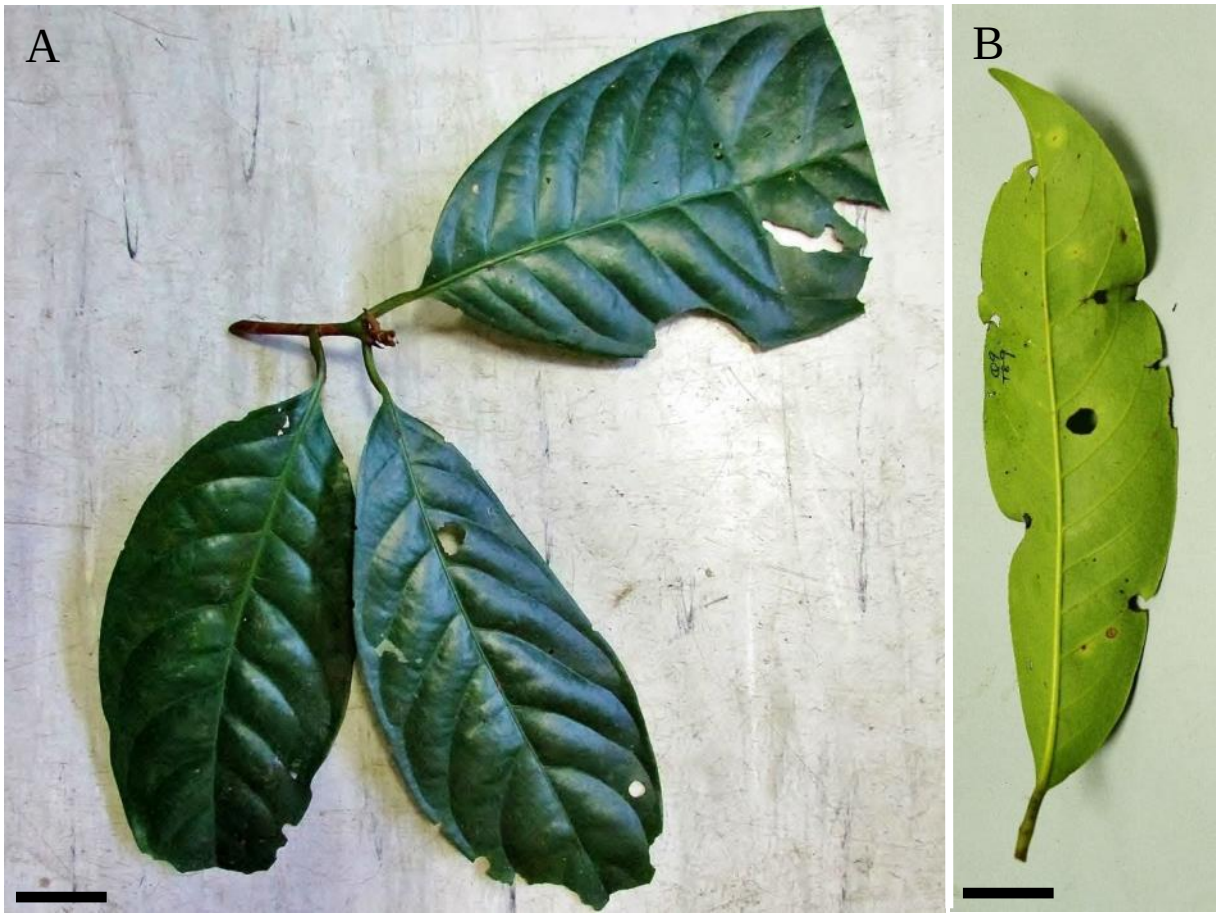

Fig. 56. *Myristica iners.* A, Leafy twig showing upper leaf surfaces. Scale bar = 2 cm. B, Lower leaf surface. Scale bar = 5 mm.

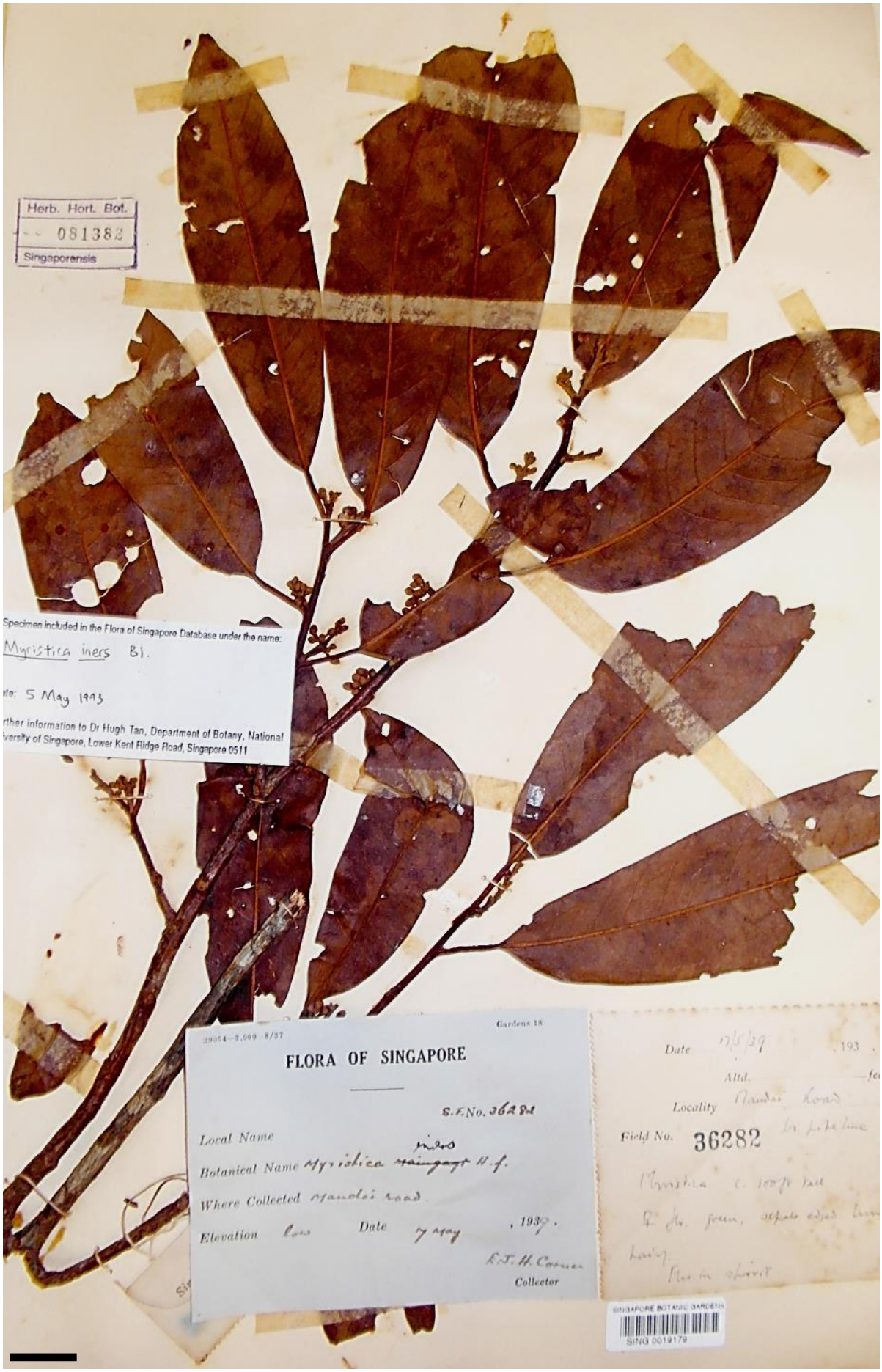

Fig. 57. *Myristica iners.* Herbarium sheet specimen of flowering twigs, *E. J. H. Corner, SF No. 36282*, Mandai Road, SING barcode no. 0019179. Scale bar = 2 cm.

4. ***Myristica lowiana*** King
(After Sir Hugh Low, 1824–1905, officer of the British East India Company; plant collector)

Key reference: de Wilde (2000a: 517–518). This name is listed as unresolved in The Plant List (2013).

Tree to 25 m tall; usually with stilt-roots, buttresses or flying buttresses up to 1.2 m tall. **Bark** chocolate or blackish, hard, brittle, longitudinally fissured or ridged or scaly; outer bark blackish; inner bark pink or brown; sapwood white turning brownish; sap red, watery. **Twigs** when mature blackish, 3–6 mm across, cracking and flaking off, lenticels indistinct or absent, late glabrescent, hairs rust-brown, rough-woolly. **Leaves** each with a lamina above drying *glossy, greyish brown, below brown*, oblong-lanceolate, *14–35 × 3.5–11.5 cm*, *coriaceous*, distinctly papillose, early glabrescent, hairs rust-brown, mealy, with midrib raised above, glabrescent, 15–22 pairs of secondary veins that are usually sunken above, and tertiary veins faint and sunken above, rendering the blade *somewhat bullate*, apex acute-acuminate, base rounded or short cuneate; petiole 25–50 × 2.5–5 mm, late glabrescent. **Inflorescence** between the lower leaves or below, branched, with rough. woolly hairs; male subumbel of 5–10 flowers, 2.5–5.5 × 2–3 cm, central axis 5–25 mm long; buds of various sizes; female 3–5 flowered, 1–1.5 cm long, hardly branched, rather thick. **Flowers** hairy. **Fruit** generally single, ellipsoid, 5–7 × 3.5–4 cm, hairs brown, velvety; pericarp 5–15 mm thick. **Seed** glossy dark brown, ellipsoid, 4–5 cm long. — Figs. 58–60.

Singapore localities: No specimens from the NSSF were found in SING at the time of writing. This species was also collected previously from the BTNR, Jurong (*E. J. H. Corner SF 28131*), Kranji (*H. N. Ridley 6451*) and the Singapore Botanic Gardens.

Habitats: Fresh water peat swamp forest, also riverine forest, ridge forest on yellow soil and undulating hills on yellow sandy soils

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Near Threatened (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: Low's nutmeg

Fig. 58. *Myristica lowiana.* A, Habit of a tree in the Singapore Botanic Gardens. B, Trunk of mature individual .

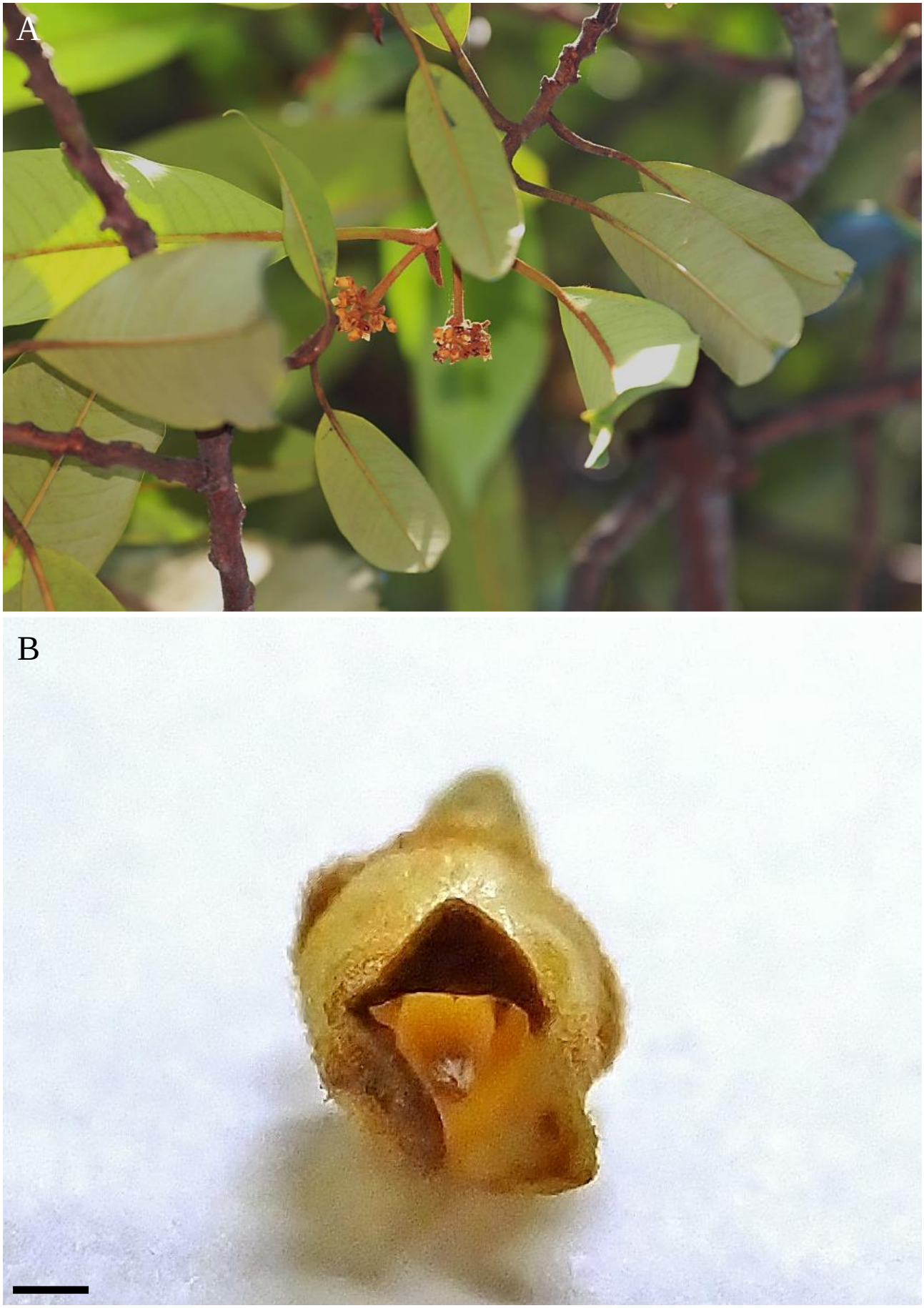

Fig. 59. *Myristica lowiana*. A, Male inflorescence. B, Closeup of an individual male flower. Scale bar = 1 mm.

Fig. 60. *Myristica lowiana*. Herbarium sheet specimen of flowering twigs, *E. J. H. Corner, SF No. 28131*, Jurong, SING barcode no. 0019186. Scale bar = 2 cm.

5. ***Myristica maxima*** Warb.
(Latin *maximum*, greatest; perhaps referring to the leaf size)

Key reference: de Wilde (2000a: 523–525). This name is listed as unresolved in The Plant List (2013).

Tree to 35 m tall; with or without buttresses, sometimes with stilt-roots or with stilt-roots and buttresses; buttresses, if present, variable, up to 3 m out and high. **Bark** grey-brown or chocolate, smooth or rather rough, hard, shallowly scaly, dippled, or shallowly fissured; inner bark usually reddish brown, soft; sapwood pale brown to whitish, also with red sap; heartwood brown; sap light to dark red , clear, copious or not. **Twigs** 4–8 mm across, mature twigs becoming rough and scaly, not longitudinally cracking, lenticels often present but indistinct, early glabrescent, indumentum minute. **Leaves** each with a lamina drying *blackish brown or brown above, sometimes bullate, brownish grey or grey below*, elliptic or oblong-lanceolate, *16–40 × 6–20 cm, membranous, chartaceous* or thinly coriaceous, seemingly glabrous, but actually minutely pubescent, or glabrescent, hairs interwoven or sparse, grey-brown, scale-like, with midrib flat or raised above, 23–33 pairs of secondary veins that are flat or impressed above, and *tertiary veins distinct on both surfaces*, apex acute-acuminate, base rounded or shallowly cordate, sometimes attenuate; petiole 25–35 × 2.5–4 mm. **Inflorescence** usually between the leaves, subglabrescent, essentially paniculate, stout, indumentum grey, minute; male 6–18 × 3–8 cm; lower branches up to 3 cm long, central axis 4–8 cm long, with up to 6 side branches; subumbels shortly stalked or sessile, each with 5–10 flowers; buds of various sizes, female smaller, 5–9 cm long; subumbels 1–5 flowered. **Flowers** coriaceous, hairs brown-grey, thin. **Fruit** ripening yellow to rust-brown, ellipsoid oblong, 9 cm long when fresh, drying 4.5–9 × 3.5–5 cm, hairs dark brown, mealy, sometimes late glabrescent, base sometimes narrowed, 1–4 per infructescence; pericarp 10–15 mm thick. **Seed** ellipsoid-oblong, 4–6 cm long; aril in lower quarter sometimes undivided, yellow turning red. — Figs. 61–62.

Singapore localities: NSSF (*J. Sinclair SF 40304, A. Samsuri, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 77*). This species was also collected previously from the BTNR.

Habitats: Primary forest; seasonal swamp forest; ridges; sandy loam, yellow clay loam, sandy and black soils, shales, loam soil containing limestone, volcanic rock

Conservation: Nationally Critically Endangered (Tan et al., 2008). The World Conservation Monitoring Centre categorised it in the IUCN Red List of Threatened Species in 1998 as Lower Risk/Least Concern (version 2.3) (World Conservation Monitoring Centre, 2014).

Suggested common name: great nutmeg

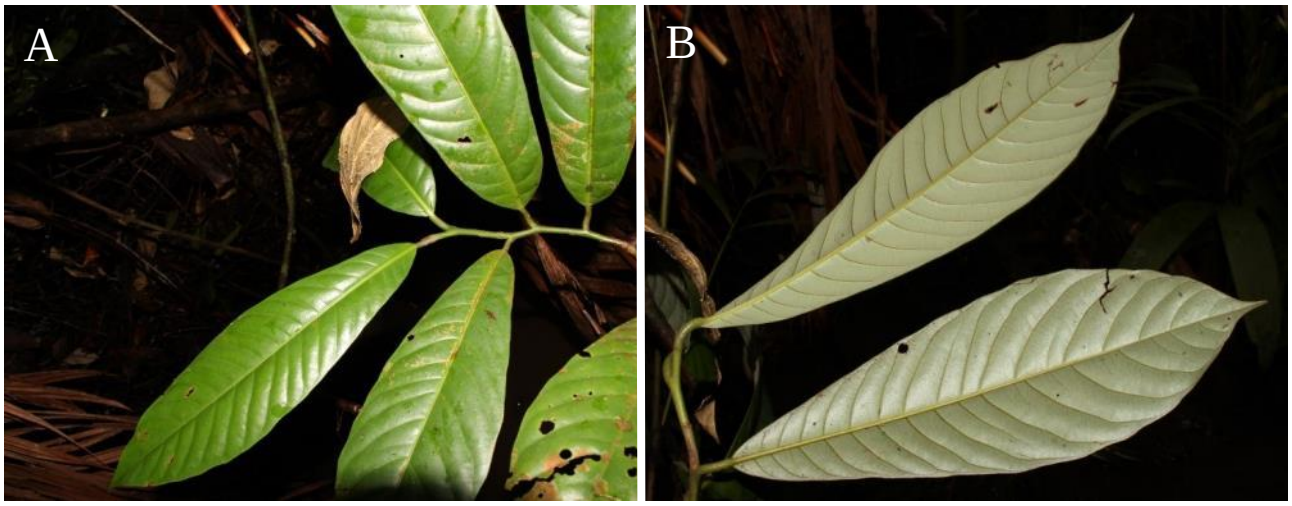

Fig. 60. *Myristica maxima.* A, Leafy twig showing upper leaf surfaces. B, Leafy twig showing lower leaf surfaces.

Fig. 61. *Myristica maxima*. Herbarium sheet specimen of leaves and fruits, *M. S. Khoo, KMS 79*, BTNR, SING barcode no. 0123455. Scale bar = 2 cm.

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