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Towards a field guide to the trees of the Nee Soon Swamp Forest (I): Lauraceae

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Abstract. The forests within and around Singapore's last substantial tract of intact freshwater swamp—Nee Soon Swamp Forest—are extremely diverse floristically and so present challenges in the recognition of plant species. Here we provide two keys and species descriptions, based on characters easily observed in the field, to the 22 species of Lauraceae found there. Two of these are new additions to Singapore's flora: *Cryptocarya nitens* (Blume) Koord. & Valeton and *Litsea resinosa* Blume. This is the first in a series of articles that aim to assist in the identification of the trees of the Nee Soon Swamp Forest.

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

INTRODUCTION

Singapore's last substantial patch of intact freshwater swamp forest, commonly known as the Nee Soon Swamp Forest (NSSF), is located within a watershed on the eastern side of the Central Catchment Nature Reserve (CCNR), between the Upper Seletar Reservoir and the Upper and Lower Peirce reservoirs, bounded by the Seletar Expressway to the northeast, Old Upper Thomson Road to the east, and the access road to the Upper Peirce Reservoir Park to the south. This part of the nature reserve inherits a portion of the former Chan Chu Kang Forest Reserve that was gazetted in the late 19th century (Corlett, 1992), so it has large trees and rare species that would otherwise have been at risk of being lost to the almost complete deforestation that occurred during Singapore's days as a British colony. Not all of this area is swamp, as dry ground occupies sites of higher elevation, and most of the swampy areas are considered primary forest as they are floristically similar to the freshwater swamp forests described by Corner (1978). Also the dry areas consist mostly of old growth forest, i.e., remnants of primary forest or forest towards the older end of secondary succession, except for the forest edges such as along roads or the water pipeline running generally north–south through the area, where human and natural disturbances are more frequent. The heterogeneity resulting from the interplay between the wet–dry and the disturbance gradients has given rise to a flora that is extremely diverse and comparable to that of the better-researched and publicly more well-known Bukit Timah Nature Reserve (BTNR; see Turner & Chua, 2011). Many recent rediscoveries of plant species formerly thought to be extinct (see Chong et al., 2012) and new records (e.g., Rodda & Ang, 2012) were from this general area, which testify to its conservation value and the need to better document its biodiversity.

Our research is part of a larger project on predicting the distribution of the water table in this site, for which we use the name "Nee Soon Swamp Forest" although it includes both swampy and non-swampy areas. In the project's first phase, a checklist of plant species (Wong et al., 2013) was compiled from a combination of past checklists and surveys (e.g., Turner et al., 1996), deposited specimens in the Herbarium, Singapore Botanic Gardens (SING), and Herbarium, Lee Kong Chian Natural History Museum, National University of Singapore (SINU), and field records from a plant inventory of 10 vegetation plots that were each 15 × 15 m. In this phase of the project, we extended the plot size to 20 × 20 m, and added more plots for a total of 40 (see Fig. 1). Half of the plots were in "wet" areas, defined by the presence of open water bodies such as swamp pools or streams, while half were in "dry" areas, without such water bodies.

This series of articles resulted from our investigations to identify the plant species that we encountered. Families with many tree species in NSSF were prioritised, because trees are expected to contribute overwhelmingly to the hydrology (via interception of rainfall by the canopy and transpiration) and biomass of the site. The brief species descriptions mostly follow the terminology of The Kew Plant Glossary (Beentje, 2010), and include our inference on the affinity of species for swampy and dry ground (i.e., "habitat"), mainly from the relative occurrence in our wet and dry ground plots but also from existing descriptions and notes on herbarium sheet labels, where available. National, regional, and global conservation status categories or suggestions of rarity will be provided whenever available. The etymology of the species names and some suggested common names for communication with the general public are also provided.

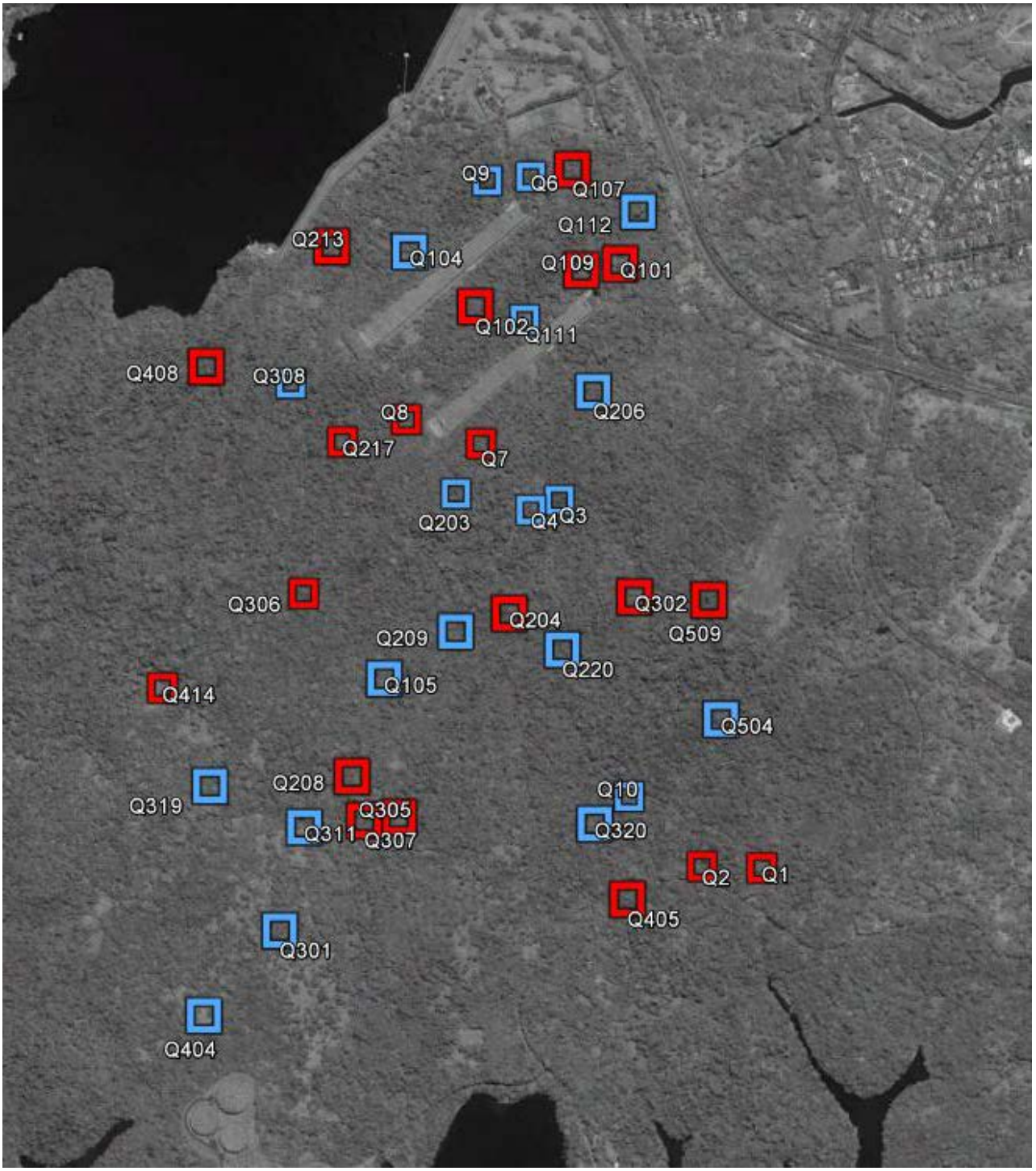

Fig. 1. Distribution of the vegetation plots in the NSSF. Blue—"wet" plots; red—"dry" plots. Plots labelled with single and three-digit numbers are from Phases 1 and 2 of the project, respectively. Image from Google Earth captured by satellite on 22 April 2013.

The Lauraceae, also known as the laurel or cinnamon family, are mostly trees, with some species such as *Litsea elliptica* capable of reaching enormous sizes. LaFrankie (2010) described the family as recognisable in the field by "the combined absence of notable features". Leaf insertion can vary from whorled (i.e., three or more leaves per node) in *Actinodaphne* to opposite or sub-opposite (i.e., two leaves per node), e.g., in *Litsea lancifolia*, although leaves in most species are usually spiral or alternate (i.e., one leaf per node). In some spiral-leaved species, the leaves can be clustered at the end of twigs, e.g., in *Alseodaphne bancana*, *Beilschmiedia kunstleri*, some *Litsea* species, *Neolitsea cassia*, and *Nothaphoebe umbelliflora*, but these are not true whorls. While the family is considered exstipulate, the buds of *Actinodaphne* are covered with scale leaves that may be mistaken for stipules, and the buds of *Alseodaphne*, *Neolitsea*, and some *Litsea* species are covered by scales that fall off, leaving nodal scars that may be mistaken for stipular scars. Latex is absent, and the crushed leaves and slashed bark of some species exude a spicy odour characteristic of cinnamon. The leaf blade margins are entire, and usually flat, but sometimes wavy. The leaf blades of many species are also at least glaucescent, if not distinctly glaucous, on the underside.

Species and even generic delimitations in the Lauraceae are still in progress of being resolved, partly because both flowers and fruits are required but fruit development takes place over a long time (van der Werff, 2001; e.g., see *Cryptocarya ferrea* below). Nomenclatural upheavals are to be expected in the future. The last comprehensive revision of the Lauraceae for Peninsular Malaysia and Singapore (i.e., "Malaya") was by Kochummen (1989). Our identifications and descriptions, especially of tree height, bark, flowers, and fruits which we have not observed consistently for all species, are therefore based on those of this account, supplemented by recent revisions or notes for certain genera for nearby Borneo (Julia, 2005; Ng, 2005a, b; Nishida, 2008; Soh, 2011) and Thailand (Ngernsaengsaruay et al., 2011).

Since the purpose of this series of articles is to assist in field identification, the more frequently available vegetative characters (i.e., those of the growth form, bark, twig, and leaf) are used where possible. However, some fruit and flower character states are included if they are easily observed in the field and if they can diagnose species easily. For example, the inflorescence of Lauraceae flowers are either in umbels (but sometimes considered as "pseudoumbels"; Rohwer et al., 1993) surrounded by involucral bracts, or in panicles. Additionally, the post-fertilisation development of the perianth is greatly varied. In many species, the perianth is persistent and enlarges to form a disc or cup around the base (i.e., a cupule) of the one-seeded fruit. In *Cryptocarya*, the persistent perianth almost completely envelopes the fruit as a hypanthium, while in *Beilschmiedia*, the perianth is not persistent and shed early. Generic differences in these characters are summarised in Table 1.

Table 1. Easily observed floral and fruit characters that can aid in identification of the genera of the Lauraceae in the Nee Soon Swamp Forest.

S/No.	Genus	Inflorescence Type	Perianth Development
1.	*Actinodaphne*	Umbel	Cupule
2.	*Alseodaphne*	Panicle	Undeveloped
3.	*Beilschmiedia*	Panicle	Undeveloped
4.	*Cinnamomum*	Panicle	Cupule
5.	*Cryptocarya*	Panicle	Hypanthium
6.	*Lindera*	Umbel	Undeveloped
7.	*Litsea*	Umbel	Cupule (various heights)
8.	*Neolitsea*	Umbel	Cupule (flat)
9.	*Nothaphoebe*	Panicle	Undeveloped

Chong et al. (2009 and updated) lists 46 species from 13 genera of the Lauraceae that are native to Singapore. Wong et al. (2013) listed 25 species from 10 genera that have been previously recorded or collected from NSSF, including the former Chan Chu Kang Forest Reserve. However, several of the listed species are misidentifications or synonyms, while there have been also new additions from recent collections. Here we provide identification keys and brief descriptions of the 22 species from nine genera for which we can confirm the identities. A note on excluded species is provided at the end. In addition to a typical key to genera that necessarily uses flower or fruit characters, we provide a field key to species based only on vegetative characters.

KEY TO THE GENERA OF THE LAURACEAE OF THE NEE SOON SWAMP FOREST

1. Leaf blade triveined or the first pair of secondary veins prominent and reaching more than two-thirds of the length of the leaf blade. 2
– Leaf blade pinnately veined and the first pair of secondary veins not reaching two-thirds of the length of the leaf blade. 3

2. Leaf blade with only one pair of lateral veins that reach the leaf blade apex. ..... *Cinnamomum*
– Leaf blade with more than one pair of lateral veins, the basal pair not reaching the leaf blade apex. ..... *Neolitsea*

3. Leaves in true whorls; buds covered by scale leaves. ..... *Actinodaphne*
– Leaves spiral, alternate, or opposite, may be clustered but not in true whorls; buds without scale leaves. 4

4. Flowers in umbels. 5
– Flowers in panicles. 6

5. Anthers 4-celled; perianth well-developed (except in *Litsea elliptica*). ..... *Litsea*
– Anthers 2-celled; perianth poorly developed. ..... *Lindera*

6. Leaf blade below or veins covered with adpressed or erect hairs when viewed under 10× magnification. Fruit completely enclosed in a hypanthium..... *Cryptocarya*
– Leaf blade below and veins not hairy or only sparsely hairy even under 10× magnification. Fruit not enclosed in a hypanthium. 7

7. Leaf blades large, usually drying >20 cm long. Anthers 2-celled. .....*Beilschmiedia*
– Leaf blades small, drying <20 cm long. Anthers 4-celled. 8

8. Leaves crowded at the tips of twigs. Pedicel swollen, red, fleshy; perianth lobes shedding quickly. ...*Alseodaphne*
– Leaves usually spaced apart. Pedicel not swollen or red, woody; perianth lobes persistent.....*Nothaphoebe*

FIELD KEY TO THE SPECIES OF LAURACEAE OF THE NEE SOON SWAMP FOREST

1. Leaf blade triveined or the first pair of secondary veins prominent and reaching more than two-thirds of the length of the leaf blade. 2
– Leaf blade pinnately veined and the first pair of secondary veins not reaching two-thirds of the length of the leaf blade. 4

2. Leaf blade with only one pair of lateral veins that reach the leaf blade apex. 3
– Leaf blade with more than one pair of lateral veins, the basal pair not reaching the leaf blade apex.....
..... *Neolitsea cassia*

3. Leaf blade glabrous below; transverse veins usually flat and faint below.....*Cinnamomum iners*
– Leaf blade hairy below; transverse veins distinctly raised below..... *Cinnamomum javanicum*

4. Leaves in true whorls; buds covered by scale leaves..... 5
– Leaves spiral, alternate, opposite, or may be clustered but not in true whorls; buds without scale leaves..... 6

5. Scale leaves large (>1 cm long); leaf blade large (≥20 cm long), with tertiary veins raised below. .....
.....*Actinodaphne macrophylla*
– Scale leaves small (<1 cm long); leaf blade small (<20 cm long), with tertiary veins flat and faint below. .....
.....*Actinodaphne malaccensis*

6. Leaf blade tertiary veins very faint or inconspicuous below. 7
– Leaf blade tertiary veins distinct or raised below. 9

7. Leaf stalk long, when dried >1 cm. ..... *Litsea erectinervia*
– Leaf stalk short, when dried ≤1 cm. 8

8. Leaves opposite to sub-opposite; leaf blade ≤4 cm wide. ..... *Litsea lancifolia*
– Leaves alternate; leaf blade usually >4 cm wide. ..... *Cryptocarya ferrea*

9. Mature leaf blade distinctly densely hairy below. 10
– Mature leaf blade very sparsely hairy, or not visibly hairy below when observed with the naked eye. 13

10. Leaf blade base cordate. .....*Litsea cordata*
– Leaf blade base cuneate to rounded..... 11

11. Leaf blade apex acuminate to caudate, drip tip 1 cm or longer; leaf stalk reddish brown hairy.....
.....*Cryptocarya griffithiana*
– Leaf blade apex usually acute to obtuse, rarely acuminate and if so, drip tip less than 1 cm long; leaf stalk light brown to brown hairy. 12

12. Leaf stalk short, when dried ≤1.5 cm long; leaf blade ≤6 cm wide, usually narrowly ovate to lanceolate, apex usually acute. .....*Litsea firma*
– Leaf stalk long, when dried, ≥2 cm long; leaf blade ≥6 cm wide, usually broadly elliptic to obovate, apex usually obtuse to emarginate..... *Litsea grandis*

13. Leaf blade secondary veins ≤8 pairs. 14
– Leaf blade secondary veins ≥8 pairs. 16

14. Leaf blade drying dark brown to black; base attenuate. ..... *Nothaphoebe umbelliflora*
– Leaf blade drying brown but the midrib and secondary veins dark brown or black; base rounded to obtuse. 15

15. The first pair of secondary veins arising at the leaf base but angled away from the leaf blade margin, with the second pair less than 0.5 cm from the leaf base, and subsequent pairs spaced further apart. ..... *Lindera lucida*
– The first pair of secondary veins running along the leaf blade margin at the base of the leaf blade, with the second and subsequent pairs spaced somewhat regularly apart. ..... *Litsea elliptica*

16. Leaf blade tertiary veins reticulate or scalariform-reticulate. 17
– Leaf blade tertiary veins clearly scalariform. 20

17. Drip tip distinct, about 1 cm long. 18
– Drip tip absent or indistinct. 19

18. Leaf blade obovate; secondary veins looping and anastomosing at least 3 mm away from the margin. .... *Alseodaphne bancana*
– Leaf blade oblong; secondary veins arching and approaching the margin but not looping and anastomosing. .... *Cryptocarya nitens*

19. Leaf blade narrowly obovate to oblanceolate; tertiary veins densely reticulate. ..... *Beilschmiedia kunstleri*
– Leaf blade ovate to elliptic; tertiary veins scalariform-reticulate and spaced widely apart. .. *Beilschmiedia madang*

20. Leaf blade scalariform tertiary veins spaced close together, ≤2 mm apart. ..... *Litsea resinosa*
– Leaf blade scalariform tertiary veins spaced far apart, >2 mm apart. 21

21. Midrib sunken above and sharply keeled below especially near the leaf blade base. ..... *Litsea costalis*
– Midrib flat above and raised but not sharply keeled below in the leaf blade. ..... *Litsea castanea*

***ACTINODAPHNE* Nees**

(Greek *aktinos*, ray; *daphne*, laurel; referring to the star-shaped leaf whorls of this genus)

Trees. Buds covered by scale leaves. Leaves whorled. Shortened racemes resembling pseudoumbels. Fruit round, seated in a cupule.

1. *Actinodaphne macrophylla* (Bl.) Nees

(Latin *macro*, large; *phylla*, leaf; referring to the large leaves of this species)

Key reference. Kochummen (1989: 105)

Medium-sized tree to 24 m tall; trunk girth to 150 cm; buttresses to 1 m high. **Bark** dull brown, smooth, inner bark bright orange-brown, granular, sapwood white. **Twigs** densely covered with long, reddish brown hairs, *buds covered with large scale leaves that dry 1.5–3 cm long*; crown domed. **Leaves** *in whorls of 6*; blade oblanceolate, 15–42 × 5–12.5 cm, drying coriaceous, often glaucescent to glaucous below, with midrib raised above and below, secondary nerves 14–17 pairs, prominently raised below, and tertiary nerves scalariform, flat and faint above and *raised below, reddish brown-hairy below*, apex attenuate to acuminate, base attenuate; stalk drying 2.5–5 cm long, reddish brown hairy. **Flowers** axillary. **Fruit** ripening yellow then bright red, 1.75–2.5 cm across; cupule woody. — Fig. 2.

Singapore localities. No specimens from NSSF were found in SING at the time of writing. Previously collected from the BTNR, the northern part of the CCNR along Mandai Road, and Pulau Ubin.

Habitat. Likely to be a dryland species.

Conservation. Once presumed to be extinct in Singapore (Tan et al., 2008), this species has since been rediscovered (see Chong et al., 2012).

Suggested common name. large-leaved star laurel

Fig. 2. Young sapling of *Actinodaphne macrophylla* showing the growing tip and yellow-green young leaves covered with reddish brown hairs, and dark green mature leaves.

2. *Actinodaphne malaccensis* Hook.f.
(named after Malacca)

Key reference. Kochummen (1989: 105)

Medium-sized tree. **Young twigs** hairy, *buds covered with small scale leaves that dry 2–3 mm long*. **Leaves** *in whorls* of 5; blade somewhat shiny and drying dark brown above, obovate to elliptic and sometimes narrowly so, 13.5–20 × 5–6 cm on drying, coriaceous, sparsely to velvety hairy and sometimes glaucescent below, with midrib raised above and more prominently so and hairy below, secondary nerves 6–9 pairs, sunken above, raised below, and tertiary veins scalariform, with reticulations dense but faint above and *faint below*, apex acuminate to attenuate, base cuneate; stalk drying brown except for the black base, 1–1.5 cm long, hairy especially when young. **Flowers** axillary or between leaf whorls. **Fruit** shiny, reddish, 8 mm across. — Fig. 3.

Singapore localities. NSSF (A. Samsuri, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 73). Also collected from Bukit Timah (H. N. Ridley s.n., SING barcode number 0013093) and more recently from Chestnut Avenue (A. T. Gwee, P. T. Chew, Ali Ibrahim et al. 2008-193).

Habitat. Likely to be a species of dry areas, although KYC has observed a 2-m tall sapling growing by a stream.

Conservation. Nationally Endangered (Tan et al., 2008). Kochummen (1989: 105) considered this species rare in Peninsular Malaysia and Singapore.

Suggested common name. Malacca star laurel

Remarks. In our opinion, the two sterile specimens collected from Nee Soon (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee & Y. K. Chua NES 336; A. T. Gwee, P. T. Chew, Hassan Ibrahim & H. K. Lua SING 2009-194) and previously determined as *Actinodaphne pruinosa* Nees do not match specimens of this species as determined by S. Julia. Instead, they match more closely to past specimens determined as *Actinodaphne malaccensis*.

***ALSEODAPHNE* Nees**
(Greek *alsos*, a grove; *daphne*, laurel)

Trees; twigs with prominent leaf scars. Leaves spirally arranged and crowded at the ends of twigs. Flowers in panicles. Fruit round or oblong, seated atop a swollen stalk.

1. ***Alseodaphne bancana*** Miq.
(named after Banka, an island in Indonesia)

Key reference. Kochummen (1989: 111)

Medium-sized tree to 27 m tall; trunk girth to 240 cm; buttresses to 0.5 m high. **Bark** brown, fissured; inner bark pinkish; sapwood pale. **Twigs** dark brown, often with prominent leaf scars. **Leaves** spiral, *often clustered at the ends of twigs; blade often glaucous and drying purplish below, obovate to oblanceolate*, 10–22 × 4–8 cm, coriaceous, midrib raised below and prominently keeled towards the base, secondary nerves 9–13 pairs, *distinctly looping and anastomosing 3–5 mm before the margin*, sunken above, raised below, sometimes with intercalary veins, and tertiary veins reticulate, distinct below, apex acuminate, base attenuate; stalk black on drying, stout when fresh, 0.5–1.5 cm long, often with a brown indumentum at the base. **Flowers** axillary. **Fruit** 1.5 cm across, perianth lobes persistent. — Fig. 4.

Singapore localities. NSSF (Samsuri Ahmad SA 1401); Chan Chu Kang (H. N. Ridley 6156*)*. Also collected from the BTNR and CCNR.

Habitat. More often found in swampy than in dry areas.

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen (1989: 111) considered this species rare in Peninsular Malaysia and Singapore.

Suggested common name. Banka grove laurel

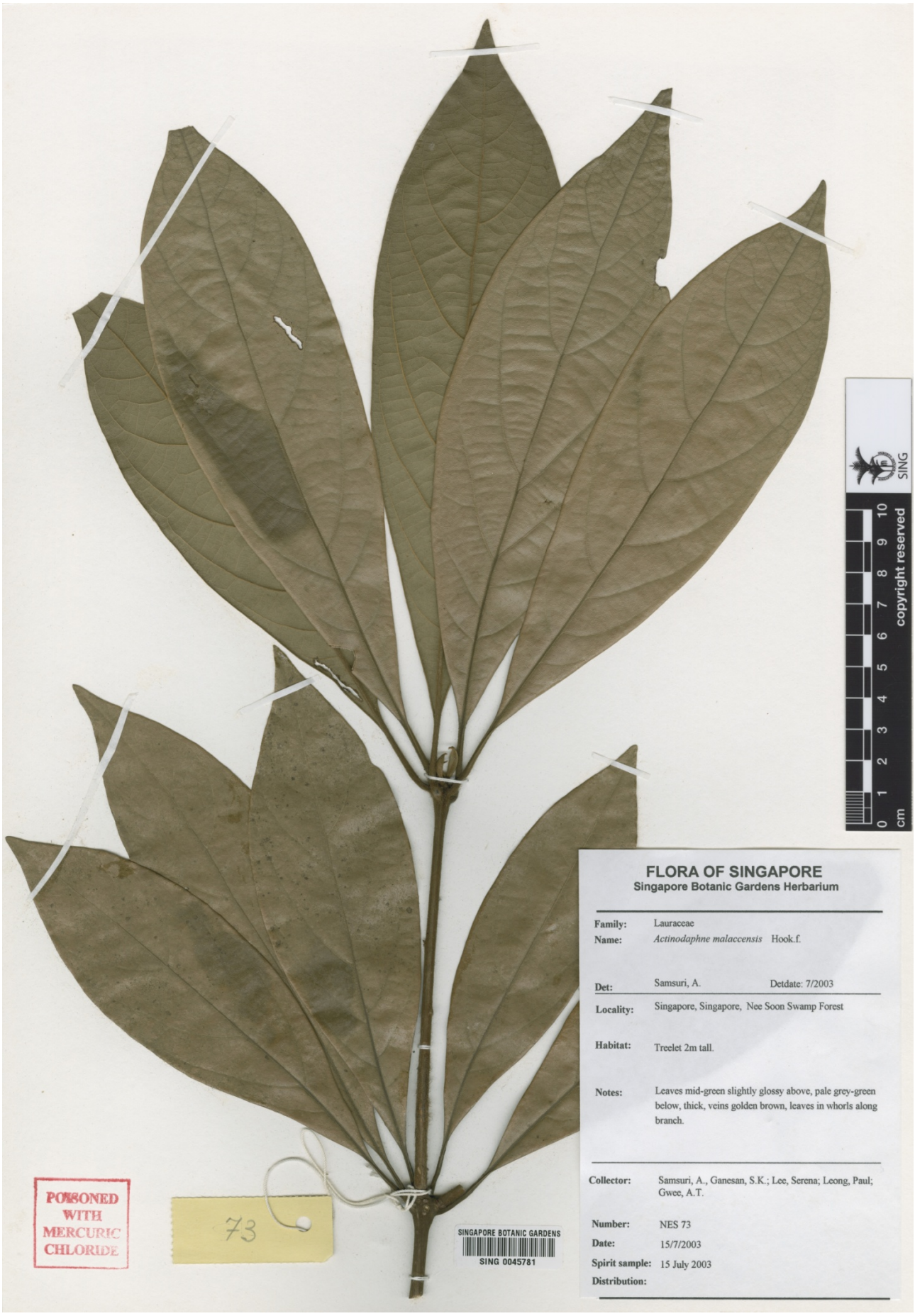

Fig. 3. Herbarium specimen of *Actinodaphne malaccensis* showing the whorled leaves at two nodes.

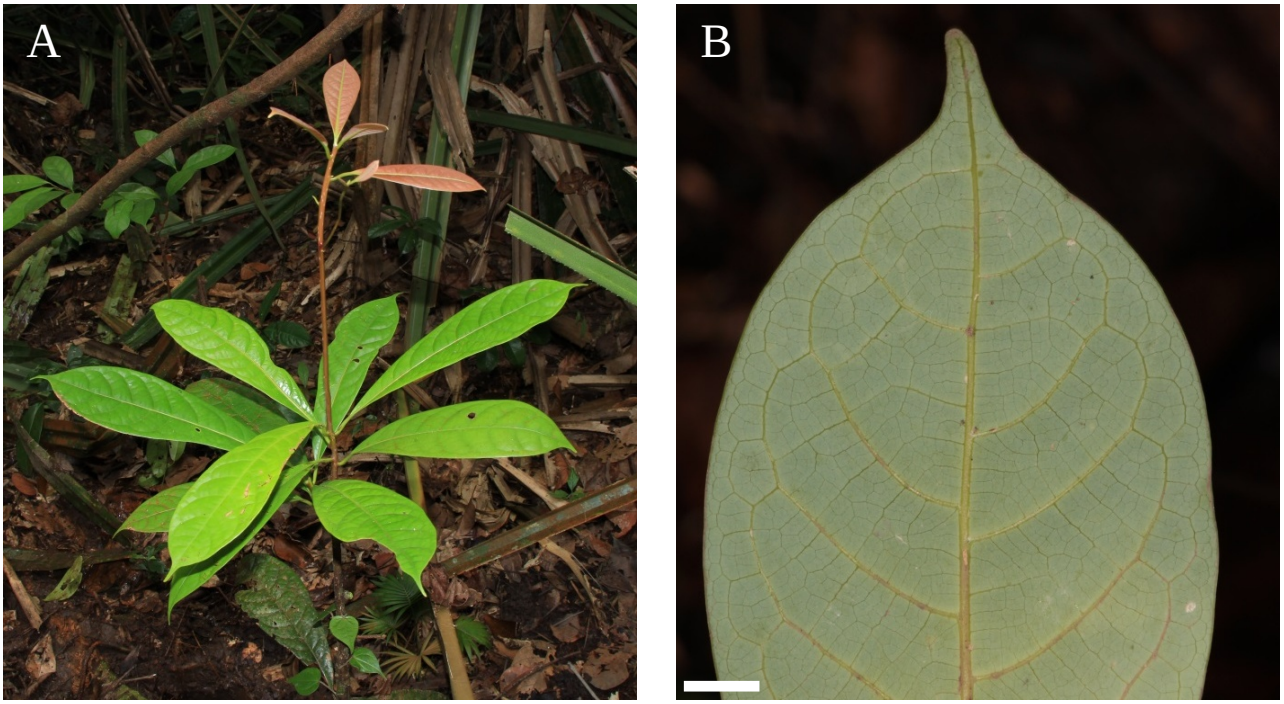

Fig. 4. A, Seedling of *Alseodaphne bancana*. B, Underside of the leaf blade showing the looping and anastomosing secondary veins. Scale bar = 1 cm.

BEILSCHMIEDIA **Nees**
(named after K.T. Beilschmied)

Trees; young twigs stout, angular in cross section; brown hairy on terminal buds and young parts. Leaves alternate or spiral; blade coriaceous, with venation distinctly reticulate and midrib prominently raised or keeled below; stalk flat above, usually stout. Flowers bisexual, in axillary panicles. Fruit ellipsoid or oblong; perianth caducous, leaving a "narrow ring" (Kochummen 1989: 118).

1. ***Beilschmiedia kunstleri*** Gamble
(named after Hermann H. Kunstler, 1837–1887, who was the collector of George King, 1840–1909)

Key references. Kochummen (1989: 120), Nishida (2008)

Small tree but can be up to 30 m tall; trunk girth to 60 cm. **Bark** brownish, smooth, lenticellate; inner bark pinkish brown; sapwood creamy. **Young twigs** stout, angular in cross section, brown-hairy on young parts and terminal buds. **Leaves** alternate or spiral; *blade oblanceolate*, drying 16–40 × 4–12 cm, coriaceous, *glabrous*, with midrib prominently raised to keeled below, secondary veins in 6–16 pairs, sunken above, raised below, and *reticulations dense, raised and distinct above and below*, apex pointed or blunt, base attenuate to acute; stalk pale brown on older leaves, flat above, *usually stout*, drying 0.5–3.5 cm long, wrinkled on drying. **Flowers** in panicles of 30–100. **Fruit** 1.5–2.5 × 1–1.5 cm. — Fig. 5A–B.

Singapore localities. NSSF (S. Dahlan et al. SING 2005-51; A. T. Gwee SING 2010-416 & SING 2010-486).

Habitat. Appears more common in swampy than dry areas. In Borneo, it can be found in heath forests (Nishida, 2008).

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen (1989: 120) considered this species uncommon in Peninsular Malaysia and Singapore.

Suggested common name. Kunstler's medang

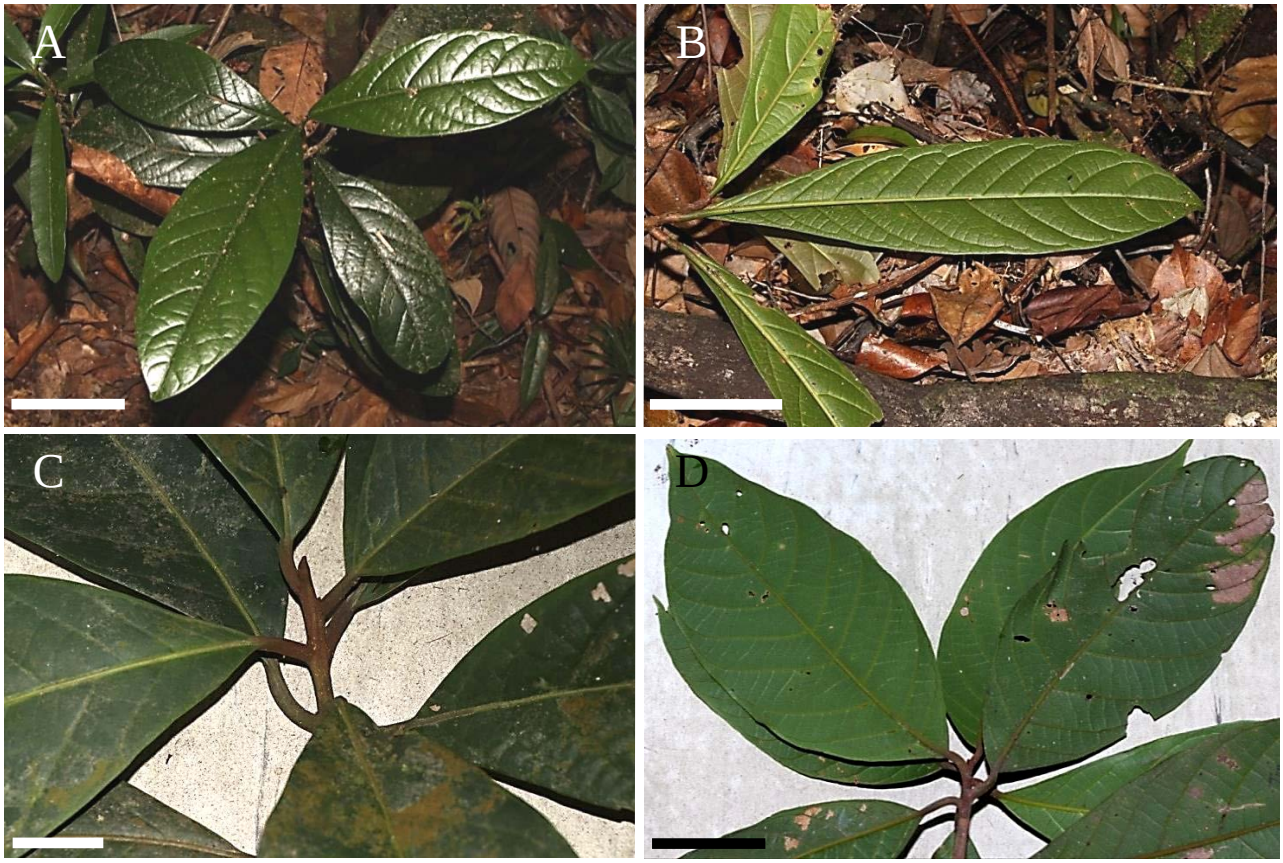

Fig. 5. A–B, *Beilschmiedia kunstleri*; C–D, *Beilschmiedia madang.* Scale bars = 5 cm.

2. ***Beilschmiedia madang*** Bl.
(from the local Malay name, *medang*)

Key references. Kochummen (1989: 120–121), Nishida (2008)

Medium-sized tree to 30 m tall; trunk girth to 150 cm; buttresses to 1.5 m high. **Bark** "fawn", smooth, lenticellate, inner bark red, sapwood yellowish brown. **Young twigs** stout, angular in cross section, brown-hairy on young parts and the terminal bud. **Leaves** alternate; *blade oblong to elliptic to ovate*, drying 15–30 × 7–16 cm, coriaceous, with midrib prominently raised and keeled below, secondary veins, 7–12 pairs, raised below, *tertiary venation scalariform-reticulate* (scalariform veins appearing somewhat stronger than the reticulations on drying), *often sparsely reddish brown-hairy on the midrib and veins*, apex emarginate to rounded to pointed, base obtuse to acute; *stalk* flat above, *usually stout*, drying 1.5–2.5 cm long. **Flowers** in panicles of about 10. **Fruit** 2–2.5 × 1 cm. — Fig. 5C–D.

Singapore localities. Seletar Firing Range (A. T. Gwee, P. T. Chew et al. SING 2009-98). Also known from primary and older secondary forests in the BTNR and the CCNR.

Habitat. So far only known locally from dry areas.

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

Suggested common name. Beilschmied's medang

***CINNAMOMUM* Schaeffer**
(Greek *kinnamomum*, cinnamon)

Shrubs or trees. Crushed leaves and bark with strong spicy smell. Singapore species have opposite to sub-opposite leaves, and triveined leaf blades. Flowers bisexual, in axillary panicles. Fruit 1–1.5 × 0.8–1 cm, seated on a cupule.

1. ***Cinnamomum iners*** Reinw.
(Latin, referring to the inert tissues of this species)

Key references. Kochummen (1989:126), Soh (2011)

Small- to medium-sized tree to 24 m tall. **Bark** smooth, greyish brown; inner bark yellowish or pinkish with a strong spicy smell; sapwood whitish. **Leaves** opposite to sub-opposite; blade oblong to elliptic, 7.5–30 × 2.5–9 cm, coriaceous, shiny and glabrous above, glaucous and *glabrous below*, *triveined or tripliveined*, with veins raised above and below, *with lateral nerves reaching near the apex*, *transverse veins faint below*, reticulations visible above, apex obtuse to acute, base cuneate to rounded; stalk 1–2 cm long. **Fruit** obovoid, seated on a lobed, very shallow cupule.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 237; previously determined as *Cinnamomum javanicum*). Occurs throughout Singapore; especially common in young secondary forest patches, abandoned plantations, and along forest edges. Pinkish young leaves make this species attractive for horticultural landscaping.

Habitat. Likely a pioneer that is uncommon in continuous forests. Soh (2011) considers this species to be a naturalised exotic in Borneo and Peninsular Malaysia, introduced early via cultivation from Java.

Conservation. Not threatened

Suggested common name. wild cinnamon

2. ***Cinnamomum javanicum*** Bl.
(named after Java)

Key references. Kochummen (1989: 126), Soh (2011)

Medium-sized to large tree to 35 m tall; trunk girth to 135 cm. **Twigs** yellow-brown to dark brown velvety hairy. **Leaves** opposite to sub-opposite; blade oblong to elliptic, 12–30 × 5–12 cm, coriaceous, *triveined*, with veins prominently raised above and below, *lateral veins reaching near the apex* and *transverse veins and intramarginal veins prominently sunken above and prominently raised below, giving a bullate appearance*, apex acuminate to mucronate, base cuneate to rounded; stalk 1–2 cm long, *velvety hairy*. **Flowers** densely velvety hairy. **Fruit** ellipsoid with an acute tip, seated in a hairy cupule.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 65). Previously collected from the BTNR, MacRitchie Reservoir (CCNR), and Changi. Also collected from Ang Mo Kio (H. N. Ridley 6453) in 1894.

Habitat. Likely a dryland species

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

Suggested common name. hairy cinnamon

***CRYPTOCARYA* R.Br.**

(Greek *kryptos*, hidden; *karyon*, nut; referring to the fruit structure where the ovary is "hidden" within the hypanthium)

Trees. Leaves alternate or spiral; leaf blades often glaucous with hairs below, penniveined in Singapore species. Flowers bisexual, in axillary and terminal panicles; perianth tube turbinate or ovoid, constricted at the tip after flowering. Fruit drupaceous: seated deep within but separate from a hypanthium that forms the outer fruit wall, leaving a small opening at the apex.

1. ***Cryptocarya ferrea*** Bl.
(Latin *ferreus*, iron, referring to the wood)

Key reference. Kochummen (1989: 134)

Fig. 6. *Cryptocarya ferrea*. A, Leafy twig showing the upper side of the leaves; B, Leafy twig showing the under side of the leaves which are usually glaucous and covered with adpressed hairs. Scale bars = 2 cm.

Medium-sized tree to 22 m tall; trunk girth to 120 cm; buttresses to 1.4 m high. **Bark** reddish brown, smooth; inner bark yellowish brown to reddish brown; sapwood yellowish. **Twigs** brownish hairy. **Leaves** alternate; blade oblong to narrowly ovate, 8–19 × 2–8 cm, drying thinly coriaceous, *glaucous to glaucescent and adpressed hairy below*, with midrib and secondaries raised below, *often appearing golden-yellow owing to the presence of adpressed hairs*, secondary veins in 7–9 pairs, rarely more (up to 19 pairs), and tertiary veins scalariform, faint but visible above and below, apex attenuate to acute, base cuneate to rounded; stalk drying 0.5 to 1 cm long, hairy. **Fruit** ripening purplish, ovoid to oblong with an apical rim, 2.5 × 1.3 cm when dry, surface smooth to warty. — Fig. 6.

Singapore localities. NSSF (Samsuri Ahmad SA 1402 & J. F. Maxwell 83-14); Chan Chu Kang (H. N. Ridley 8040). All these collections are with flowers or flower buds, possibly suggesting that flowering occurs at the start of the year or that it is free-flowering. A series of collections in the same year at Mandai Track 7 near the entrance to the Nee Soon firing range suggests a timeline for the development of fruits: T. O'Dempsey SING 2012-013 (27 Jan.2012; with flowers), T. O'Dempsey 2012-159 (4 May 2012; with newly developing fruits), C. K. Yeo s.n. SING barcode number 0194908 (18 Sep.2012; with developed fruits). Also occurs in primary and older secondary forests in the BTNR and the CCNR.

Habitat. Found in both wet and dry areas.

Conservation. Listed as Nationally Critically Endangered (Tan et al., 2008), but this status may need to be revised as the species can be considered fairly common locally, especially in older-growth forests.

Suggested common name. common cryptocarya

Remarks. Ng (2005a) recognised three varieties: var. *erectinervia*, var. *scortechinii*, and var. *ferrea* (in which he included *Cryptocarya kurzii* Hook.f. that is listed as presumed nationally extinct in Singapore; Tan et al., 2008). Among our specimens, there appears to be a continuum from leaf blades being narrowly ovate, base cuneate, midrib lighter brown and more distinctly glaucous below upon drying, to leaf blades oblong or broadly ovate, base rounded, midrib and blade darker brown below upon drying.

2. ***Cryptocarya griffithiana*** Wight
(named after William Griffith [1810–1845], doctor and botanist)

Key reference. Kochummen (1989: 135) based the description of this species on *Cryptocarya crassinervia* which he considered to be very similar, while Ng (2005a) considered *Cryptocarya crassinervia* to be a variety of this species. Our description is therefore also based on that of *Cryptocarya crassinervia* by Kochummen (189: 133–134).

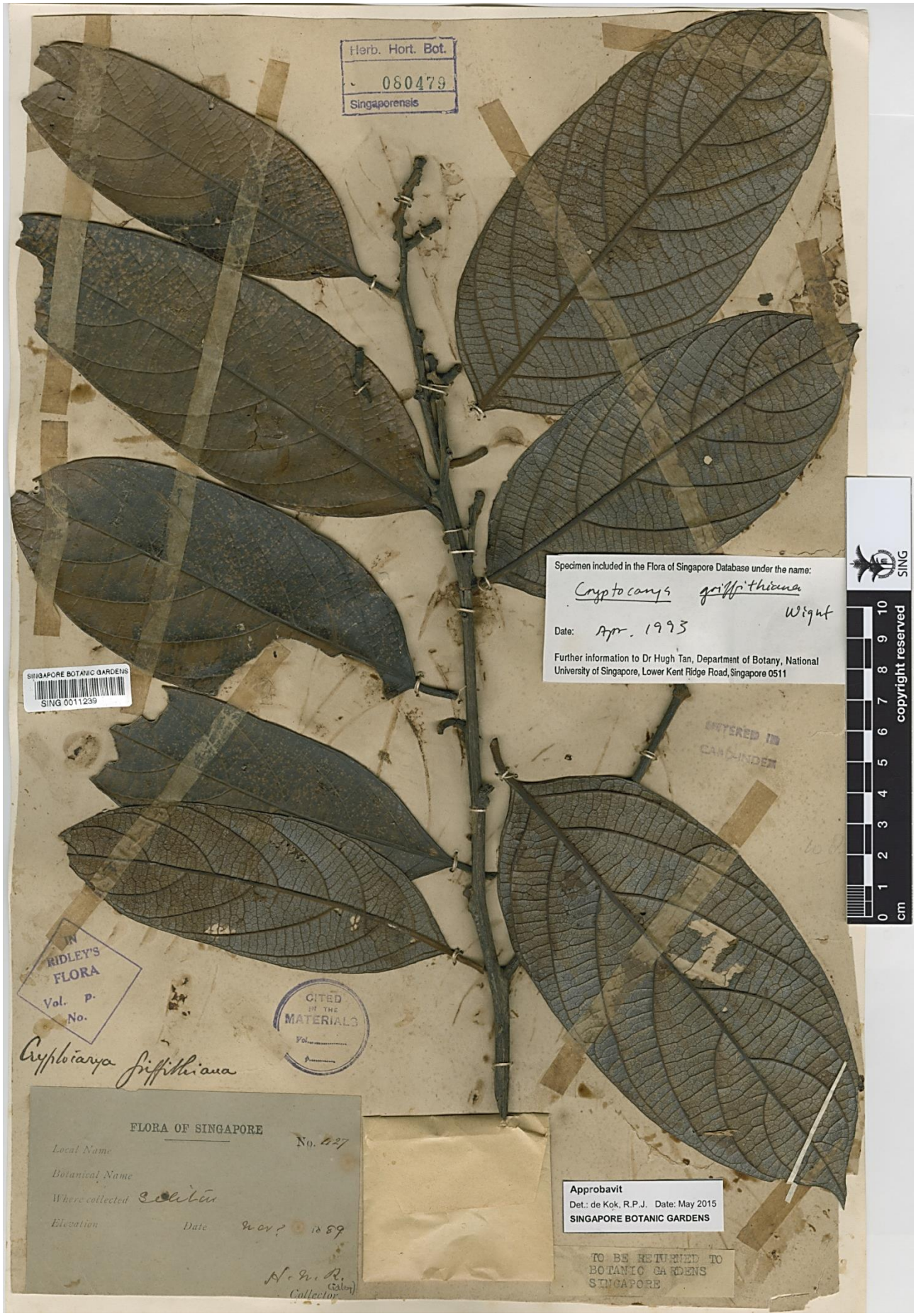

Fig. 7. Herbarium specimen of *Cryptocarya griffithiana* showing the glaucous underside of the leaf blade, with secondary and tertiary veins covered by reddish brown hairs.

Medium-sized tree to 20 m tall, rarely to 33 m; trunk girth to 125 cm. **Twigs** stout, reddish brown velvety hairy. **Leaves** alternate; blade oblong to elliptic, 15–22 × 4.5–9.5 cm, coriaceous, distinctly *glaucous and densely velvety hairy below*, with midrib prominently raised below, hairy, secondary veins in 6–11 pairs, prominently raised and hairy below, looping and joining or almost joining near the margin, and tertiary veins scalariform but with distinct reticulations, prominently raised below, *apex acuminate to caudate*, base cuneate to obtuse, sometimes asymmetric; stalk velvety hairy, drying 0.8–1.5 cm long. **Fruit** oblong to ovoid, 2.5 cm × 1.5 cm when dry, with faint ridges. — Fig. 7.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 51); Seletar Firing Range (A. T. Gwee, P. T. Chew et al. SING 2009-118); "Selitar" (H. N. Ridley 427; Mat 6738). Also occurs in primary and older secondary forests in the BTNR and the CCNR.

Habitat. Not likely to be a species of waterlogged areas.

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen considered this species uncommon in Peninsular Malaysia and Singapore (1989: 135).

Suggested common name. Griffith's cryptocarya

Similar species. Leaf blades of *Cryptocarya impressa* Miq. are almost identical to those of this species, including the veins and the reticulations being clearly sunken above and prominently raised below. However, the tertiary veins in *Cryptocarya impressa* are denser with more prominent reticulations, while those of *Cryptocarya griffithiana* are also covered by longer, sparser hairs.

3. ***Cryptocarya nitens*** (Blume) Koord. & Valeton
(Latin for bright)

Key reference. Kochummen (1989: 136)

Medium-sized tree to 27 m tall; trunk girth to 150 cm. **Bark** grey-brown, smooth, lenticellate, inner bark brownish, granular, sapwood cream. **Twigs** strongly angled when young, hairy. **Leaves** alternate; blade oblong, 11–22 × 4.5–7 cm, thinly coriaceous, distinctly *glaucous below*, with midrib hairy above and below, secondary veins in 7–10 pairs, hairy above and below, arching but not joining near the margin, and tertiary veins scalariform-reticulate, visible above and below, *apex caudate*, base cuneate to obtuse, sometimes slightly asymmetric; stalk hairy, drying 1–1.5 cm long. **Fruit** round, 8 mm across, with shallow ridges. — Fig. 8.

Singapore localities. This is a new record for Singapore (R. de Kok, pers. comm.). Apart from our encounters of this species in the NSSF it has been collected from the BTNR (*M. S. Khoo KMS 14*) and the part of the CCNR along Mandai Road (*P. Leong et al. SING 2009-248*).

Habitat. We have collected it from both wet and dry areas in the NSSF.

Conservation. This species is not yet assessed as this is a new record for Singapore.

Suggested common name. bright-leaved cryptocarya

***LINDERA* Thunb.**
(named after Johann Linder, 1678–1723)

Shrubs or small trees. The single Singapore species usually has alternate or spiral, rarely sub-opposite, leaves. Flowers unisexual, in umbels, axillary or along short shoots. Fruit oblong; perianth not developing into a cupule.

1. ***Lindera lucida*** (Bl.) Boerl.
(Latin *lucida*, shining, referring to the shiny leaves of this species)

Key reference. Kochummen (1989: 146)

Recent synonym. *Lindera malaccensis* Hook.f. was listed as a separate species by Wong et al. (2013) but is a synonym (Kochummen, 1989: 146).

Fig. 8. Under side of a leaf of *Cryptocarya nitens*. Scale bar = 1 cm.

Shrub or small tree, reaching 15 m tall; trunk girth to 120 cm. **Bark** greyish, smooth; inner bark yellow; sapwood yellowish brown. **Leaves** alternate, rarely sub-opposite; *blade broadly ovate* to elliptic, drying 8–17 × 4–8 cm, chartaceous, with powdery white hairs visible under the microscope, denser on the veins and on younger twigs and leaves or sometimes glaucous below, with midrib to tertiary veins sometimes drying dark brown or black, raised below, *secondary veins 5–8 pairs*, raised below, *with first pair arising at the blade base and running close to but angled away from the blade margin*, and the second pair arising 0.5 cm or less away from the first pair, subsequent secondary veins much further apart and becoming weaker, anastomosing to tertiary veins near the margin, and tertiary veins faint to distinct below, inconspicuous above, weakly and laxly scalariform with faint reticulations, apex acute to attenuate, base cuneate to rounded, sometimes disjointed; stalk often drying black in older leaves, 0.5–1.5 cm long, golden hairy on new leaves. **Fruit** with yellow tinge when mature, 0.8 cm long, apex pointed, seated on a tiny, undeveloped perianth. — Fig. 9A–B.

Singapore localities. NSSF (J. Sinclair SFN 40520; Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee & Y. K. Chua NES 330); Chan Chu Kang (Collector unknown SING barcode number 0013153); "Selitar" (H. N. Ridley 3373). Also occurs in secondary and primary forests in the BTNR and CCNR.

Habitat. This species appears to be more common in wet areas of the NSSF.

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

Suggested common name. shiny leaved lindera

***LITSEA* Lamk.**

(*li tse*—Romanisation of the Chinese term for chestnuts, in the family Fagaceae, i.e., the oaks. May refer to the cupule development in the fruits of many species of this genus that bear superficial resemblance to those of many members of the Fagaceae. Alternatively, it may refer to the chestnut-coloured wood, leaves, and nut upon drying; see the etymology of Kochummen [1989: 152] for *Litsea castanea* below.)

Trees, rarely shrubs. Leaves spiral, alternate, or sometimes opposite or sub-opposite, often glaucous or glaucescent below. Flowers in umbels, axillary or along short shoots. Fruit seated on a persistent perianth enlarged to various sizes.

1. ***Litsea castanea*** Hook.f.

(Kochummen [1989: 152] stated that the name is a reference to the colour of the edible chestnut, *Castanea* species)

Key references. Kochummen (1989: 152–153), Ngernsaengsaruay et al. (2011)

Large tree to 30 m or taller; trunk girth to 235 cm; buttresses thin. **Bark** reddish brown, smooth with horizontal rings, lenticellate; inner bark cream-coloured and orange mottled, with pungent smell; sapwood pale yellow. **Twigs** with adpresssed reddish brown to pale yellow hairs. **Leaves** spiral; blade obovate, 20–23 × 8–10 cm, drying thinly coriaceous, *glabrous or only sparsely powdery hairy below*, with midrib raised below, prominently so towards the base but not keeled, sparsely hairy, secondary veins 11–18 pairs, raised below, sparsely hairy, looping and joining especially towards the apex, and *tertiary veins scalariform, lax, raised below*, faint above, with reticulations visible above and below, apex shortly acuminate to emarginated, base cuneate to rounded; stalk up to 3 cm long, powdery hairy. **Fruit** ovoid to cylindrical, to 3.5 × 3 cm, seated on an entire-rimmed cupule up to 1 cm thick. — Fig. 9C–E.

Singapore localities. No specimens collected from the NSSF were found in SING at the time of writing. We have so far only encountered this species in a restricted area at the end of Firing Range 2. Otherwise, it is frequently collected from the BTNR and other parts of the CCNR.

Habitat. Dry areas

Conservation. Nationally Endangered (Tan et al., 2008). Kochummen (1989: 153) considered this species common in Peninsular Malaysia and Singapore.

Suggested common name. chestnut medang

Fig. 9. A, Under side; and B, upper side of the leaf blade of *Lindera lucida*; C, Young twig and leaf stalk of *Litsea castanea* covered with light brown hairs; D, Upper side and E, under side of the leaf blade of *Litsea castanea*. Scale bars = 2 cm.

2. ***Litsea cordata*** (Jack) Hook.f.
(Latin *cordata*, heart-shaped, referring to the base of the leaf blade of this species)

Key references. Kochummen (1989: 154), Ngernsaengsaruay et al. (2011)

Medium-sized to large tree, to 36 m tall; trunk girth to 190 cm; buttresses short, with stilt roots and pneumatophores in swampy habitats. **Bark** pale grey, smooth, lenticellate; inner bark yellow brown, mottled, granular; sapwood yellowish. **Leaves** spiral; *blade broadly ovate*, up to 26 × 17 cm, thinly coriaceous, glabrous above, densely *brown hairy below*, with midrib raised below, secondary veins up to 15 pairs, raised below, and tertiary veins scalariform with reticulations and raised below, apex acuminate, *base cordate*, somewhat asymmetrical; stalk up to 2.5 cm long, brown-hairy. **Fruit** ellipsoid to oblong, about 2 × 1 cm, apex pointed, seated on a shallow or nearly flattened cupule. — Fig. 10.

Singapore localities. The only specimen of this species collected from Nee Soon and deposited in SING was previously misidentified as Litsea robusta. We have re-determined this specimen (Samsuri Ahmad, S. K. Gaensan, S. Lee, P. Leong & A. T. Gwee NES 86). Also previously collected from Kranji (Mat 4743) and the Western Catchment Area (Samsuri Ahmad, A. T. Gwee, T. P. Ng, A. Chia & K. S. Lioe WC 57).

Habitat. Likely to be mainly found in wet areas.

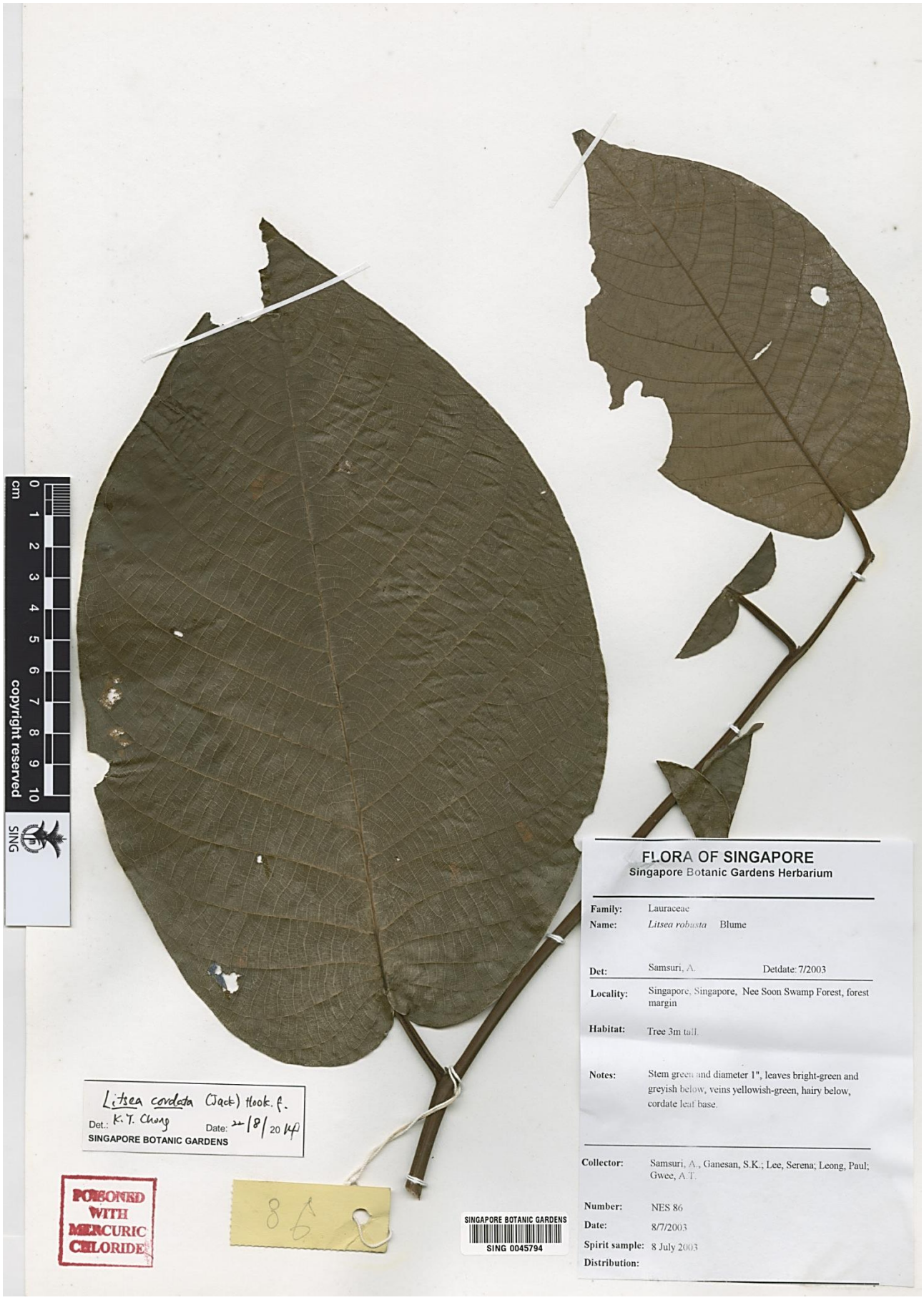

Fig. 10. Herbarium specimen of *Litsea cordata*. The base of the leaf blade is cordate and the underside of the leaf blade is covered with brown hairs.

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

Suggested common name. heart-shaped medang

3. ***Litsea costalis*** (Nees) Kosterm.
(Latin *costa*, ribbed, which may refer to the strongly angled young twigs of this species)

Key reference. Kochummen (1989: 154)

Medium-sized tree reaching 30 m tall; buttresses absent, stilt roots rare. **Bark** grey-brown or reddish brown, smooth, lenticellate; inner park pale yellow to pale orange, slightly mottled, with strongly fragrant smell; sapwood yellowish, vessels visible. **Young twigs** stout and strongly angled in cross section. **Leaves** spiral; *blade sometimes glaucous below drying unevenly purple, oblong-obovate*, 14–46.5 × 6–20 cm, coriaceous, with *midrib sunken above especially towards the base, prominently raised below and strongly keeled near the base*, secondary veins 12–14 pairs, prominently raised below, arching near the margin, and tertiary venation reticulate but weakly scalariform, faint and flat above, raised below, apex rounded, base rounded or abruptly attenuate; stalk drying 3–5 cm long. **Fruit** yellow turning reddish when ripe, round, 2.5 cm across, seated on a cup or saucer-shaped cupule that is almost as wide as the fruit. — Fig. 11.

Singapore localities. NSSF (P. Leong, Y. W. Low, P. T. Chew, H. K. Lua et al. SING 2011-374). We have also determined I. M. Turner, J. T. W. M. Gan & Y. W. K. Khng NRS 128 as this species. Previously collected from the BTNR and the CCNR.

Habitat. Mostly found in dry areas, although also found near streams.

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen (1989: 154) considered this a "fairly common" species in lowland forests of Peninsular Malaysia and Singapore.

Suggested common name. ribbed medang

4. ***Litsea elliptica*** Bl.
(Latin *elliptica*, elliptical, referring to the shape of the leaf blades)

Key references. Kochummen (1989: 155), Ngernsaengsaruay et al. (2011)

Large tree up to 45 m tall; trunk girth to 240 cm; buttresses to 1 m high. **Bark** grey or greyish brown, smooth, rarely fissured or scaly, lenticellate; inner bark pinkish, with strongly spicy smell; sapwood pale yellow. **Leaves** spiral; blade obovate to elliptic, rarely ovate, 6–16 × 2–7 cm, mostly glabrous except sometimes hairy on the veins below, often glaucous below, with midrib raised below, secondary veins often black upon drying, *4–8 pairs*, spaced about 1.5–2 cm apart, raised below, arching near the margin, and *tertiary veins scalariform*, faint to distinct but rarely raised below, apex shortly acuminate to obtuse, base cuneate to obtuse, sometimes asymmetrical; *stalk slender, 1–2.5 cm long*, glabrous. **Fruit** green with white dots ripening dark pink, dark purple, then black, glossy, round to elliptic, seated on a saucer-shaped or shallow cupule.

Singapore localities. NSSF (Samsuri Ahmad SA 1446; Samsuri Ahmad, S. Lee, A. T. Gwee, Md. Noor, P. Leong & S. K. Ganesan NES 147); Chan Chu Kang (H. N. Ridley 8056). Common throughout forests in Singapore, including regenerating forests in former abandoned plantations.

Habitat. Although this is a common species in the dry areas, it appears to be adaptable to wetter areas in the NSSF.

Conservation. Not threatened

Suggested common name. common medang

Fig. 11. Herbarium specimen of *Litsea costalis* with developing fruits.

5. ***Litsea erectinervia*** Kosterm.
(Latin *erectinervia*, erect nerves, referring to the erect secondary veins)

Key reference. Kochummen (1989: 156)

Medium-sized tree to 30 m tall, trunk girth to 180 cm. **Twigs** densely reddish brown hairy. **Leaves** alternate or spiral; *blade oblong to oblanceolate*, 14–20 × 4–6 cm, drying chartaceous, *glaucescent and softly hairy to scurfy below*, reddish brown glabrous above, with midrib raised below, *secondary veins 8–9 pairs*, arching gradually approaching the margin, faint above, distinctly visible below, and tertiary veins scalariform, dense reticulations faintly visible above, *inconspicuous below*, apex attenuate, base cuneate, sometimes disjointed; *stalk drying 1.5–2.5 cm long, densely reddish brown hairy*. **Fruit** depressed globose, 1.7 cm across, seated on a cupule. — Fig. 12A–B.

Singapore localities. Locally only known from the NSSF (S. Lee, Ahmad Samsuri, A. T. Gwee & P. Leong SING 2005-07; A. T. Gwee SING 2010-440). We have re-determined a specimen (J. Sinclair SFN 40249) as this species. See also "similar taxa" below.

Habitat. Wet areas

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen (1989: 156) considered this species uncommon in Peninsular Malaysia and Singapore.

Similar species. According to Kochummen's key (Kochummen, 1989**. —** 150), *Litsea ferruginea* Bl. is very similar to *Litsea erectinervia* with the twigs and leaf undersides also covered with reddish brown hairs, but the main difference is that the former has opposite (or sub-opposite) leaves. However, a specimen (*H. N. Ridley 6151*) from "Selitar Road" determined as *Litsea ferruginea* does not have opposite or sub-opposite leaves, but has secondary veins that are very prominently raised below and arch very closely to the margin, like those of other specimens of *Litsea erectinervia*. Owing to the uncertainty of the identity and the ambiguity of the collection locality, *Litsea ferruginea* is not included in this treatment.

6. ***Litsea firma*** Hook.f.
(Latin for stable)

Key references. Kochummen (1989**. —** 156–157), Ngernsaengsaruay et al. (2011)

Medium-sized to large tree, to 42 m tall; trunk girth to 230 cm; buttresses to 2.5 m high. **Bark** greyish brown or yellowish grey, smooth to scaly, or dippled, lenticellate; inner bark yellow; sapwood yellow, vessels visible. **Young twigs** light brown hairy, sometimes angular in cross section. **Leaves** spiral; *blade elliptic to narrowly oblong to lanceolate*, 7–20 cm × 3–6 cm, drying thinly chartaceous, glabrous above, *visibly hairy especially on the veins and sometimes glaucescent below*, with midrib raised below, hairy, secondary veins raised below, hairy, 10–17 pairs, looping near the margin, and *tertiary veins scalariform, raised and distinct below, hairy, apex obtuse to acute*, base cuneate, sometimes oblique; stalk drying 1–1.5 cm long, hairy. **Fruit** ovoid-oblong, 1.5 × 1 cm, seated on a 0.5 cm deep cupule. — Fig. 12C–D.

Singapore localities. NSSF (*A. T. Gwee, P. T. Chew, Hassan Ibrahim & H. K. Lua SING 2009-215*); Chan Chu Kang (*Mat 6828*). See also "similar taxa" below. This species occurs in young and older secondary forest and primary forests throughout Singapore.

Habitat. Usually in dry areas, but sometimes also in wet areas

Conservation. Nationally Vulnerable (Tan et al., 2008). Kochummen (1989: 157) considered this species common in Peninsular Malaysia and Singapore.

Suggested common name. hairy medang

Similar species. Two sterile specimens (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 209; Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 286) collected from the NSSF and identified as *Litsea umbellata* (Lour.) Merr. appear more similar to *Litsea firma*. According to Kochummen (1989: 166), *Litsea umbellata* should have shorter (5–7 mm long) leaf stalks, while those of *Litsea firma* are 1–1.5 cm long.

7. ***Litsea grandis*** Hook.f.
(Latin *grandis*, large, referring to the large leaves of this species)

Key references. Kochummen (1989: 158), Ngernsaengsaruay et al. (2011)

Medium-sized to large tree, to 30 m tall, trunk girth to 250 cm. **Bark** greyish brown, smooth to cracking and scaly, lenticellate; inner bark pale brown and yellowish mottled, gritty, strongly aromatic; sapwood yellowish. **Young twigs** light brown to brown hairy, sometimes angular in cross section. **Leaves** spiral; *blade broadly obovate to elliptic*, 19–30 × 6–17 cm, drying coriaceous, *distinctly hairy and sometimes glaucous below*, with midrib prominently raised below, densely hairy, secondary veins 10–17 pairs, raised below, densely hairy, and *tertiary veins scalariform, distinctly hairy, apex rounded or obtuse to emarginate*, base cuneate; stalk drying 2–2.5 cm long, hairy. **Fruit** green with white dots ripening dark red, dark purple, and then black, glossy, ovoid, 1 × 0.7 cm, glabrous, seated in a cupule 0.5 cm deep. — Fig. 12E–F.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee & Mohd. Noor NES 281; M. Ragupathy et al. SING 2007-182; A. T. Gwee SING 2008-36; W. F. Ang, K. Y. Chong, P. X. Ng, S. Y. Tan & C. K. Yeo s.n. SING barcode 0154974; C. K. Yeo, W. F. Ang, J. Gan & Y. F. Chung SING 2012-198); Chan Chu Kang (H. N. Ridley 3962). Also known to occur in the BTNR and other older growth forest patches in the CCNR.

Habitat. This species can be found in both wet and dry areas.

Conservation. Nationally Endangered (Tan et al., 2008). Kochummen (1989: 158) considered this species common in Peninsular Malaysia and Singapore.

Suggested common name. broad-leaved medang

8. ***Litsea lancifolia*** (Roxb.) Fern.-Vill.
(Latin *lancifolia*, lance-shaped leaf, referring to the shape of the leaf blades of this species)

Shrub or small tree to 8 m tall, rarely up to 12 m tall; trunk girth to 150 cm. **Bark** greyish or dark brown, smooth. **Twigs** often ridged, slender, powdery hairy. **Leaves** *opposite to sub-opposite; blade narrowly oblong to lanceolate or oblanceolate*, 9–16 × 3–4 cm, drying chartaceous, glaucous and sparsely hairy below, with midrib raised and hairy below, secondary veins 7–11 main pairs with intercalcate veins, visible and somewhat shiny below, and tertiary veins laxly scalariform-reticulate, *faint below*, apex attenuate, base cuneate; *stalk short*, drying up to 0.5 cm long. **Fruit** green with white dots ripening dark purple then black, glossy, ellipsoid-cylindrical to ovoid, 1–2 cm long, glabrous, seated in a shallow cupule. — Fig. 12G–H.

Singapore localities. NSSF (J. F. Maxwell 82-78). Also found in the northern part of the CCNR, e.g., Seletar Reservoir and the forests along Mandai Road.

Habitat. This species likely occurs only in the dry areas.

Conservation. Nationally Critically Endangered (Tan et al., 2008). Kochummen (1989: 160) considers this species uncommon in Peninsular Malaysia and Singapore.

Suggested common name. narrow-leaved medang

Similar species. *Litsea lanceolata* (Bl.) Kosterm. which is Presumed Nationally Extinct (Tan et al., 2008), also has opposite or subopposite leaves, but the secondary veins loop near the blade margin (Kochummen 1989: 151) while those of *Litsea lancifolia* arch to approach the margin but do not loop and join.

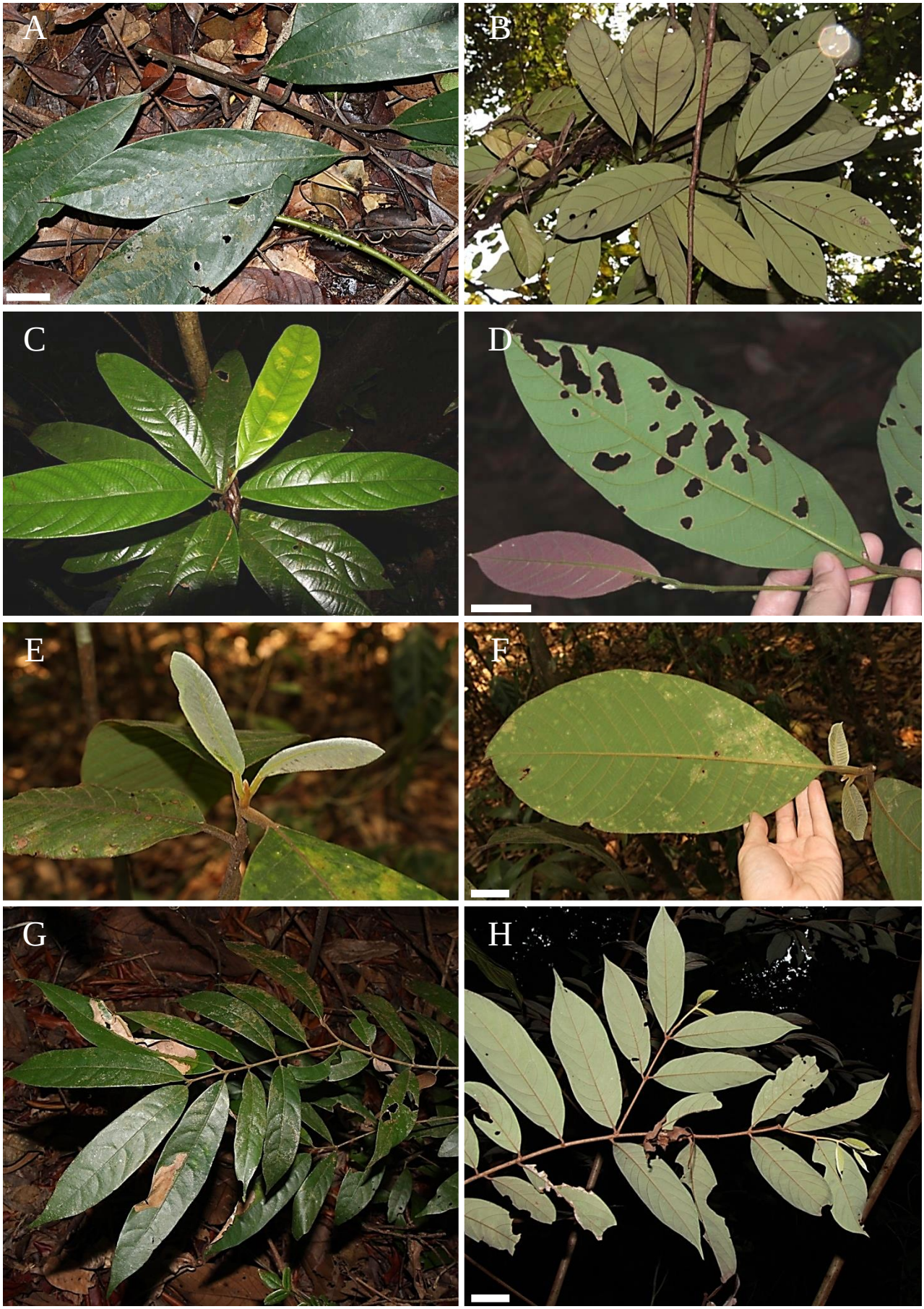

Fig. 12. A, Upper side; and B, under side of the leaves of *Litsea erectinervia*. C, upper side; and D, under side of the leaves of *Litsea firma*. E, new leaves; and F, the under side of a leaf blade of *Litsea grandis*. G, upper side; and H, under side of the opposite to subopposite leaves of *Litsea lancifolia*. Scale bars = 2 cm.

9. ***Litsea resinosa*** Bl.
(Latin *resinosa*, resin-producing)

Key reference. Kochummen (1989: 163)

Medium-sized tree to 30 m tall; trunk girth to 180 cm; buttresses short; with stilt roots in swampy habitats. **Bark** grey, smooth with wide fissures, lenticellate; inner bark reddish; sapwood pale. **Twigs** pale brown, angular in cross section. **Leaves** alternate; blade obovate to elliptic, *glabrous*, sometimes glaucescent below, drying thinly coriaceous, 14–25 × 7–13 cm, with midrib raised prominently below and keeled near the base, secondary veins 9–16 pairs, sunken above, raised below, arching gently towards the margin, and *tertiary veins densely scalariform, spaced 1–2 mm apart*, faint above, *visible below*, *apex acuminate*, base cuneate, sometimes oblique; stalk 1–2 cm long, drying finely wrinkled. **Fruit** ellipsoid or ovoid, 2 × 1 cm, seated in a saucer-shaped or shallow cupule. — Fig. 13.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong & A. T. Gwee NES 98; listed as Cryptocarya costata Bl. in Wong et al. [2013]). Also collected several times likely from the same tree behind Seletar Reservoir Carpark A (e.g., Hassan Ibrahim SING 2011-249, sterile; Hassan Ibrahim & H. K. Lua SING 2012-058, with fruits). Our own encounters were in two plots, one wet and one dry, along the Woodcutter's Trail. No other Singapore localities are known.

Habitat. Kochummen (1989: 163) and Ngernsaengsaruay et al. (2011) both state that this is a common species in swamp forest, especially peat swamp forests.

Conservation. Not assessed as this is a recent new record for Singapore.

NEOLITSEA **Merr.**
(Greek *neos*, new; referring to the split of this genus from *Litsea*; see Ng [2005b])

Shrubs or small trees. The single Singapore species has leaves that are alternate or spiral, rarely sub-opposite or pseudo-whorled, and the leaf blade, tripliveined. Flowers unisexual, in umbels. Fruit seated on a disc-shaped cupule.

1. ***Neolitsea cassia*** (L.) Kosterm.

Key references. Kochummen (1989: 169)

Recent synonyms. *Neolitsea zeylanica* (Nees) Merr. in Kochummen (1989); see Ng (2005b)

Shrub or small tree. **Leaves** alternate or spiral, rarely sub-opposite or pseudowhorled; blade broadly to narrowly ovate or elliptic, drying 8–20 × 5–8 cm, chartaceous, glabrous, *often distinctly glaucous below*, with midrib raised below and above; *tripliveined* (where the first pair may arise 0.5–3 cm away from the base but extends more than half the length of the leaf), *with 3–5 pairs of secondary veins*, raised above and below, irregularly arranged, the second pair arising halfway along the midrib, each pair progressively weaker and less distinct towards the apex, and tertiary veins more-or-less scalariform, visible but indistinct below, with reticulations dense and visible above but faint below, apex acuminate, base cuneate to rounded, rarely disjointed; stalk 2.5–3.5 cm long, drying finely wrinkled. **Flowers** in sessile umbels. **Fruit** round, 0.8–1.5 cm across, on a disc-shaped, wavy-margined cupule. — Fig. 14.

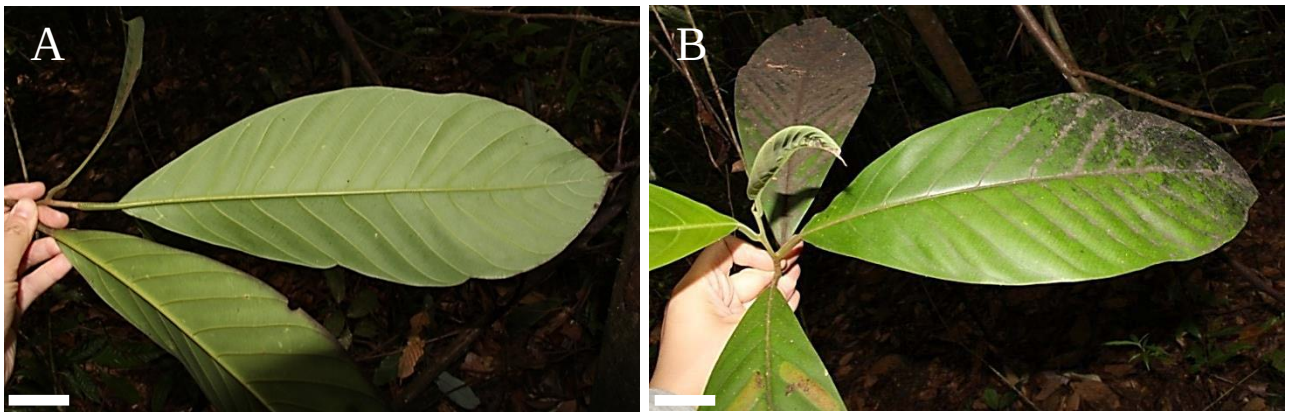

Fig. 13. A, upper and B, under side of a fresh leaf of *Litsea resinosa*. Scale bars = 2 cm.

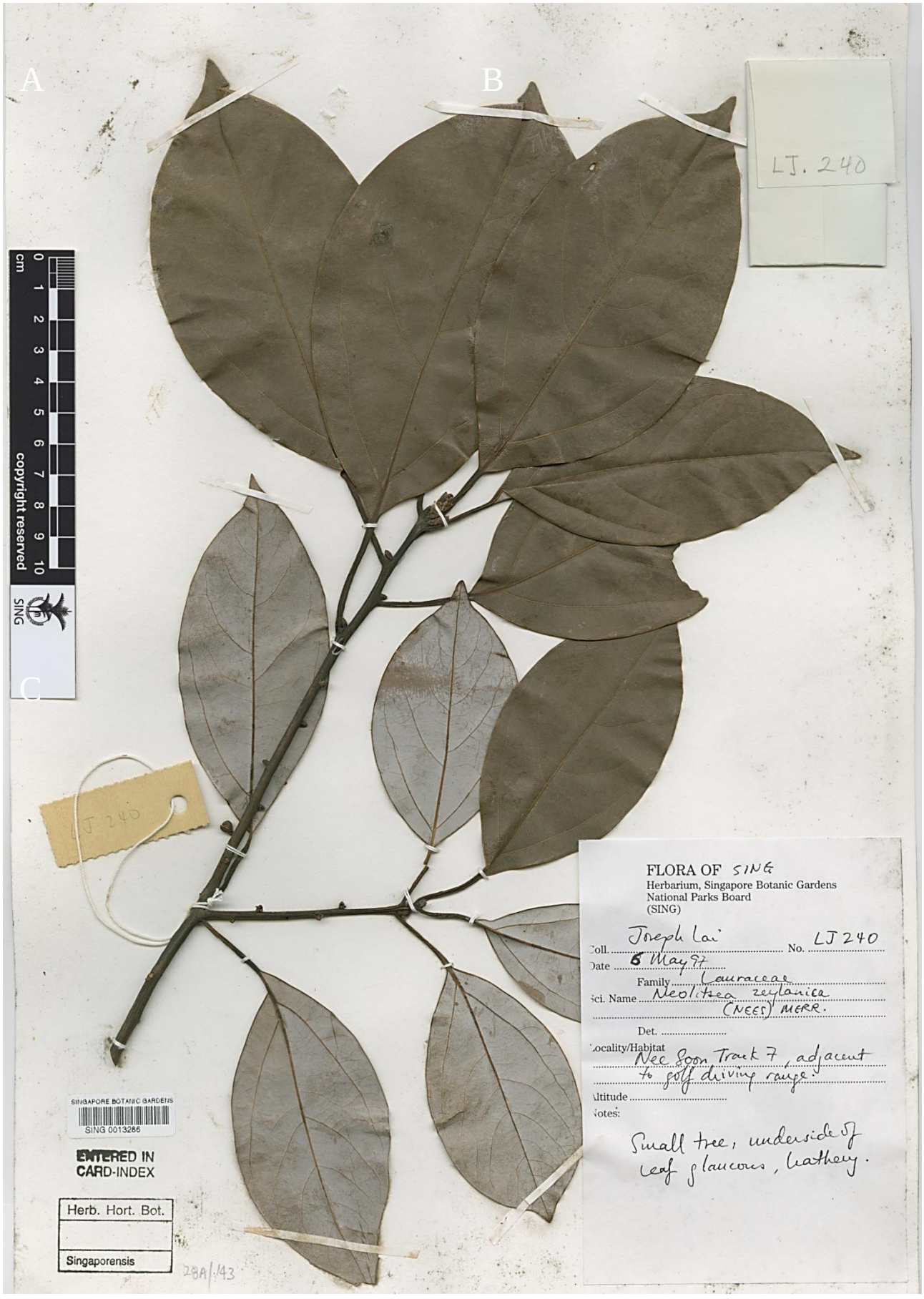

Fig. 14. Herbarium specimen of *Neolitsea cassia* showing the tripliveined leaves and intensely glaucous underside of the leaf blade.

Singapore localities. NSSF (J. Lai LJ 240; Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee & Y. K. Chua NES 331; W. F. Ang, X. Giam, A. F. S. L. Lok & C. K. Yeo s.n. SING barcode number 0154973). This species appears to have a wide ecological amplitude, with a "vast geographic range" (Ng, 2005b) from sea coasts to limestone hills and montane forests (Kochummen 1989: 169). In Singapore, it has likewise been collected from the coast (Changi and Bedok) and islands (Pulau Tekong, Pulau Ubin) in the east of Singapore, as well as hills (BTNR) and near swampy areas (but see below). The coastal specimens have narrower, almost lanceolate leaf blades with a more acute apex.

Habitat. Despite its apparent wider ecological amplitude at larger spatial scales, within the NSSF it is found on dry ground and along forest edges.

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

NOTHAPHOEBE Bl.

(Greek *nothos*, false; referring to close resemblance to the genus *Phoebe*)

Trees. Leaves alternate, rarely sub-opposite or opposite, penniveined. Flowers bisexual, in panicles; Singapore species have axillary inflorescences (Kochummen 1989: 170). Fruit ellipsoid or oblong; perianth persistent but not enlarged (Kochummen 1989: 170).

1. *Nothaphoebe umbelliflora* (Bl.) Bl.

(Latin, *umbelliflora*, flowers in umbels, referring to the inflorescences of this species)

Key references. Kochummen (1989: 172)

Medium-sized to large tree to 33 m tall; trunk girth to 300 cm. **Bark** grey or grey-brown, smooth to faintly dippled or scaly, lenticellate, inner bark yellow-brown, mottled, fragrant, sapwood yellow. **Young twigs** often drying black, growing tip and young leaves with fine golden hairs; trunk base slightly fluted. **Leaves** alternate, sometimes sub-opposite, rarely opposite; blade *often drying dark brown or almost black*, elliptic, often narrowly so, 7.5–19.5 × 3.5–6.5 cm, coriaceous to chartaceous, glabrous, with midrib raised above and below, secondary nerves raised above and below, 5–7 pairs, looping near the margin, and *tertiary veins scalariform-reticulate*, distinct above and below, apex attenuate, *base narrowly cuneate to attenuate*, sometimes disjointed; *stalk often drying black, slender*, drying 1–1.5 cm long. **Fruit** ripening reddish, oblong, 3 × 1 cm when dried; stalk pink. — Fig. 15.

Singapore localities. NSSF (Samsuri Ahmad, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee et al. NES 37, 344 & 364); Chan Chu Kang (J. S. Goodenough 1855); "Selitar" (H. N. Ridley 6267). Occurs in secondary and primary forests in the BTNR and the CCNR. Also previously collected from Changi (H. N. Ridley 3954).

Habitat. This species occurs in both wet and dry areas.

Conservation. Not threatened

Suggested common name. common false laurel

EXCLUDED SPECIES

Older specimens of *Litsea ridleyi* Gamble (e.g., collected from Chan Chu Kang H. N. Ridley s.n. SING barcode number 0013175) have been re-determined by F. S. P. Ng as *Litsea accedens* (Bl.) Boerl., except for a recent sterile specimen (Upper Peirce Reservoir: A. T. Gwee SING 2010-143). We have collected several sterile specimens that match either Ridley's or Gwee's specimens. While Ng (2005b) considers *Litsea accedens* to be a highly variable species of which *Litsea ridleyi* is a synonym, we will reserve judgment until further studies have been conducted.

Several specimens collected from the NSSF and determined as *Litsea machilifolia* Gamble do not match Peninsular Malaysian specimens of this species.

Fig. 15. A leafy twig of *Nothaphoebe umbelliflora*.

Almost all local specimens previously identified as "*Phoebe* cf. *opaca* Bl.", a synonym of *Phoebe grandis* (Nees) Merr., except for one, have been re-determined by A. J. G. H. Kostermans to be either *Alseodaphne intermedia* Kosterm. or *Alseodaphne oblanceolata* (Merr.) Kosterm. The only specimen not re-determined, SFN 37264, is likely to have been just missed out by Kostermans. We have collected sterile specimens that will match very closely with either *Alseodaphne intermedia* or *Alseodaphne oblanceolata*, but we are unable to differentiate between these two species; Kochummen (1989: 114) who based his descriptions on Kostermans' work, only mentions that these two species are very close but *Alseodaphne oblanceolata* has thinner leaves, a character that we found difficult to use to tell them apart. Furthermore, two specimens that were duplicates (SFN 37269) were each determined by Kostermans to be one of these two species. Further comparisons with specimens in other herbaria will be required.

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LITERATURE CITED

Beentje H (2010) The Kew Plant Glossary: An Illustrated Dictionary of Plant Terms. Royal Botanic Gardens, Kew, Richmond, Surrey, 160 pp.

Chong KY, Tan HTW & Corlett RT (2009) A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore. 273 pp. Uploaded 12 November 2009. http://lkcnhm.nus.edu.sg/nus/pdf/PUBLICATION/LKCNH%20Museum%20Books/LKCNHM%20Books/flora_of_singapore_tc.pdf. (Accessed 8 June 2015).

Chong KY, Lee SML, Gwee AT, Leong PKF, Samsuri Ahmad, Ang WF, Lok AFSL, Yeo CK, Corlett RT & Tan HTW (2012) Herbarium records do not predict rediscovery of presumed nationally extinct species. Biodiversity & Conservation, 21: 2589–2599.

Corlett RT (1992) The ecological transformation of Singapore, 1819–1900. Journal of Biogeography, 19: 411–420.

Corner EJH (1978) The freshwater swamp-forest of South Johore and Singapore. Gardens' Bulletin Singapore, Supplement 1: 1–266 pp.

Julia S (2005) A synopsis of the genus *Actinodaphne* Nees (Lauraceae) in Sabah and Sarawak, Malaysia. Gardens' Bulletin Singapore, 57: 69–100.

Kochummen KM (1989) Lauraceae. Tree Flora of Malaya, 4: 99–178.

LaFrankie JV (2010) Trees of Tropical Asia: An Illustrated Guide to Diversity. Black Tree Publications Inc, Philippines, 750 pp.

Ng FSP (2005a) Taxonomic notes on Bornean *Cryptocarya* R.Br. (Lauraceae). Gardens' Bulletin Singapore, 57: 63–68.

Ng FSP (2005b) Taxonomic notes on Bornean *Litsea*, *Lindera*, *Neolitsea*, and *Iteadaphne* (Lauraceae). Gardens' Bulletin Singapore, 57: 217–246.

Ngernsaengsaruay C, Middleton DJ & Chayamarit K (2011) A revision of the genus *Litsea* Lam. (Lauraceae) in Thailand. Thai Forest Bulletin (Botany), 39: 40–119.

Nishida S (2008) Taxonomic revision of *Beilschmiedia* (Lauraceae) in Borneo. Blumea, 53: 345–383.

Rodda M & Ang WF (2012) *Hoya caudata* Hook.f. (Apocynaceae), a new record for Singapore, and keys to the *Hoya* species of Singapore. Nature in Singapore, 5: 123–128.

Soh W-K (2011) Taxonomic revision of *Cinnamomum* (Lauraceae) in Borneo. Blumea, 56: 241–264.

Tan HTW, Tan K-x, Ali bin Ibrahim, Chew PT, Chua KS, Duistermaat H, Ganesan SK, Goh MWK, Gwee AT, Kiew R, Lee SML, Leong P, Lim J, Lok AFSL, Loo AHB, Lum SKY, Morgany T, Saifuddin bin Suran, Sim S, Haji Samsuri bin Haji Ahmad, Wee YC, Yap KF, Yeo CK & Yong JWH (2008) Checklists of threatened species—Seed plants. In: Davison GWH, Ng PKL & Ho HC (eds.) The Singapore Red Data Book: Threatened Plants & Animals of Singapore. 2nd Edition. Nature Society (Singapore), Singapore. Pp. 213–244.

Turner IM & Chua KS (2011) Checklist of the Vascular Plant Species of the Bukit Timah Nature Reserve. Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, Singapore. 85 pp. Uploaded 8 August 2011. http://lkcnhm.nus.edu.sg/nus/pdf/PUBLICATION/LKCNH%20Museum%20Books/LKCNHM%20Books/btnr_plants_checklist.pdf. (Accessed 8 June 2015).

Turner IM, Boo CM, Wong YK, Chew PT & Ali bin Ibrahim (1996) Freshwater swamp forest in Singapore, with particular reference to that found around the Nee Soon Firing Ranges. Gardens' Bulletin Singapore, 48: 129–157.

van der Werff H (2001) An annotated key to the genera of Lauraceae in the Flora Malesiana region. Blumea, 46: 125–140.

Wong HF, Tan SY, Koh CY, Siow MHJ, Li T, Heyzer A, Ang AHF, Mirza Rifqi bin Ismail, Srivathsan A & Tan HTW (2013) Checklist of Plant Species of Nee Soon Swamp Forest, Singapore: Bryophytes to Angiosperms. National Parks Board and Raffles Museum of Biodiversity Research, National University of Singapore, Singapore, 521 pp. http://lkcnhm.nus.edu.sg/nus/pdf/PUBLICATION/LKCNH%20Museum%20Books/LKCNHM%20Books/NSSF_FloraChecklist.pdf. (Accessed 8 June 2015).