

A revision of *Cinnamomum* Schaeff. (Lauraceae) for Peninsular Malaysia and Singapore

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ABSTRACT. A revision of all species of the genus *Cinnamomum* Schaeff. (Lauraceae) occurring in Peninsular Malaysia and Singapore is presented with a summary of taxonomic history, notable features of morphology, a key to species, and a description, distribution map, Provisional IUCN Conservation Assessment for each species, together with notes on ecology and ethnobotany. In this revision, twenty-two distinct species are recognised, including one former variety that is elevated to species level as *Cinnamomum selangorense* (Ridl.) de Kok. Eleven names are lectotypified (*Camphora inuncta* Nees; *Cinnamomum cinereum* Gamble, *C. graciliflorum* Gamble, *C. malaccense* Meisn., *C. ridleyi* Gamble, *C. rhynchophyllum* Miq., *C. sintoc* Blume, *C. subcuneatum* Miq., *C. velutinum* Ridl., and *C. vimineum* Wall. ex Nees; *Laurus malabathrum* Wall. ex Nees), and five names are placed into synonymy for the first time. A small number of species are considered to have a Provisional IUCN Conservation Assessment of Least Concern, while most are either Endangered or Critically Endangered, with one species considered to be Data Deficient (*Cinnamomum trintaense* Kosterm.).

Keywords. *Cinnamomum*, Lauraceae, Peninsular Malaysia, taxonomy

Introduction

The genus *Cinnamomum* Schaeff. was first described in 1760 based on the widely-cultivated species *Cinnamomum verum* J.Presl (Schäffer, 1760). It comprises about 350 species and occurs naturally in tropical and subtropical Asia, South America, Australia and the Pacific (van der Werff 2001: 135). The bark, flowers and fruits of a small number of species are used as spices and these species are now commonly cultivated throughout the tropics. Other species are used as shade trees. The taxonomy is reasonably well known for a genus of Lauraceae. Nees von Esenbeck & Nees von Esenbeck (1823) wrote a book on the then known species of the genus and one of them later revised the taxonomy in his *Systema Laurinarum* (Nees von Esenbeck, 1836). Blume (1836) reviewed some species which had been described by Rumphius in *Herbarium Amboinense* (Rumphius, 1741). The genus was also studied by several authors in the 20th century: for Indonesia by Cammerloher (1925), and for South China and Indo-China by both Liou Ho (1932) and Allen (1939). In addition, Kostermans planned to revise all the Asian species in a set of five papers but only three of these were published, one dealing with the species of the Eastern Malaysian Islands

(Kostermans, 1986), another with the species from South India (Kostermans, 1985) and one as part of the flora of Sri Lanka (Kostermans, 1983). The two remaining papers were prepared but never published, one dealing with Western Malesia and the other with China. Copies of these unpublished papers are now kept at the Botanical Library of the Naturalis Biodiversity Center in Leiden, The Netherlands. In the unpublished paper dealing with the species of Western Malesia, he recognised 12 endemic species for Peninsular Malaysia and a few additional species that were shared with either Sumatra and/or Borneo (Kostermans, unpublished). More recent works on the genus include revisions of the species for Borneo (Soh, 2011) and China (Li et al., 2008). In molecular phylogenetic studies, *Cinnamomum* is part of the ‘core’ Lauraceae group (Rohwer & Rudolph, 2005; Huang et al., 2016).

Nomenclature

The nomenclature of some species of *Cinnamomum* is very challenging. The species which are most commonly used have many names that have been employed to catalogue their morphological variation in detail. A good example of this is the account of Lukmanoff (1889) who described many taxa based on variation in the mainly cultivated species of *Cinnamomum*. He also assigned older names as synonyms of his newer names. Kostermans (1983, 1985, 1986) tried to deal with these nomenclatural problems, and also included some pre-Linnean names. In this paper, I have dealt principally with names relevant to Peninsular Malaysia and Singapore and have only included names from outside this area if I have seen the type material and their inclusion in the synonymy is not problematic.

Morphology

Habit

All species are either trees or shrubs, usually of modest height, but some can be up to 50 m tall, with a diameter up to 300 cm. The bark is either smooth or slightly fissured and is usually reported to be fragrant.

Leaves and bracts

The leaves of most species are subopposite with only a few species having almost exclusively alternate leaves (e.g. *Cinnamomum parthenoxylon* (Jack) Meisn.). In the literature, it is often reported that the leaves are opposite, rather than subopposite, but from observations of specimens from Peninsular Malaysia, opposite leaves are very rare and not constant within a species, and usually not even constant within a specimen.

One native (*Cinnamomum parthenoxylon*) and one introduced species (*C. camphora* (L.) J.Presl) has domatia in the axils between the midrib and the secondary

veins. These domatia are clearly visible on the upper surface of the leaves as domed structures and as pits on the lower surface.

The bracts that are situated at the base of the axillary inflorescences are usually leaf-like and are morphologically indistinguishable from the leaves, apart from usually being significantly smaller in size. Only in those species which have true terminal inflorescences are the bracts morphologically very different from the leaves.

Twigs and terminal buds

Twigs and terminal leaf buds are generally important characters for species recognition in the Lauraceae (de Kok, 2015, 2016a, 2016b) but in *Cinnamomum* they are of less importance. The main exception is in the terminal leaf buds of *Cinnamomum parthenoxylon*, a species which has perulate buds that are orbicular, mainly glabrous, and their bracts leave a series of scars at the base of older twigs. Thus, they are very different from the usually long-acuminate and hairy terminal leaf buds in the remaining species.

Leaf venation

Leaf venation is an important character, not only in recognising the genus, but also in recognising the various species. Although the leaf venation of *Cinnamomum* has most often been described as being trinerved, it is more precise to describe them as triplinerved, as defined in Stearn (1992).

Amongst the species found in Peninsular Malaysia and Singapore, several different types of leaf venation are present, although most species are triplinerved. However, when triplinerved, the venation is not always entirely symmetrical, as often one of the lateral veins starts slightly more distally along the midrib than the other. Exceptions to this pattern of venation are seen in *Cinnamomum parthenoxylon*, which has pinnate venation, and *C. verum*, which has palmate venation, and some species which are truly trinerved (*C. camphora*). Some of those species with triplinerved or palmate venation have pinnate secondary veins more distally (*Cinnamomum sintoc* Blume).

In several species, the major secondary veins additionally sometimes have more prominent side veins. This is very obvious in most leaves of *Cinnamomum rhynchophyllum* Miq., whereas in other species it is less common. This character is different from the brochidodromous venation of some species (in which there is a looping intramarginal vein) as these side veins are straight and look very similar to the secondary veins.

Indumentum

The hair density on the undersurface of the leaves is a useful character in species recognition. Some species have velutinous leaf surfaces, while others have completely glabrous leaves.

Three hair types are present in the *Cinnamomum* species of Peninsular Malaysia and Singapore. The first one is the rarest and only present in *Cinnamomum aureofulvum* Gamble where the hairs are golden brown, appressed, and completely

cover the undersurface of the leaves. The two other types of hairs are more common in the Lauraceae in general. The second type is of appressed and whitish hairs that form a dense to very sparse covering. In young leaves the hairs are very uniformly spread, but they become patchier when the leaf becomes older. The third type of hair is erect, yellowish and usually forms a dense indumentum.

Inflorescences

In many descriptions, the inflorescences in this genus are said to be axillary, terminal or pseudo-terminal. Most species in Peninsular Malaysia have axillary inflorescences. In some cases, they appear to be terminal, as they are situated at the end of the twig, but a terminal bud of the shoot is clearly present, making these inflorescences not terminal, but axillary. Only in a few species (*Cinnamomum altissimum* Kosterm., *C. javanicum* Blume and *C. rhynchophyllum*) are truly terminal inflorescences present, and these have a set of small bracts at the base.

The inflorescences of *Cinnamomum* in Peninsular Malaysia all belong to type 2 in the system proposed by van der Werff (2001). However, within this definition, two subtypes can be recognised. In most species, the inflorescence is well developed, consisting of many-flowered panicles and the branching in the inflorescence is well spread out. This gives the whole inflorescence an open and balanced appearance (for instance in *Cinnamomum iners* (Reinw. ex Nees & T.Nees) Blume). This is the same inflorescence subtype as defined by Soh (2011: Fig 2a). In a small number of species, the inflorescence is also a panicle, but only has a few flowers and the higher order peduncles are very much reduced in length and number. This gives the whole inflorescence a slender and spike-like appearance (see *Cinnamomum cuspidatum* Miq., *C. microphyllum* Ridl. and *C. mollissimum* Hook.f.). This is somewhat similar to Soh's second subtype (2011: Fig. 2b), except that he observed that in the Bornean species the individual flowers are arranged alternately or suboppositely along the main axis or lateral branches, while in the Peninsular Malaysian species the flowers are usually only subopposite.

Anthers

Most species have 4-celled anthers. However, a small number have either 2-celled anthers or a mixture of whorls with either 2- or 4-celled anthers (*Cinnamomum cuspidatum*, *C. iners*, *C. javanicum*, *C. microphyllum*, *C. rhynchophyllum* and *C. vimineum* Nees). In each case, it is the two upper anthers cells that have not developed.

Ovary

In most species, the ovary is clearly superior, which is common in the Lauraceae. In some species however, the ovary is partly placed in the very small perianth tube (*Cinnamomum sintoc*), which gives the appearance of a half-inferior ovary.

Materials and Methods

This study is based mainly on observations of herbarium specimens from the following herbaria: BM, BO, GZU, IBK, K, KEP, L, MEL, P, PE and SING. Only native and naturalised species are included; species only found in cultivation, of which there are several, are not included.

In the following descriptions:

- i) All measurements and colour descriptions are from mature material;
- ii) All measurements and all statements about the position of the veins relative to the remainder of the leaf are taken from dried material;
- iii) All collections of *Cinnamomum* from Peninsular Malaysia and Singapore seen by the author are cited;
- iv) Selected specimens from outside Peninsular Malaysia or Singapore are cited when the material was used in making the descriptions;
- v) All synonyms of *Cinnamomum* taxa from Peninsular Malaysia and Singapore are included. Synonyms from outside the area are included only in those cases where the type material has been seen by the author;
- vi) Scans of type material were seen on <http://plants.jstor.org> on 21 August 2017; barcode information is given for all specimens where available;
- vii) For the IUCN Provisional IUCN Conservation Assessments, all Areas of Occurrence and Areas of Occupancy were calculated using <http://geocat.kew.org> on 28 August 2017.

Taxonomic treatment

Cinnamomum Schaeff., Bot. Exped. 74 (1760), nom. cons.; Gamble, J. Asiatic Soc. Bengal 75: 71 (1912); Ridley (1924: 90); Corner, Wayside Trees Mal., 339 (1952); Kostermans, Reinwardtia 4: 233 (1957); Dandy, Ind. Gen. Vasc. Pl. 1753 (Regn. Veg. li.) 40 (1967); Kostermans, Reinwardtia 8: 29 (1970); Kochummen, Tree Fl. Malaya 4: 124 (1989); Lorea-Hernandez, Syst. Rev. Neotrop. Spec. Cinnam. (1996: 1); Soh, Blumea 56: 241 (2011). – TYPE SPECIES: *Laurus cinnamomum* L. = *Cinnamomum verum* J.Presl.

Camphora Fabr., Enum. 218 (1759); Dandy, Ind. Gen. Vasc. Pl. 1753 (Regn. Veg. li.) 1967. – TYPE SPECIES: *Laurus camphorifera* Kaempf. ex Fabr. = *Camphora officinarum* Nees ex Wall. = *Cinnamomum camphora* (L.) J.Presl.

Septina Noronha, Verh. Batav. Genootsch. Kunst. 5(Art. 4): 3. (1790), nom. inval.; Kostermans, Reinwardtia 4: 233 (1957), nom. nud.

Camphorina Noronha, Verh. Batav. Genootsch. Kunst. 5(Art. 4): 1 (1790), nom. inval.; Kostermans, Reinwardtia 4: 233 (1957), nom. nud.

Cecidaphne Nees in Wallich, Pl. Asiat. Rar. 2: 70 (1836); Kostermans, Reinwardtia 4: 233 (1957), as *Cecidodaphne*. – TYPE SPECIES: *Cecidaphne glaucescens* Nees = *Cinnamomum glaucescens* (Nees) Hand.-Mazz.

Parthenoxylon Blume, Mus. Bot. 1: 322 (1851); Kostermans, Reinwardtia 4: 233 (1957). – TYPE SPECIES: *Parthenoxylon porrectum* (Roxb.) Blume = *Cinnamomum parthenoxylon* (Jack) Meissn.; *Parthenoxylon pruinatum* Blume = *Cinnamomum parthenoxylon* (Jack) Meissn.; *Parthenoxylon pseudosassafras* (Blume) Blume = *Cinnamomum pseudosassafras* (Blume) Meissn.

Shrubs to trees, crushed fresh leaves and inner bark with a strong aromatic smell. Terminal leaf buds usually not perulate (except in *Cinnamomum parthenoxylon*). **Leaves** subopposite, rarely alternate or spiral, triplinerved, rarely pinninerved, trinerved or venation palmate. **Inflorescence** usually axillary or rarely terminal, formed of cymose panicles. **Flowers** bisexual or rarely unisexual; involucral bracts absent; perianth lobes 6, subequal, persistent, becoming partly truncate or deciduous in fruit; perianth tube short, funnel-shaped, becoming enlarged and indurate in fruit. **Stamens** (6) 9, in (2) 3 whorls, those of the 3rd whorl with a pair of stalked or sessile glands on the filaments; anthers (2) 4-celled, those of the 1st and 2nd whorl introrse, those of the 3rd whorl ± extrorse; staminodes cordate or sagittate, stalked. **Ovary** sessile, at the bottom of the perianth tube; style slender; stigma discoid or obscurely 3-lobed. **Fruit** a drupe seated on the usually cup-shaped indurate perianth tube (cupule), the perianth lobes persistent and sometimes truncate, or deciduous.

Distribution. About 350 species in tropical Asia, Australia, and the western Pacific. In Peninsular Malaysia and Singapore twenty-three species are recognised of which ten are endemic and four are introduced.

Uses. Several species have been introduced into the region for agricultural purposes. *Cinnamomum cassia* (L.) J.Presl from south China and Indo-China is cultivated in Java and has been grown in the Singapore Botanic Gardens, while *C. culilawan* Blume from the Moluccas used to be grown in the Penang Botanic Gardens. In addition, *Cinnamomum camphora*, *C. burmannii* (Nees & T.Nees) Blume and *C. verum* are, or have been, commercially cultivated in Peninsular Malaysia (Burkill, 1966) although their cultivation did not prove to be very successful (Kochummen, 1989).

Several native and non-native species of *Cinnamomum* have been used either medicinally, as spices, as shade trees or as a source of chemicals. *Cinnamomum iners* is used as a shade tree and its wood is used to make fragrant joss sticks. The oil extracted from *Cinnamomum camphora* is used as a source of camphor, while the dried fruits of *C. cassia* are used to treat coughs, sore throats and chest complaints, and as a food flavouring (Burkill, 1966). The bark of *Cinnamomum javanicum* is used to

extract massaia, which was once widely used as a natural food flavouring. The bark of several species (*Cinnamomum burmannii*, *C. cassia* and *C. verum*) are used as a spice in cooking or in betel juice (*C. mollissimum*).

The essential oil named *Kulit lawang*, which is on sale in Peninsular Malaysia, is extracted from the bark of various species, including *Cinnamomum iners* and *C. rhynchophyllum*. However, the amount of aromatic substance varies greatly according to species. Several species (*Cinnamomum iners*, *C. javanicum*, *C. pendulum* Cammerl. and *C. sintoc*) may be the source of sintoc barks seen in Malaysian medicinal shops. This bark is very aromatic, with a smell of cloves, and is very similar to *Kulit lawang* except for a bitter and astringent taste. In Peninsular Malaysia, it is used in powdered form on wounds and to treat numbing of the feet (Burkill, 1966).

Key to the species

- 1a. Leaves penninerved or trinerved, rarely triplinerved; leaves alternate or (sub) opposite; lower surface of leaves usually with domatia in the angle between the lateral and main veins 11. *C. parthenoxylon*
- 1b. Leaves triplinerved or venation palmate; leaves subopposite, rarely alternate; lower surface of leaves without domatia in the angle between the lateral and main veins 2
- 2a. Leaves stiffly leathery, base cordate; shrubs or small trees on mountains 3. *C. cordatum*
- 2b. Leaves membranous to thickly leathery, base rounded to cuneate; usually big trees of lowland and hill forest, rarely in montane forest 3
- 3a. Leaf undersurface completely covered with golden brown, appressed hairs; shrubs or small trees confined to montane forests 2. *C. aureofulvum*
- 3b. Leaf undersurface sparsely to densely hairy; hairs whitish or yellow, appressed to erect; usually big trees of lowland and hill forest, rarely in montane forests 4
- 4a. Leaves mostly alternate, rarely some subopposite, blades triplinerved 12. *C. puberulum*
- 4b. Leaves subopposite, rarely some alternate, blades triplinerved or rarely with palmate venation 5
- 5a. Leaves triplinerved at the base with other major lateral veins arranged in a pinnate fashion distally along the midrib; fruit with calyx rim entire; bark smelling of cloves 16. *C. sintoc*
- 5b. Leaves triplinerved at the base or palmate without any major lateral veins more distally along the midrib (though sometimes with clear false lateral veins); fruit with calyx rim entire to lobed; bark usually smelling of cinnamon 6

- 6a. Inflorescence a few-flowered (3, 6 or 9, rarely more) slender axillary spike-like panicle (1.5–15 cm long), the higher order peduncles are very much reduced in length and number 7
- 6b. Inflorescence a many-flowered ((3–)9 to many) broad axillary and/or terminal panicle (> 3 cm long), the higher order peduncles are well developed in both length and number 14
- 7a. Twigs and leaves with yellowish erect hairs 8
- 7b. Twigs and leaves glabrous or with white or dark brown appressed hairs 10
- 8a. Lower surface of leaves densely hairy 9. *C. mollissimum*
- 8b. Lower surface of leaves sparsely hairy to glabrous 9
- 9a. Trees 6–9 m tall; twigs velutinous when young; terminal leaf bud 3–3.5 mm long, with the apex acuminate; leaves 4.3–9.3 × 1.2–2.7 cm, with the apex acuminate; inflorescence velutinous 18. *C. trintaense*
- 9b. Trees 9–12 m tall; twigs sparsely hairy when young; terminal leaf bud 3–6 mm long, with the apex acute; leaves 7.5–16 × 2.5–6.5, with the apex broadly acute to rounded; inflorescence sparsely hairy 7. *C. kunstleri*
- 10a. Inflorescence covered in dark brown hairs 15. *C. selangorensis*
- 10b. Inflorescence glabrous or covered in white to yellow hairs 11
- 11a. Shrubs or small trees 1.5–6 m tall; leaves 2–7.2 × 2–3.2 cm 8. *C. microphyllum*
- 11b. Trees (1.8–)7–16 m tall, if tree < 7 m tall, then flowers velutinous when young and leaf apex acute to acuminate; leaves 5–15.5 × 1.5–6 cm 12
- 12a. Inflorescence and outer surface of perianth lobes velutinous at least when young; leaves acute to acuminate 19. *C. vimineum*
- 12b. Inflorescence and outer surface of perianth lobes glabrous to sparsely hairy when young; leaves broadly acute to long-acuminate 13
- 13a. Inflorescence and outer surface of perianth lobes glabrous to sparsely hairy when young; leaves long-acuminate 4. *C. cuspidatum*
- 13b. Inflorescence and outer surface of perianth lobes glabrous; leaves broadly acute to acuminate 10. *C. pachypes*
- 14a. Lower surface of mature leaves sparsely to densely hairy with yellowish and erect or curly hairs 15
- 14b. Lower surface of mature leaves glabrous or sparsely hairy with whitish and appressed hairs 16
- 15a. Inflorescence axillary; leaves not bullate and tertiary veins not sunken above; cupule with an entire margin 14. *C. scortechinii*

- 15b. Inflorescence terminal; leaves usually bullate and tertiary veins sunken above; cupule with persistent lobes 6. *C. javanicum*
- 16a. Inflorescence strictly terminal 17
- 16b. Inflorescence axillary and sometimes also terminal 18
- 17a. Leaf apex acute to acuminate; fruit (dried) 19–25 × 8.2–10 mm, cupule 12–13.5 mm diameter, lobes 6.5–10 mm long 1. *C. altissimum*
- 17b. Leaf apex acuminate with a long tip; fruit (dried) 9–10 × 7.9–8 mm, cupule 3–4.5 mm diameter, lobes 2–3 mm long 13. *C. rhynchophyllum*
- 18a. Cupule margin clearly lobed 5. *C. iners*
- 18b. Cupule margin entire to minutely lobed 17. *C. subavenium*

1. *Cinnamomum altissimum* Kosterm., Reinwardtia 10: 439 (1988); Kochummen, Tree Fl. Malaya 4: 127 (1989). – TYPE: Peninsular Malaysia, Terengganu, South Loh, 4 July 1968, *P.F. Cockburn FRI 10694* (holotype L [L0035685]; isotypes A [A00041293], K, SING [SING0260184]). (Fig. 1)

Trees 6–40 m tall, 25–50 cm diameter at breast height (dbh), with plank-like buttresses. Bark grey-brown or reddish brown, smooth, rarely slightly rugose, with faint hoop marks, lenticellate; inner bark pale to red-brown, with a strong aromatic smell of cloves; sapwood (creamy) white or pale brown. **Twigs** slender, 1.8–3.2 mm thick, smooth, rounded to faintly angled in cross-section, densely hairy, some becoming glabrous; hairs yellowish, appressed; terminal leaf bud ovoid, 6.3–7.8 mm long, apex acuminate, velutinous. **Leaves** subopposite, domatia absent; leaf blade ovate to elliptic, (4.5–)9–30 × (2–)3.5–9.8 cm, apex acute to acuminate, base cuneate to rounded, margins straight, triplinerved, secondary veins 1 pair which extend almost to the leaf apex, tertiary veins scalariform, blade thickly or thinly leathery; upper surface glabrous, shining, midrib and secondary veins raised or flattened, tertiary veins faint; lower surface glabrous, glaucous, midrib and secondary veins raised, tertiary veins sometimes distinct; petiole channelled, 8–20 mm long, slender, very sparsely hairy, wrinkled. **Inflorescence** a many-flowered broad panicle, terminal, 4–25 cm long, axis angled in cross-section, densely hairy, hairs yellowish, appressed; bracts scale like; bracteoles elliptic, 2–3 mm long, caducous to persistent. **Flowers** unisexual, creamy yellow to green-white, densely pale yellow hairy inside and out; perianth tube 0.6–1.5 mm long, ridged, velutinous; perianth lobes oblong, 2–3 × 1–1.7 mm, each apex acute to rounded, velutinous inside and outside. **Stamens** 9, 1.2–2.5 mm long, sparsely hairy; anthers 4-celled, apical ones smaller. **Ovary** unknown. **Fruit** ellipsoid, 19–25 × 8.2–10 mm, apex rounded, smooth, dull olive-green, drying blackish; cupule 12–13.5 mm diameter, cup-shaped, green, glabrous, woody, margin 6-lobed, lobes 6.5–10 mm long, each apex broadly acute to truncate, erect; stalk swollen at base and apex, 2–3 mm thick, often with circular constrictions at base and/or apex.

Distribution. Endemic to Peninsular Malaysia and occurring throughout (Fig. 1).

Ecology. In lowland and hill forest, rarely in montane forests, at 60–1200(–1800) m. Flowering from February to September; fruiting from July to September.

Vernacular names. *Medang teja*, *Medang kemangi*, *Madang kulit manis* and *Medang lawaug* (Malay).

Provisional IUCN conservation assessment. Endangered (EN B2ab(ii,iii)). This species is known only from a small number of collections from Peninsular Malaysia. An analysis of the Extent of Occurrence (EOO) gives a Provisional IUCN Conservation Assessment of Least Concern, but the Area of Occupancy (AOO) suggests an assessment of Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the region in question during the last 50 years, this species must be considered endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Penang:** Jul, *Curtis s.n.* (SING [SING0267684]). **Perak:** Tiong, Aug 1888, *Wray 2768* (SING [SING0267683]); Grik, Temenggor Forest Reserve, 24 Sep 1993, *Mat Asri bin Ngah Sanah FRI 26878* (K, KEP). **Kelantan:** Kamahang Forest Reserve, 1 Jul 1968, *Chelliah FRI 6543* (K, KEP, SING [SING0267682]). **Selangor:** Bukit Badong Kepong, 29 Oct 1930, *Jan Tan 26346* (KEP, SING [SING0267690]). **Pahang:** Taman Negara, 5 Mar 1968, *Whitmore FRI 8535* (K, KEP, SING [SING0267681]); Fraser's Hill, 10 Sep 1923, *Nur 11312* (BM, K, KEP 2 sheets, SING [SING0267680]); Kuantan, 21 Mar 1919, *Foxworthy FMS 3129* (KEP); Pauh, 22 Jul 1923, *Bain 5999* (K, KEP); Ulu Keniyam, Bukit Terom, 5 Mar 1968, *Shah MS 1573* (K, KEP, SING [SING0267691]). **Malacca:** *Griffith s.n.* (BM). **Johor:** Kluang Forest Reserve, 8 Feb 1968, *Cockburn FRI 7539* (K, KEP, SING [SING0267692]); South Sedili, 28 Jul 1939, *Ngadiman SFN 36896* (K, SING 3 sheets [SING0267685]); foot of Gunung Lambak, 15 Dec 1922, *Rahim 5853* (K, KEP 2x, SING [SING0267687]); Gunung Panti Forest Reserve, 2 Mar 1968, *Cockburn FRI 7757* (K, KEP, SING [SING0267688]).

Notes. This is one of the few species of *Cinnamomum* in which the flowers are unisexual. I have only seen male flowers, but in these the ovary does not seem to develop. Fruiting specimens are more common in herbaria, but female flowers seem to be rarely collected.

This species is relatively easy to recognise by its combination of triplinerved venation, completely glabrous leaves and a terminal inflorescence.

2. *Cinnamomum aureofulvum* Gamble, Bull. Misc. Inform. Kew 1910: 220 (1910); Ridley, Fl. Malay Penins. 3: 95 (1924); Kochummen, Tree Fl. Malaya 4: 125 (1989); Kostermans, Reinwardtia 8: 32 (1970). – TYPE: Peninsular Malaysia, Selangor, Semangkok, August 1904, *H.N. Ridley 12103* (holotype SING [SING0055877]; isotype K [K000778627]). (Fig. 1)

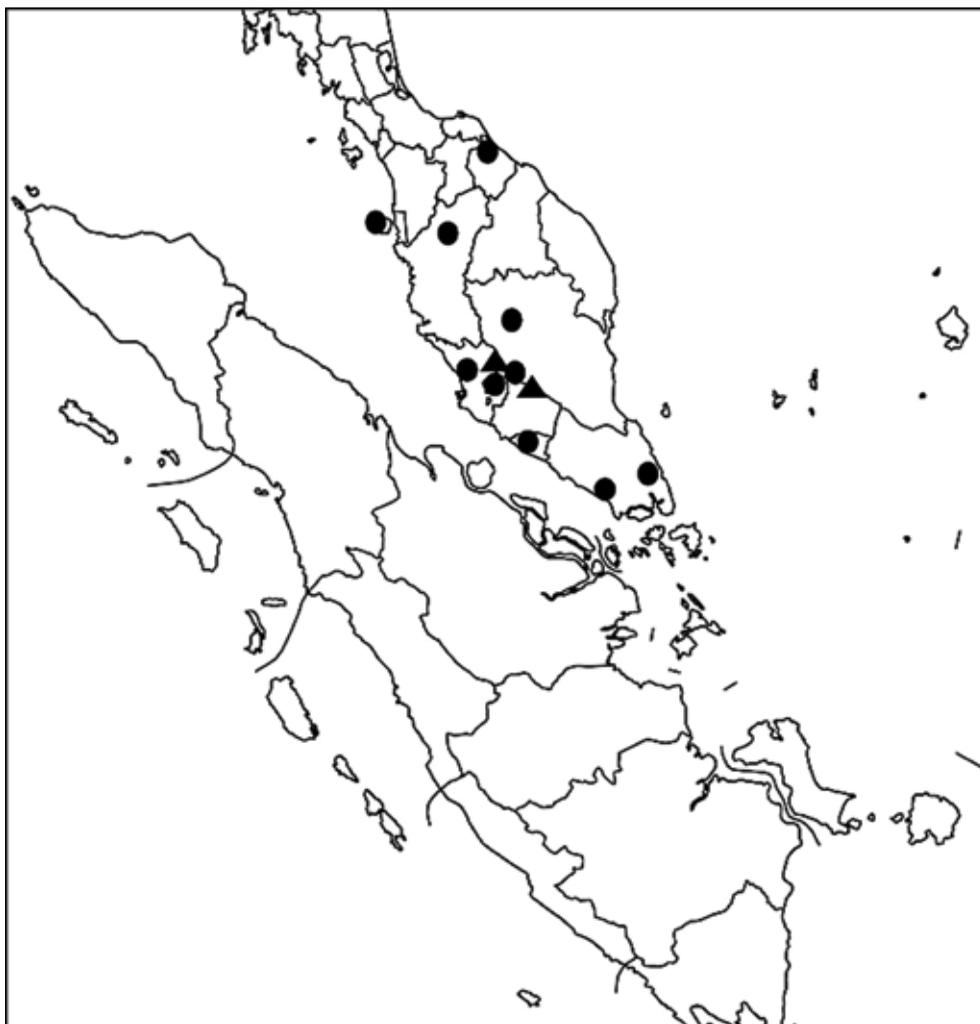


Fig. 1. Distribution of *Cinnamomum altissimum* (●) and *Cinnamomum aureofulvum* (▲).

Trees or shrubs, 1.2–13 m tall, 3–10 cm dbh. Bark reddish brown to grey, smooth. **Twigs** slender 1.3–3 mm thick, rounded to slightly angular in cross-section, velutinous when young to densely hairy when older; hairs reddish or golden brown, erect to appressed; terminal leaf bud ovoid to lanceolate in outline, 3.6–4.6 mm long, velutinous. **Leaves** subopposite to alternate, domatia absent; leaf blade elliptic to lanceolate, 4–12 × 1.5–5.5 cm, apex long-acuminate, base cuneate, sometimes asymmetric, margins recurved, blade triplinerved, secondary veins one pair which extend to the base of the apex, tertiary veins scalariform, blade membranous to thinly leathery, leaves held slightly downwards; upper surface sparsely hairy, midrib and secondary veins sunken, tertiary veins inconspicuous; hairs long, appressed, whitish; lower surface completely covered by appressed hairs, midrib and secondary veins raised, tertiary

veins inconspicuous; hairs golden or reddish brown when young, appressed; petiole half-terete, 7–23 mm long, slender, densely hairy; hairs reddish brown when young, erect to appressed. **Inflorescence** a few-flowered slender panicle, axillary, 1.1–4 cm long, velutinous; bracts leaf-like; bracteoles linear, 2–3 mm long, velutinous outside, densely hairy inside, mostly persistent. **Flowers** bisexual, cream-coloured; perianth tube 0.6–1 mm long, velutinous; perianth lobes 1–2.5 × 0.8–1.1 mm long, apex acute, velutinous. **Stamens** 9, 1.4–1.7 mm long, sparsely hairy; anthers 4-celled, upper ones greatly reduced. **Ovary** 0.5–1.1 mm diameter, glabrous; style 0.6–1.3 mm long; stigma peltate. **Fruit** ellipsoid, 4.8–10 × 2.8–6 mm, smooth, glabrous; cupule 2.9–4.2 mm diameter, cup-shaped, sparsely hairy, margin entire; stalk swollen, tapering distally, to 2.6 mm thick.

Distribution. Peninsular Malaysia, endemic to the mountains of Pahang and Selangor (Fig. 1).

Ecology. Growing in primary forests at 1000–1560 m altitude. Flowering from April to September; fruiting from October to January.

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known from a small number of collections, all from a restricted area of Peninsular Malaysia where it is reported to be locally abundant. An analysis of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) both give an assessment of Endangered. Given this and the threats posed by landscape modification that has occurred during the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Selangor:** top of Gunung Semangkok, Apr 1911, *Ridley 15598* (BM, K 2 sheets, SING [SING0267688]); Bukit Fraser, Pine Tree Hill, 14 Sep, 1933, *Symington 29485* (K, KEP); Gunung Bunga Buah, 27 May 1966, *Whitmore FRI 298* (K, KEP, SING [SING0267699]); Gunung Bunga Buah, 11 Jun 1981, *Wong FRI 32227* (K, KEP, SING [SING0267697]); Bunga Buah Range, Ulu Kali, 7 Jul 1974, *Kasim 1143* (K); Gunung Bunga Buah, Summit of Quartz Ridge, 11 Jun 1981, *Wong FRI 32230* (K, KEP, SING [SING0267696]); Gunung Bunga Buah Range, on Quartz Ridge, 1958, *anonymous 66491* (KEP). **Pahang:** Genting Highlands, Bukit Tunggul, 18 Jan 1994, *Perumal et al. FRI 41664* (KEP, SING [SING0080499]); Genting Highlands, Gunung Ulu Kai, near Wireless Station, 12 Jun 1973, *Modh Shah & Modh Ali MS 2976* (KEP 2 sheets, SING [SING0267693]); Cameron Highlands, Sungai Pauh Valley, 4 Oct 1963, *Chew CWL 794* (K, SING [SING0267700]); Fraser's Hill, upon the Selangor border, 16–30 Sep 1922, *Burkill & Holtum 8940* (SING [SING0267694]); Pine Tree Hill, 27 Aug 1923, *Nur 11052* (K, KEP, SING [SING 0267698]); path to Bukit Pine, 16 Jun 1964, *Paton 94825* (KEP).

Notes. This species is easy to identify even when sterile because the undersurface of young triplinerved leaves is completely covered by appressed golden-brown hairs.

3. *Cinnamomum cordatum* Kosterm., Reinwardtia 7: 295 (1968); Kosterm., Reinwardtia 8: 56 (1970); Kochummen, Tree Fl. Malaya 4: 125 (1989). – TYPE: [Peninsular Malaysia], Perak, Gunung Korbu (Mt. Kerbau), 22 July 1933, C.F. Symington 32130 (holotype K [K000778632]; isotypes A [A00041294], KEP [97054], SING [SING0055558]). (Fig. 2)

Shrubs or small trees, 2–7 m tall, up to 15 cm dbh. Bark strongly aromatic. **Twigs** stout, 1.8–8 mm thick, dark brown, strongly angular in cross-section, glabrous to sparsely hairy; terminal leaf buds orbicular, 4.2–4.5 × 4–4.5 mm, apex acuminate, glabrous with a velutinous apex. **Leaves** subopposite to rarely alternate, domatia absent; leaf blade ovate to elliptic, 4.5–18 × 2–13 cm, apex broadly acute to rounded, base slightly to strongly cordate, margins recurved, domatia absent, blade triplinerved at base; secondary veins 1–2 pairs, not reaching the apex; tertiary veins reticulate to scalariform, blade stiffly leathery, with a strong spicy smell when crushed; upper surface glabrous, midrib raised to sunken, secondary veins raised to sunken, tertiary veins obscure; lower surface glabrous, glaucous, midrib and secondary veins raised, tertiary veins obscure; petiole stout, up to 5 mm thick, channelled to half-terete, 4–10 mm long, glabrous to sparsely hairy. **Inflorescence** a few-flowered slender panicle, axillary, 56–65 mm long, sparsely hairy, bracts leaf-like; bracteoles unknown, caducous. **Flowers** bisexual; perianth tube 2.1–2.7 mm long; perianth lobes elliptical, 2–3.5 × 1.5–2 mm, apex rounded to acute, velutinous inside and out. **Stamens** 9, 2–3 mm long, hairy; anthers 4-celled. **Ovary** 2–2.5 mm diameter, glabrous; style 2–3 mm long; stigma peltate. **Fruit** ellipsoid, 8–11 × 5–7 mm, surface wrinkled, glabrous, apex rounded; cupule 6–10 × 6–7 mm, cup-shaped, margin shallowly lobed or entire, sparsely hairy but more densely so at margin; hairs appressed, white; stalk slightly swollen, 2.5–3.5 mm thick.

Distribution. Endemic to Peninsular Malaysia, where it is only found on mountains in Perak and on the Pahang/Selangor border (Fig. 2).

Ecology. Grows on open ridge tops and shady gullies in montane forests, from 1500–1800 m altitude. Flowering in May; fruiting in July to September.

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known from a small number of collections from a limited area in Peninsular Malaysia, where it is reported to be locally abundant (Ibrahim bin Jantan et al., 2002). Analyses of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) both give the assessment of Endangered. Given this and the landscape modification that has occurred in the last 50 years, this species must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Selangor/Pahang:** summit plateau of Gunung Ulu Kali, 11 Nov 1972, Whitmore FRI 20470 (KEP, SING [SING0267707]); Gunung Ulu Kali, 11 May 1972, Stone 10730 (K, KEP); Fraser's Hill, Sep 1933, Symington

33231 (KEP); Fraser's Hill, Pine Tree Hill, 14 Apr 1968, *Whitmore FRI 8621* (KEP); Pine Tree Hill path, 28 Jun 1969, *Stone 8672* (SING [SING0267708]).

Notes. *Cinnamomum cordatum* was included in the synonymy of *C. microphyllum*, without any comments, by Kostermans (1970). When writing the account for the Tree Flora of Malaya, Kochummen (1989), after examining the type specimen of *Cinnamomum microphyllum*, recognised *C. cordatum* as a distinct species. The two taxa only resemble each other superficially as both are shrubs or small trees with small leaves from the same mountainous area. The differences between them are given in Table 1. I agree with Kochummen that the two should be kept separate.

This is one of the few species of *Cinnamomum* which is easily recognisable in the field, as it has stiff, leathery, triplinerved leaves and a cordate leaf base.

Cinnamomum cordatum is used in the mountains of Perak and Pahang as a medicine to reduce pain (Ibrahim bin Jantan et al., 2002).

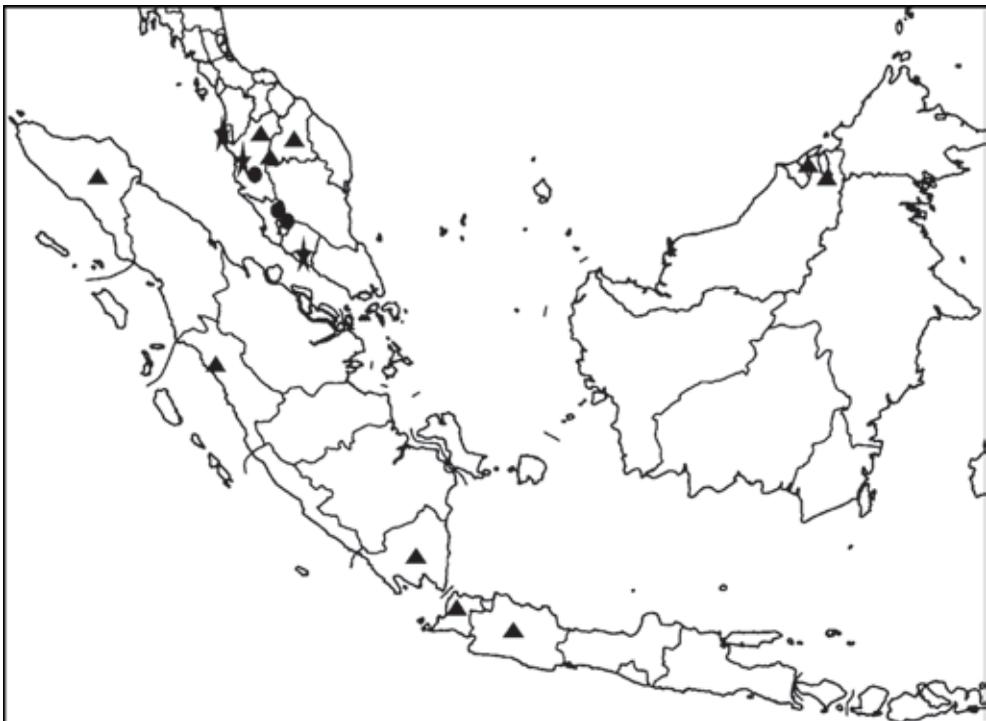
4. *Cinnamomum cuspidatum* Miq., Ann. Mus. Bot. Lugduno-Batavi 1: 262 (1864); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 489 (1925); Kostermans, Reinwardtia 8: 39 (1970); Kochummen, Tree Fl. Malaya 4: 126 (1989); Soh, Blumea 56: 249 (2011). – TYPE: [Indonesia] Sumatra, *P.W. Korthals s.n.* (lectotype L [L0035772], designated by Soh (2011); isolectotypes L [L0035768, L0035769, L0035770, L0035771, L0035773, L0035774], U [U0002652])). (Fig. 2)

Cinnamomum graciliflorum Gamble, Bull. Misc. Inform. Kew 1910: 218 (1910); Ridley, Fl. Malay Penins. 3: 91 (1924). – TYPE: [Peninsular Malaysia] Perak, Gunung Ijok, *B. Scortechini 1228* (lectotype K [K000778634], first step designated by Soh (2011), second step designated here; isolectotypes BM [BM 000950943], K [K000778635]).

Trees or shrubs, 2–10 m tall, 5–10 cm dbh. Bark smooth, purplish brown; inner bark purplish brown; sapwood light pinkish brown. **Twigs** slender 1–2.2 mm thick, rounded to slightly angular in cross-section, sparsely hairy, soon glabrescent; hairs white, appressed; terminal leaf bud lanceolate in outline, 1.5–2.8 mm long, apex acuminate, covered with long hairs. **Leaves** subopposite, domatia absent, young leaves yellowish white; leaf blade obovate-ovate, elliptic to lanceolate, 5–13 × 1.5–6 cm, apex long acuminate, tip up to 1.2 cm long, base cuneate to rounded, margins straight, blade triplinerved, secondary veins 1 pair which extend to the base of the long tip, tertiary veins scalariform, blade membranous; upper surface glabrous, midrib and secondary veins raised, false intramarginal vein running along the margins, tertiary veins distinct; lower surface slightly glaucous, green with brown veins glabrous apart from a few hairs along the main veins, midrib and secondary veins raised, tertiary veins distinct; petiole channelled, 5–10 mm long, glabrous or sparsely hairy, smooth or wrinkled. **Inflorescence** a few-flowered slender panicle, axillary, 1.6–7 cm long, glabrous or sparsely hairy when young; bracts leaf-like; hairs white, appressed; bracteoles

Table 1. Morphological differences between *Cinnamomum cordatum* and *C. microphyllum*.

Species	Leaf base	Terminal leaf bud	Lower leaf surface	Inflorescence length (mm)
<i>C. cordatum</i>	Cordate	Orbicular, glabrous with a velutinous apex	Glabrous	56–65
<i>C. microphyllum</i>	Rounded	Linear to lanceolate, velutinous throughout	Sparsely hairy	12–25

**Fig. 2.** Distribution of *Cinnamomum cordatum* (●), *Cinnamomum cuspidatum* (▲) and *Cinnamomum kunstleri* (★).

triangular, 1.1–1.2 mm long, glabrous, caducous. **Flowers** bisexual, cream to pale green or yellowish white; glabrous to sparsely hairy, hairs white, appressed; perianth tube 0.7–1 mm long; perianth lobes 1.8–2.6 × 1–1.2 mm, apex acute to rounded, glabrous to sparsely hairy outside, velutinous inside, margin ciliate. **Stamens** 9, 1.2–2 mm long; anthers 2- or 4-celled, the 2 apical cells reduced in the 2-celled form. **Ovary** 0.7–1 mm diameter, glabrous; style 1–1.3 mm long; stigma small. **Fruit** ellipsoid, 9–20 × 6.2–18 mm, glabrous, smooth; cupule 8–9 × c. 5 mm, cup-shaped, margin shallowly lobed; lobes 1.2–1.3 mm long, apex broadly acute, erect, glabrous; stalk swollen, 2–3 mm thick.

Distribution. Malaysia (Peninsular and northern Sarawak), Brunei, Indonesia (Sumatra and West Java) (Fig. 2).

Ecology. Growing in lowland to montane forest, sometimes in *kerangas* forests, 90–1200 m altitude. Flowering from February to March; fruiting from April to July.

Vernacular name. *Medang teja* (Malay).

Provisional IUCN conservation assessment. Endangered (EN B2ab(ii,iii)). This species is known only from a small number of collections from Southeast Asia. An analysis of the Extent of Occurrence (EOO) gives a Provisional IUCN Conservation Assessment of Least Concern, but the analysis of the Area of Occupancy (AOO) gives an assessment of Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Perak:** Jul 1909, *Ridley s.n.* (SING [SING0267709], picture at KEP); Gunung Bubu, 22 Feb 1970, *Suppiah FRI 11901* (KEP 2 sheets, SING [SING0267710]); Upper Perak, Jun 1889, *Wray 3664* (K). **Kelantan:** Ulu Kelantan, Ulu Sungai Ketil, 16 Mar 1972, *Mohd Shah MS 2589* (KEP 2 sheets, SING).

Notes. This is one of the few species of *Cinnamomum* which have two-celled anthers in some of its stamens. This is a rare phenomenon in the genus, commented on by Soh (2011: table 1) and van der Werff (2001), and makes this species easily recognisable when in flower. When not in flower, it can be distinguished by the long-acuminate leaf apex, the small, slender inflorescences and the glabrous triplinerved leaves.

In 2011, Soh lectotypified the name *Cinnamomum graciliflorum* Gamble with the gathering *Scortechini 1228* housed at K. However, there are two sheets of this gathering at K (K000778634 & K000778635). As only one can be the lectotype, I am making a second step lectotypification (see McNeill, 2012: Art. 9.17) of this name here, with the specimen K000778634. I have chosen this sheet because it has Gamble's usual signed card with his floral dissections and the notes in his handwriting that he made when he described it.

The brewed leaves of *C. cuspidatum* are used as a stimulant.

5. *Cinnamomum iners* (Reinw. ex Nees & T.Nees) Blume, Fl. Ned. Ind. 11: 570 (1826); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 471 (1925); Liou Ho, Laurac. Chine & Indochine 30 (1932); Ridley, Fl. Malay Penins. 3: 92 (1924); Corner, Wayside Trees Mal. 340 (1952); Kostermans, Ginkgoana 6: 50 (1986); Kochummen, Tree Fl. Malaya 4: 126 (1989); Soh, Blumea 56: 249 (2011). – *Laurus iners* Reinw. ex Nees & T.Nees, Cinnam. Disp. 57 (1823). – *Cinnamomum nitidum* var. *iners* (Reinw. ex Nees & T.Nees) Miq., Ann. Mus. Bot. Lugduno-Batavi 1: 258 (1864). – TYPE: [Indonesia] Java, *Reinwardt s.n.* (holotype L [L0035811]). (Fig. 3)

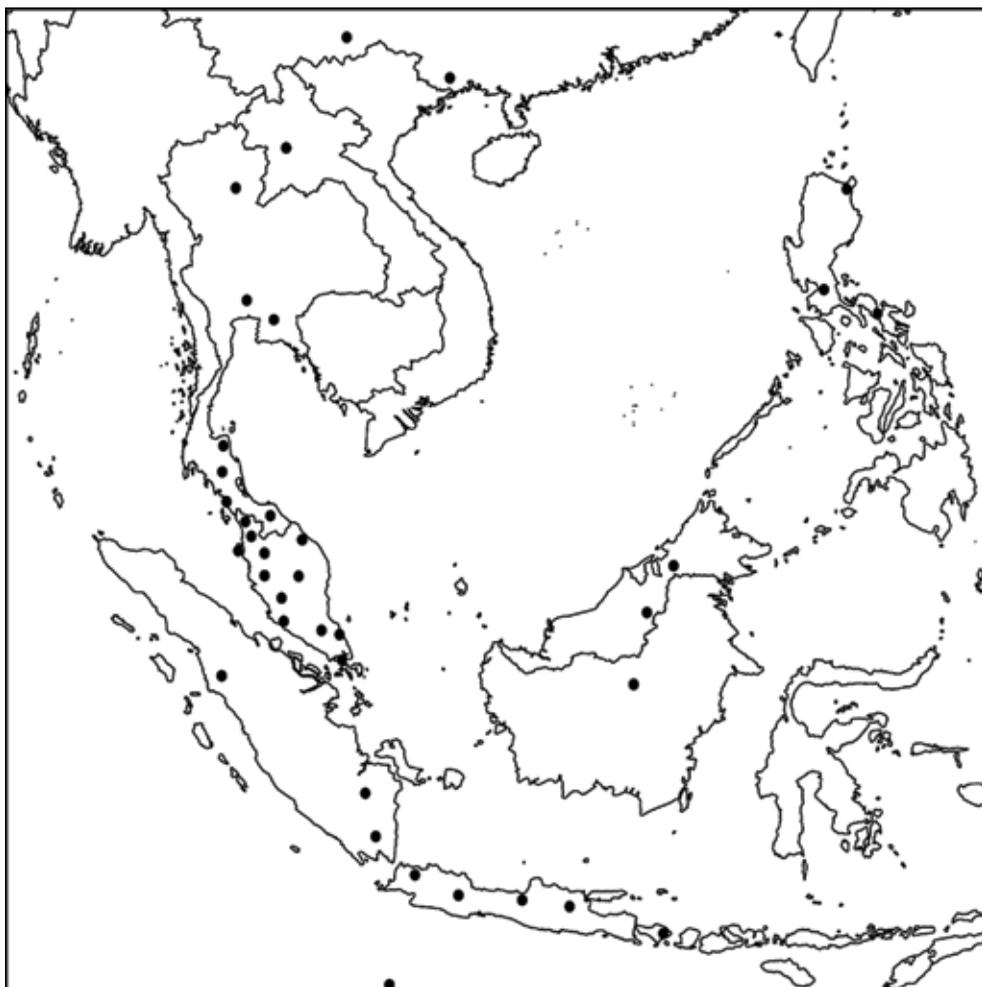


Fig. 3. Distribution of *Cinnamomum iners* (●).

Laurus malabathrum Wall. ex Nees in Wall., Pl. Asiat. Rar. 2: 73 (1831), nom. illeg. non *Laurus malabathrum* Burm.f. – TYPE: [Peninsular Malaysia] Penang, *N. Wallich* 2583a (lectotype GZU [GZU000253943], designated here; isoelectotypes BM, K 2x, K-W [K001116501], GZU [GZU000253945, GZU000253944]).

Cinnamomum subcuneatum Miq., Fl. Ned. Ind. 1: 895 (1858); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 493 (1925); Kochummen, Tree Fl. Malaya 4: 131 (1989); Soh, Blumea 56: 259 (2011). – TYPE: [Indonesia] Sumatra, Kotta Nopan en Rau, *Teijsmann H.B. 1016* (lectotype U [U0002679] designated here; isoelectotype BO (not seen)), **synon. nov.**

Cinnamomum griffithii Meisn. in DC., Prodr. 15: 19 (May 1864); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 471 (1925); Kostermans, Ginkgoana 6: 53 (1986). – *Cinnamomum gracile* Miq., Ann. Mus. Bot. Lugduno-Batavi 1: 259 (Oct–Dec. 1864), nom. superfl. – TYPE: [Peninsular Malaysia], Malacca, *Griffith 4240* (holotype K [K000227501]; isotypes L, M [M0147248] NY, S [S-G-1381], U [U0226542]).

Cinnamomum iners (Reinw. ex Nees & T.Nees) Blume var. *angustifolium* Ridl., Fl. Malay Penins. 3: 93 (1924); Liou Ho, Laurac. Chine & Indochine (1932) 30. – TYPE: [Peninsular Malaysia] Perak, Ulu Temenggor, Jul 1909, *H.N. Ridley 14516* (lectotype SING [SING0055564], designated by Soh (2011); isolectotypes BM, K).

Trees, 3.5–24 m tall, 18–60 cm dbh. Bark greyish brown or greenish black, smooth; inner bark pinkish to (light) brown, with strong fragrant smell of cloves, sapwood yellowish to whitish. **Twigs** slender, 1.6–2.7 mm thick, densely hairy when young, soon becoming sparsely hairy to glabrous, round to slightly angular in cross-section, dark brown to black; hairs whitish, appressed, straight; terminal leaf bud ovoid, 1.4–3.7 mm long, apex acuminate, velutinous. **Leaves** subopposite, domatia absent, young leaves pink; leaf blade ovate to elliptic, lanceolate or linear, 5–35 × (1.4–)2–9 cm, apex broadly acute to acuminate, base (broadly) cuneate to rounded, sometimes almost cordate, margins straight to slightly revolute, blade triplinerved, secondary veins one pair that extend to the apex, often with a few thin shorter veins spreading towards the margins and forming a looping marginal vein (brochidodromous), tertiary veins scalariform to scalariform-reticulate, blade (thinly) leathery; hairs white, appressed; upper surface deep green, shiny, glabrous or sometimes with hairs on major veins and/or at base of blade when young, midrib and secondary veins raised, tertiary veins faint to distinct; lower surface often glaucous, dull green, glabrous to sparsely hairy, midrib and secondary veins raised, tertiary veins faint or distinct; petiole 5.5–30 mm long, channelled to half-terete, velutinous when young, soon becoming sparsely hairy, wrinkled when dried. **Inflorescence** a many-flowered broad panicle, axillary and terminal, 5–26 cm long, densely hairy, becoming sparsely hairy later, pale green; hairs white, appressed; bracts leaf-like; bracteoles lanceolate, 1.5–2 mm long, apex acute, persistent to caducous. **Flowers** bisexual, velutinous to densely hairy, creamy to green-white or yellow, with an unpleasant smell; hairs white, appressed; perianth tube obconical, 0.8–2 mm long; perianth lobes (ovate)-oblong to elliptic, 1.9–4 × 1–2.2 mm, apex acute, densely whitish appressed hairy outside and inside. **Stamens** 9, 1.5–3.6 mm long, yellow, densely hairy; anthers mostly 4-celled, those in the third whorl sometimes 2-celled. **Ovary** 0.8–1.5 mm diameter, glabrous; style 1–3 mm long; stigma discoid. **Fruit** ellipsoid to ovoid, 8–13 × 5–7.8 mm, apex rounded, smooth, glabrous, blue-black when mature; cupule obconical, c. 8 mm diameter, sparsely hairy, woody, perianth lobes persistent, free; lobes 1.2–3 mm long, apex acute, erect to patent, densely hairy, persistent; stalk slightly swollen, 1.1–1.8 mm thick.

Distribution. Thailand, South China, Laos, Peninsular Malaysia, Singapore, Borneo, Sumatra, Java, Bali and the Philippines. Reported from Vietnam (Lê, 2003). In Peninsular Malaysia and Singapore, it is common throughout (Fig. 3).

Ecology. Growing in primary and secondary lowland to montane forest or in wastelands, often along riverbanks, 0–1000 m. The seeds are dispersed by birds, bats and squirrels (Corner, 1952: 340). Flowering throughout the year; fruiting from February to October.

Vernacular names. Wild Cinnamon (English); *Kayu manis*, *Medang enijur*, *Medang teja* or *Teja badak* (Malay), *Medang tenyo* (Temuan) and *Medang tajoh* (Sakai).

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Penang:** 1824, *Phillips s.n.* (K); Aug 1890, *Curtis 2252* (BM 2 sheets); Hamphius Estate, 1898, *Curtis s.n.* (K); Batu Feringgi, Mar 1890, *Curtis 2252* (BM, K, SING 2 sheets [SING0267772, SING0267773]); Penang Hill, 8 Mar 1996, *van Balgooy 7156* (KEP). **Perlis:** Kaki Bukit Forest Reserve, 1 Mar 1972, *Chan FRI 19919* (K, KEP, SING [SING0267761]); Kaki Bukit, 19 Apr 1995, *Saw et al. FRI 40009* (KEP); Kangar, Mata Ayer, 22 Nov 1929, *Henderson 23047* (BM, KEP, SING [SING0267886]). **Perak:** Grik, 19 Jun 1924, *Haniff 12374* (SING [SING 0267743]); Grik, Ulu Perak, Sungai Sengoh, 6 Jul 1993, *Mat Asri bin Ngah Sanah FRI 26856* (K, KEP); Batu Gajah, 16 Jul 1926, *Woolley 11739* (KEP); Pondok Tanjung, Mar 1909, *Hashim 22* (KEP); Pondok Tanjung, 17 Feb 1909, *Hashim s.n.* (KEP); Meru, Aug 1926, *Idris 11952* (KEP, SING [SING0267751]); Banks of Sungai Perak, at former Fort Tapong, 24 Jan 1971, *Whitmore FRI 15725* (K, KEP, SING [SING0267733]); Dengang, Telok Ausn, 24 Sep 1924, *Haniff 14187* (K, SING [SING0267942]); Thapai Laud Ausn, 1888, *Wray 2674* (K); Gunung Inas, 25 Feb 1927, *Meh 11496* (KEP); Kinla R., Aug 1880, *King's Collector 423* (K); Larut, Aug 1884, *King's Collector 5456* (BM); Larut, Mar 1884, *King's Collector 5705* (BM); Larut, 1883, *King's Collector 3861* (SING 2 sheets [SING0267755, SING0267756]); Larut, Aug 1884, *King's Collector 6456* (K, SING [SING0267739]); Larut, Aug 1884, *King's Collector 6510* (K, SING 2 sheets [SING0267724, SING0267725]); Temango, Jul 1904, *Ridley s.n.* (SING [SING0267882]); Temango, Jul 1909, *Ridley s.n.* (SING [SING0267884]); Taupan, *Wray 556* (SING [SING0267885]); Ulu Keuderoug Grik, 11 Mar 1926, *Hamid 11011* (KEP, SING [SING0267765]); Batu Puteh, *Wray 1222* (BM, K); Sungai Koran Estate, 23 Dec 1938, *Spare 36730* (K 2 sheets, KEP, SING [SING0267712]); Kambury Kota, 1884, *Wray 3328* (K). **Kedah:** Bukit Kleday, 11 Feb, 1931, *Meh 21892* (K, KEP, SING [SING0267776]); Sungai Balu Asap, Feb 1911, *Ridley 15470* (K, SING [SING0267738]); Lanai, Jan 1930, *Dolman FMS 21505* (KEP, SING [SING0267750]); Tampoi Forest Reserve, 10 Feb 1950, *anonymous 71172* (KEP). **Kelantan:** Palie R., 3 Feb 1917, *Ridley s.n.* (K); Bukit Baka, Sungai Merkeh, 23 Feb 1974, *Shad & Shukor MS 3181* (KEP, SING [SING0267888]); Kuala Krai, Taman Negara, Kuala Koh, 30 Mar 1995, *Latiff 4156* (K); Chaning, Feb 1917, *Ridley s.n.* (BM 2 sheets, SING [SING0267883]); Kuala Kai, 24 Jan 1923, *Haniff 10149* (KEP, SING [SING0267877]). **Terengganu:** Sungai Lah, Bukit Bongkok, 2 Mar 1976, *Modh Shah & Samsuri MS 3825* (KEP). **Selangor:** Gunung Supai, Apr 1894, *Ridley 15581* (BM 2 sheets, K 2 sheets, SING [SING0267943]); Kuala Lumpur, May 1902, *Curtis s.n.* (SING [SING0267748, SING0267759]); Bukit Tunggul, 4 Mar 1959, *Gadoh anak Umbai KL 1434* (K, KEP, SING 3 sheets [SING 267723, SING0267753, SING 0267758]); Kepong Plantation, 17 Jul 1937, *Symington 44028* (KEP); Kepong Plantation, 15 Mar 1934, *Hamid 33879* (K); Bukit Lagong, 29 Jul 2005, *Sow FRI 49451* (KEP); Bukit Kutu, 1894, *Ridley 15540* (K); near Balu Caves, Dec 1820, *Ridley s.n.* (K); Gunung Suppiah Forest Reserve, 9 Mar 1961, *Ahmad 94355* (K, KEP, SING [SING0267734]); Ulu Gombak, 11 Apr 1968, *Soepadmo HUM 9045* (K, SING [SING0267951]); Dusun Tua, 4 Aug 1929, *Symington 16961* (KEP, SING

[SING0267746]); Weld's Hill, 20 Aug 1916, *Hamid* 583 (KEP); Weld's Hill, 19 Feb 1918, *Rahman FMS* 2639 (KEP); Weld's Hill, 17 Feb 1918, *Hamid FMS* 2855 (KEP); Weld's Hill, 29 Mar 1923, *Kiai FMS* 8247 (KEP); road from Kepong to F.R.I., *Modh. Kasim bin Rajab* 588 (K 2 sheets); Bukit Nanas, 9 Apr 2015, *Norzielawati FRI* 83013 (KEP); Bukit Tunggul, 1 Feb 1959, *Gadoh anak Umbai KL* 1370 (KEP, SING); Bukit Tunggul, 6 May 1959, *Gadoh anak Umbai KL* 1454 (KEP); Bukit Tunggul, 1 Feb 1959, *Gadoh anak Umbai KL* 1370 (KEP, SING [SING0267740, SING0267741]); Ulu Langat, 3 Jan 1959, *Gadoh anak Umbai KL* 1239 (KEP); Kepong, 1 Sep 1927, *Pawanche & Awang* 13656 (KEP, SING [SING0267778]); Mata Ayer Forest Reserve, 17 Feb 1981, *Wong et al.* 32112 (K, KEP, SING [SING0267769]); Kepong, Arboretum F.R.I., 4 Feb 1970, *Teo & P* 325 (K); Arboretum F.R.I., 21 Mar 1980, *Kamarudin FRI* 28630 (K, KEP). **Negeri Sembilan:** Pasoh Forest, 1988, *LaFrankie* 3300 (KEP). **Malacca:** Alor Jajak, Malacca R., 26 Jan 1918, *McKenzie* 3039 (K); Malacca, *Maingay* 1243 (BM, K); 17 Jul 1865 or 1866, *Maingay* 1992 (1242) (K). **Pahang:** Romping, 7 Feb 1929, *Soh FMS* 15715 (KEP, SING [SING0267876]); Tembeling, 13 Jul 1929, *Henderson SFN* 21789 (K, KEP, SING [SING0267742]); Tembeling, Ulu Sungai, Kuala Keniyam, 2 Mar 1968, *Modh. Sah MS* 1505 (K, SING [SING0267722]); Tembeling, 15 Jul 1929, *Henderson* 21900 (BM, K 2 sheets, SING [SING0267952]); 6 miles N of Bentong, 7 Nov 1924, *Burkill & Haniff* 16722 (SING [SING0267749]); Tembeling, 13 Jul 1929, *Henderson* 21489 (K 2 sheets); Panching Forest, 5 Jun 1968, *Ogata* 10443 (KEP); Pekin, 14 Feb 1929, *Jaamat* 16506 (KEP); Kuala Tahan Area, 16 Feb 1968, *Modh Shah MS* 1301 (KEP); West Lesong Forest Reserve, Sungai Jekatih, 20 Feb 1971, *Whitmore FRI* 15927 (K, KEP, SING [SING0267945]); Sungai Bera, 18 Mar 1939, *Marshall* 35814 (KEP); Taman Negara, South Keniyam, 3 Mar 1968, *Whitmore FRI* 4946 (K, KEP); Tahan woods at Kuala Teku, 22 Feb 1968, *Whitmore FRI* 4829 (K, KEP, SING [SING0267732]); Kota Gelanggi, 5 Aug 1929, *Henderson* 22442 (K 2 sheets, KEP, SING [SING0267745]); Lesong Forest Reserve, 3 Oct 1981, *Kamarudin FRI* 28886 (K, KEP); Sungai Mai, 26 Mar 1959, *Kadim & Mahmoud KM* 13 (K, SING [SING0267775]); Kuala Bera, 18 Dec 1919, *Hamid* 5173 (K, KEP, SING [SING 0267774]). **Johor:** Sungai Berassau, Mawai-Jemaluang road, 6 Feb 1935, *Corner* 28957 (K, KEP, SING [SING0267744]); Segamat, 19 Mar 1981, *Wong & Kochummen FRI* 32182 (KEP); Kota Tinggi, Jan 1910, *Ridley* 15400 (BM, K, SING [SING 0267726]); Gunung Pantii Forest Reserve, 5 Mar 1968, *Cockburn FRI* 7823 (K, KEP); Kota Tinggi (Waterfall), 8th Mile, 4 Feb 1980, *Vethevelu FRI* 25291 (K, KEP, SING [SING0267946]).

SINGAPORE: **Without precise locality:** *Anonymous* 2602 (BM); Jul – Aug 1933, *Teruya* 2426 (KEP, SING [SING0267737]). **Tanglin:** 1892, *Ridley* 3370 (BM, K). **Bukit Timah:** 3rd Mile Bukit Timah Road, 11 May 1936, *Corner* 31000 (K 2x, KEP, SING [SING0042457]). **Tanglin:** Tanglin Barracks, 14 Mar 1919, *Anonymous* 4084 (SING [SING0267736]); Botanical Garden, 1891, *Ridley* 4703 (BM); Upper Willkie Road, 21 Apr 1929, *Teruga* 588 (KEP).

Notes. New leaves are produced several times a year after a period of rain followed by a dry spell, the flowers are produced after these new leaves have developed. The flowers produce a rancid smell which attracts hover-flies, small beetles and many other small insects (Corner, 1952).

Specimens often have galls in the place of the fruits (see Blume, 1836). These galls are bigger than the fruits (up to 16 mm long when dried), ellipsoid and their surface is flaky, not smooth.

In 1924, Ridley described the variety *Cinnamomum iners* var. *angustifolium* Ridl. based on a specimen from a larger tree with bigger leaves, growing along river

banks (Ridley, 1924). Having seen more material, this variety is not morphologically distinct.

In 1858 Miquel described the species *Cinnamomum subcuneatum* Miq., based on material collected by Teijsmann from Sumatra. I could only find one collection housed at U which matched this description and this collection is designated as the lectotype.

In 1831 Nees von Esenbeck validated a name proposed by Wallich: *Laurus malabathrum*. This name is illegitimate as Burman already published this name earlier for a different taxon. Nees von Esenbeck's Lauraceae material is now housed at GZU and the specimen GZU000253943 is selected here as the lectotype.

Soh (2011), in his revision of the Bornean species, separated *Cinnamomum iners* from *C. subcuneatum* on the basis of *C. iners* having a cupule which is inconspicuous and very shallow (c. 1 mm high by c. 2 mm diameter) and leaves with straight appressed hairs up to 0.2 mm long; and *C. subcuneatum* having a cupule which is conspicuous (c. 4 mm high, 4–6 mm diameter) and leaves with wavy or curly hairs that are 0.2–1 mm long. In this research, I have seen specimens with distinct cupules that have both straight and appressed hairs (*Henderson s.n.*, *Symington 16961 & Woolley 11739*) and with both long and short appressed hairs (0.1–1 mm long) (*van Balgooy 7156, Wong & Kochummen FRI 32182*). I could not find any specimens from Peninsular Malaysia with cupules which are as small as those specified by Soh (2011) (i.e. 1 × 2 mm) nor any specimens with curly hairs, though my study included specimens identified by him as having small cupules and curly hairs. He also states that the difference between these two species is partly based on the difference in leaf colour after drying (pale green in *Cinnamomum iners* and dark green in *C. subcuneatum*). He also claims that there is an ecological difference with *Cinnamomum iners* being a naturalised exotic in Borneo, Peninsular Malaysia and Singapore, introduced early via cultivation from Java, and *Cinnamomum subcuneatum* being a native of Borneo and Peninsular Malaysia. In this research, I have found no evidence to support his claim that *Cinnamomum iners* is different from *C. subcuneatum*, or that *C. iners* is not native to Peninsular Malaysia and Singapore. Therefore, in this treatment I have placed the name *Cinnamomum subcuneatum* in synonymy under *C. iners*.

Ridley (1924) accepted *Cinnamomum paraneuron* Miq. as a distinct species, based on differences in venation, leaf hairiness and the fruiting calyx, but I have found no evidence to support this distinction.

Cinnamomum iners is often planted as an ornamental or as a shade tree. The wood is used for the manufacture of fragrant joss sticks, and as timber (Burkill, 1966: 560). This species is sometimes used to make the essential oil *Kulit lawang* in Peninsular Malaysia.

The roots of the tree are used medicinally. They are boiled and given to the mother after childbirth, and also to someone who has a fever. The Orang asli use the juice of the leaves as a remedy for poisoning with *Antiaris*, by squeezing the liquid into the wound. The leaves are also used as a poultice against rheumatism. The fruits are reported to be eaten by children (Burkill, 1966). The Sakai in Pahang grind the leaves and stems and apply it to the body to ease pain.

6. *Cinnamomum javanicum* Blume, Bijdr. 570 (1826); Ridley, Fl. Malay Penins. 3: 94 (1924); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 465 (1925); Corner, Wayside Trees Mal. 341 (1952); Kostermans, Reinwardtia 8: 47 (1970); Kochummen, Tree Fl. Malaya 4: 126 (1989); Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. 18 (1990); Soh, Blumea 56: 251 (2011). – TYPE: [Indonesia] West Java, Bantam, Harriang, *C.L. Blume s.n.* (lectotype L [L0035826]), designated by Soh (2011). (Fig. 4–5)

Cinnamomum saffrol Kosterm., Reinwardtia 10: 451 (1988); Kochummen, Tree Fl. Malaya 4: 130 (1989). – TYPE: Peninsular Malaysia, Pahang, Telom ridge, North of Sungai Kadjau, 20 May 1971, *T.C. Whitmore FRI 20045* (holotype L [L0035957]; isotypes K [K000778653], KEP [97103], SING) **synon. nov.**

Trees, 6–35 m tall, 2–35 cm dbh, buttresses up to 1 m high. Bark grey, smooth or lenticellate, very aromatic; inner bark fibrous, yellowish brown to pink or orange, sapwood yellowish to white. **Twigs** slender, 2.5–4.5 mm thick, rounded to angled in cross-section, velutinous, glabrescent; hairs yellow-brown, erect; terminal leaf bud ovoid, 3–8 mm long, velutinous; hairs yellow-brown, curly to straight. **Leaves** subopposite, domatia absent; leaf blade slightly ovate or elliptic to narrowly lanceolate, 7–40 × 2.8–15 cm, apex acute to acuminate, with a long tip, base cuneate to slightly rounded, margins straight, blade triplinerved, secondary veins 1 pair, extending to the base of the leaf tip, tertiary veins scalariform, false secondary veins present, blade thinly to thickly leathery; hairs yellow-brown, erect; upper surface shiny, almost glabrous except veins sometimes densely hairy at base, soon glabrescent, midrib and secondary veins raised, major tertiary veins sunken, making the surface bullate; lower surface slightly glaucous, sparsely hairy to velutinous, midrib and secondary veins raised, tertiary veins distinct; petiole half-terete, 10–20 mm long, swollen, glabrous to velutinous; hairs erect, yellow-brown. **Inflorescence** a many-flowered broad panicle, terminal, 5–30 cm long, axis angled in cross-section, velutinous, hairs yellowish brown, curly; bracts leaf-like; bracteoles oblong to elliptic, 1.8–7 mm long, apex acute, velutinous, sometimes persistent. **Flowers** bisexual, yellowish white, velutinous; perianth tube 1–1.4 mm long; perianth lobes elliptic to broadly elliptic, 1.5–2.8(–3.5) × 1.6–1.8 mm, apex acute, densely hairy outside and inside. **Stamens** usually 9, 2–2.5 mm long; anthers 2- or 4-celled. Ovary ovoid or subglobose, c. 1 mm diameter; style c. 1 mm long; stigma subpeltate. **Fruit** ellipsoid, 9–15 × 1.2–8 mm, glabrous, smooth; cupule woody, cup-shaped, 7–8 mm diameter, velutinous to glabrous when mature, enveloping half of the fruit; lobes broadly ovate, 2.5–6 × 2.4–3 mm, apex acute, velutinous, persistent; stalk slightly swollen, 1.2–2 mm thick, densely yellow-brown, velutinous.

Local names: *Medang wangi*, *Medang teja*, *Medang kayu* and *Madang lawang* (Malay).

Distribution. Peninsular Malaysia, Singapore, Borneo, Sumatra and Java (Fig. 4).

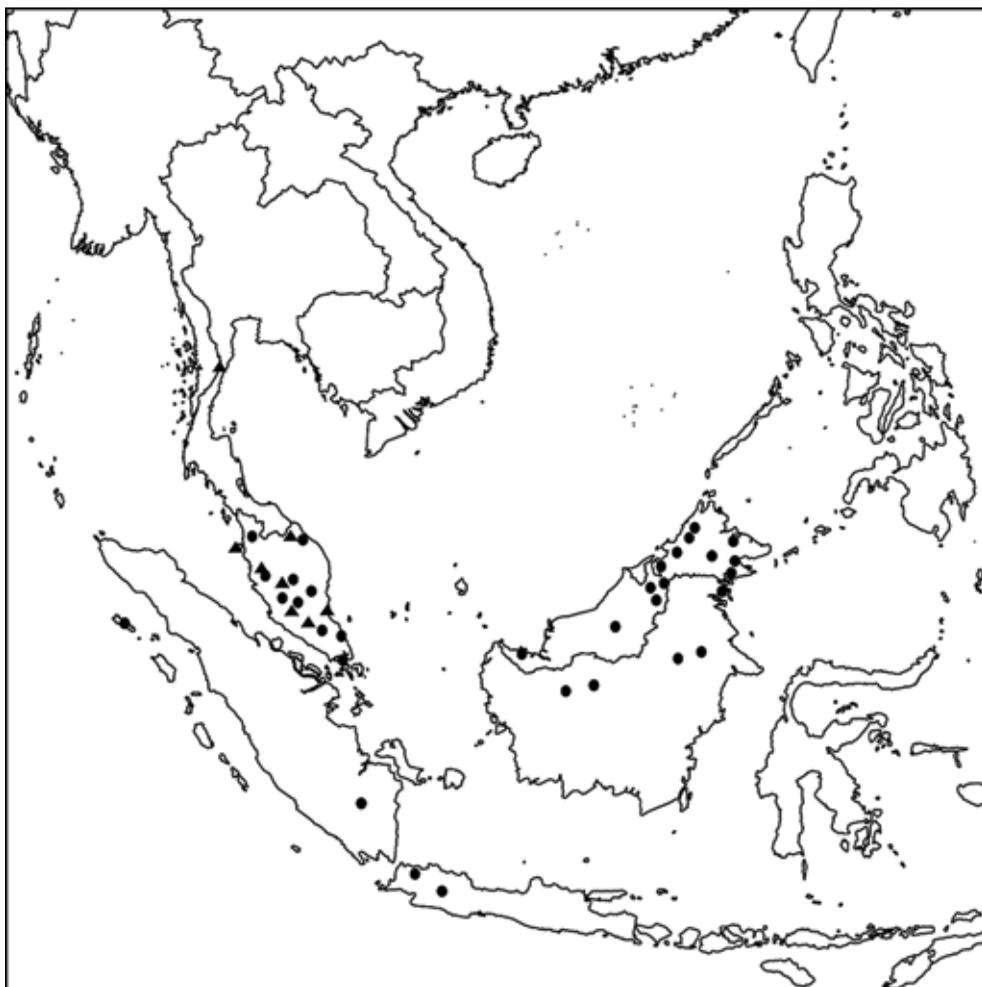


Fig. 4. Distribution of *Cinnamomum javanicum* (●) and *Cinnamomum mollissimum* (▲).

Ecology. Growing in primary or secondary lowland and hill forests, sometimes on sandy loam, sometimes in seasonal swamp forests, at 20–400 m altitude in Peninsular Malaysia and Singapore. Flowering in March to June; fruiting from Jul to December.

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Kedah:** Jerai Reserve, 5 May 1929, *Mat 17937* (KEP, SING [SING0267899]); Gunung Bongsu, 18 May 1929, *Harun 17709* (KEP, SING [SING0267896]); Bongsu Reserve, 19 Mar 1940, *Sharin 35162* (KEP). **Perlis:** Kuala Kangar, 21 Oct 1924, *Haniff 15963* (SING [SING0267898]). **Perak:** *Scortechini s.n.* (BM); Larut, May 1885, *King's Collector 7603* (BM, K); Tanjung Reserve, 23 Jul 1916, *anonymous FMS 1121* (KEP, SING [SING 0267897]); Grik, 19 Jun 1924, *Haniff 13632* (SING

[SING0267904]). **Pahang:** Kuantan, Jun 1923, *O'Hara 6667* (K, KEP, SING [SING0267901]); Temerloh, 13 Dec 1920, *Hamid 5485* (KEP, SING [SING0267895]); Endau-Rompin, Bukit Peta Hill, 25 Aug 1973, *Stone s.n.* (KEP); Rompin Iron Mine, Bukit Santong, 9 May 1967, *Whitmore FRI 3607* (KEP); Bentong, 26 Jul 1958, *KEP 92467* (KEP); Lipis, Sungai Jelau, Ulu Kerdajan, 27 May 1971, *Burgess FRI 19326* (KEP). **Johor:** Mersing Forest Reserve, 4 Jul 1957, *Kochummen 77823* (K, KEP, SING [SING0267902]); Arong Forest Reserve, 3 Jul 1917, *Wong KEP 84713* (KEP); Ulu Endau, Labis Forest Reserve, 23 Mar 1968, *Ogata KEP 110370* (K, KEP, SING [SING0267900]).

SINGAPORE OR PENANG: 1830, *Walker 29* (K).

SINGAPORE: **Without precise locality:** *Cantley's Collector s.n.* (K). **Bukit Timah:** Mar 1911, *Ridley 15621* (K); Fern valley, 14 Mar 1951 *Sinclair SFN 39227* (SING [SING0013137]).

Tanglin: Botanical Gardens, Jungle, 1894, *Noor s.n.* (SING [SING0000620]). **Pinerong:** 1881, *Cantley's Collector s.n.*, (SING [SING0013132]). **Changi:** Feb 1894 *Ridley s.n.* (SING [SING0013133]).

Notes. In his revision of the Bornean species, Soh (2011) said that the leaves of *Cinnamomum javanicum* are very variable in texture, size and venation. The lowland populations have stout vegetative and reproductive structures, strongly bullate leaves and prominent major intercostal veins. Those found at higher elevation and in extreme conditions, such as on ultramafic soil or in *Kerangas* and montane forest, have a more slender vegetative and reproductive structure, less bullate leaves and less prominent major intercostal veins. This pattern of variation has also been found in Peninsular Malaysia and Singapore. The upland population was recognised in the past as *Cinnamomum saffrol* Kosterm.

In Perak, a decoction of the leaves is given to a mother after childbirth. In addition, *massoia*, which was once widely used as a natural food flavouring, is extracted from the bark (Burkill, 1966).

7. *Cinnamomum kunstleri* Ridl., J. Straits Branch Roy. Asiat. Soc. 82: 191 (1920); Ridley, Fl. Malay Penins. 3: 94 (1924); Kochummen, Tree Fl. Malaya 4: 127 (1989). – TYPE: [Peninsular Malaysia] Perak, Larut, February 1884, *Kunstler (King's Collector) 5568* (lectotype K [K000778640], designated by Turner (2012); isolectotypes BM [BM000950947], K [K000778642, K000778641]). (Fig. 2)

Trees, 9–12 m tall. **Twigs** slender, 1.7–3 mm thick, sparsely hairy when young, glabrous when older; hairs yellowish, erect; terminal leaf bud ovoid, 3–6 mm long, apex acute; hairs yellowish, erect. **Leaves** subopposite, domatia absent, young leaves purplish red; leaf blade elliptic to lanceolate, 7.5–16 × 2.5–6.5 cm, apex broadly acute to rounded, base cuneate to rounded, margins revolute, blade triplinerved, secondary veins 1 pair, extending to the apex, with a few slender side veins extending towards the margin forming a looped intramarginal vein, tertiary veins scalariform-reticulate, blade leathery; hairs yellowish, erect; upper surface glossy, bright green, glabrous except for a few erect yellowish hairs at base, midrib and secondary veins raised at base, tertiary veins faint; lower surface glaucous, sparsely hairy, midrib and secondary

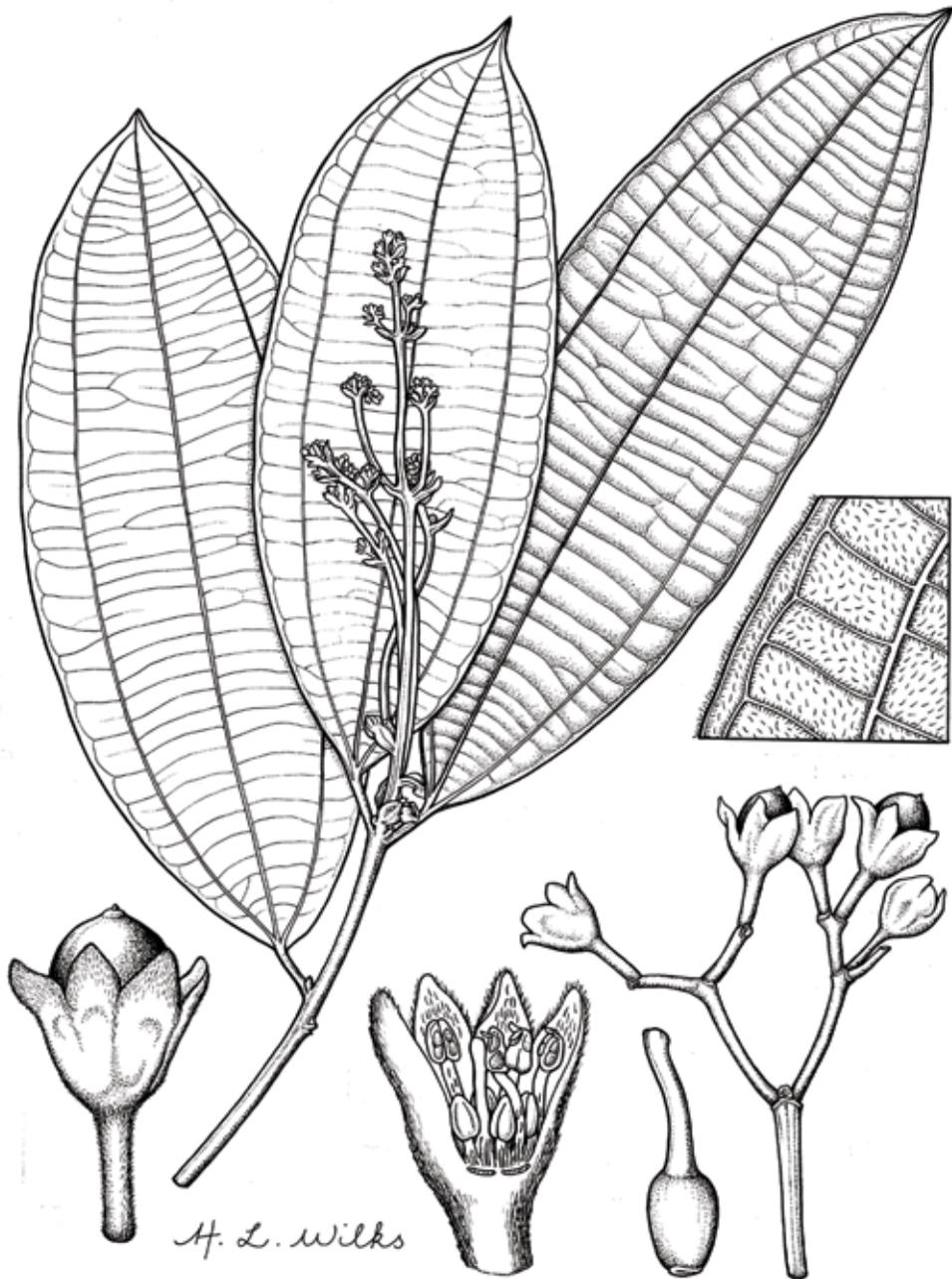


Fig. 5. *Cinnamomum javanicum* Blume. Drawn by H.L. Wilks.

veins raised, tertiary veins visible; petiole half-terete, 9–13 mm long, densely hairy; hairs yellowish, erect. **Inflorescence** a few-flowered slender panicle, axillary, 9–15 cm long, sparsely hairy; hairs yellowish, erect; bracts leaf-like; bracteoles linear to

spathulate, 1.4–2.6 mm long, persistent to caducous. **Flowers** bisexual, yellow; hairs yellow; perianth tube 0.7–0.9 mm long, densely hairy; perianth lobes elliptic, 2–2.5 × 1–2 mm, apex acute, densely hairy outside, sparsely hairy inside. **Stamens** 9, 1–1.5 mm long; anthers 4-celled, with the distal apical cells much reduced. **Ovary** ellipsoid, 0.8–1.5 mm long, glabrous; style 1.1–1.2 mm long; stigma capitate. **Fruit** unknown.

Distribution. Endemic to Peninsular Malaysia (Penang, Perak and Malacca) (Fig. 2).

Ecology. Growing in lowland forest at about 30 m altitude. Flowering from January to February; fruiting unknown.

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known from only three collections from Peninsular Malaysia and is reported to be rare. An analysis of the Extent of Occurrence ((EOO) and the Area of Occupancy (AOO) gives an assessment of Endangered. Given this and the intensive logging and landscape modification that has occurred in the last 50 years, this species must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Penang:** Julloh Bakang, Jan 1885, *Curtis 1548* (SING [SING0267906]). **Malacca:** 11 Mar 1985, *Alvins 1180* (SING [SING0267905]).

Notes. The characters of this species have been disputed since it was first described. Ridley (1920) claimed that the veins in the upper leaves are sunken whereas Kochummen (1989) stated that the veins are raised on the upper surface, based on examination of the type specimen. Kostermans (1970) placed both *Curtis 1548* and *Alvins 1180* under *Cinnamomum subcuneatum* (= *C. iners*). All the specimens I have seen of this species have raised veins at the base of the upper surface of the leaves and they have erect, yellowish, long curly hairs on the twigs, leaves and inflorescences and a slender inflorescence. These characters make this species distinct from *Cinnamomum iners*, which has appressed white hairs and a broad inflorescence.

8. *Cinnamomum microphyllum* Ridl., Fl. Malay Penins. 3: 92 (1924); Kochummen, Tree Fl. Malaya 4: 127 (1989). – *Cinnamomum parvifolium* Ridl., J. Fed. Malay States Mus. 6: 54 (1915), nom. illeg. non Lecomte (1913); Kostermans, Reinwardtia 8: 56 (1970). – TYPE: [Peninsular Malaysia] Perak, Gunung Korbu (Mt. Kerbau), 20 March 1913, *H.C. Robinson s.n.* (holotype K [K000778644]). (Fig. 6)

Shrubs or small trees, 1.5–6 m tall, c. 9 cm dbh. **Twigs** slender, 1.7–3.5 mm thick, round to angular in cross-section, sparsely hairy, dark brown to black; terminal leaf buds linear to lanceolate in outline, 3–3.5 mm long, velutinous. **Leaves** subopposite or rarely alternate, domatia absent; leaf blade ovate to elliptic, 2–7.2 × 2–3.2 cm, apex acute to acuminate, often with a distinct tip, base rounded, margins revolute to straight, blade triplinerved, secondary veins 1 pair, extending up to 2/3 of the length of the leaf,

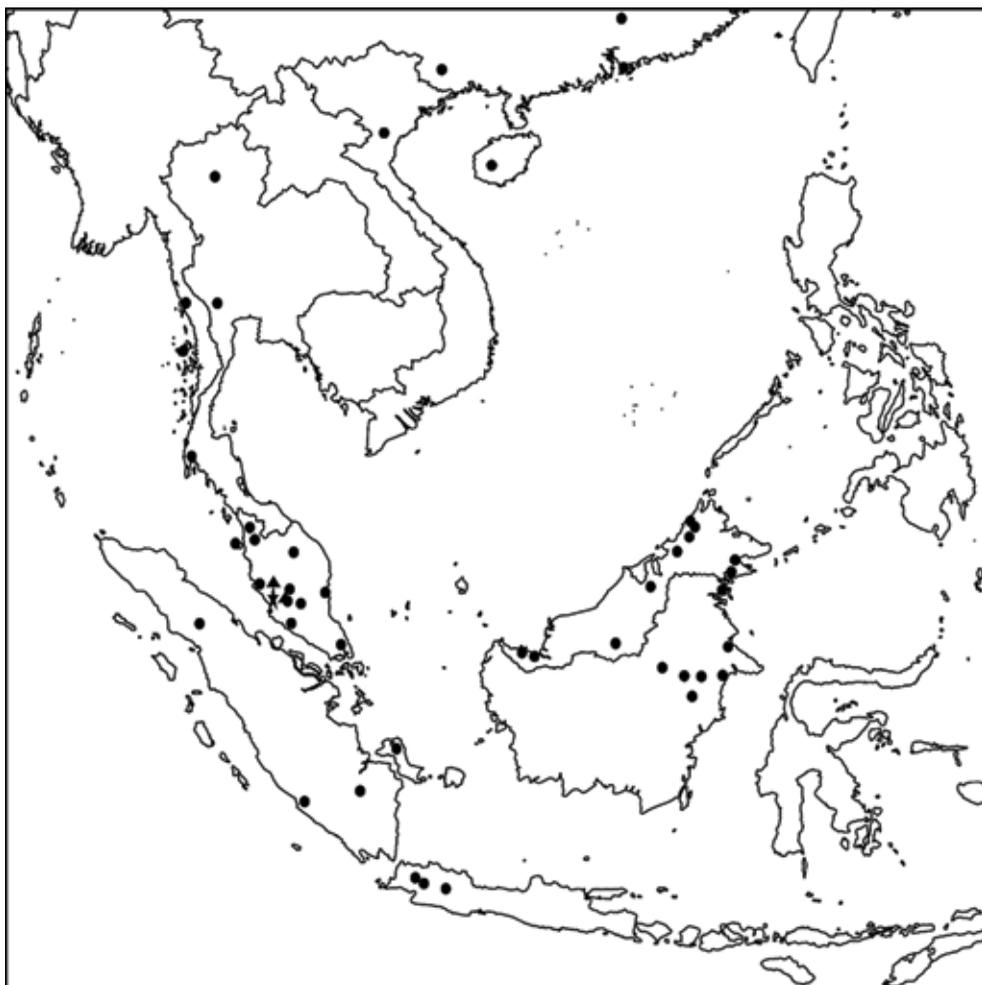


Fig. 6. Distribution of *Cinnamomum parthenoxylon* (●), *Cinnamomum microphyllum* (▲) and *Cinnamomum pachypes* (★).

tertiary veins scalariform, blade thickly leathery; hairs appressed, white; upper surface glabrous, midrib and secondary veins sunken, tertiary veins faint to inconspicuous; lower surface glaucous, sparsely hairy, midrib and secondary veins raised, tertiary veins faint to inconspicuous and brown; petiole half-terete, 5–7 mm long, slender, sparsely hairy, drying black. **Inflorescence** a few-flowered slender panicle, axillary, 1.2–2.5 cm long; bracts leaf-like; bracteoles unknown, caducous. **Flowers** bisexual, greenish-yellow; perianth tube 1–1.2 mm long; perianth lobes elliptic, 1.7–2.5 × 1–1.9 mm, apex acute, glabrous to sparsely hairy inside and outside. **Stamens** 9, 1.5–1.8 mm long, sparsely hairy; anthers 2- or 4-celled. **Ovary** 1–1.2 mm diameter, sparsely hairy; style 1–1.2 mm long; stigma minute. **Fruit** ellipsoid, 7.5–10 × 4–5.6 mm, apex rounded, smooth, glabrous, shiny; cupule 3–3.7 mm diameter, cup-shaped, woody, margin entire, glabrous; stalk swollen and tapering distally 2.4–3.2 mm thick.

Distribution. Endemic to Perak (Gunung Korbu) and Pahang (Gunung Pasar, Gunung Berembun and the Pauh Valley) in Peninsular Malaysia (Fig. 6).

Ecology. Growing along open ridges and in mossy forests on mountain summits at 1280–2100 m altitude. Flowering from September to March; fruiting from October to February.

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known from two areas in Peninsular Malaysia and is reported to be uncommon. An analysis of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) gives an assessment of Endangered. Given this and the intensive logging and landscape modification that has occurred in the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Perak:** Gunung Korbu, 22 Jul 1933, *Symington 31497* (K, KEP); Gunung Korbu, 22 Sep 1933, *Symington 32113* (K, KEP); Korbu, Raya Ridge, 1 Feb 1938, *Strugnell & Tachun 45968* (KEP 2 sheets). **Pahang:** Cameron Highlands, Gunung Pasar, start of trail to Gunung Pasar, 23 Oct 1970, *Whitmore FRI 15582* (KEP); Cameron Highlands, Gunung Berembun, ridge top, 27 Oct 1972, *Chan FRI 16829* (KEP); Cameron Highlands, Gunung Berembun, Tanah Rata, 25 Mar 1998, *Mat FRI 43042* (KEP); Cameron Highlands, Sungai Pauh Valley, 4 Oct 1963, *Chew CWL 794* (KEP).

Notes. See discussion under *Cinnamomum cordatum*.

9. *Cinnamomum mollissimum* Hook.f., Fl. Brit. India 5: 131 (1886); Ridley, Fl. Malay Penins. 3: 92 (1924); Corner, Wayside Trees Mal., 341 (1952); Kochummen, Tree Fl. Malaya 4: 128 (1989). – TYPE: [Peninsular Malaysia] Penang, July 1885, *C. Curtis 308* (holotype K [K000778646]). (Fig. 4)

Trees or shrubs, 1.8–12 m tall, 5–20 cm dbh. Bark smooth to finely fissured and cracked, (pinkish) greyish to grey-dark brown, aromatic; inner bark (reddish or yellowish to dark) brown, sapwood (pale) yellow to white or pale brown. **Twigs** slender, 1.2–2.4 mm thick, slightly angled in cross-section when young, velutinous when young, often remaining densely to sparsely hairy on older branches; hairs appressed to erect, straight, long, white to yellow; terminal leaf bud ovoid, 4.6–6.1 mm long, velutinous. **Leaves** subopposite, domatia absent; leaf blade elliptic to lanceolate, 4.5–20 × 2.2–8.7 cm, apex acute to long-acuminate, base cuneate, margins straight to revolute, blade triplinerved, secondary veins 1 pair, together with main vein extending to the leaf apex, with a few side veins that radiate towards the margins and form looped intramarginal veins, tertiary veins scalariform-reticulate, blade thinly leathery, aromatic when crushed, young leaves bright green, drying greenish yellow; upper surface green, sparsely hairy to densely hairy at base, more densely hairy on main veins, midrib and secondary veins flattened to sunken, tertiary veins distinct; hairs whitish, appressed; lower surface pale green, sparsely hairy to velutinous on main veins, midrib and secondary

veins raised, tertiary veins distinct, hairs whitish, erect; petiole half-terete, 0.5–20 mm long, slender, densely hairy. **Inflorescence** a few-flowered slender panicle, axillary, 5.5–8.2 cm long, sparsely to densely hairy; hairs erect, long, whitish to yellowish; bracts leaf-like; bracteoles linear, 1.8–2 mm long, persistent to caducous. **Flowers** bisexual, cream to yellowish green or white, hairy; perianth tube 0.9–1.3 mm long, densely hairy; perianth lobes elliptic, 1.6–2.9 × 1–1.4 mm, apex acute, densely hairy outside and inside. **Stamens** 9, 1–2.3 mm long, densely hairy; anthers 4-celled. **Ovary** ellipsoid, 0.9–1.5 mm diameter, densely hairy; style 0.9–1.1 mm long; stigma capitate. **Fruit** ellipsoid, 7–12.8 × c. 10 mm, apex rounded, smooth, glabrous; cupule 8.5–8.7 mm diameter, cup-shaped, sparsely hairy to glabrous, woody; perianth lobes 1.4–1.8 mm long, apex rounded, ridged; stalk slightly swollen, 1.4–2 mm thick.

Distribution. Endemic to Peninsular Malaysia and Peninsular Thailand. In Peninsular Malaysia, almost throughout the region, but not recorded from Kedah and Perlis (Fig. 4).

Ecology. Growing in primary and secondary lowland forest (including dry *Dryobalanops* forest) and in hill and montane forests, sometimes in fresh water swamps forests or along rivers, at 60–1420 m altitude. Flowering all year around; fruiting from May to July.

Vernacular names. *Medang wangi*, *Kayu manisi* and *Medang teja* (Malay); *Daun lawang kichil* (Perak); *Mai chit* (Thai).

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Penang:** Jul 1885, *Curtis 308* (K); West Hill, Mar, *Curtis s.n.* (SING [SING 0268492]); Penang Hill, 13 Feb 1976, *Sidek ben Kiah SK 399* (KEP). **Perak:** Taiping, Aug 1888, *Wray 2696* (K, SING [SING0268480]); Pangkor, Jul 1888, *Curtis s.n.* (SING [SING 0268491]); Larut, Apr 1884, *King's Collector 6013* (K 4 sheets, SING 2 sheets [SING 0267968, SING 0268498]); Kota Laura, Kuala Kangjan, 20 Oct 1924, *Haniff 15547* (SING [SING0268489]); Kota Laura, 21 Oct 1924, *Haniff 16028* (SING [SING 0268488]); Bubu Forest Reserve, 31 Mar 1933, *Symington 29910* (K, KEP); Trolak Forest Reserve, 18 Mar 1967, *Chelliah FRI 104614* (K, KEP, SING 2 sheets [SING0267970, SING0268495]). **Kelantan:** Kampong Gobek, 3 Mar 1959, *Md. Shah & Kadim MS 527* (K, SING [SING0267969]). **Terengganu:** Bukit Bauk, 28 Apr 1962, *anonymous 5066* (K); Sungai Pelang, 9 Apr 1971, *Suppiah FRI 14852* (K, KEP, SING [SING0268484]); Belara Forest Reserve, 13 Jul 1953, *Sinclair & Kiah ben Salleh 39921* (K, SING [SING0268481]). **Selangor:** Kuala Lumpur, Welds Hill, 18 Nov 1916, *Forest Department C 7872* (SING [SING0268490]); Kuala Lumpur, Welds Hill, 20 Jan 1919, *Ahmad 3013* (K, KEP, SING [SING 0268499]); Welds Hill Reserve, 18 Nov 1916, *Hamid 872* (KEP 2 sheets); Gunung Lesong Forest Reserve, Rompin, 28 Apr 1956, *Lindong 83455* (K, KEP, SING [SING0267963]). **Negeri Sembilan:** Sungai Ujong, *Alvins s.n.* (SING [SING0268487]); Semarang Forest Reserve, 4 Dec 1922, *Holtum 9942* (K, SING 2 sheets [SING0267967, SING0268494]); Pasoh Experimental Station, 6 Nov 1978, *Suppiah FRI 28181* (K, KEP, SING [SING0267960]); Pasoh Forest Reserve, 16 Apr 1981, *Mat Asri FRI 25907* (KEP); Pasoh Forest Reserve, 30 Mar 1989, *Kamarudin FRI 31415* (K);

Jelebu, Pasoh Forest Reserve, trail to 50 ha plot, 17 Apr 2003, *Fakhul Effendi FRI 48128* (KEP 2 sheets, SING [SING0268500]). **Malacca** or **Negeri Sembilan**: 5 Nov 1985, *Alvins 3326* (SING [SING0268486]). **Pahang**: Sungai Telom ridge North of Sungai Kadjau, 27 May 1971, *Zainudin FRI 14749* (K, KEP, SING [SING0268493]); Cameron Highlands, Sungai Bertram, 9 Apr 1934, *Jaamat & Saw 36170* (K, KEP); Cameron Highlands, Tamah Rota, 25 Nov 1925, *Whitley & Henderson SFN 18005* (KEP, SING [SING0268482]); Cameron Highlands, Jalan Jasar, 6 Apr 1988, *Sukup Akin FRI 32725* (K, KEP); Cameron Highlands, path from MARDI agricultural station to Gunung Beremban, 11 Aug 1986, *Wong FRI 35220* (K, KEP); Cameron Highlands, path to Gunung Jasar, 26 Oct 1972, *Chan FRI 16817* (K, KEP 2 sheets, SING [SING0267962]); Sungai Bilut, 20 Apr 1932, *Osman 28420* (KEP 2 sheets); Gua Musang, 20 Mar 1996, *Teo & Tarelli KL 4573* (KEP); Ulu Sungai Kuantan, 11 Jun 1934, *Symington 28770* (K, KEP 2 sheets, SING [SING0268496]); Gunung Berembun, 24 Mar 1998, *Mat FRI 43040* (KEP). **Johor**: Sungai Kayu Ara, Mawai-Jemaluang road, 11 May 1935, *Corner 29325* (K, KEP, SING [SING0267964]); Mawai, 13 Apr 1936, *Corner 30885* (BM, K, KEP, SING 2 sheets [SING0268485, SING0268497]); West Gunning Panti, 14 Apr 1936, *Corner 30953* (K, KEP, SING 2 sheets [SING0267965, SING0267966]); 2 miles South of Labis Forest Reserve, 16 Apr 1966, *Whitmore FRI 0190* (K, KEP, SING [SING0268483]); Kluang, Renggam Forest Reserve, 13 Apr 1971, *Chan FRI 17623* (K, KEP, SING [SING0267961]); Endau State Park, Kuala Jasin, 1 Apr 1998, *Damanhuri s.n.* (KEP). THAILAND: [Mueang Prachuap Khiri Khan] Tapli Klong Wan, 3 Mar 1919, *Hamid FMS 3759* (KEP).

Notes. In the original description accompanying the publication of this name only one unnumbered Curtis collection from Penang is mentioned (Hooker, 1886). At Kew, two specimens made by this collector have the same number, date and collection locality. One is in flower [K000778646] and one in full fruit [000778645]. In the original description, no mention is made of the fruit, while the flowers are described as minute and shortly pedicelled. Therefore, the specimen with flowers is accepted here as the only type material.

The bark of *C. mollissimum* is used as a spice in betel juice and the wood is used in house building (Burkill, 1966). In Perak, a decoction of the leaves is given to a mother after childbirth.

10. *Cinnamomum pachypes* Kosterm., Reinwardtia 10: 447 (1988); Kochummen, Tree Fl. Malaya 4: 128 (1989). – TYPE: Peninsular Malaysia, Ulu Selangor, Gadding Forest Reserve, 21 July 1969, *Y.C. Chan FRI 13182* (holotype L [L0035895]; isotypes K, SING [SING0260192]). (Fig. 6)

Trees, 12–13 m tall, c. 15 cm dbh. Bark smooth, inner bark brown, sapwood whitish with an aromatic smell. **Twigs** slender, 0.4–1.3 mm thick, slightly angled in cross-section, glabrous; leaf buds lanceolate in outline, 1–2 mm long, velutinous; hairs whitish, appressed. **Leaves** subopposite, rarely alternate, domatia absent; leaf blade elliptic to lanceolate, 6–14 × 2–4.5 cm, apex broadly acuminate, base cuneate, margins straight, domatia absent, blade palmately veined, secondary veins 1 pair which extend almost to the leaf apex, tertiary veins scalariform, areolate-reticulate, blade leathery, drying yellowish green; upper surface glabrous, shiny, midrib and secondary veins raised, tertiary veins faint; lower surface glabrous, glaucous, midrib and secondary

veins raised, tertiary veins faint; petiole half-terete to channelled, 5–15 mm long, slender, glabrous. **Inflorescence** a few-flowered slender panicle, axillary, 1–3.3 cm long, glabrous; bracteoles unknown. **Flowers** unknown. **Fruit** unknown; cupule (immature) woody, cup-shaped, margin entire, glabrous; stalk tapering distally, 5–10 mm long, glabrous.

Distribution. Endemic to Peninsular Malaysia (Fig. 6).

Ecology. Growing in forest at 560–600 m altitude. Flowering time unknown; fruiting in July (immature fruit).

Provisional IUCN conservation assessment. Critically Endangered (CR B1ab(ii,iii), CR B2ab(ii,iii)). This species is only known from one collection from Peninsular Malaysia made in 1969. An analysis of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) gives an assessment of Critically Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the last 48 years, it must be considered to be critically endangered.

Notes. According to Kostermans (1988), this species is morphologically close to *Cinnamomum cuspidatum* Miq. as it has similar leaves and inflorescence/infructescence. However, it differs from this species in having completely glabrous leaves and twigs and in having short hairs on the terminal bud.

11. *Cinnamomum parthenoxylon* (Jack) Meisn. in DC., Prodr. 15: 26 (1864); Ridley, Fl. Malay Penins. 3: 96 (1924); Corner, Wayside Trees Mal. 341 (1952); Li et al., Fl. China 7: 175 (2008). – *Laurus parthenoxylon* Jack, Malayan Misc. 1: 28 (1820). – *Camphora parthenoxylon* (Jack) Nees in Wallich, Pl. Asiat. Rar. 2: 72 (1831) – *Sassafras parthenoxylon* (Jack) Nees, Syst. Laur. 491 (1836). –TYPE: [Indonesia] Sumatra, 'Kayo Gadis' (holotype BR [BR0000005931088]). (Fig. 6)

Cinnamomum porrectum (Roxb.) Kosterm., J. Sci. Res. (Jakarta) 1: 126 (1952); Kostermans, Reinwardtia 8: 60 (1970); Kochummen, Tree Fl. Malaya 4: 128 (1989); Soh, Blumea 56: 255 (2011); Applequist, Taxon 62: 1326 (2013). – *Laurus porrecta* Roxb. [Hort. Bengal. 30 (1814)] Fl. Ind. 2: 308 (1832). – *Camphora porrecta* (Roxb.) Voigt, Hort. Suburb. Calcutt. 308 (1845). – *Parthenoxylon porrectum* (Roxb.) Blume, Mus. Bot. 1: 323 (1851). –TYPE: *W. Roxburgh s.n.* (neotype BR [593 108]), designated by Kostermans (1970) and refined by Turner (2013).

Camphora inuncta Nees in Wallich, Pl. Asiat. Rar. 3: 32 (1831); Miquel, Fl. Ned. Ind. 1: 905 (1858). – *Cinnamomum inunctum* (Nees) Meisn. in DC., Prodr. 15: 25 (1864); Ridley, Fl. Malay Penins. 3: 97 (1924). –TYPE: [Myanmar, Tanintharyi] Tavoy, October 1827, Gomez [Wallich cat.] 6347 (lectotype GZU [GZU 000253883]; designated here, isotype K [K001123637]).

Cinnamomum malaccense Meisn. in DC., Prodr. 15: 27 (1864). – TYPE: [Peninsular Malaysia] Malacca, *Griffith 4256* (lectotype K [K000793550], designated here).

Trees, 6–50 m tall, 40–280 cm dbh. Bark (deeply) fissured, peeling off in lamellae, dark grey or reddish or greyish brown; inner bark pink to reddish brown, with a strong scent of camphor; sapwood (pale) yellow to white. **Twigs** slender, 2.2–5 mm thick, glabrous, brownish; terminal leaf buds (perulate) orbicular, 1.4–5.4 mm long, glabrous or with a patch of hairs at the centre, leaving a series of scars at the base of older twigs. **Leaves** spirally arranged to subopposite, young leaves light green to red, domatia present; leaf blade elliptic to elliptic-ovate or elliptic-obovate, 4–17 × 2–8 cm, apex acute to acuminate or sometimes rounded, base cuneate to rounded, often asymmetric, blade glabrous, (thinly) leathery to membranous, margins revolute, blade pinninerved, secondary veins in 3–7 pairs, tertiary veins reticulate, venation brochidodromous; upper surface glabrous, dark to bright green and shiny, main vein sunken, secondary veins raised, tertiary veins faintly to distinctly visible; lower surface glabrous, greenish or glaucous green, main vein raised, secondary veins raised, tertiary veins distinct, domatia (hairy pockets) at proximal ends of lateral veins; petiole channelled, 8–30 mm long, slender to slightly swollen, glabrous, red. **Inflorescence** a few-flowered slender panicle, axillary, 2.5–10 cm long, sparsely to densely hairy; bracts leaf-like; bracteoles spatulate, c. 1.3 mm long, caducous. **Flowers** bisexual, cream to pale or green-yellow, sweetly scented; perianth tube campanulate, 0.7–1.1 mm long; perianth lobes oblong to elliptic, 1.4–2.5 × 0.9–1.5 mm, apex acute to round, glabrous outside, velutinous inside; hairs long, yellowish, straight. **Stamens** 9, 1–1.7 mm long, pubescent; anthers 4-celled. **Ovary** ellipsoid, 1–2 mm diameter, glabrous; style c. 1 mm long; stigma discoid. **Fruit** globose, 4.5–8.5 mm diameter, glabrous, black; cupule funnel-shaped, persistent, 4.5–10 mm diameter, margin entire, patent, glabrous, red to purplish black when mature; perianth lobes caducous; stalk tapering distally, 9–10 mm long, 1–4 mm thick.

Distribution. South China, Myanmar, Vietnam, Thailand, Malaysia, Indonesia (Sumatra, Kalimantan and Java) (Fig. 6). In Peninsular Malaysia occurring along the west coast from Perlis to Johor. Common in the northern states, but rarer further south.

Ecology. Growing in primary and secondary lowland to montane forest, sometimes on sands, sandstone or granite, at 0–2000 m altitude. Flowering in September to March; fruiting from December to June.

Vernacular names. Safrol Laurel (English); *Medang kemangi*, *Medang gatal*, *Madang busuk*, *Medang loso(h)* and *Medang sasi* (Malay).

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Perlis:** Kaki Bukit, Mata Air, 12 Mar 1996, *van Ballgooy 7212* (K, KEP); Kangar, 14 Jun 1952, *Saad 73905* (KEP).

Penang: Government Hill, Nov 1885, *Curtis 512* (K, SING [SING0268519]); Government Hill, Jul 1885, *Curtis 1406* (SING [SING0268804]); Government Hill, Mar 1889, *Curtis 1038* (SING [SING0268512]); Waterfall Gardens, Mar 1890, *Curtis 1038* (BM); Waterfall Gardens, Dec 1892, *Curtis 1038* (K, SING 4 sheets [SING0268508, SING0268515, SING0268516, SING0268517]); Bukit Penang, May 1890, *Curtis 1038* (BM); 1888, *Curtis 1038* (K); Bukit Penang, Oct 1886, *Curtis 1038* (K, SING 3 sheets [SING0268520, SING0268521, SING 0268530]); Penang Bukit, Mar 1896, *Hur 7212* (SING [SING0268807]); 18 Mar 1915, *Ridley s.n.* (BM, K); Penang Hill, 20 Jul 1936, *Corner s.n.* (SING [SING0268803]); Penang Hill, 20 Jul 1936, *Corner s.n.* (SING); Penang Hill, 22 Nov 1937, *Henderson s.n.* (SING [SING0268514]); Moniot Road West, 16 Oct 1951, *Sinclair 39331* (K, SING [SING0268523]); [Prov. Wellesley] Bukit Pampar, *Mohd 6418* (K, KEP, SING [SING0268524]); [Prov. Wellesley] 1890, *Guard 12585* (BM, SING [SING0268503]); Pangkor, Telok Nipah, 11 Feb 1932, *Strugnell 27099* (K, KEP, SING [SING0268511]); [Prov. Wellesley] Dec 1895, *Ridley 6968* (BM, K, SING [SING0268802]); **Kedah:** Kuala Muda, 11 Dec 1946, *Abdulla 59602* (K); Kubang Pasu, 28 Oct 1952, *Bakar 73655* (KEP); Tampoi Forest Reserve, 5 Jan 1940, *Rejab 42000* (KEP); Tampoi Forest Reserve, 9 Feb 1950, *Haniff 71154* (K); Kubang Pasu, Bukit Perangin Forest Reserve, 25 Jan 1994, *Zainudin 4788* (K); Gunung Jerai Forest Reserve, 2 Nov 1926, *Arohad 11262* (KEP); Katumbah, 14 Oct 1933, *Meh 27353* (KEP); Gunung Jerai Reserve, 18 Sep 1922, *Noordin 7711* (K, KEP, SING [SING0268526]); Gunung Jerai Forest Reserve, 16 Dec 1928, *Midah 7585* (KEP); Gunung Jerai, 16 Dec 1928, *Bell FMS 7585* (SING [SING0268805]); nursery, Gunung Jerai Forest Reserve, 14 May 1944, *Meh 9039* (KEP); Gunung Jerai, Dec 1925, *Boswell 9050* (KEP); Gunung Jerai Forest Reserve, 4 Aug 1952, *Rahman 32902* (KEP); Gunung Jerai, Dec 1925, *Guard 9039* (K, SING [SING0268522]); Kayu Hitam Forest Reserve, 27 Mar 1959, *Mat Din 42173* (KEP); Bukit Kayu Hitam, 26 Mar 1939, *Mat bin Dia 42172* (KEP); Bukit Kayu Hitam Forest Reserve, 28 Mar 1959, *Mat Din 42174* (KEP); Ulu Tawar Forest Reserve, 10 Mar 1927, *Meh 11499* (KEP); Hutan Simpang, 28 Apr 2006, *Teo & Din KL 5237* (KEP); foot of Kedah peak, 25 Feb 1960, *Kochummen 94401* (K, KEP); on way to Kedah peak, 11 Jun 1966, *Kochummen FRI 2001* (K, KEP, SING [SING0268518]); Suching, Mar 1911, *Bell & Haniff s.n.* (K); opposite Thy Lye Estate, *anonymous FRI 16294* (KEP); Ulu Sungai Tawar, 30 Mar 1929, *Meh 17781* (KEP); 20 Dec 1934, *Midah 33063* (KEP); Silk, Mar 1997, *Teo & Tetu KL 4676* (KEP); Pantai Acheh Forest Reserve, *anonymous KEP 72563* (KEP); Inas Forest Reserve, 7 Feb 1968, *Burgess KEP 4951* (KEP). **Perak:** Dindings, 4 Aug 1953, *Mat Zaib KEP 69513* (KEP); Dindings, 18 Jul 1953, *Rahman KEP 75852* (KEP); Kinta, 31 Jan 1950, *Grant 65703* (KEP); Dindings, Feb 1897, *Ridley s.n.* (SING [SING0268504]); summit Duidiul, 1892, *Ridley 3044* (K, SING [SING0268528]); Gunung Batu Puteh, *Wray 1072* (K); Kuila, Jan 1885, *King's Collector 7120* (K 3 sheets, SING 2 sheets [SING0268525, SING0268529]); Pulau Lang, 6 Dec 1925, *Seimund s.n.* (KEP, SING [SING0268502]); Gunung Booloo, Mar 1885, *King's Collector 8354* (K 3 sheets); Grik, 2 Feb 1994, *Penomot & Teo KL 4330* (KEP); Chior Reserve, 27 May 1938, *Hassan 16773* (KEP). **Kelantan:** Laupiu, 1919, *Ridley s.n.* (K); Gunung Rabong, 13 Mar 1972, *Whitmore 20668* (K, SING [SING0268507]). **Selangor:** Batang Kali, 2 Dec., 1930, *Matnol 22006* (K, KEP); 1908, *Hoskin 13243* (BM, K 2 sheets, SING [SING0268515]); Ulu Selangor, 11 Jun 1973, *Sudin KEP 122601* (KEP); Bukit Lagong, 8 Aug 1964, *Jainuddin KEP 98894* (KEP); Bachang Hill, 15 Jan 1937, *Symington 43251* (KEP); Kepong Plantation Field, 5 Mar 1934, *Hamid 33860* (KEP); Kepong, 3 Mar 1956, *Kepong field no. 76692* (K, KEP); Kuala Lumpur, Kepong, 3 Mar 1956, *anonymous 76692* (KEP); Ulu Langat Forest Reserve, 14 Aug 1968, *Whitmore FRI 12174* (KEP); Kuala Lumpur, 21 Feb 1925, *Awang 9978* (KEP). **Malacca:** *Griffith 4256* (K); 1845, *Griffith s.n.* (K); 4 Feb 1885, *Abrins 734* (SING [SING0268501]); *Maingay 1244* (1996) (K); *Maingay 1512* (BM, K 2 sheets); 18 Mar 1886,

Malirus s.n. (SING [SING0268506]); Tebaug, *Ridley s.n.* (K). **Negeri Sembilan:** Pajam, 19 Feb 1919, *Jakim 1997* (K, KEP, SING [SING0268510]); Kopis Forest Reserve, 19 Apr 1918, *Kinsey FMS 1866* (K, KEP, SING 2 sheets [SING0267911, SING0268509]); Tampin, 14 Dec 1915, *Burkill 1368* (SING [SING0268505]); Gunung Tampin, 27 May 1970, *Loh FRI 17056* (K, KEP, SING [SING0268513]); Gunung Tampin, 29 May 1970, *Everett FRI 14239* (K, SING [SING0268800]); Tampin Forest Reserve, 29 May 1970, *Everett FRI 14239* (KEP); Setul Road, 21 Nov 1919, *Othman FMS 523* (KEP). **Pahang:** Fraser's Hill, 10 Nov 1937, *Medan 45410* (KEP); Fraser's Hill, 10 Nov 1909, *Ridley s.n.* (KEP); Fraser's Hill, 10 Nov 1909, *anonymous 303* (SING [SING0268806]); Cameron Highlands, 1 Apr 1937, *Nur 32801* (K 2 sheets, KEP, SING [SING0268801]); Kuantan, Kuala Terepai, 27 Aug 1919, *Raujen 2728* (K); Raub Pahay, 27 Jun 1931, *Walker 23521* (KEP); Pontain, Sungai Kerepai, 17 Jul 1921, *Lambak 3557* (KEP); Sungai Kiang, 11 Mar 1930, *Strugnell 20426* (KEP); Kuantan: Kuala Terepai, 27 May 1919, *Lambak 2728* (KEP). **Johor:** Kota Tinggi, 17 Jul 1961, *Ismail 93878* (KEP).

Notes. In the original description of *Cinnamomum malaccense* (Meissner, 1864), two very similar gatherings were mentioned: Malacca, 1845, *Griffith s.n.* and Malacca, *Griffith 4256*. *Griffith 4256* (K) is designated here as the lectotype.

In the original description of *Camphora inuncta* (Nees von Esenbeck, 1831), only one gathering was mentioned. The Lauraceae specimens of Nees von Esenbeck herbarium are housed at GZU and the specimen there is designated here as the lectotype.

This species is very variable in leaf size, shape and texture and many formal taxa have been based on this variation. Soh (2011) stated that in Borneo two distinct forms can be recognised based on leaf form. The first has leaves with a small, less pointed apex and a thinly coriaceous blade, whereas the second has a larger, more chartaceous blade with a more pointed apex. This variation can also be seen in Peninsular Malaysia, but with much overlap between the two forms (see also Kostermans, 1970).

This species is more or less deciduous with the old leaves falling as some of the new leaves develop. It usually flowers after it has changed its leaves (Ridley, 1924; Corner, 1952). Specimens often have red-tomentose galls in the place of the fruits; these galls are much bigger than the fruits (up to 18 mm long when dried), ellipsoid and the surface is flaky not smooth.

The wood of *Cinnamomum parthenoxylon* is used in house building and for furniture and musical instruments, and because of its pronounced and persistent smell, it is supposed to be resistant to insect attack. The aromatic oil mainly contains saffrol. The bark is used in flavouring food and as scent for soap. It is also used in a tonic against menstrual pains, while the roots are used medicinally against fever. Half-ripe fruit smell strongly of saffras and are used as an alternative for Chinese cassia buds (Burkill, 1966: 561).

12. *Cinnamomum puberulum* Ridl., Fl. Malay Penins. 3: 96 (1924); Kochummen, Tree Fl. Malaya 4: 128 (1989). – TYPE: [Peninsular Malaysia] Pahang, Ulu Raub, Bentong, 5 January 1920, *Ahmad 5096* (lectotype K [K000778651], designated by Turner (2012); isoelectotypes KEP [97094], L [L0035946], SING [SING0055568]). (Fig. 7)

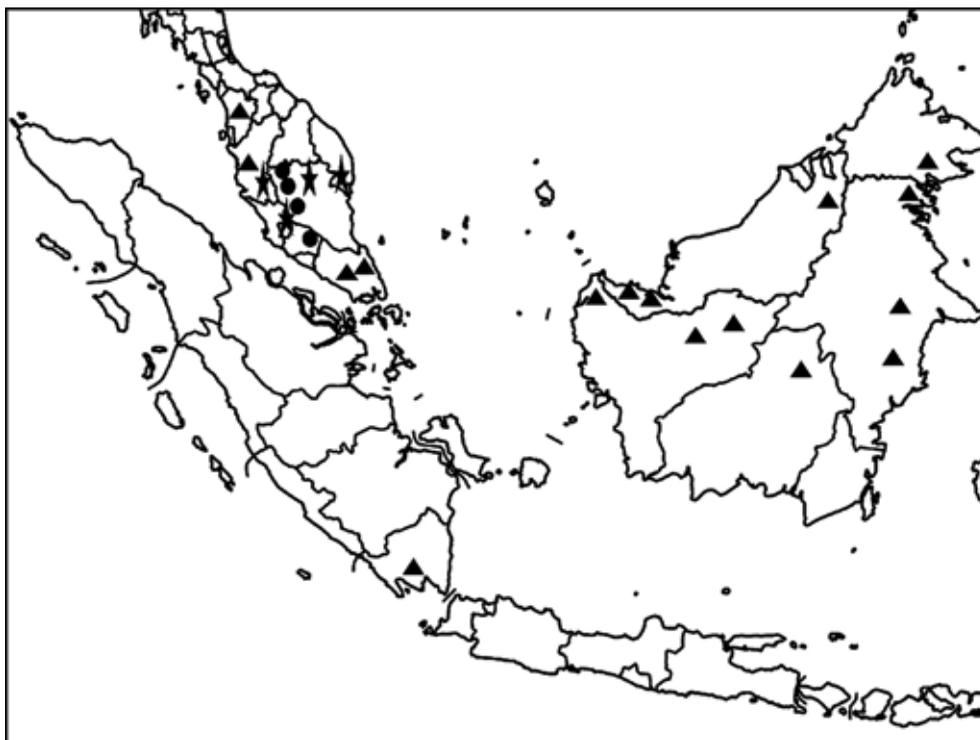


Fig. 7. Distribution of *Cinnamomum puberulum* (●), *Cinnamomum rhynchophyllum* (▲) and *Cinnamomum scortechinii* (★).

Trees, 5–17 m tall, 10–40 cm dbh. Bark dark brown to brownish, smooth; inner bark dark brown to pale yellow, sapwood yellow. **Twigs** slender, 2.4–3 mm thick, sparsely to densely hairy when young, glabrous when older; hairs short, pale yellow; terminal leaf bud ovoid, 1.8–3.2 long, apex acute, velutinous. **Leaves** alternate, rarely some subopposite, domatia absent; leaf blade elliptic to oblong, 5–13 × 2–5.7 cm, apex acute, base cuneate to rounded, margins straight, blade triplinerved, occasionally apical part of midrib with additional secondary veins, secondary veins 1–5 pairs, basal pair prominent and extending 2/3 the length of the leaf, tertiary veins reticulate, blade thinly leathery, drying greenish brown; upper surface glabrous, dark green, shiny, midrib and secondary veins raised, tertiary veins inconspicuous; lower surface densely hairy, pale green, slightly glaucous, midrib and secondary veins raised, tertiary veins faintly visible; hairs appressed short, white; petiole half-terete, 10–15 mm long, slender, sparsely to densely hairy, hairs yellow. **Inflorescence** a few-flowered slender panicle, terminal and axillary, 1.4–5 cm long, velutinous; hairs yellow, short; bracts leaf-like; bracteoles ovate, 1.8–2.5 mm long, apex acute, persistent, velutinous. **Flowers** bisexual, white to pinkish; perianth tube 1–1.2 mm long; perianth lobes 2.7–3.7 × 1.3–1.7 mm long, apex acute, velutinous outside, densely hairy inside. **Stamens** 9, 1.5–2.7 mm long, sparsely hairy; anthers 4-celled, upper ones much smaller. **Ovary** 1.5–2 mm long, glabrous or with a few hairs at apex; style c. 1.5 mm long; stigma

peltate. **Fruit** ellipsoid, 10–11 × 6–9 mm, smooth, glabrous; cupule woody, 6–7.5 mm diameter, shallowly lobed; lobes 0.7–2 mm long, apex acute, velutinous to glabrous when old; stalk tapering distally, 1.5–2.3 mm thick.

Distribution. Endemic to Peninsular Malaysia. Only known from Negeri Sembilan and Pahang (Fig. 7).

Ecology. Growing in montane forests at 900–1000 m altitude. Flowering in December to February; fruiting in June.

Vernacular names. *Medang kamangi* and *Medang teja* (Malay).

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is only known from a small number of collections from Peninsular Malaysia and is reported to be rare. An analysis of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) gives an assessment of Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Negeri Sembilan:** Hutan Simpan Jeram Padang, 15 Feb 2006, *Teo & Din KL 5191* (KEP); Tampin Forest Reserve, 14 Jul 1947, *anonymous 64265* (KEP). **Pahang:** Lipis district, SW of Sungai Bertram near K. Mensoon, 2 Jun 1971, *Zainudin FRI 17899* (K, KEP, SING [SING0267918]); Bentung, 29 Dec 1919, *Ahmad 5063* (K, KEP, SING).

Notes. This species is relatively easy to recognise as it is the only species in Peninsular Malaysia with leaves that are mostly alternate with no domatia in the axils of the midrib and secondary veins, and it has simple, short terminal and axillary inflorescences.

13. *Cinnamomum rhynchophyllum* Miq., Fl. Ned. Ind. 1: 895 (1858); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 481 (1925); Ridley, Fl. Malay Penins. 3: 93 (1924); Kostermans, Reinwardtia 8: 62 (1970); Kochummen, Tree Fl. Malaya 4: 130 (1989); Soh, Blumea 56: 256 (2011). – TYPE: [Indonesia] Sumatra, Loeboe Aloeng, *Teijsmann H.B. 1031* (lectotype U; designated here. isolectotype BO). (Fig. 7)

Trees, 6–15 m tall, 10–45 cm dbh. Bark smooth, lenticellate, grey, inner bark light brown; wood brownish or yellowish white. **Twigs** slender 1.6–2.8 mm thick, rounded to angled in cross-section, velutinous when young, soon glabrescent; hairs long, yellowish, appressed to erect; terminal leaf bud ovoid, 3.4–5.5 mm long, apex acute, velutinous. **Leaves** subopposite; domatia absent; smelling like *Cinnamomum* when crushed; leaf blade elliptic to oblong, 5–23 × 1.8–8 cm, apex acuminate, often with a long tip, base cuneate, margins straight to slightly revolute, blade triplinerved, secondary veins 1 pair which extends to the apex, secondary veins often with 1–3 third order veins which form a looped marginal vein, tertiary veins scalariform, blade thinly

leathery, drying yellowish brown; upper surface glabrous, shiny, bluish to light green, midrib and secondary veins raised at base, tertiary veins faint; lower surface sparsely hairy, slightly glaucous, whitish beneath, midrib and secondary veins raised, tertiary veins prominent; hairs appressed, long, yellowish; petiole half-terete, 1–1.5 cm long, slender, sparsely hairy, hairs appressed. **Inflorescence** a many-flowered broad panicle, terminal, 8–15 cm long, densely hairy; hairs yellowish, long, appressed to erect; bracts leaf-like; bracteoles triangular to lanceolate, 0.8–2.8 mm long, apex acute, velutinous, persistent. **Flowers** bisexual, yellow to pale yellowish green; perianth tube 0.7–1.4 mm long, velutinous; perianth lobes oblong, $2.5\text{--}3.3 \times 1.5\text{--}2.5$ mm long, apex acute, velutinous outside, densely to sparsely hairy inside. **Stamens** 9, 1.4–2.8 mm long, sparsely hairy; anthers 2 or 4-celled. **Ovary** 0.7–1.1 mm diameter, glabrous; style 1.1–1.4 mm long; stigma peltate. **Fruit** ellipsoid to globose, $9\text{--}10 \times 7.9\text{--}8$ mm, glabrous, black when mature; cupule shallow, 3–4.5 mm diameter; perianth lobes elliptic, $2\text{--}3 \times 2\text{--}2.5$ mm, apex acute, persistent; stalk 2.2–3 mm long.

Distribution. Peninsular Malaysia, Borneo and Sumatra (Fig. 7).

Ecology. Growing in primary and secondary lowland and hill forests at 30–160 m (–600 m in Borneo) altitude. Flowering from April to September; fruiting from August to February.

Vernacular name. *Medang wangi* (Malay).

Provisional IUCN conservation assessment. Endangered (EN B2ab(ii,iii)). This species is known from a wide area in South East Asia but is reported to be uncommon in Peninsular Malaysia. An analysis of the Extent of Occurrence (EEO) gives an assessment of Least Concern and the analysis of the Area of Occupancy (AOO) gives an assessment of Endangered. Given the small and fragmented area of occupancy and the intensive logging and landscape modification that has occurred in the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Perak:** Larut, Aug 1882, *Kunstler 3287* (K); Larut, Aug 1882, *King's Collector 3251* (K 2 sheets, picture at KEP); Larut, Sep 1884, *King's Collector 6595* (BM, K 3 sheets); Tapa, *Wray 4304* (BM, K, picture at KEP). **Kedah:** Bongsu Forest Reserve, 20 Mar 1940, *Sharin 35167* (K, KEP). **Pahang:** Lesong Forest Reserve, 27 Jun 1972, *Chan FRI 19831* (K, KEP). **Johor:** Mersing, Tenggaroh Forests Reserve, 7 Apr 1968, *Ogata KEP 105186* (K, KEP, SING [SING0267920]); Ulu Endau, Labis Forest Reserve, Gunung Janing, 27 Mar 1968, *Ogata KEP 110414* (K, KEP, SING [SING0267921]); Labis Forest Reserve, Mersing, 2 Apr 1968, *Ogata 105031* (SING [SING0267919]).

Notes. Soh (2011) reported that this species only has 2-celled anthers. In Peninsular Malaysia, I have observed that most anthers are 4-celled with the two upper cells very small but apparently functional (they resemble the lower, larger anthers except in size). However, in every flower some stamens have 2-celled anthers.

In 1858 Miquel described the species *Cinnamomum rhynchophyllum* Miq., Fl. Ned. Ind. 1: 895 (1858), based on material collected by Teijsmann from Sumatra. I could only find one collection housed at U which matched this description and this collection is designated here as the lectotype.

Cinnamomum rhynchophyllum is used as a source of the essential oil *Kulit lawang* (Burkill 1966: 562).

14. *Cinnamomum scortechinii* Gamble, Bull. Misc. Inform. Kew 1910: 219 (1910); Ridley, Fl. Malay Penins. 3: 95 (1924); Kochummen, Tree Fl. Malaya 4: 130 (1989). – TYPE: Malay Peninsula, Perak, camp on Ulu Batang Padang, *L. Wray 1520* (lectotype K [K000778655], designated here). (Fig. 7)

Cinnamomum velutinum Ridl., J. Straits Branch Roy. Asiat. Soc. 82: 190 (1920); Ridley, Fl. Malay Penins. 3: 95 (1924). – TYPE: [Peninsular Malaysia], Pahang, Gunung Tahan, Teku Woods, July 1911, *H.N. Ridley 16110* (lectotype BM, designated here; isolectotype K [K000778660]).

Cinnamomum pubescens Kochummen [Tree Fl. Malaya 4: 129 (1989)] Gard. Bull. Singapore 43: 23 (1992 [‘1991’]). – TYPE: Peninsular Malaysia, Pahang, Cameron Highlands, Gunung Jasar, 13 August 1986, *K.M. Wong FRI 35248* (holotype KEP [97098]; isotypes A [A00062536], K, SING [SING0260194]), **synon. nov.**

Shrubs to trees, (2–)6–30 m tall, up to 30 cm dbh. Bark smooth, grey brown; inner bark brownish to pink with a spicy or cinnamon smell, sapwood cream to whitish. **Twigs** slender, 1.7–3 mm thick, slightly angled to round in cross-section, velutinous when young, glabrous with patches of hairs when mature; hairs erect, curly, yellowish; terminal leaf bud ovoid, 3.7–5.2 mm long, apex acuminate, velutinous. **Leaves** subopposite or alternate, domatia absent; leaf blade slightly ovate, elliptic to lanceolate, 6–15 × 3–6 cm, apex acute to short acuminate, base cuneate, margins revolute, blade triplinerved, secondary veins one pair which reach all the way to the apex, secondary veins with few short ‘false’ side veins which join near margin to form looped marginal vein, tertiary veins scalariform, blade thin to medium thickness and leathery, young leaves red, aromatic; hairs yellowish, curly or straight; upper surface sparsely hairy at base, more densely hairy on major veins, midrib and secondary veins usually raised at base, sunken at middle, tertiary veins sunken, distinct; lower surface glaucous, sparsely to densely hairy, midrib and secondary veins raised, tertiary veins prominent; petiole half-terete to slightly channelled, 10–18 mm long, slender, sparsely hairy to velutinous. **Inflorescence** a many-flowered broad panicle, axillary, 3–5.7 cm long, sparsely hairy to velutinous; hairs yellowish, curly; bracts leaf-like; bracteoles lanceolate, 2.3–5.7 mm long, apex acute, caducous. **Flowers** bisexual, densely hairy, pale green; perianth tube 0.5–2 mm long, velutinous; perianth lobes 2–3 × 1.1–2 mm, apex acute, velutinous inside and out. **Stamens** usually 9, 2–2.6 mm long, sparsely to densely hairy; anthers 4-celled, distal ones sometimes much smaller. **Ovary** ellipsoid, 1.2–2.4 mm long, glabrous; style 1.8–1.9 mm long; stigma capitate. **Fruit** oblong to

globular, 8–10 × 5–6 mm, apex rounded, glabrous, smooth; cupule 4–5.5 mm diameter, cup-shaped, rim entire, glabrous; stalk swollen, up to 1.6–2 mm thick, densely hairy, hairs straight.

Distribution. Endemic to the mountains of Perak, Kelantan, Terengganu and Pahang in Peninsular Malaysia (Fig. 7).

Ecology. Growing in montane forests, sometimes over shale, at 700–1600 m altitude. Flowering in April to June; fruiting from October to April.

Vernacular name. *Baloi* (Sakai Language).

Provisional IUCN conservation assessment. Endangered (EN B2b(ii,iii)). This species is known from a number of collections from Peninsular Malaysia and is reported to be common. An analysis of the Extent of Occurrence (EOO) gives an assessment of Vulnerable and the analysis of the Area of Occupancy (AOO) gives an assessment of Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the last 50 years, it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Perak:** *Scortechini* 322b (BM, K 2 sheets); camp on Ulu Batang Padang, *Scortechini* 322 (A, K, L, MEL, P). **Kelantan:** Gunung Rabong, 16 Mar 1972, *Soepadmo & Mahmud* 1155 (KEP, SING [SING0267925]). **Terengganu:** summit ridge, South of Gunung Mandi, 12 Jul 1968, *Whitmore* FRI 12116 (K, KEP); Gunung Padang, 19 Jun 1937, *Moysey & Kiah* 31886 (KEP, SING 2 sheets [SING0267929, SING0267931]). **Pahang:** Fraser's Hill, Gap, 28 Oct 1930, *Raub* 22550 (K, KEP, SING [SING0267930]); Fraser's Hill, Hill top, 18 Nov 1937, *Symington* 45495 (K, KEP); Cameron Highlands, Batu Bintang, 28 Nov 1925, *Whitley & Henderson* 18038 (KEP, SING [SING0267927]); Cameron Highlands, Sungai Ikan, 23 Oct 1970, *Whitmore* FRI 15597 (K, KEP, SING [SING0267923]); Cameron Highlands, Telom valley, 10 Sep 1970, *Whitmore* FRI 15516 (K, KEP, SING [SING0267924]).

Notes. *Cinnamomum pubescens* was first recognised by Kochummen (1989) as part of his studies on the Tree Flora of Malaya. However, he did not publish the name until 1992 (Kochummen, 1992 [‘1991’]). He considered that *Cinnamomum pubescens* differed from *C. mollissimum* by having twigs and leaves with appressed hairs, whereas the latter has woolly hairs (Kochummen, 1989). After careful examination of the type material of *Cinnamomum pubescens*, I conclude that it has the same type of erect curly hairs as *C. scortechinii*. In addition, it also has, in common with *Cinnamomum scortechinii*, veins that are raised at the base on the upper surface of the leaves. As I could find no differences between *Cinnamomum pubescens* and *C. scortechinii*, I therefore place the former name in the synonymy of *C. scortechinii*.

Two collections were cited in the original description of *Cinnamomum scortechinii*: *Wray* 1520 and *Scortechini* 322. The sheet of *Wray* 1520 at K is selected here as the lectotype as it has Gamble's original dissections and drawings on a card accompanying the specimen and Gamble worked at K at this point in his career.

One gathering was cited in the original description of *Cinnamomum velutinum*: *Ridley 16110* with one collection at K and one at the BM. The BM collection is selected here as the lectotype.

15. *Cinnamomum selangorens* (Ridl.) de Kok, **comb. nov.** – *Cinnamomum scortechinii* Gamble var. *selangorens* Ridl., Fl. Malay Penins. 3: 95 (1924); Kochummen, Tree Fl. Malaya 4: 130 (1989). – TYPE: [Peninsular Malaysia] Selangor, Gunung Ulu Kali, 20 June 1910, *M. Burn-Murdoch 339* (lectotype SING [SING0051711], designated by Kostermans (1970); isolectotypes K [K000778662, K000778661], KEP [97105]). (Fig. 8)

Trees, 9–30 m tall, c. 10 cm dbh. Bark grey brown, smooth with large raised warts in patches; inner bark brownish with a spicy smell, sapwood whitish. **Twigs** slender, 2–3.6 mm thick, slightly angular in cross-section, velutinous when young, soon glabrescent; hairs curly, dark brown; terminal leaf bud ovoid, 3.5–5.1 mm long, apex acute, velutinous. **Leaves** subopposite or alternate, domatia absent; leaf blade elliptic to lanceolate, 6–15 × 3–6 cm, apex acute, base cuneate, margins revolute, blade triplinerved, secondary veins 1 pair which extend to the apex, secondary veins with a few short lateral veins which join near margin to form a looped marginal vein, tertiary veins scalariform, blade thinly leathery; upper surface dark green, with a few hairs at the base when young, glabrous later, midrib and secondary veins raised to sunken at the base, tertiary veins indistinct; lower surface glabrous to sparsely hairy, glaucous-green, midrib and secondary veins raised, hairy at base when young, tertiary veins indistinct; petiole half-terete, 10–18 mm long, slender, velutinous when young, soon glabrescent, wrinkled. **Inflorescence** a few-flowered slender panicle, axillary, 2.5–5 cm long, velutinous; hairs curly, dark brown; bracts leaf-like; bracteoles linear, 1.3–1.9 mm long, apex acute, velutinous, caducous. **Flowers** bisexual, greenish white, densely hairy, hairs dark brown; perianth tube 0.9–1.5 mm long; perianth lobes 2–3 × 1.4–1.7 mm, apex acute, densely hairy inside and out. **Stamens** 6 or 9, 2–3 mm long, densely hairy; anthers 4-celled, all introrse when 6 stamens. **Ovary** c. 1.1 mm diameter, densely hairy; style c. 1.4 mm long; stigma minute. **Fruit** oblong, c. 10 × 5 mm, cupule shallow, rim entire; stalk unknown.

Distribution. Endemic to the Cameron and Genting Highlands (Pahang and Selangor) in Peninsular Malaysia (Fig. 8).

Ecology. Growing in montane forest at 1500–1750 m. Flowering from May to June; fruiting time unknown.

Vernacular name. *Kayu Manis* (Malay).

Provisional IUCN conservation assessment. Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known from three collections from the Cameron and Genting Highlands in Peninsular Malaysia. Analyses of both the Extent of Occurrence (EOO)

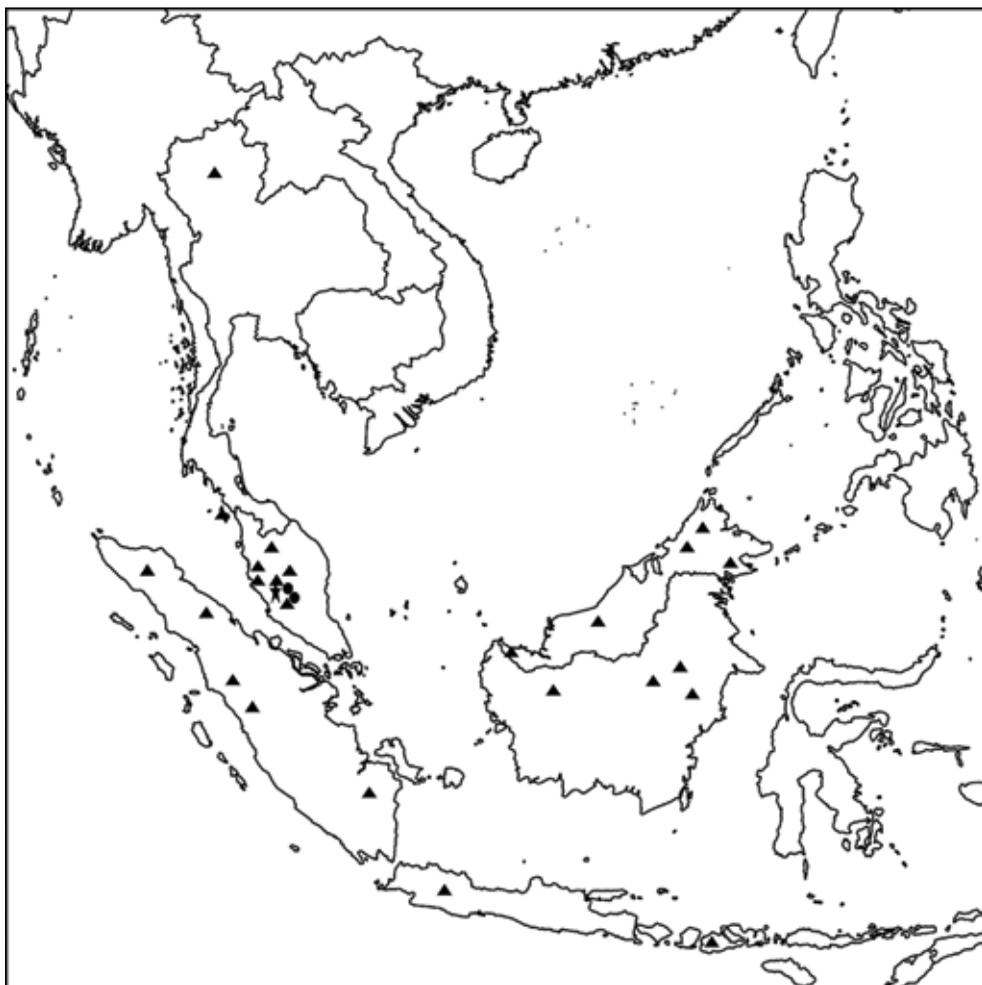


Fig. 8. Distribution of *Cinnamomum selangorensis* (●), *Cinnamomum sintoc* (▲) and *Cinnamomum trintaense* (★).

and the Area of Occupancy (AOO) give an assessment of Critically Endangered. However, as the species is known from at least three populations it must be considered to be endangered.

Additional specimens examined. PENINSULAR MALAYSIA: **Pahang:** Cameron Highlands, 6 May 1986, *Teo & David 993 (KL 3493)* (K); Cameron Highlands, Rhododendron hills, 21 Jun 1923, *Henderson 11207* (SING [SING0267932]).

Notes. This species differs from *Cinnamomum scortechinii* in having an inflorescence with many fewer flowers, arranged in a slender panicle with dark brown hairs. In contrast, *Cinnamomum scortechinii* has a many-flowered and much-branched panicle with yellowish hairs.

In specimens with only 6 stamens, the anthers are introrse and those in the second whorl have glands at the base. Specimens with 9 stamens have the typical *Cinnamomum* configuration.

16. *Cinnamomum sintoc* Blume, Bijdr. 571 (1826); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 455 (1925); Kochummen, Tree Fl. Malaya 4: 131 (1989); Kostermans, Reinwardtia 8: 64 (1970); Soh, Blumea 56: 257 (2011). – TYPE: [Indonesia] Java, *C.L. Blume s.n.* (lectotype L [sheet no. 905229197], designated here; isolectotype BO [sheet no. BO1267347]). (Fig. 8)

Cinnamomum cinereum Gamble, Bull. Misc. Inform. Kew 1910: 220 (1910); Ridley, Fl. Malay Penins. 3: 96 (1924); Kostermans, Reinwardtia 8: 64 (1970). – TYPE: [Peninsular Malaysia] Perak, Waterfall Hill, August 1888, *L. Wray 2629* (lectotype K [K000778628], designated here; isolectotypes BM [BM000950941], E [E00393153], K [K000778629], SING [SING0051700]).

Cinnamomum soegengii Kosterm., Reinwardtia 8: 67 (1970). – TYPE: Malaysia, Sabah, Mesilau Cave, March, *W.L. Chew & E.J.H. Corner R.S.N.B. 4750* (holotype SAN; isotype SING).

Trees, 15–40 m tall, 20–55 cm dbh, buttresses up to 2 m high. Bark grey or dark brown, smooth to shallowly fissured, lenticellate; inner bark red with white striations, with a strong aromatic smell, mucous-like sap present; sapwood pale whitish to white. **Twigs** terete, 1.5–2.5 mm diameter, glabrous, drying blackish; terminal leaf buds 1.6–2.5 mm long, linear to spatulate, velutinous. **Leaves** subopposite, rarely some leaves alternate, domatia absent; leaf blade ovate to lanceolate or oblong, 7–22.5 × 2–8.5 cm, apex acute to acuminate, base cuneate to round, sometimes asymmetrical, margins slightly wavy, often with a thick rim, blade triplinerved, secondary veins 2–4 pairs, basal pair not reaching the apex of the leaf, tertiary veins reticulate, blade leathery, strongly aromatic; upper surface glabrous, dark green, midrib and secondary veins raised or flattened, tertiary veins faint; lower surface glabrous, dull pale green, mid-nerve and secondary veins raised, tertiary veins faint; petiole half-terete, glabrous, 8–18 mm long, slender, wrinkled when dried, darkening on drying. **Inflorescence** a many-flowered broad panicle, axillary and terminal, 6–30 cm long, greenish white, velutinous, becoming sparsely hairy; bracts leaf-like; bracteoles linear to elliptic, 3–5 mm long, velutinous, caducous. **Flowers** bisexual, (greenish) white to pale yellow or pale green, hairs grey tomentose; perianth tube 0.8–2.5 mm long, velutinous; perianth lobes 2–3 × 1.2–2 mm, elliptic, each apex round to sub-acute, velutinous. **Stamens** 9, 1.6–2 mm long, hairy at base; anthers 4-celled, ovoid with a truncate tip, yellow. **Ovary** globose, 1–1.4 mm diameter, glabrous; style 1–2.2 mm long, stigma peltate. **Fruit** ellipsoid or obovoid, 10–18 × 7.5–8 mm, smooth, glabrous, apex rounded with a small umbo, base rounded; cupule 7–8 mm diameter, cup-shaped, with entire rim, glabrous; perianth lobes, erect, caducous; stalk slightly swollen, up to 1.5–2 mm thick.

Distribution. Peninsular Malaysia, Borneo, Sumatra, Java and Sumbawa (Fig. 8).

Ecology. Growing in lowland to montane forests, sometimes along streams or on sandstone, at 20–1300 m altitude. Flowering in August to April; fruiting from November to July.

Vernacular names. *Medang teja* and *Medang lawang* (Malay).

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Perak:** Taiping, Feb 1886, *King's Collector 8515* (BM); Taiping, Haunt Hill, 18 Nov 1969, *Chan 13086* (KEP); Taiping, Larut Forest Reserve, Maxwell Hill, 18 Nov 1969, *Chan FRI 13194* (K, KEP, SING [SING0267938]); Maxwell Hill, Jun 1893, *Ridley s.n.* (SING [SING0267937]); Maxwell Hill, *anonymous 76337* (KEP); Bintang Hijau, 25 Jan 1935, *Yassin 30318* (KEP); Grik, 23 Mar 1926, *Hamid 11581* (KEP); Kuala Kangsar, 16 Jul 1967, *Kochummen FRI 2469* (K, KEP, SING [SING0267934]). **Kedah:** Langkawi, 26 Oct 1920, *Dohuan 20766* (K, KEP, SING [SING0267940]); Bukit Balat, 23 Mar 1929, *Meh FMS 17789* (KEP, SING [SING0267935]). **Selangor:** Bukit Enggang, 27 Aug 1937, *Symington 44917* (KEP); Cameron Highlands, Apr 1997, *Teo & Tetu KL 4699* (KEP). **Pahang:** Lipis, Sungai Telom, 26 May 1971, *Burgess FRI 19340* (KEP).

Notes. In 1826 Blume described the species *Cinnamomum sintoc* Blume based on material he collected in the forest of Java. I could only find one specimen housed at L which matched this description and this collection is designated as the lectotype.

Soh (2011) thought that Kostermans had lectotypified the name *Cinnamomum cinereum* Gamble in Kostermans (1970). However, he mentioned that the specimens of *Wray 2629* housed at K and SING are the type, and the other specimens were paratypes. As only one specimen can be a lectotype specimen, I designate one of the K specimens here.

Several species of *Cinnamomum* (*C. sintoc*, *C. javanicum*, *C. pendulum* and *C. iners* and *C. camphoratum* in Borneo) may be the source of *sintoc* barks that are found in local medicinal shops. These barks are aromatic with a smell of cloves and are very similar to *kulit lawang* but have a bitter and astringent taste. They are used in Indonesia against diarrhoea and other internal complaints and are considered to be a vermifuge. In Peninsular Malaysia, the bark is used in powdered form to treat wounds and numbness of the feet (Burkill, 1966).

17. *Cinnamomum subavenium* Miq., Fl. Ned. Ind. 1: 902 (1858); Cammerloher, Bull. Jard. Bot. Buitenzorg ser. III, 7: 452 (1925); Kostermans, Reinwardtia 8: 68 (1970); Kochummen, Tree Fl. Malaya 4: 131 (1989); Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. 18 (1990); Li et al., Fl. China 7: 186 (2008); Soh, Blumea 56: 258 (2011). – TYPE: [Indonesia] Sumatra, Solok, *Teijsmann H.B.1037* (lectotype U [U0002677], designated by de Kok (2017); isolectotypes BO, U [U0002678]). (Fig. 9)

Cinnamomum ridleyi Gamble, Bull. Misc. Inform. Kew 1910: 218 (1910); Ridl., Fl. Malay Penins. 3: 93 (1924); Kostermans, Reinwardtia 8: 69 (1970); Keng, Concise Fl. Singapore, vol. 1, Gymn. Dicot. 18 (1990).– TYPE: Singapore, Changi Road, 1893, *H.N. Ridley 4823* (lectotype K [K000778657], designated here; isolectotypes BM, K [K000778656], KEP, L [L0035987], SING [SING0055570]).

Trees, 12–30 m tall, 30–60 cm dbh, buttresses up to 2 m high. Bark grey-brown or reddish brown, smooth; inner bark light brown, rapidly becoming red on exposure, with an aromatic smell; sapwood pale yellow. **Twigs** slender, 2–3 mm thick, round to angular in cross-section, glabrous to sparsely hairy; terminal leaf buds ovate to lanceolate in outline, 1.3–3 mm long, glabrous to sparsely hairy. **Leaves** subopposite to alternate, domatia absent, pale pink when young; leaf blade elliptic, oblong to lanceolate, 4–16 × 2–6 cm, apex long-acuminate, base cuneate to rounded, margins straight, blade triplinerved, leathery, secondary veins 1 pair, extending almost to the leaf apex, tertiary veins scalariform, blade thin-leathery, drying reddish brown on both surfaces; hairs appressed, white when young; upper surface glabrous, dark green and shiny, a few hairs at base on veins, midrib and secondary veins flat to sunken or raised, tertiary veins inconspicuous; lower surface yellow-green, sparsely hairy, midrib and secondary veins raised, tertiary veins faintly visible; petiole channelled, 5–15 mm long, slender, glabrous to sparsely hairy, wrinkled. **Inflorescence** a few-flowered slender panicle, axillary, 8–10 cm long, sparsely to densely hairy at apex; bracts leaf-like; bracteoles linear, 2–3 mm long, densely to sparsely hairy, persistent to caducous. **Flowers** bisexual, yellowish to greenish white, velutinous to densely hairy, glabrescent when old; perianth tube 0.5–1 mm long; perianth lobes oblong-lanceolate to ovate-oblong, 1.7–3 × 1–1.8 mm long, apex acute, densely hairy outside and inside. **Stamens** 9, 2–2.7 mm long, velutinous; anthers 4-celled, velutinous abaxially. **Ovary** globose, 1 mm diameter, glabrous; style 1.5–2.5 mm long; stigma small, discoid. **Fruit** ovoid to ellipsoid, 7–13 × 5–9.5 mm, apex round, smooth, glabrous, blue-black when mature; cupule 5–7 mm diameter, cup-shaped, margin entire to minutely lobed, erect to patent; stalk not to slightly swollen, up to 1–2 mm thick.

Distribution. Bangladesh, South China, Thailand, Vietnam, Peninsular Malaysia, Singapore, Borneo and Sumatra (Fig. 9).

Ecology. Growing in lowland to montane forests, sometimes on sandy soil, at 0–1200 m altitude in Peninsular Malaysia and Singapore, up to 2500 m altitude in China. Flowering from April to October; fruiting in August to April.

Provisional IUCN conservation assessment. Least Concern.

Additional specimens examined. PENINSULAR MALAYSIA: **Selangor:** Semangkok Forest Reserve, near Gap, Aug-Sep 1968, *Ando et al. AKK 20* (KEP); Sungai Bertram, 11 Mar 1934, *Jaamat & Saw 36251* (KEP). **Pahang:** Telom valley, Kuala S. Kiah, 22 Aug 1980, *Kiah 23910* (K, KEP, SING [SING0267941]).

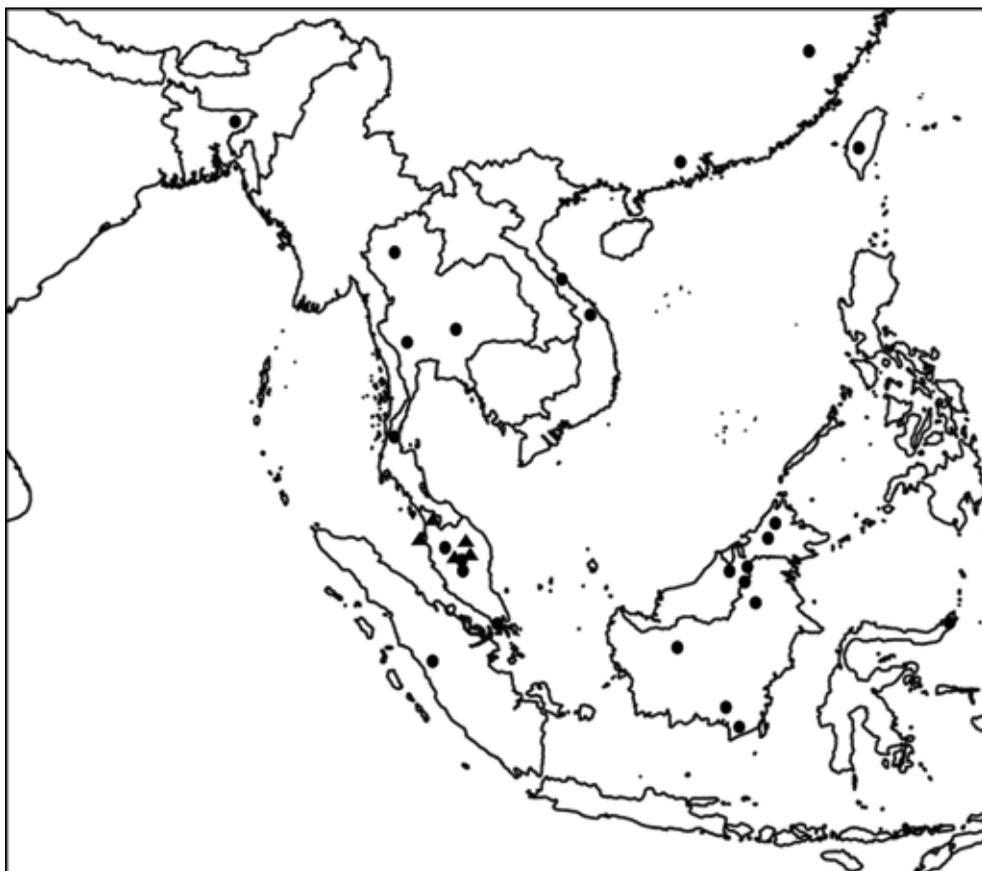


Fig. 9. Distribution of *Cinnamomum subavenium* (●) and *Cinnamomum vimineum* (▲).

Notes. In Gamble's description of *Cinnamomum ridleyi* (Gamble, 1910), he mentioned only one collection: *Ridley 4823*. There are several specimens of this collection in various herbaria (BM, K 2 sheets, KEP & SING). As he was working at Kew at the time, a K specimen would be the best candidate as the lectotype, and so K000778657, which has an envelope containing a card with his notes and dissected flowers attached, is selected here as the lectotype.

The morphology of this species is very similar to that of *Cinnamomum iners* and so *C. subavenium* can only be identified with confidence if mature fruits are available, which is rare. *Cinnamomum iners* has a cupule with clearly developed persistent lobes, while the cupule of *C. subavenium* has a rim that is entire or only slightly lobed (Table 2). When not in fruit the only other character that can be used to distinguish between them is the hair type. In *Cinnamomum iners*, the hairs on the lower leaf surface are appressed and white, while *C. subavenium* has erect, curly, yellowish hairs. This is sometimes difficult to see in specimens which are dirty and/or are almost glabrous on the lower leaf surface.

Table 2. Differences between *Cinnamomum iners* and *C. subavenium*.

	Hairs on lower leaf surface	Cupule margin
<i>C. iners</i>	Appressed, straight, white	Lobes distinct
<i>C. subavenium</i>	Erect, curly, yellowish	Lobes absent or minute

18. *Cinnamomum trintaense* Kosterm., Reinwardtia 10: 453 (1988). – TYPE: [Peninsular Malaysia] Perak, Goping, Trinta, Aug 1883, *King's Collector 4802* (holotype K [K000778659]; isotype K [K000778658]). (Fig. 8)

Trees, 6–9 m tall, 7.6–12 cm dbh. **Twigs** slender, 1.2–3 mm thick, velutinous when young, glabrescent, round or slightly angular in cross-section, hairs yellowish, curly, erect; terminal leaf bud ovoid, 3–3.5 mm long, apex acuminate, velutinous; hairs long appressed, yellowish. **Leaves** subopposite, domatia absent; leaf blade ovate to elliptic, 4.3–9.3 × 1.2–2.7 cm, apex acuminate, base cuneate, margins straight, blade triplinerved, secondary veins 1 pair, extending to the leaf apex, tertiary veins scalariform-reticulate, blade greenish yellow; upper surface glabrous, shiny, midrib and secondary veins raised, tertiary veins distinct; lower surface sparsely hairy at base and on the veins when young, later glabrescent, midrib and secondary veins raised, tertiary veins distinct; hairs erect, yellowish; petiole channelled, 7–12 mm long, slender, velutinous. **Inflorescence** a few-flowered slender panicle, axillary, 2.2–3 cm long, velutinous, peduncle angular in cross-section; bracts leaf-like; bracteoles unknown, caducous; hairs short, erect, yellowish. **Flowers** unknown. **Fruit** ellipsoid, 11–14 × 6.8–7.5 mm, glabrous, smooth, glossy pale green; cupule 9.2–9.9 mm diameter, cup-shaped, woody, sparsely hairy, yellow; lobes 1.4–1.5 mm long, apex broadly acute, velutinous at apex; stalk tapering distally, to 2 mm thick.

Distribution. Endemic to Perak, Peninsular Malaysia (Fig. 8).

Ecology. Growing in rich soil in dense limestone forest, at 150–240 m altitude. Flowering time unknown; fruiting in August.

Provisional IUCN conservation assessment. Data Deficient (DD). This species is only known from one fruiting collection made in 1883. The accompanying notes are sparse, but it seems to be restricted to limestone forest in Perak (Peninsular Malaysia). An analysis of the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) gives an assessment of Critically Endangered. However, given the amount of underexplored limestone forest in Perak, it is best considered as Data Deficient.

19. *Cinnamomum vimineum* Wall. ex Nees in Wallich, Pl. Asiat. Rar. 2: 76 (1831); Gamble, J. Asiat. Soc. Bengal. 75: 80 (1912); Ridley, Fl. Malay Penins. 3: 92 (1924); Kochummen, Tree Fl. Malaya 4: 132 (1989). – *Laurus viminea* Wall., Numer. List 2578 (1830), nom. nud. – TYPE: [Peninsular Malaysia] Penang, from the hill, *Porter [Wallich] 2578* (lectotype GZU [GZU000253984], designated here; isolectotypes BM [BM000799321], K [K000778663], K-W [K001116490], L [L0036038, L0036039]). (Fig. 9)

Cinnamomum impressicostatum Kosterm., Reinwardtia 8: 46 (1970); Kochummen, Tree Fl. Malaya 4: 126 (1989). – TYPE: [Peninsular Malaysia] Pahang, Fraser's Hill upon the Selangor border, 16–30 September 1922, *J.H. Burkill & R.E. Holttum 8447* (holotype SING [SING0268811]; isotype K), **synon. nov.**

Cinnamomum malayanum Kosterm., Reinwardtia 10: 444 (1988). – TYPE: Peninsular Malaysia, Pahang, Bukit Terom, Ulu Keniyam, 5 March 1968, *Moh. Shah MS 1575* (holotype L [L0035874]; isotypes K, KEP [97057], SING [SING0260190]), **synon. nov.**

Trees or shrubs, (1.8–)7–16 m tall, 3–10 cm dbh. Bark lenticellate, smooth, light brown; inner bark pale or whitish or brownish cream, wood whitish to pale cream, with a spicy smell. **Twigs** slender, 1–3.4 mm thick, sparsely to densely hairy when young, soon glabrescent, round to angular in cross-section; hairs white, short, appressed; terminal leaf buds lanceolate in outline, 2–4.8 mm long, apex acuminate, velutinous. **Leaves** subopposite to alternate, domatia absent, young leaves dull red, very aromatic, smelling of camphor; leaf blade (sub)ovate to elliptic or lanceolate, 6–15.5 × 1.5–5.3 cm, apex acute to acuminate, base cuneate, margins straight to recurved, blade triplinerved or venation palmate, secondary veins 1 pair which extend 2/3 of the length of the leaf, tertiary veins scalariform-reticulate, closely spaced, blade papery to leathery, drying yellowish brown; hairs appressed, long, whitish; upper surface shiny, dark green, glabrous except for a few hairs at the base, midrib and secondary veins sunken to raised, tertiary veins distinct; lower surface glaucous, glabrous to sparsely hairy, midrib and secondary veins raised, tertiary veins distinct; petiole channelled to half-terete, 5–14 mm long, slender, glabrous to sparsely hairy. **Inflorescence** a few-flowered slender panicle, terminal and axillary, 3–9 cm long, densely to sparsely hairy when young, glabrescent in fruit; hairs appressed to erect, white; bracts leaf-like; bracteoles linear, 1.4–3 mm long, apex acuminate, velutinous, caducous. **Flowers** bisexual, pale green or cream, fragrant; perianth tube 0.5–3.5 mm long, densely hairy when young, soon glabrescent; perianth lobes 1.8–3 × 1.2–2 mm, apex acute to rounded, densely hairy inside and outside. **Stamens** 9, 1.4–1.5 mm long, densely hairy; anthers 2–4 celled, with anthers of 1st and 2nd whorl sometimes 2-celled, when 4-celled the 2 distal cells much smaller. **Ovary** 0.8–1 mm diameter, glabrous or with a few hairs; style 0.8–1 mm long, with a few hairs; stigma capitulate. **Fruit** ellipsoid, 7.8–10 × 5–7 mm, smooth, glabrous; cupule cup-shaped, woody, margin lobed; lobes 0.8–1.8 mm long, apex rounded, erect to reflexed, densely hairy, soon glabrescent; stalk tapering distally, up to 3.2 mm thick, densely hairy, soon glabrescent.

Distribution. Endemic to Peninsular Malaysia (Fig. 9).

Ecology. Growing in primary and secondary hill and montane forests at 330–1500 m altitude. Flowering in February to September; fruiting from May to October.

Vernacular names. *Madang Teja* (Malay).

Provisional IUCN conservation assessment. Near Threatened. This species is known from Peninsular Malaysia where it is reported as either rare or common, according to the locality. An analysis of the Extent of Occurrence (EOO) gives an assessment of Near Threatened and an analysis of the Area of Occupancy (AOO) gives an assessment of Endangered. Given that the species is known from more than 10 populations it must be considered as Near Threatened.

Additional specimens examined. PENINSULAR MALAYSIA: **Penang:** North Hill, May 1881, *Curtis 1571* (K, SING [SING0268840]); Hampshire Estate, Oct 1898, *Curtis s.n.* (SING [SING0268844]). **Perak:** Gunung Batu Puteh, *Wray 274* (K); Tapah, trail to Gunung Batu Puteh, 25 Feb 1994, *Perumal et al. FRI 41678* (KEP). **Kedah:** lower slopes of Kedah peak, Jun 1893, *Ridley s.n.* (SING [SING0268845]). **Kelantan:** Sungai Lebir, 28 Apr 1976, *Stone & Mahmud K 12522* (KEP). **Pahang:** Jul 1911, *Ridley 16182* (K, SING [SING0268847]); Mt. Benom, 15 Mar 1967, *Whitmore FRI 3170* (K, KEP, SING [SING0267714]); Fraser's Hill, 20 Jun 1920, *Strugnell 22384* (KEP, SING [SING0267713]); Fraser's Hill, Sep 1923, *Nur SFN 11304* (KEP 2 sheets, SING [SING0267716]); Fraser's Hill, 16–30 Sep 1922, *Burkill & Holttum 7758* (K, SING [SING0268846] & picture at KEP); Fraser's Hill, 16–30 Sep 1922, *Burkill & Holttum 8801* (K, KEP, SING [SING0268843] & picture at KEP); Fraser's Hill, 28 Aug 1971, *Loh FRI 19170* (K, KEP, SING [SING0268848]); Raka Hill Forest Reserve, 20 Mar 1973, *Kochummen FRI 16657* (K, KEP, SING [SING0268842]); Bentong, 20 Jul 1929, *Bain 18665* (KEP); Mt. Tahan, Wray's Camp, Jul, *Ridley 16182* (SING [SING0268847]).

Notes. Kostermans (1970) described the new species *Cinnamomum impressicostatum* based on *Burkill & Holttum 8447* at SING. In his description, he also mentioned a series of specimens which he considered to belong here: *Burkill & Holttum 8801*, *SFN 11304*, *Strugnell 22384*, *Whitmore 3170* and *Ridley 16182*. During his visit to K in 1978, he named all these specimens (including the K isotype of *C. impressicostatum*) as *Cinnamomum vimineum*, apart from *Strugnell 22384* for which there is no duplicate at K. I agree with him that there are no significant and constant differences between *Cinnamomum impressicostatum* and *C. vimineum*, and I have therefore placed *C. impressicostatum* into the synonymy of *C. vimineum*.

Cinnamomum malayanum was considered by Soh (2011), in his revision of the Borneo species, as a synonym of *C. cuspidatum*. This was mainly because *Cinnamomum malayanum* and *C. cuspidatum* share several characters, such as a funnel-shaped cupule with persistent, hardened perianth lobes, a slender, short (4–6 cm long) inflorescence with only first order branching, glabrous leaves with a caudate leaf apex and a distinctly grooved petiole. However, after studying the type material, it is clear that *Cinnamomum malayanum* differs in several characters from *C. cuspidatum* and is better placed into the synonymy of *C. vimineum*.

In the original description of *Cinnamomum vimineum* Wall. ex Nees (1831) only one gathering is mentioned. The Lauraceae specimen of Nees von Esenbeck herbarium are housed at GZU and the duplicate there is designated here as the lectotype.

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