

Towards a field guide to the trees of the Nee Soon Swamp Forest (IV): *Xanthophyllum* (Polygalaceae)

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Abstract. This paper is the fourth part of a continuing series on the tree species of the floristically diverse Nee Soon Swamp Forest, Singapore's last substantial tract of intact freshwater swamp forest. We provide a key and descriptions for six species of *Xanthophyllum* from the family Polygalaceae, based on characters easily observed in the field and of dried specimens.

Key words. Polygalaceae, *Xanthophyllum*, Nee Soon Swamp Forest, trees, field identification

INTRODUCTION

The milkwort family or Polygalaceae, named after the genus *Polygala*, is represented by trees, shrubs, woody climbers, autotrophic green-leaved or saprophytic herbs (de Wilde & Duyfjes, 2007; LaFrankie, 2010; van der Meijden, 1988) which occur in four tribes: the Xanthophylleae, consisting of trees and shrubs in Indo-Malesia, and including *Xanthophyllum*, the only tree genus in Nee Soon Swamp Forest; the Polygaleae consisting of herbs; the Carpolobieae consisting of shrubs, small trees, and lianas in Tropical Africa; and the Mutabaeae, consisting of woody plants including lianas in Tropical America, New Guinea to New Caledonia (Stevens, 2001 onwards). There are approximately 18 genera with more than 1,000 species worldwide, about half of which are in the genus *Polygala* (LaFrankie, 2010). The species are distributed across tropical and temperate regions, and many are found particularly in South America and South Africa. In tropical Asia, this family is chiefly represented by trees of the genus *Xanthophyllum*, with about 100 species from India to Australia. In this region, species richness of *Xanthophyllum* is highest in the everwet parts of Borneo. The abundance and diversity decline in dry seasonal areas and with altitude above 500 m in tropical Asia. Other regional generic representatives are mainly made up of the herbs of *Polygala* and a few lianas in *Securidaca*. Similarly in Singapore, the family is mainly represented by trees from the genus *Xanthophyllum*, with 11 native species recorded; another three species from the two genera *Polygala* and *Salomonina* are either exotic or cryptogenic herbs (Chong et al., 2009). We encountered a woody climber, *Securidaca philippinensis* Chodat (specimens K. Y. Chong, L. Neo, S. Y. Tan & C. Y. Koh NSSF2-Q102T27, NSSF2-Q102U124, and NSSF2-Q8U72 deposited in the Herbarium, Lee Kong Chian Natural History Museum, SINU) during our survey in Nee Soon Swamp Forest (NSSF), making a new species record to the family for Singapore. Out of the 11 *Xanthophyllum* species, Wong et al. (2013) reported six that have been recorded for Nee Soon Swamp Forest (NSSF). We provide a key to and brief descriptions for these species here.

The more recent accounts of the Polygalaceae include van der Meijden (1988) for Malesia, Ng (1972) for Peninsular Malaysia, and de Wilde and Duyfjes (2007) for Sabah and Sarawak. Our identifications and descriptions, especially for details for tree height, bark, inflorescence, and fruit which we may not have observed for all species, are therefore based on those of these three accounts.

XANTHOPHYLLUM Roxb

(Greek *xanthos*, yellow; *phullon*, leaf; referring to the leaves that often dry yellow)

Shrubs to large trees. **Bark** usually smooth and faintly hooped, sometimes lenticellate or pocked. **Twigs** terete, sometimes with annular or cap-like nodal glands, with growth always sympodial. Axillary buds solitary or in clusters of 2–8, each with 2 bud scales. **Leaves** alternate, drying yellow, green or brown, often with glands on the lower surface of the leaf blade, sometimes near the leaf blade base; petiole often finely transversely wrinkled when fresh. **Inflorescence** axillary, branched or unbranched. **Flowers** bisexual, bilaterally symmetrical, with five sepals, five petals, with the lower petal usually boat-shaped; stamens (7–)8(–10); ovary superior, style terminal. **Fruit** indehiscent, globular or rarely ellipsoid, usually with a hard pericarp. **Seeds** 1 or 4–20, glabrous.

Key references. Ng (1972), van der Meijden (1988), de Wilde and Duyfjes (2007)

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

1. Leaf blade glaucous beneath. Young twigs whitish. *Xanthophyllum discolor*
 – Leaf blade not glaucous beneath. Young twigs dark green, yellowish green or greenish brown. 2
2. Axillary buds prominent, conical in shape, 3.5–11 mm long. *Xanthophyllum vitellinum*
 – Axillary buds less conspicuous, up to 2 mm long. 3
3. Dried leaf blade dark brown or greyish red brown above, same colour or darker coloured below, rarely green.
 *Xanthophyllum obscurum*
 – Dried leaf blade green on both sides, often lighter coloured below. 4
4. Leaf blade tertiary veins scalariform; glands beneath the leaf blade visible to the naked eye.
 *Xanthophyllum flavescens*
 – Leaf blade tertiary veins reticulate or scalariform-reticulate; glands beneath the leaf blades hardly visible to the naked eye. 5
5. Leaf blade margin shallowly crenate or wavy, with glands present. Nodal glands present on the twigs.
 *Xanthophyllum ellipticum*
 – Leaf blade margin entire, without glands. Nodal glands absent on the twigs. *Xanthophyllum eurhynchum*

1. *Xanthophyllum discolor* Chodat

(Latin *discolor*, of different colours, referring to the colours of the upper and lower leaf blade)

Shrubs or small trees, up to 10 m tall; trunk with diameter to 10 cm. **Bark** whitish green. **Twigs** glabrous, without glands, *pale whitish or yellowish*; *axillary buds solitary, ovate, 1–6 mm long, pale brown, subglabrous*. **Leaves** purple when young, *mature leaf blade green above and glaucous beneath when fresh*, lower surface drying grey-green to pale brown, elliptic or ovate, drying 6–15.5 × 2.5–5.5 cm, papery, glabrous or sometimes with minute hairs on the midrib which is as slender as the secondary veins and sunken above or almost flat, secondary veins 4–8 pairs not forming an intramarginal vein or only faintly in the apical half of the leaf blade, tertiary veins reticulate, apex acuminate, base pointed to rounded; petiole drying 3–12 mm long, transversely wrinkled, glabrous. **Inflorescence** unbranched or rarely with one branch. **Flowers** with petals white or pinkish. **Fruit** dull, light brownish, globular, 1.8–3 cm across. — Fig. 1.

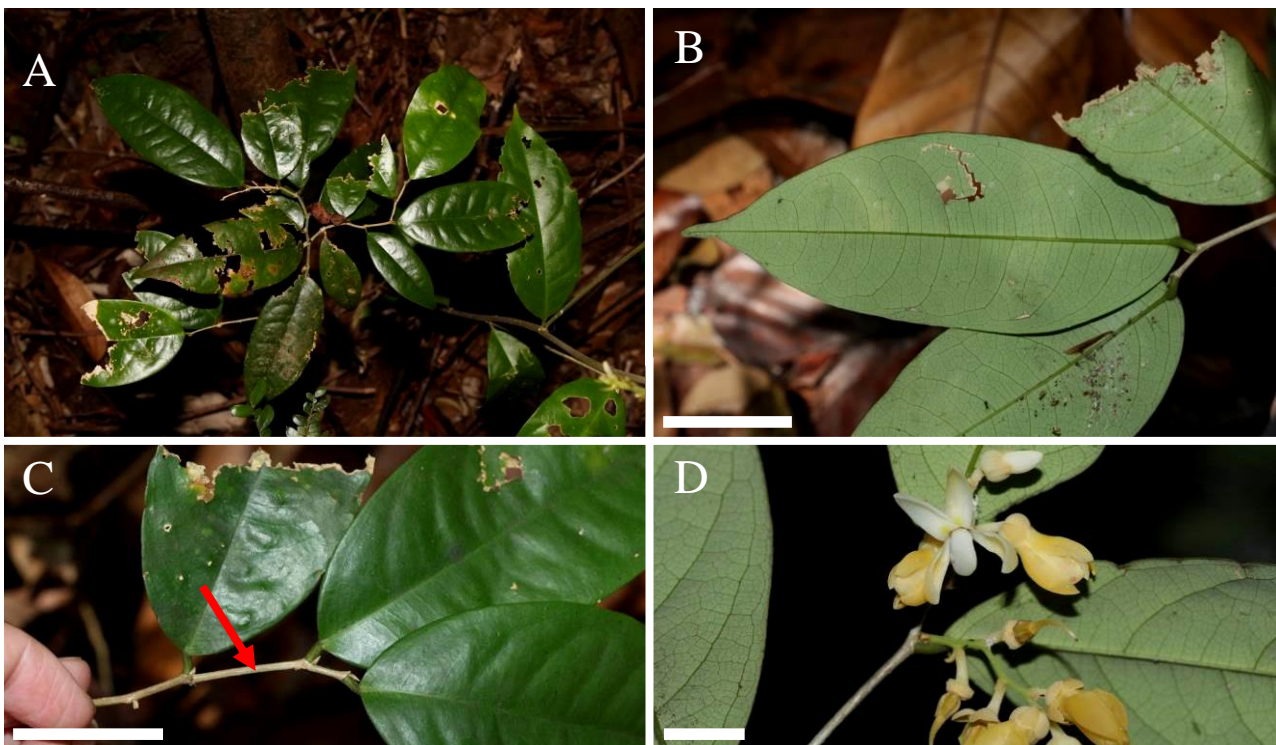


Fig. 1. *Xanthophyllum discolor*. A, Sapling; B, Glaucous lower surface of the leaf blade. Scale bar = 3 cm; C, Whitish twig (arrowed). Scale bar = 2 cm; D, Inflorescences with white-petalled flowers. Scale bar = 1 cm. (Photographs by: Louise Neo).

Singapore localities. Nee Soon Swamp Forest (K. Y. Chong, L. Neo, S. Y. Tan, C. Y. Koh, J. W. T Loh & R. C. J. Lim NSSF2-Q101U35 and NSSF2-Q111U36; K. Y. Chong, L. Neo, S. Y. Tan & C. Y. Koh NSSF2-Q107U107 in SINU). Also known locally from the Bukit Timah Nature Reserve (S. K. Y. Lum s.n. SING barcode number 0123514), Central Catchment Nature Reserve (H. K. Lua, C. M. Boo, W. F. Ang & P. T. Chew SING 2014-147), and Chestnut Avenue (A. T. Gwee SING 2010-553).

Habitats. In Sabah and Sarawak, the species is found in mixed dipterocarp forest, lower montane forest, padang forest, on hill summit or hill ridge up to 1,100 m in altitude (de Wilde and Duyfjes, 2007). In the NSSF, we collected this species from both dry and wet forest.

Conservation. Endangered (Tan et al., 2008)

Suggested common name. white xanthophyllum

2. *Xanthophyllum ellipticum* Korth. ex Miq.

(Latin *ellipticum*, elliptical, referring to the shape of this species' leaf blade)

Shrubs or trees, up to 30 m tall; trunk columnar, **diameter** up to 40 cm, with short buttresses, or rarely with prop roots. **Bark** grey or reddish brown, smooth; sapwood yellow. **Twigs** glabrous or minutely short hairy, with distinct nodal glands; axillary buds solitary, inconspicuous, 1 mm long. **Leaves** with leaf blade light yellowish green in young leaves, green or pale brownish in mature leaves, ovate-elliptic, drying 5–20 × 2–7 cm, papery to somewhat leathery, glabrous, glands scattered on the lower surface of the leaf blade, with *at least six pairs at the leaf blade margin*, midrib sunken above, secondary veins 5–9 pairs, forming an intramarginal loop, tertiary veins reticulate, apex acuminate, base cuneate; petioles drying 4–7 mm long, longitudinally or transversely wrinkled, glabrous or minutely hairy, without glands. **Inflorescence** several together on a secondarily thickened node, shorter than the leaves, unbranched. **Flowers** with petals white to light yellow. **Fruit** sessile, dark reddish, somewhat shiny, globular, 1.5–2.2 cm across. — Fig. 2.

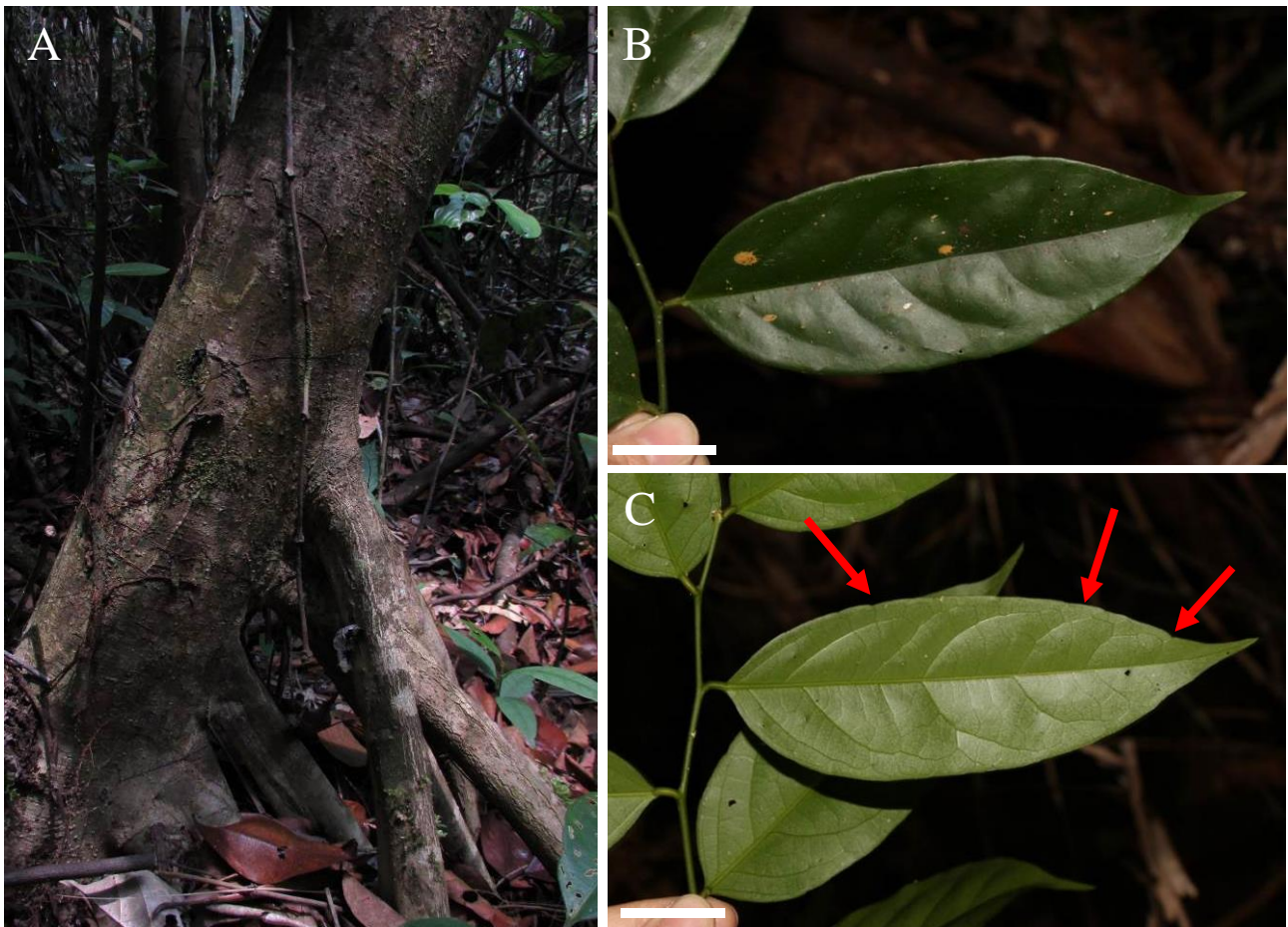


Fig. 2. *Xanthophyllum ellipticum*. A, Trunk with prop roots; B, Upper surface of leaf blade. Scale bar = 2 cm; C, Shallowly crenate leaf margin with glands arrowed. Scale bar = 2 cm. (Photograph A by: Tan Siu Yueh; photographs B and C by: Louise Neo).

Singapore localities. Nee Soon Swamp Forest (K. Y. Chong, L. Neo, S. Y. Tan & C. Y. Koh NSSF2-Q4U154; K. Y. Chong, L. Neo, S. Y. Tan, C. Y. Koh, J.W. Loh & R. C. J. Lim NSSF2-Q319aU67 in SINU). Also previously collected from Ang Mo Kio (H. N. Ridley s.n. SING barcode number 0025061), Bukit Timah Nature Reserve (R. D. Hill H.464), Central Catchment Nature Reserve (J. W. H. Yong, S. E. Hin, Y. W. K. Khng & J. A. Hardie NRS575; A. T. Gwee SING 2011-337), Changi (H. N. Ridley no. 6080), and Tanglin Barracks (H. N. Ridley s.n. SING barcode number 0025058).

Habitats. Lowland forest, mainly in swamp forest or along rivers (de Wilde and Duyfjes, 2007). However, in the NSSF, we collected this species from dry forest areas.

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

Suggested common name. crenate-leaved xanthophyllum

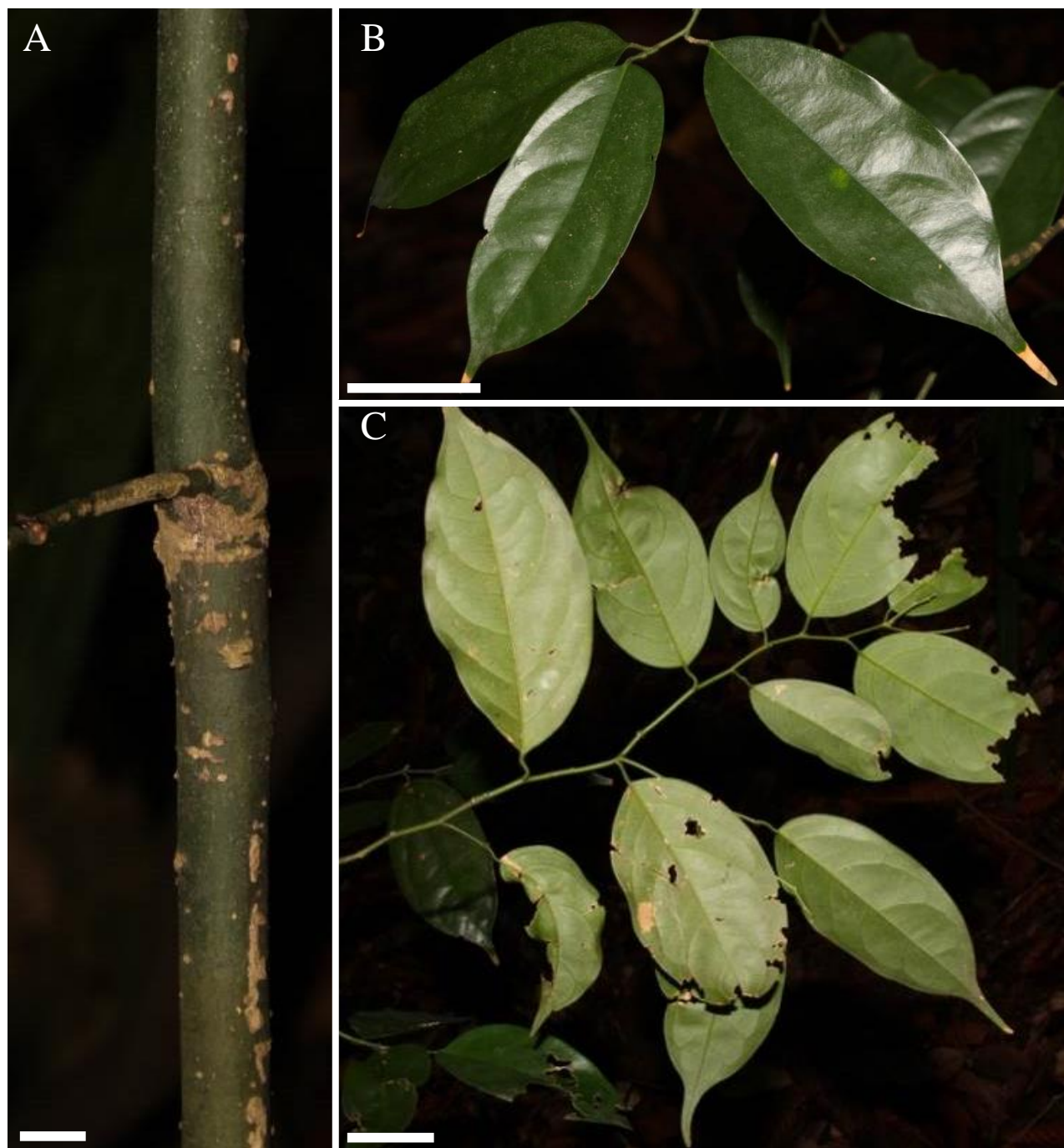


Fig. 3. *Xanthophyllum eurhynchum*. A, Trunk of sapling. Scale bar = 1 cm; B, Upper surface of leaf blades. Scale bar = 2 cm; C, Lower surface of leaf blades. Scale bar = 2 cm. (Photographs by: Louise Neo).

3. *Xanthophyllum eurhynchum* Miq.(Greek *eu*, well; *rhynchos*, a beak, referring to the fruit surface)

Shrubs or trees, 3–20 m tall; trunk with diameter up to 20 cm. **Bark** grey. **Twigs** minutely hairy to glabrous, *green when young*, axillary buds 2–4, usually less than 0.5 mm long, mostly very densely and patently hairy. **Leaves** with leaf blade grayish green above, dull green beneath, linear-lanceolate, drying 2.5–18 x 1–7 cm, papery to leathery, glabrous, *glands indistinct*, midrib slightly sunken or sometimes flat to slightly prominent, secondary veins 3–6 pairs, forming an intramarginal loop, apex acuminate to cuspidate, base cuneate; petioles drying 3–14 mm long, glabrous to shortly densely hairy in the upper grooves. **Inflorescences** solitary or with two together; petals white. **Fruit** globular, 1.5–2 cm across, warty with densely appressed hairs between warts. — Fig. 3.

Singapore localities. Nee Soon Swamp Forest (K. Y. Chong, L. Neo, S. Y. Tan & C. Y. Koh NSSF2-Q109T45, NSSF2-Q509U13, and NSSF2-Q109U98 in SINU). Also known locally from Bukit Timah Nature Reserve (M. S. Khoo KMS93), Central Catchment Nature Reserve (C. M. Boo 150714-001), and Mandai (A. T. Gwee SING 2010-185).

Habitats. In the NSSF, we collected this species from dry forest areas.

Conservation. Vulnerable (Tan et al., 2008)

Suggested common name. warty fruited xanthophyllum

4. *Xanthophyllum flavescens* Roxb.(Latin *flavescere*, becoming yellow, alluding to the dried leaf colour)

Shrubs or trees, 8–30 m tall; trunk columnar with diameter to 50(–100) cm, with short buttresses. **Bark** grey or greenish brown, smooth, rugulose to finely lenticellate, sometimes pock-marked; sapwood pale yellow. **Twigs** minutely hairy to glabrous, glabrescent, without glands; axillary buds solitary or in clusters of two or three, the upper one sometimes stalked or slightly supra-axillary, 0.5–4 mm long, glabrous or hairy. **Leaves** with yellowish green leaf blade and dull yellow veins when fresh, *drying grey-green to bright yellow-green*, elliptic to oblong-elliptic, rarely ovate, drying 6–27 × 2.8–10 cm, papery to leathery, glabrous or sometimes minutely hairy at the basal part of leaf blade below, *glands absent or with up to 10 pitted glands scattered on the leaf blade lower surface, a pair of glands usually present at the leaf blade base*, midrib prominent above, seldom shallowly sunken, secondary veins 4–12 pairs, usually forming an incomplete or distinct intramarginal loop, tertiary veins scalariform, apex acuminate, base pointed, rarely round; petioles drying 6–20 mm long. **Inflorescence** several together on a thickened node, rarely unbranched. **Flowers** with petals bright yellow, or white and the upper petals with yellow spot, or fully white. **Fruit** yellowish to brownish, somewhat dull to shiny, globular, up to 2 cm across. — Fig. 4.

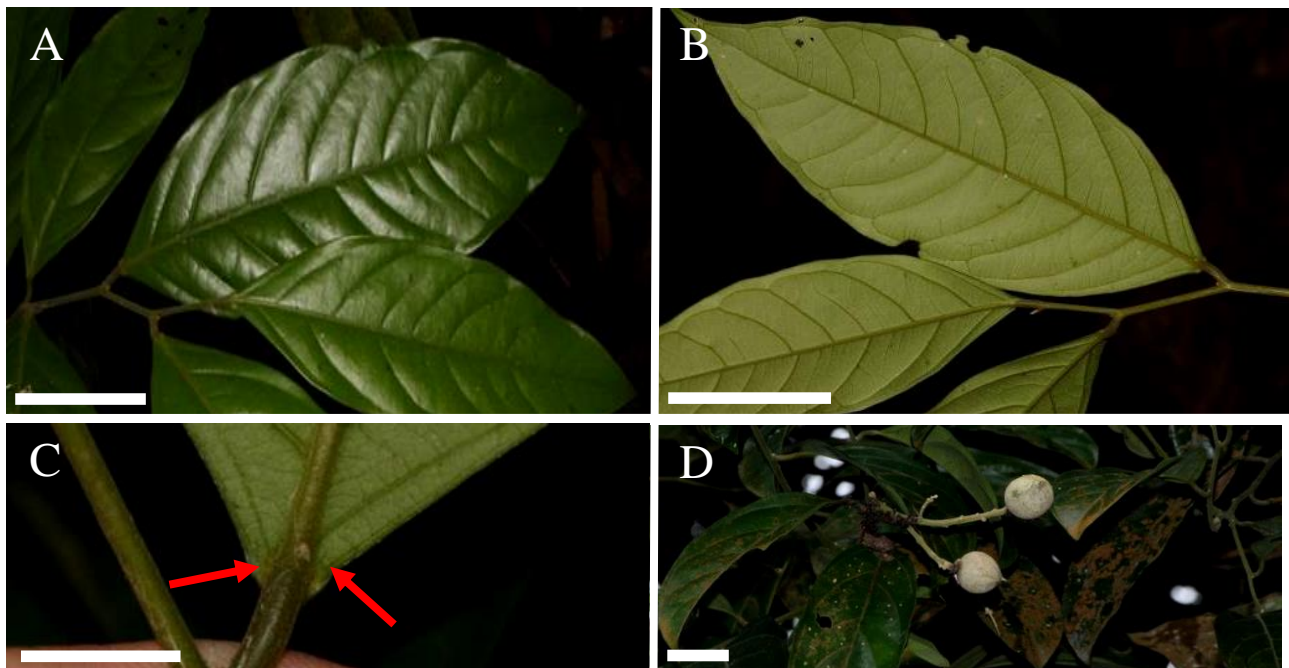


Fig. 4. *Xanthophyllum flavescens*. A, Upper surface of leaf blades. Scale bar = 5 cm; B, Lower surface of leaf blades. Scale bar = 5 cm; C, A pair of glands at leaf blade base (arrowed). Scale bar = 2 cm; D, Fruits. Scale bar = 2 cm. (Photographs by: Louise Neo).

Singapore localities. Nee Soon Swamp Forest (K. Y. Chong, L. Neo, S. Y. Tan & C. Y. Koh NSSF2-Q10T92, NSSF2-Q405U64, and NSSF2-Q208U95; A. F. S. Lok & W. F. Ang SING 2010-772 in SINU). Also previously collected from Bukit Timah Nature Reserve (J. S. Goodenough 340), Central Catchment Nature Reserve (G. C. H. Tan, D. P. Y. Lim & M. Marzuki NRS 995), Chestnut (T. O'Dempsey SING 2010-925), Jurong (J. S. Goodenough 1943b), Bukit Mandai (collector unknown s.n. SING barcode number 0025050), Mandai Road (E. J. H. Corner s.n. SING barcode number 0025071).

Habitats. Mixed dipterocarp to montane forest, up to 2,000 m in altitude (de Wilde and Duyfjes, 2007). In the NSSF, we collected this species from dry forest sites.

Conservation. Endangered (Tan et al., 2008)

Suggested common name. yellow xanthophyllum

5. *Xanthophyllum obscurum* A.W.Benn.

(Latin *obscurus*, dark, alluding to the dark colour of dried flowers and fruits)

Trees 15–47 m tall; trunk with diameter 20–70 cm. **Bark** pale brown-grey, smooth; sapwood white or yellow. **Twigs** glabrous, often thickened at the nodes and with adventitious buds, nodal glands usually distinct, circular or elongated; axillary buds solitary, up to 0.5 mm long. **Leaves** with leaf blade drying dark brown or greyish red-brown, rarely green above, the same or darker coloured below, ovate to elliptic, 4–17 × 1.5–9 cm, glabrous, pitted glands 2–16, scattered on or near veins or leaf blade margin, midrib prominent or flat above, secondary veins 3–9 pairs, occasionally forming an intramarginal loop at leaf blade apex, tertiary veins coarsely reticulate, apex rounded to obtuse or sometimes short-acuminate, base cuneate; petioles drying 5–15 mm long, transversely wrinkled. **Inflorescence** unbranched. **Flowers** with petals white or purple, the upper petals with a yellow or green spot, all petals drying black. **Fruit** dull brown to blackish, globular, 4–14 cm across, reportedly edible. — Fig. 5.

Singapore localities. Turner et al. (1996) lists this species as present within the three plots in the Nee Soon Swamp Forest established by Wong et al. (1994), and is therefore included here. However, we have not encountered this species in our surveys, nor seen any collections deposited in SING or SINU. Also previously collected from Ang Mo Kio (H. N. Ridley s.n. SING barcode number 0025091) and the Bukit Timah Nature Reserve (H. N. Ridley s.n. SING barcode number 0025090).

Habitats. Lowland forest, up to 1,800 m in altitude (de Wilde & Duyfjes, 2007).

Conservation. Endangered (Tan et al., 2008)

Suggested common name. brown xanthophyllum

6. *Xanthophyllum vitellinum* (Blume) D.Dietr.

(Latin *vitellinus*, egg yolk yellow, referring to this species' petal colour)

Shrubs, treelets, or trees, up to 30 m tall; trunk with diameter up to 40 cm. **Bark** whitish or greyish brown, smooth, lenticellate; sapwood yellow. **Twigs** stout, 2–3 mm thick, glabrous, without nodal glands; axillary buds solitary, conical, up to 11 mm long. **Leaves** with leaf blade greyish green, narrowly elliptical to elliptical, drying 6–30 × 2.5–11 cm, membranous to somewhat leathery, glabrous or sometimes sparsely hairy on midrib and veins above, glands up to 10, near the midrib or scattered, midrib protruding or nearly flat in the basal half of the leaf blade above, secondary veins 6–11 pairs, forming an indistinct intramarginal loop in apical half of leaf blade, tertiary veins coarsely reticulate, apex acuminate, base cuneate; petioles drying 4–16 mm long, with fine transverse wrinkles, with or without a pair of glands in apical half. **Inflorescence** branched. **Flowers** with petals white or yellow, drying dark red or black, often with white incrustations. **Fruit** pale or dark brown, dull or shiny, globular, 1.5–1.8 cm across, hairy or glabrescent. — Fig. 6.

Singapore localities. Nee Soon Swamp Forest (A. Samsuri, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee & G. Chua NES 322; A. T. Gwee et al. SING 2005-110). Also known locally from the Bukit Timah Nature Reserve (J. F. Maxwell 83-5), Central Catchment Nature Reserve (H. K. Lua SING 2014-160), and Changi (A. T. Gwee, P. T. Chew, S. Saifuddin et al. SING 2009-286).

Habitats. Mixed dipterocarp forest, riverine forest or lower montane forest, up to 800 m in altitude (de Wilde & Duyfjes, 2007).

Conservation. Vulnerable (Tan et al., 2008)

Suggested common name. big-budded xanthophyllum

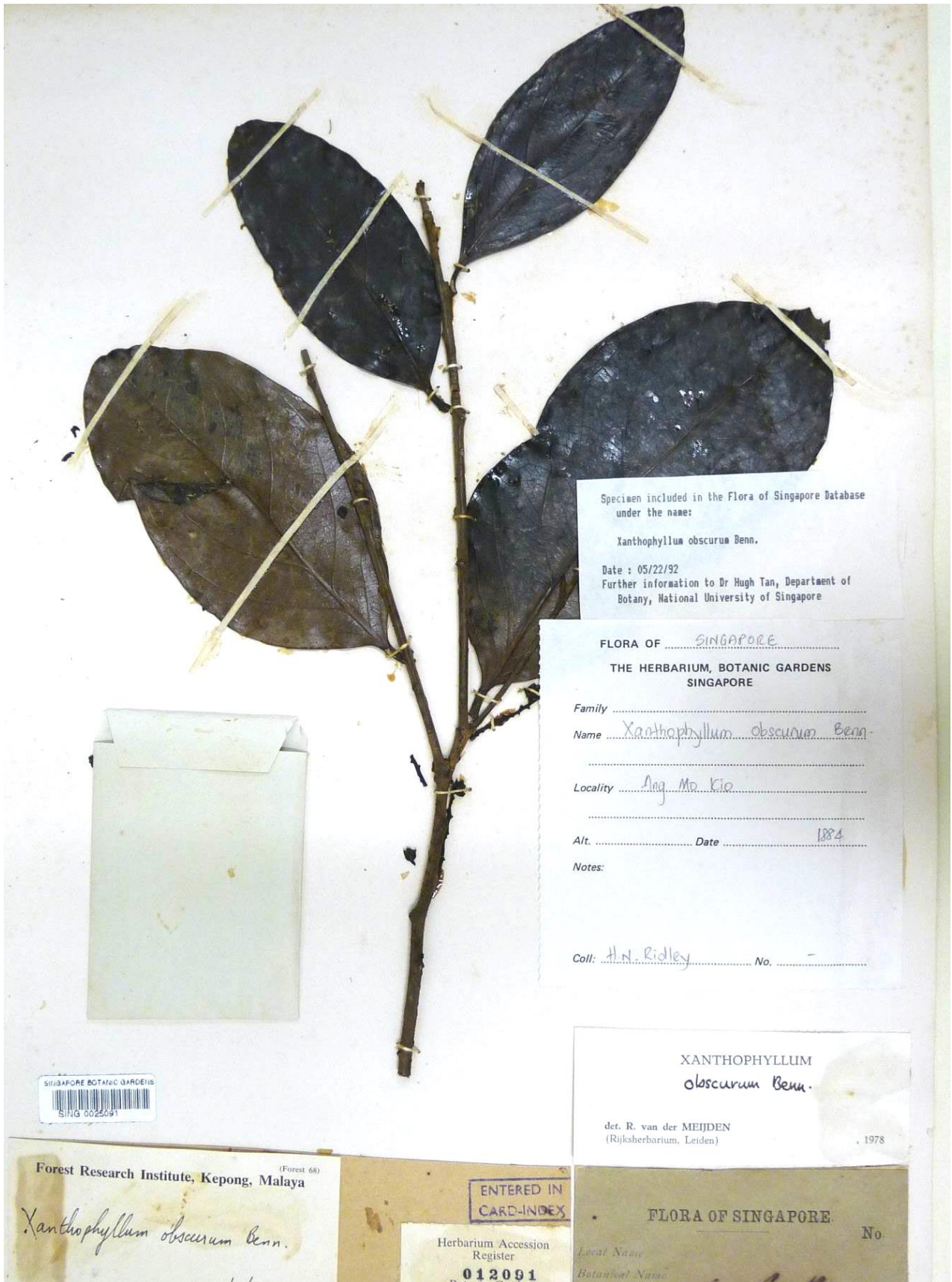


Fig. 5. *Xanthophyllum obscurum*. Herbarium specimen, H. N. Ridley, s.n., Ang Mo Kio, SING barcode 0025091. Scale bar = 10 cm. (Photograph by: Tan Siu Yueh).

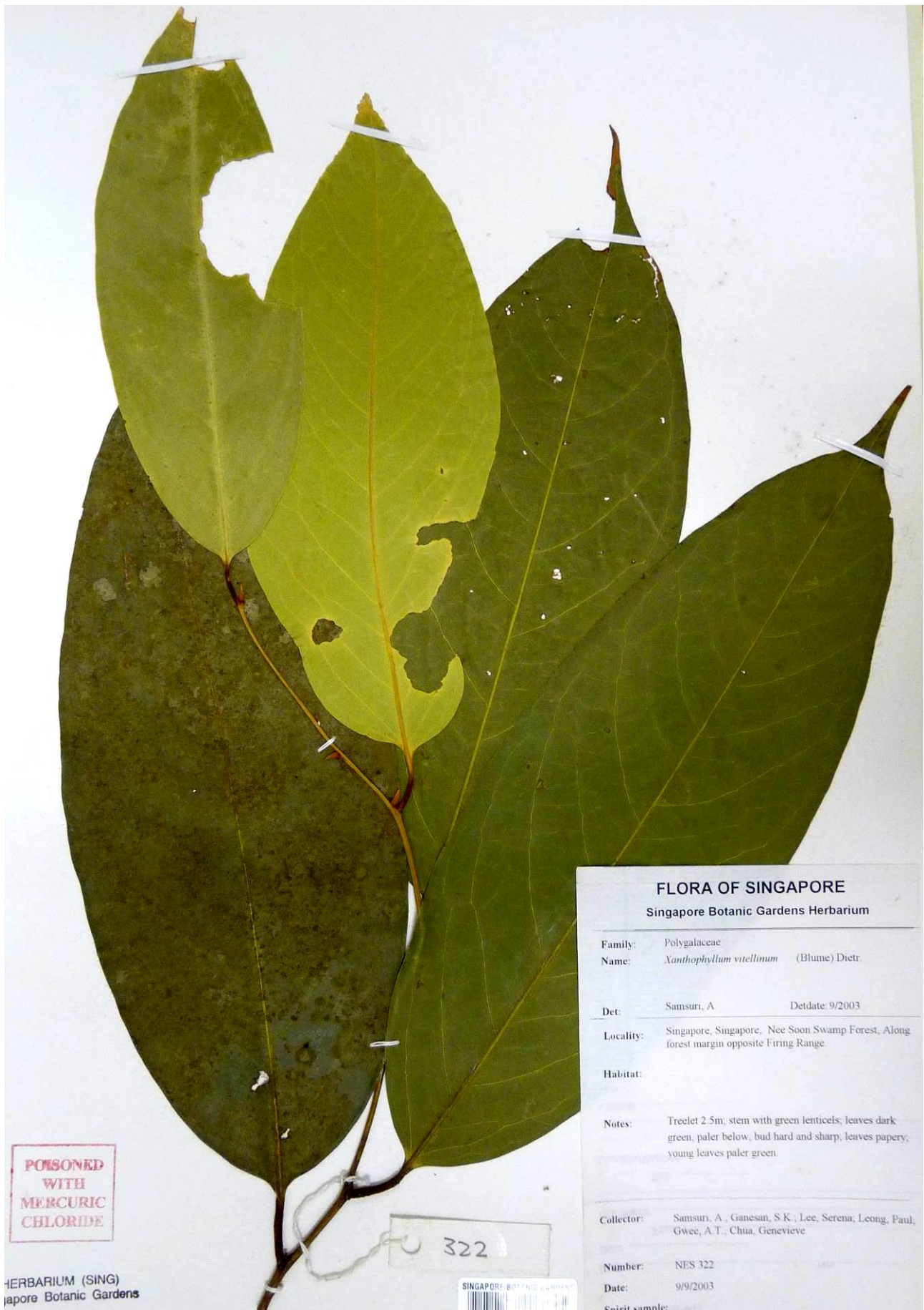


Fig. 6. *Xanthophyllum vitellinum*. Herbarium specimen A. Samsuri, S. K. Ganesan, S. Lee, P. Leong, A. T. Gwee, and G. Chua, NES 322, Nee Soon Swamp Forest, SING barcode 0046581. Scale bar = 10 cm. (Photograph by: Tan Siu Yueh).

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