

New Taxa and Taxonomic Status in *Xanthophyllum* Roxb. (Polygalaceae) from Borneo

W.J.J.O. DE WILDE AND BRIGITTA E.E. DUYFJES

National Herbarium of the Netherlands, Leiden Branch
P.O. Box 9514, 2300 RA Leiden, The Netherlands

Abstract

Thirteen new taxa or taxa with a new status in *Xanthophyllum* (Polygalaceae) from Borneo are described. The ten new species described in this paper are: *X. bicolor* W.J. de Wilde & Duyfjes, *X. brachystachyum* W.J. de Wilde & Duyfjes, *X. crassum* W.J. de Wilde & Duyfjes, *X. inflatum* W.J. de Wilde & Duyfjes, *X. ionanthum* W.J. de Wilde & Duyfjes, *X. longum* W.J. de Wilde & Duyfjes, *X. nitidum* W.J. de Wilde & Duyfjes, *X. pachycarpon* W.J. de Wilde & Duyfjes, *X. rectum* W.J. de Wilde & Duyfjes and *X. rheophilum* W.J. de Wilde & Duyfjes, and the new variety is *X. griffithii* A.W. Benn var. *papillosum* W.J. de Wilde & Duyfjes. New taxonomic status has been accorded to *X. adenotus* Miq. var. *arsatii* (C.E.C. Fisch.) W.J. de Wilde & Duyfjes and *X. lineare* (Meijden) W.J. de Wilde & Duyfjes.

Introduction

During the study of *Xanthophyllum* carried out in the BO, KEP, L, SAN, SAR and SING herbaria for the account of Polygalaceae in the Tree Flora of Sabah and Sarawak, several new taxa were defined. Their taxonomic position within the more than 50 species of *Xanthophyllum* recognised in Sabah and Sarawak will be clarified in the treatment of the family in the forthcoming volume of the Tree Flora of Sabah and Sarawak series. In addition, three new species from Brunei and Kalimantan are also described below.

1. *Xanthophyllum adenotus* Miq. var. *arsatii* (C.E.C. Fisch.) W.J. de Wilde & Duyfjes, *stat. nov.*

Basionym: *Xanthophyllum arsatii* C.E.C. Fisch., Bull. Misc. Inform., Kew (1932) 176. **Type:** *Arsat BNBFD 1213*, Borneo, Sabah, Lokan [Lukan] (*holo* K).

Distribution: Endemic to Borneo (Sabah, Sarawak, Brunei, Kalimantan).

Ecology: In mixed dipterocarp forest, along streams, on flat land or on ridges, on sandy soil, sandstone, shale or silty clay, at altitudes to 400 m.

Notes: We recognise two varieties of *Xanthophyllum adenotus*: var. *adenotus* and var. *arsatii*. The latter differs from the typical variety in its leaves that have a cuneate or rounded base (not rounded-cordate) with flat (not upturned) margins on both sides of the petiole.

Selection of specimens examined: SABAH - Kinabatangan District, Tangkulap Forest Reserve (e.g. SAN 124676); Labuk Sugut District, Bidu Bidu Forest Reserve (e.g., SAN 130719); Pensiangan District, Sogo Sogo (e.g., SAN 91117); Ranau District, Kilimu Forest (e.g., SAN 65111); Sandakan District, Kebon China Forest Reserve (e.g., SAN 37456), Sipitang District (e.g., SAN 133578). SARAWAK - Kapit District, Sungai Mengiong (e.g., S 29155 and S 41217); Kuching District (e.g., S 20887 and S 32692); Lubok Antu District (e.g., S 33564); Lundu District, Sungai Sebuloh (e.g., S 49914 and S 59969), Gunung Pueh (e.g., S 34490); Miri District, Lambir Hill National Park (e.g., S 46424). BRUNEI - Belait District, Sungai Liang Arboretum (e.g., Niga Nangkat NN 94), Brunei Town (e.g., Hotta 13182 and Sands 5673); Tutong District (e.g., BRUN 15060 and BRUN 15370). KALIMANTAN - WEST KALIMANTAN, Bukit Baka National Park (e.g., Church 159), Gunung Bentuang (e.g., Yahud ITTO/BA 792), Gunung Senuyah (e.g., Suzuki 9675); CENTRAL KALIMANTAN, Sambas (e.g., Jarvie 5668), Sungai Katingan (e.g., Wiradinata 3566), Tumbong Riang (e.g., Mogeia 3626); EAST KALIMANTAN, Bilatalang (e.g., Kostermans 12707), Djenean (e.g., Endert 4958), Nunukan Island (e.g., Meijer 2424).

2. *Xanthophyllum bicolor* W.J. de Wilde & Duyfjes, *sp. nov.*

luxta Xanthophyllum penibukanensem Heine, *foliis longioribus 14–24 cm longis, basi in petiolo longo attenuata 20–30 mm longo, fructu 2 cm diam, distinctum. Typus:* Niga Nangkat NN 182, Borneo, Brunei, Belait District, Sungai Mau (*holo* KEP; *iso* BRUN, L, SAN, SAR, SING).

Tree to 30 m tall and 32 cm diam. **Twigs** grey. **Bark** dark brown, smooth, inner bark pale yellow. **Axillary buds** 1–3, conical, 2–4 mm long, glabrous, with corky thickenings at base. **Leaves** glabrous, green and shiny above, *contrastingly pale cinnamon and papillose beneath*; blade oblong, 14–35 x 4.5–10 cm, *base long-attenuate and forming part of the petiole*, apex rounded to bluntly acute; midrib somewhat raised above; lateral veins 8–12 pairs, indistinct, basal veins hardly reaching the middle of the leaf, intramarginal vein faint; *intercostal venation coarsely reticulate*, faint; glands inconspicuous; *petiole 20–30 mm long, consisting of the basal half grey-brown, transversely or longitudinally furrowed or wrinkled, and the distal part smooth yellowish-coloured like the midrib*. **Inflorescences** nearly half as long as the leaves, 6–11 cm long, *unbranched*; axis minutely sparsely appressed hairy, 15–25–

flowered. **Flowers:** 1–3 per bract, bracts minute; *pedicel* 5–10 mm long, appressed fine-hairy or subglabrous; sepals *c.* 4 mm long, subglabrous; petals glabrous, yellowish orange when fresh, brown-orange on drying; ovary ovoid, *c.* 4 mm diam., sparsely minutely appressed hairy, *c.* 2 mm stipitate, style caducous, *ovules* 8 (?). **Fruits** globose, 1.5–2 cm diam., 2 mm stipitate, blue when ripe, drying light brown, glabrous; pericarp thin; *fruiting pedicel c.* 10 mm long.

Distribution: Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology: Mixed dipterocarp, riverbank and hill forest, on peaty or (yellow) sandy clay soil, at low altitudes.

Notes: *Xanthophyllum bicolor* belongs to a group of species with 8–16 ovules per ovary and a pale, whitish, papillose leaf lower surface, to which also belong *X. discolor*, *X. penibukanense* and *X. pulchrum*. It differs from *X. discolor* and *X. penibukanense*, by its long petiole, which is two-coloured as it actually consists of a brown basal part that appears to be the 'true' petiole and a more greenish part which can be regarded as derived from the base of the leaf blade narrowed to the same width as the 'true' petiole. This phenomenon is less conspicuously seen in *X. penibukanense*, and even more so in the unrelated *X. longum*, described below. The lower leaf surface is of a distinctive pale cinnamon, much contrasting with the dark green upper surface. Although known only from few specimens, *X. bicolor* seems to be confined to forest on poor wet soils or peaty riverbank swamp forest, whereas *X. penibukanense* is found mainly in forest on well-drained soils.

Specimens examined: SABAH - Beaufort District (SAN 43595, SAN 77790 and SAN 86129); Tenom District (SAN 64344); SARAWAK - Lubok Antu District, Ulu Sungai Engkari (S 34123). BRUNEI - Mostly from Belait District (BRUN 17868, BRUN 17936, Joffre et al. JAA 10, Haslani Abdullah HA 80, Niga Nankat NN 182 [type] and Niga Nankat NN 369).

3. *Xanthophyllum brachystachyum* W.J. de Wilde & Duyfjes, *sp. nov.*

Iuxta Xanthophyllum pedicellatum Meijden, *racemis brevioribus paucifloris c. 5 mm longis, pedicellis 2–4 mm longis differt.* **Typus:** Normaya & Sirukit S 91521, Borneo, Sarawak, Marudi District, Sungai Silat Basin, Bukit Palutan (*holo* SAR; *iso* KEP, L, SAN, SING).

Tree to 12 m tall and 9 cm diam. **Bark** smooth, grey-green or whitish, slash bark yellow, tough. **Sapwood** yellow, hard. **Twigs** 0.5–1 mm diam., brown

patently hairy, hairs *c.* 0.5 mm long, later glabrescent. **Axillary buds** less than 1 mm long, hairy. **Leaves** green, hairy mainly on midrib, *papillose* beneath; blade narrowly oblong, 3–7–9.5) x 0.5–1–2) cm, base narrowly rounded or cuneate, apex long-acute; lateral veins 4–7 pairs, forming a faint intramarginal vein; *intercostal venation reticulate*; glands numerous, minute, *c.* 0.1 mm diam., scattered; *petiole c.* 2 mm long, hairy. **Inflorescences** much shorter than the leaves, *c.* 0.5 cm long, *unbranched*, with 2–4 flowers; axis glabrescent. **Flowers:** *pedicel* 2–4 mm long, subglabrous; sepals sparsely appressed hairy or subglabrous, outer sepals 1.5–2 mm long, inner sepals *c.* 2.5 mm long; petals pale purplish, drying orange brown, (sub)glabrous, *c.* 12 mm long; filaments subglabrous, anthers *c.* 0.5 mm long, with some hairs at base; ovary *c.* 1 mm stipitate, densely light brown half-patently hairy, hairs 0.5–1 mm long, style glabrous in apical part, *ovules* presumably 8 or more. **Fruits** globose, 1–1.5 cm diam., pale brown, hairy; *fruiting pedicel c.* 5 mm long.

Distribution: Endemic to Borneo (Sabah and Sarawak).

Ecology: Hill mixed dipterocarp forest, at altitudes between 500 and 900 m.

Notes: This species resembles *Xanthophyllum purpureum* Ridl, because its midrib is densely hairy beneath. *X. brachystachyum* is easily distinguished by its strikingly delicate branches (1 mm thick or less) and small leaves, by which it is reminiscent of *X. pedicellatum*. The latter, however, differs by its longer inflorescences with more flowers with longer pedicels, 10–15 mm long (pedicels 2–4 mm long in *X. brachystachyum*). Both *X. pedicellatum* and *X. brachystachyum* can possibly be regarded as derived from delicate ecotypic forms, possibly confined to ridge forest on poor soils, of the very variable *X. purpureum*.

Specimens examined: SABAH–Beaufort District, Mt. Sunggau (SAN 77425). SARAWAK–Marudi District, Bukit Palutan (S 91521 [the type] and S 91825); Miri District (S 3735).

4. *Xanthophyllum crassum* W.J. de Wilde & Duyfjes, *sp. nov.*

luxta Xanthophyllum vitellinum (Blume) D. Dietr., *foliis crassis coriaceis nervatura inconspicua, inflorescentiis validissimis eramosis differt. Typus:* Sugau SAN 134307, Borneo, Sabah, Kinabatangan District, Bukit Tawai (*holo* SAN).

Figure 1

Shrub or treelet *c.* 2 m tall and *c.* 3 cm diam. **Bark** blackish brown. **Twigs** black, glabrous, 4–5 mm thick. **Axillary buds** long-conical, (2–)4–5 mm



Figure 1. *Xanthophyllum crassum* W.J. de Wilde & Duyfjes
A. Flowering leafy twig; B. Part of inflorescence, (from SAN 134307)

long, glabrous. **Leaves** thickly coriaceous, glabrous, on drying dark brown above; concolorous and *not papillose* beneath; blade (shortly) (ovate-) elliptic, 6–10(–12) x 6(–7) cm, base broadly rounded, apex rounded with short, broad, blunt tip; midrib slightly raised above; lateral veins 4–7 pairs, *not* forming an intramarginal vein; *intercostal venation reticulate*, flat and indistinct beneath; glands few, scattered, less than 0.5 mm *diam.*; *petiole* 8–10 mm long, stout, black on drying, without glands. **Inflorescences** *stout, erect*, (almost) *unbranched*, finely yellow-brown appressed hairy; axis 5–7 cm long, 3–4 mm thick, 10–15-flowered. **Flowers** solitary or 2–3 together; *pedicel* short, stout, 4–5 mm long; sepals 5–6 mm long, densely appressed yellow-brown hairy; petals 14–15 mm long, purple-black on drying, partly grey-yellow appressed hairy; stamens and pistil not seen; ovary subglobose, *c.* 2.5 mm *diam.*, densely yellow-brown subpatently hairy, hairs *c.* 0.5 mm long, *ovules* 4. **Fruits** not seen.

Distribution: Endemic to Sabah, where it is known only from the type locality in the Bukit Tawai Forest Reserve, Kinabatangan District.

Ecology: Stunted montane forest over ultrabasic substrate, at *c.* 1250 m altitude.

Notes: *Xanthophyllum crassum* is obviously close to *X. vitellinum*, which has membranous leaves and branched inflorescences. It differs, however, from *X. vitellinum* in its stout habit, (ovate-)elliptic, very coriaceous leaves with faint venation, and stout, erect, almost unbranched inflorescences. It is also similar to *X. rectum* from lowland *kerangas* in west Sarawak, which differs in its prominent and distinct coarsely reticulate leaf venation.

5. *Xanthophyllum griffithii* A.W. Benn. var. ***papillosum*** W.J. de Wilde & Duyfjes, *var. nov.*

Iuxta Xanthophyllum griffithii A.W. Benn. var. *angustifolium* Ng, *ramulis 2 mm diam., gemmis axillaribus 5-10 mm longis pubescentibus, foliis infra distincte papillosis differt. Typus:* Abang Mohtar S 54289, Borneo, Sarawak, Lundu District (*holo* SAR; *iso* K, KEP, L, MO, SAN).

Synonym: *Xanthophyllum griffithii* A.W. Benn. subsp. *angustifolium* (Ng) Meijden, Leiden Bot. Ser. 7 (1982) 94, *p.p.*, *excluding the collections cited for Peninsular Malaysia.*

Twigs hairy, towards apex 1–2 mm thick. **Axillary buds** long-triangular or oblong (-linear), 5–9(–10) mm long, hairy. **Leaves** (ovate or) elliptic-oblong, 5–10(–13) x 2–5 cm, apex acute-acuminate, dull, pale (grey-glaucous) and

distinctly papillose beneath; petiole 6–12 mm long, hairy. Branches of inflorescences 1–2 mm thick, *densely brown hairy*. **Fruits** *densely* patently *hairy*, sometimes glabrescent; *fruiting pedicel* *c.* 3 mm long, *densely fine-hairy*.

Distribution: Endemic to Borneo (Sarawak and Kalimantan).

Ecology: In mixed lowland dipterocarp and heath forest, also close to the sea.

Notes: Two varieties of *Xanthophyllum griffithii*, var. *angustifolium* and var. *papillosum*, can be found in the same area, e.g. at Gunung Santubong, Sarawak, where the former seems to grow at somewhat higher altitudes. The type of *X. griffithii* var. *angustifolium* from Peninsular Malaysia (Ng, 1970, 1972) has axillary buds that are somewhat longer (5–7 mm long), the branches slightly thicker, and the flowers more hairy, as compared to the Bornean material. *Xanthophyllum griffithii* var. *papillosum* comes close to *X. pseudostipidaceum* Merr, from Luzon, the Philippines, but the latter differs in its larger and glabrous axillary buds, and glabrous twigs.

Specimens examined: SARAWAK - Bintulu District (*S* 54289); Kuching district, Gunung Santubong (*S* 47097, *S* 60111, *S* 91154 and *S* 91159), Bako National Park (*S* 6730, *S* 7006 and *S* 54289 [the type], Gunung Matang (*S* 81803); Lundu District, Samunsam Wildlife Sanctuary (*S* 40567). EAST KALIMANTAN, Berau (*Ambriansyah et al.* 942, *Arifin et al.* 1108 and *Kessler et al.* 651).

6. *Xanthophyllum inflatum* W.J. de Wilde & Duyfjes, sp. nov.

Xanthophyllo flavescenti Roxb, *similis*, *fructu maiore* *c.* 4 cm diam., *infructescentia racemosa eramosa differt*. **Typus:** *Ambriansyah* AA 2772, Borneo, Central Kalimantan, Barito River, Batampang Village area, 2° 01' 25" N 114° 38' 2" E (*holo* L; *iso* WAN).

Small tree to 5 m tall and 7 cm diam. **Bark** greyish. **Axillary buds** minute, less than 1 mm long. **Leaves** coriaceous, yellow on drying, glabrous, *not papillose* beneath; blade oblong, 12–20 x 3–5.5 cm, base cuneate, apex acute-acuminate; midrib prominent beneath; *intercostal venation* (in parts of the leaf) *scalariform*; *petiole* 10–15 mm long. **Inflorescences** (infructescences) terminal, *long-racemose, unbranched*, 15–20 cm long, 20–25-flowered (flower-scars). **Flowers** not known. **Fruit** developed near the apex of the infructescence, single, globose, large, 3.5–4 cm diam. (*c.* 7 cm diam. and orange when fresh), glabrous; *pericarp* *c.* 5 mm thick, somewhat

wrinkled, (yellow-)brown on drying; sepals not persistent; *fruiting pedicel* stout, 4–5 mm long. **Seed** single, globose, *c.* 2 cm diam.

Distribution: Endemic to Borneo; confined to Kalimantan where it is known only from the type.

Ecology: Peat swamp forest, at *c.* 25 m altitude.

Notes: This species from peat swamp forest is, in its vegetative characters, closely related to the large, variable species *Xanthophyllum flavescens*, which differs in having branched inflorescences and smaller fruits (1–2 cm diam.) with a thinner pericarp.

7. *Xanthophyllum ionanthum* W.J. de Wilde & Duyfjes, *sp. nov.*

Xanthophyllo pedicellato Meijden *et* *X. neglecto* Meijden *similis*, *foliis infra pubescentibus nec papillois, basi anguste cuneata, inflorescentia brevi c. 0.5 cm longa pauciflora, pedicellis 6–8 mm longis, ovulis 4 differt. Typus: Susanto & Peters 1177, Borneo, West Kalimantan (holo L; iso BO, NY).*

Treelet, stem 3–6 cm diam. **Axillary buds** long-triangular, *c.* 3 mm long, hairy. **Leaves** green on drying, (sparsely) patently hairy and *not papillose* beneath; blade oblong, 8–13 x 2–4 cm, base long-cuneate, apex acute-acuminate; intercostal venation *reticulate*; *petiole* 5–7 mm long, short-hairy. **Inflorescences** 1 or 2 on the node or on the older wood, *unbranched*, short, 0.5(–1) cm long, pubescent, 3–5-flowered; bracts minute; pedicel 6–8 mm long, hairy; flowers yellow, sepals hairy; ovary ovoid, stipitate, *hairy*, *ovules* 4. **Fruits** (immature) subglobose, *c.* 6 x 5 mm, densely hairy; *fruiting pedicel* 8–10 mm long.

Distribution: Endemic to Borneo; confined to West Kalimantan.

Ecology: Mixed dipterocarp forest, on rocky soil, at 100–300 m altitude.

Notes: The long-pedicelled flowers of the (sometimes paired) short inflorescences give the impression that the flowers are more or less fascicled. *Xanthophyllum ionanthum* resembles *X. beccariana* or *X. pedicellatum* in its similar hairy leaves, but the last two species have a much broader leaf base, purplish flowers and 8–12 ovules per ovary. It is also superficially reminiscent of *X. neglectum*, a largely glabrous species with 4 ovules per ovary.

Specimens examined: WEST KALIMANTAN (*Susanto & Peters 1177* [the

type], *Suzuki K9720* and *Suzuki K10071*).

8. Xanthophyllum lineare (Meijden) W.J. de Wilde & Duyfjes, *stat. nov.*

Basionym: *Xanthophyllum adenotus* Miq. var. *lineare* Meijden, *Leiden Bot. Ser. 7* (1982) 101; *Fl. Males. 1, 10* (1988) 516. **Type:** *Sinanggul SAN 57294*, Borneo, Sabah, Lahad Datu District, Bukit Silam (*holo* K; *iso* SAN).

Notes: Additional collections made since its original description as a variety of *Xanthophyllum adenotus* indicate that this taxon can best be regarded as a distinct species. It is possibly derived from the widespread *X. adenotus*, but it is different especially in its coriaceous linear leaves. It seems restricted to an environment with divergent ecology, namely, in stunted forest on ultrabasic bedrock on Bukit Silam. Some other local endemic species, like *X. crassum*, *X. petiolatum* Meijden and *X. rectum*, may similarly be regarded as derived from the widespread *X. vitellinum*, induced by special edaphically defined environments.

Specimens examined: SABAH — Lahad Datau District, Bukit Silam (*Beaman et al. 10030*, *Rimi Repin et al. SP 6225*, *SAN 29652*, *SAN 57294* [the type], *SAN 95535*, *SAN 109836*, *SAN 144533* and *Wood SAN A 4182*).

9. Xanthophyllum longum W.J. de Wilde & Duyfjes, *sp. nov.*

luxta Xanthophyllum vitellinum (Blume) D. Dietr., *foliis tenuibus concoloribus petiolis gracilibus 35–40 mm longis differt.* **Typus:** *Signin, Lideh & Patrick SAN 107165*, Borneo, Sabah, Kinabatangan District, Ulu Sungai Pinangah (*holo* SAN; *iso* KEP, L, SAR).

Figure 2

Tree to 5 m tall and 10 cm diam. **Bark** pale greenish or blackish. **Sapwood** white. **Axillary buds** 1 (or 2), less than 1 mm long, minutely hairy. **Leaves** green on both surfaces, glabrous, except for minutely patently hairy midrib and petiole, *not papillose beneath*; blade (narrowly) oblong, 15–20 x 6–7 cm, base rounded to short-attenuate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, *forming an intramarginal vein*; *intercostal venation reticulate*; glands inconspicuous; petiole (20–)30–40 mm long, 1–2 mm thick, the basal portion of *c.* 15 mm brown, the rest slightly narrower and drying as green-yellow as the midrib, glands absent. **Inflorescences** about half as long as the leaves, subapical, *branched*, axes minutely patently hairy. **Flowers** (after anthesis) single; *pedicel* 1–2 mm long; perianth, stamens and pistil unknown; *ovary* globose, densely grey(-brown) patently hairy (hairs *c.* 0.5 mm long), style caducous, *ovules* 4. **Fruits** hairy, brownish, globose, 1.5–1.7 cm diam.; pericarp thin; *fruiting pedicel c.* 4 mm long.

Distribution: Endemic to Borneo (Sabah and Sarawak).

Ecology: Lowland forest, along streams, on undulating land and hillsides.

Notes: *Xanthophyllum longum* resembles *X. vitellinum* but differs, in general aspect, from the latter (and from all other known species in Sabah and Sarawak), by its thin, bright green leaves and extremely long and slender petioles, (20–)30–40 mm long (*versus* 8–14(–16) mm long in *X. vitellinum*). The upper two-thirds of the petiole is obviously derived from the leaf blade as it has the same green-yellow colouring as the midrib; the basal one-third dries brown as is the case in most species of *Xanthophyllum*.

Specimens examined: SABAH - Kinabatangan District, Ulu Sungai Pinangah (SAN 81178, SAN 95970, SAN 107165 [type], SAN107277 and SAN 107314); Tawau district (SAN 95970). SARAWAK - Limbang District (*Brunig* 48, specimen slightly deviating).

10. *Xanthophyllum nitidum* W.J. de Wilde & Duyfjes, *sp. nov.*

luxta Xanthophyllum vitellinum (Blume) D. Dietr., *partibus omnibus flavovirentibus, venatione intercostali tenuissima et acuta in folii pagina inferiore nitidi, areolis consimilibus c. 0.5 mm diam, differt. Typus:* Dewol, Tuyok & Langkap SAN 108778, Borneo, Sabah, Kinabatangan District, Bukit Tawai (*holo* SAN; *iso* A, BO, K, KEP, L, SAR, SING).

Tree to 20(–30) m tall and 20(–35) cm diam. **Twigs** yellow. **Bark** smooth, black, inner bark yellowish. **Sapwood** white. **Axillary buds** *c.* 1 mm long, minutely hairy. **Leaves** green-yellow, shiny above, concolorous, *not papillose* beneath; blade oblong-lanceolate, 7–11 x 2–4 cm, base cuneate, apex acute-acuminate; midrib above flat; lateral veins 4 or 5 pairs, *intramarginal vein indistinct; intercostal venation finely reticulate on both surfaces*, areoles all of about the same size, small, *c.* 0.5 mm diam., glands inconspicuous; petiole 8–12 mm long, transversely wrinkled. **Inflorescences** 5–10 cm long, *branched*, minutely light brown hairy. **Flowers** 2 together at base, other flowers solitary: *pedicel* 2–3 mm long, hairy; perianth, stamens and pistil not known; developing *ovaries* and immature fruit sessile, globose, 4–6 mm diam., (not densely) hairy, light green, *ovules* 4. **Fruit** not known.

Distribution: Endemic to Borneo (Sabah and Kalimantan).

Ecology: Lowland forest, on brown soil over ultrabasic bedrock, at 100–400 m altitude.

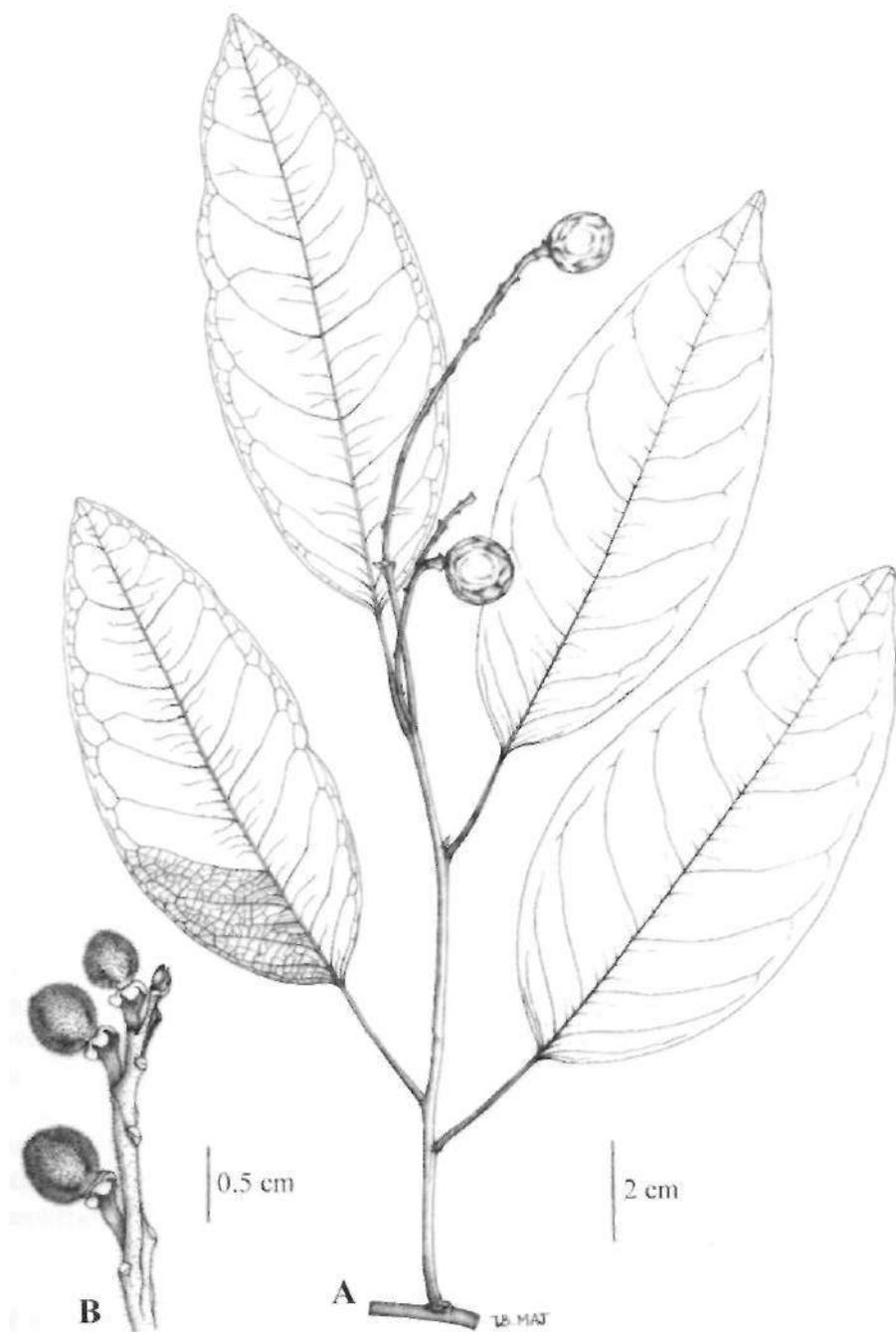


Figure 2. *Xanthophyllum longum* W.J. de Wilde & Duyfjes
A. Fruiting leafy twig; B. Part of inflorescence (post-anthesis) with developing ovaries (young fruits). (A from SAN 107277, B from SAN 107165).

Notes: *Xanthophyllum nitidum* resembles superficially the variable and widespread *X. flavescens* in its overall yellow-green colour of the dried leaves, its yellow twigs, and its widely branched inflorescences. However, it differs from the latter by its ovary, which is hairy all-over (glabrous in *X. flavescens*), shiny aspect of the leaves (not shiny in *X. flavescens*) and finely and regularly areolate-reticulate venation (scalariform in *X. flavescens*). It is also close to *X. vitellinum*, a species with the leaves dull and mostly green-brown on drying and with coarser, irregularly sized areoles. The collections from Sabah are from ultrabasic localities.

Specimens examined: SABAH - Kinabatangan District, Bukit Tawai (SAN 108778, the type); Sandakan District, Bukit Tangkunan (SAN 71499), Bukit Malawali (SAN 46624). EAST KALIMANTAN, Kutai (Arifin AA 968 and *Sidiyasa 1118*).

11. *Xanthophyllum pachycarpon* W.J. de Wilde & Duyfjes, *sp. nov.*

Iuxta Xanthophyllum tenuem Chodat, *fructu maiore* 2–3 cm diam., *pericarpio crassiore* 5–10 mm *crasso differt.* **Typus:** *Lai et al. S 69651*, Borneo, Sarawak, Lubok Antu district, Nanga Segara, Sungai Engkari (holo SAR; iso K, KEP, L, SAN, MO).

Tree 12–30 m tall and to 30 cm diam. **Bark** greyish or darkish green, smooth or with large warty lenticels. **Sapwood** orange-yellow. **Twigs** glabrous, smooth, yellowish. **Axillary buds** long-triangular, 1–1.5 mm long, glabrous. **Leaves** glabrous, green-brown or light brown above, *concolorous*, *not papillose* beneath; blade oblong, 8–16 x 2.5–6 cm, base cuneate, apex acute-acuminate; midrib scarcely raised above, prominent beneath; lateral veins 4–6 pairs, forming an irregular intramarginal vein; *intercostal venation finely and sharply reticulate on both surfaces*; glands inconspicuous; *petiole* 6–12 mm long, longitudinally and transversely wrinkled, glabrous, glands absent. **Inflorescences** much shorter than the leaves, *unbranched*, with 7–10 flowers (flower-scars), axis short hairy, glabrescent. **Flowers** not known. **Fruits** glabrous, globose, 2–3 cm diam, light brown, coarsely wrinkled on drying; pericarp 5–10 mm thick, solid or spongy due to irregularly-sized scattered hollows; *fruiting pedicel* 3–4 mm long. **Seed** 1.

Distribution: Endemic to Borneo (Sabah, Sarawak and W Kalimantan).

Ecology: Mixed dipterocarp forest, on hill ridges and slopes, at altitudes to 650 m, also in forest on brown soil over ultrabasic bedrock.

Notes: This species, for which flowers are unknown, can be readily recognized by its diagnostic large globose fruits, 2–3 cm in diam., which dry light brown with a coarsely, wrinkled surface. The dry pericarp is somewhat woody, 5–10 mm thick, solid or with scattered hollows of various sizes. The venation of the glabrous concolourous leaves is fine and distinct on both surfaces, by which the plant is reminiscent of *Xanthophyllum nitidum*, but in the latter species the distinct venation is still finer, the inflorescences branched and the young fruits densely hairy. In *X. pachycarpon*, the fruits (and presumably the ovaries) are glabrous.

Specimens examined: SABAH - Keningau District (SAN 78275 and SAN 78258); Kinabatangan District (SAN 52086, SAN 52099, SAN 53303 and SAN 54072); Labuk Sugut District (SAN 82833); Ranau District (SAN 76778 and SAN 97680); Sandakan District (SAN 51297); Tenom District (Aban *et al.* 65263). SARAWAK - Belaga District, Sungai Kenaban (S 3525 and S 3541); Lubok Antu District (S 69651, the type); Serian District, Sungai Engkabang (S 27397). WEST KALIMANTAN - Senawai (Church *et al.* 1524).

12. *Xanthophyllum rectum* W.J. de Wilde & Duyfjes, *sp. nov.*

Iuxta Xanthophyllum vitellinum (Blume) D. Dietr., *inflorescentiis crassis et validis erectis et eramosis differt. Typus: Ilias Paie S 17903*, Borneo, Sarawak, Kuching District, Bako National Park, Lintang path (*holo* SAR; *iso* A, BO, K, KEP, L, MEL, SAN, SING).

Tree 5–12 m tall and to c. 20 cm diam.. **Bark** pale grey, smooth or fine-fissured. **Inner bark** yellow-brown. **Twigs** black, glabrous, c. 5 mm thick. **Axillary buds** less than 0.5 mm long, subglabrous. **Leaves** coriaceous, dark grey(-green) brown above, chocolate-brown and *not papillose* beneath; blade elliptic-oblong, 7–13 x 3–7.5 cm, base rounded or short-cuneate, apex acute-acuminate (very tip bluntish); midrib above flat or slightly raised; lateral veins 4–7 pairs, *not* forming an intramarginal vein; *intercostal venation reticulate, prominent and distinct beneath*; glands absent or inconspicuous; *petiole* 7–12 mm long, without glands. **Inflorescences** stout, straight, erect, unbranched, axis 15–20-flowered, 8–13 cm long, 2–8 mm thick, sparsely minutely appressed brown hairy. **Flowers** solitary: *pedicel* c. 1 mm long; *sepals* c. 4 mm long, drying blackish; petals not seen; stamens and mature pistil not seen; *ovary* sessile, (densely) hairy, *ovules* 4. **Fruit** globose, c. 1.8 cm diam., smooth, ± shiny, dark-brown, ± sparingly hairy, glabrescent; pericarp thin, seed 1; *fruiting pedicel* c. 2.5 mm long, 3–4 mm thick.

Distribution: Endemic to Sarawak.

Ecology: Lowland heath forest, ridge of dipterocarp forest, and rocky padang.

Notes: Earlier collected specimens of this species were left unnamed by Ng (in herb. KEP, 1968), but determined by van der Meijden (1982) as *Xanthophyllum vitellinum*, which it resembles. *Xanthophyllum vitellinum* normally has branched inflorescences, but occasionally has unbranched ones, and it has membranous leaves. *Xanthophyllum rectum* is conspicuously stout with thick twigs and coriaceous leaves with prominent venation beneath, the whole plant dries dark brown, with stout, erect and unbranched inflorescences. Apparently, it is confined to low heath forest of the Sampadi Forest Reserve and Bako National Park, at low altitudes, in west Sarawak.

Specimens examined: SARAWAK - Kuching District, Bako National Park, Lintang path (S 4446 and S 17903, the type), Sampadi Forest Reserve (S 66789), Selang Forest Reserve (*Brunig* 7343); Lundu District, Bedaun, Sematan (S 65493).

13. *Xanthophyllum rheophilum* W.J. de Wilde & Duyfjes, *sp. nov.*

Xanthophyllo flavescenti Roxb, *differt in foliis lineare-lanceolatis, petiolis 3–4 mm longis, fructu c. 1 cm diam.* **Typus:** Rids dale PBU 97, Borneo, Central Kalimantan, Barito Ulu, 0.02' S 114° 06' E, (holo L; iso BO).

Shrub *c.* 3 m tall. **Axillary bud** minute. **Leaves** glabrous, yellow on drying, lower surface concolorous, *not papillose*; blade lanceolate-linear, 6–12 x 0.5–1 cm, base attenuate, apex long-acuminate; intercostal venation *reticulate*; *petiole* 3–4 mm long, glabrous. **Inflorescences** *racemose* or *few-branched*, *c.* 7 cm long, (5–)10–15-flowered. **Flowers:** *pedicel c.* 5 mm long; petals cream; *ovary* subglobose, glabrous, except for a few hairs at apex, *ovules* 12. **Fruits** globose, 0.8–1 cm diam., glabrous, blackish on drying.

Distribution: Endemic to Central Kalimantan; known only from the type.

Ecology: Riverine vegetation, at low altitude.

Notes: *Xanthophyllum rheophilum* is close to the broadly defined *X. flavescens*, a species usually with the intercostal venation scalariform and with 5–15 mm-long petioles. The lanceolate-linear leaves with a short petiole make *X. rheophyllum* distinctive.

Acknowledgements

We thank the Director General of Forest Research Institute Malaysia, the Director of the Sabah Forestry Department, the Director of the Sarawak Forestry Department and Engkik Soepadmo (KEP) who gave us the opportunity of working for the Tree Flora of Sabah and Sarawak Project. We thank the Curators of the herbaria BO, KEP, L, SAN, SAR, and SING for their hospitality and permission to study their collections. We are especially grateful to Normaya Nordin and Soh Wu Kuang (KEP), Julia Sang (SAR) and Joan T. Pereira (SAN) for their assistance and friendship. Ubaldus Majawal (SAN) made the beautiful drawings, and Jan Frits Veldkamp (L) translated the diagnoses into Latin.

References

- Meijden, R. van der. 1982. Systematics and evolution of *Xanthophyllum* (Polygalaceae). *Leiden Botanical Series*. **7**: 1—159.
- Meijden, R. van der. 1988. Polygalaceae. *Flora Malesiana*. **1,10**: 455-539.
- Ng, F.S.P. '1968' (1970). X. *Xanthophyllum* (Polygalaceae). In: K.M. Kochummen, F.S.P. Ng and T.C. Whitmore, Notes on the Systematy of Malayan Phanerogams: VI—X, *Federation Museums Journal* (new series). **13**: 137.
- Ng, F.S.P. 1972. Polygalaceae. *Tree Flora of Malaya*. **1**: 351-366.