

# Studies in Southeast Asian *Melastoma* (Melastomataceae), 1. Morphological variation in *Melastoma malabathricum* and notes on rheophytic taxa and interspecific hybridisation in the genus

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**ABSTRACT.** Morphological variation in the widespread Indo-Pacific *Melastoma malabathricum* L. is discussed, as well as the possibility of hybridisation or introgression with other species. Hypanthium indumentum is a reliable character to diagnose the group and species. Five rheophytic taxa, including four distinctive species and a variant of the widespread *M. malabathricum*, which are superficially alike because of their stenophyllous leaf form, are enumerated for Southeast Asia and a key is provided for their identification. *Melastoma kahayanense* K.M.Wong from Borneo is described for the first time and the Sumatran *Melastoma stenophyllum* Merr. is considered a distinct species and not synonymous to *M. malabathricum*. Various putative hybrids or introgression products involving *M. malabathricum* are identified.

**Keywords.** Brunei, identification key, indumentum, introgression, Kalimantan, Malesia, morphology, Sarawak, Sumatra, taxonomy, variation

## Introduction

The most recent revision of *Melastoma* L. by Meyer (2001) included 22 species, of which an overwhelming 18 were considered to have ranges within or including Malesia. Of these, eight species are listed for the Malay Peninsula and nine species for Borneo. Nevertheless this appears to be very incomplete because collections that were apparently not consulted include new taxa characterised by distinctive forms of hypanthium indumentum (see Wong & Low, 2015). In addition Meyer adopted wide species concepts for a number of taxa without much clarification and which sometimes appeared to be inconsistent. This series presents various discussions and taxonomic changes, including the description of new or overlooked taxa. We begin with a commentary on the fundamental significance of the hypanthium indumentum type and variation within *Melastoma malabathricum* L., the type species. Based on this and other characters, distinct Southeast Asian rheophytic species are then distinguished from a rheophytic form of *Melastoma malabathricum*. Finally, the evidence for interspecific hybridisation in the genus is reviewed and putative hybrids between *Melastoma malabathricum* and other species in Malesia are identified.

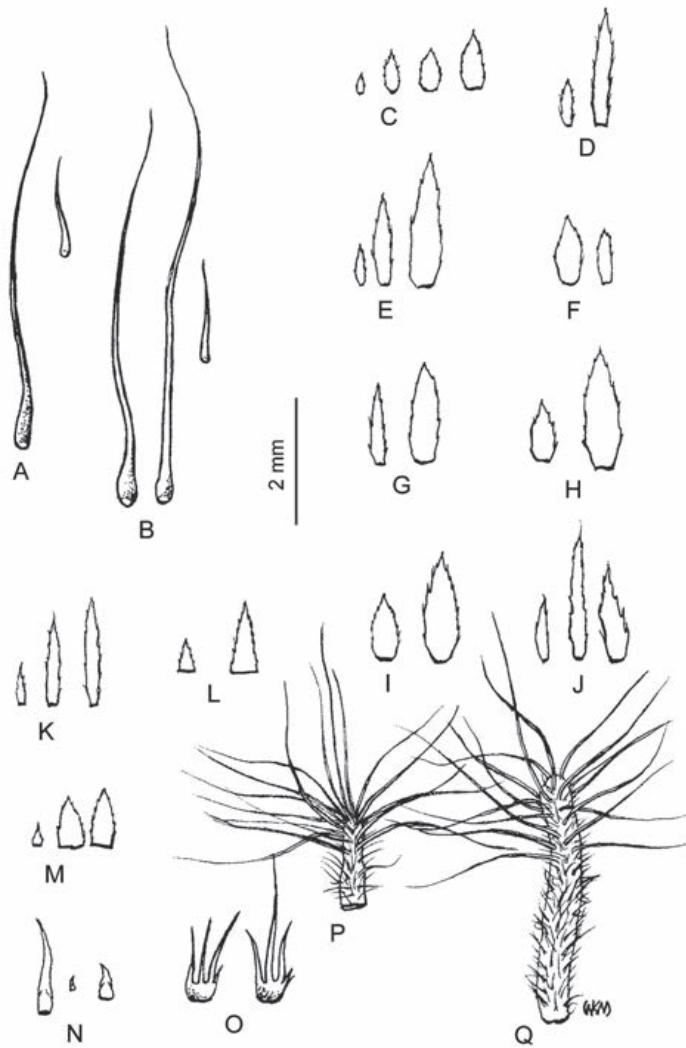
### **Hypanthium indumentum type a reliable distinguishing character**

Species with distinctive types of hypanthium indumentum consistently differ in other morphological characters, ecology or distribution (Naudin, 1850; Cogniaux, 1891; Li, 1944). The main hypanthium indumentum types documented for *Melastoma* include bristles (filiform or terete, hair-like indumentum, as in *M. molle* Wall. ex Ridl. or *M. sanguineum*) (Fig. 1A, B) or scales (visibly flat even under  $\times 10$  magnification, usually triangular to ovate or lanceolate (= narrowly ovate) indumentum, as in *M. imbricatum* Wall. ex C.B. Clarke or *M. malabathricum*) (Fig. 1C, D–J), or sometimes penicillate emergences (outgrowths of hypanthium tissue that bear bristles on their edges or at their tips, as in the trans-oceanic vicariants *M. beccarianum* Cogn. and *M. saigonense* (Kuntze) Merr.; Cogniaux, 1891; Hansen, 1977; Meyer, 2001) (Fig. 1P, Q). Thus far, the scales documented are mainly triangular to ovate or lanceolate flat scales with irregularly and shallowly serrate margins (e.g., *Melastoma malabathricum*, *M. normale*, *M. stenophyllum* Merr.) (Fig. 1D–L), or subulate-subentire (e.g., *M. ariffinii* K.M.Wong) (Fig. 1N), or deeply divided nearly to base forming several linear segments (e.g., *M. ashtonii* K.M.Wong) (Fig. 1O) (Wong & Low, 2015).

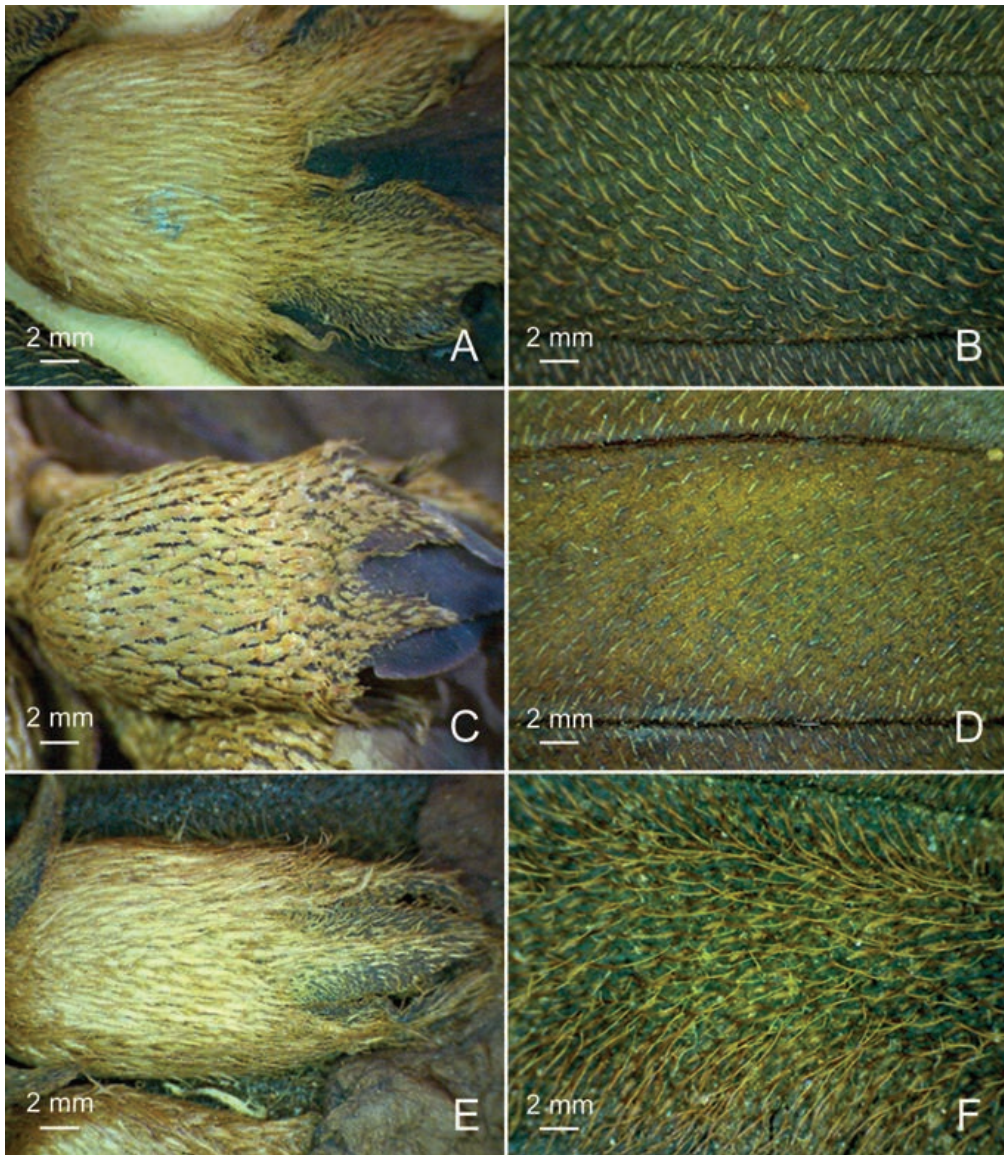
### **Variation in *Melastoma malabathricum***

“On account of the great variation among the plants which must be identified as *M. malabathricum* in the wide sense, no satisfactory classification of them has been proposed.” – E.J.H. Corner, *Gardens' Bulletin Straits Settlements* 10: 300 (1939).

*Melastoma malabathricum* was lectotypified by Bremer in Jarvis et al. (1993: 65). The lectotype is *Herb. Hermann*, Vol. 1: 55, No. 171, Ceylon in the Natural History Museum, London (BM). There are two elements numbered “171”. One is a leafy twig without flowers (barcode BM000621418) and is found on the same sheet together with another separate leafy twig bearing an open flower (barcode BM000621419). Both these elements are ostensibly conspecific. They have twigs covered in appressed ovate, triangular and broad-lanceolate scales, the margins of which have short irregular serrations. The flower has a hypanthium clothed and completely hidden in overlapping, flat, narrowly triangular to lanceolate scales (length typically three times or more the width), also with irregular and shallow marginal serrations. All these character-states are also found together in most of the material attributable to this species from India through Malesia (Fig. 1D–J), into northern Australia and the Pacific region, where indeed leaf size and shape, number of flowers in an inflorescence, and flower size appear to vary continuously without any significant morphological gap that could be used to justify taxonomic division. Hypanthium scale dimensions are less variable and, although the hypanthium scales of material from Sri Lanka (Ceylon) (Fig. 1D, 2A) are merely half the width of the largest hypanthium scales found in Malesian material (Fig. 1E–I, 2C), there are intermediate sizes between these extremes, and the smaller scale sizes occur also in Malesia (Fig. 1E, F, G, J).



**Fig. 1.** Hypanthium indumentum types found in *Melastoma* species. Bristles in **A.** *Melastoma molle* Wall. ex Ridl., and **B.** *M. sanguineum* Sims. Scales with serrate margins in **C.** *M. imbricatum* Wall. ex C.B.Clarke, **D.** *M. malabathricum* L. from Ceylon, **E.** Malay Peninsula-Selangor, **F.** Malay Peninsula-Pahang, **G.** Sumatra, **H.** Java, **I.** Borneo-Sarawak, and **J.** Borneo-West Kalimantan, **K.** *M. normale* D.Don, **L.** *M. stenophyllum* Merr. and **M.** *M. kahayanense* K.M.Wong. Subulate-subentire scales in **N.** *M. ariffinii* K.M.Wong. Scales that are deeply divided into linear segments in **O.** *M. ashtonii*. Penicillate emergences in **P.** *M. saigonense* (Kuntze) Merr. and **Q.** *M. beccarianum* Coqn. Drawn by K.M. Wong from (A) *Symington* KEP 21361; (B, left) *Webb et al.* WA 64, (B, middle and right) *Sidek* SK 409; (C, three on left) *Shah & Sidek* MS 1123, (C, right) *Everett* FRI 13992; (D) *Gardner* 296; (E) *Hume* 7313; (F) *Burkill & Haniff* SFN 16660; (G) *Jacobs* 8193; (H) *Zollinger* 1938; (I) *Othman* S 21107; (J) *Church et al.* 557; (K) *Ribu* (*Dr Prain's collector*) s.n. 5 Apr 1902; (L) *Rahmat Si Boeea* 7000; (M) *Mahyar* 890; (N) *Chai & Ilias* S 31110; (O) *Ashton* BRUN 5629; (P) *Webb et al.* WA 81; (Q) *Wong* WKM 189; all from SING. 2 mm scale shown applies throughout; measurements were made with a Micro-Scale with 0.1 mm divisions from Minitool Inc.



**Fig. 2.** Hypanthium scales and upper leaf surface scabrid-hairy indumentum. **A–D.** *Melastoma malabathricum* L. **A, B.** Typical in material from Ceylon (*Gardner 296* (= *Hooker 8246*), SING); **C, D.** Malay Peninsula (*Burkill & Shah HMB 935*, SING). **E, F.** *Melastoma normale* D. Don from Sikkim (*Hooker 9577*, SING). (Photomicrographs courtesy of Y.W. Low)

This is, therefore, a highly variable species and, in the present assessment, no consistent varieties or forms seem possible to delimit using clear-cut and discontinuous characters. It is possible that, although apparently extreme environments may be expected to pose selection pressure that skews some morphological expression, this has not happened because the different populations still participate in sufficient

genetic exchange. It is useful to identify some of this variation, bearing in mind the characteristics highlighted in the previous paragraph are consistently present throughout.

- (i) Leaves are typically elliptic, with 5 longitudinal veins (on the upper surface distinct as 5 longitudinal furrows, the outermost two very near to the leaf margins). In the Malay Peninsula and Borneo there are rheophytic forms with leaves narrowly elliptic to almost linear, with 3 longitudinal veins (on the upper surface distinct as 3 longitudinal furrows), and sometimes 3–5 longitudinal veins on some or many leaves.
- (ii) Leaf blades are typically (1.6–)2.5–4.5(–8) cm wide. In the rheophytic forms leaf blades are (0.3–)0.7–1.1(–2.2) cm wide.
- (iii) The upper leaf surface typically has short rows of crystalliferous cells immersed in the leaf tissue (visible as pale spicule-like patterns under magnification) proximal to appressed-suberect scabrid hairs typically up to 0.5 mm long (Fig. 2B & D).
- (iv) Flowers with open corollas typically span 4–5.5 cm in dried material. In the rheophytes, flowers have open corollas spanning (2.5–)3.5–4 cm in dried material.

Thus a rheophytic variant may be encountered that has leaves as small and narrow as 2 cm long and 1.6 cm wide, with small flowers (spanning only 2.5 cm in dried material). These are, however, connected by intermediate states with other variants, all of which have the hypanthium scales and twig scales described above for the species.

The status of *Melastoma normale* D. Don, which was reduced to synonymy of *M. malabathricum* by Corner (1939) and treated as a subspecies of *M. malabathricum* by Meyer (2001), apparently because of similar hypanthium scale types found in both (Fig. 1D–J, K; 2 A, C, E), requires comment. In spite of the type of *Melastoma normale* D. Don, which should be a Hamilton collection from Nepal (Don, 1825), not being traced (see also Meyer, 2001), there are other Himalayan (including Nepal) collections available that have been identified with it (Naudin, 1850; Clarke in Hooker, 1879), such as *Hooker* s.n. from Sikkim (G-DC, G00319474), *Native Collectors No. 22* from Khasia [Khasi] Hills (G-DC, G00319472), and *Wallich 4039* from Nepal (BM, K, P; also the type of *M. wallichii* DC., placed in synonymy of *M. normale*) that amply display consistent characteristics: a dense twig indumentum of erect-spreading bristles and leaf upper surfaces with 0.6–1 mm long hairs that are erect and then curved over (Fig. 2E), visibly longer than those of typical *M. malabathricum*. Don (1825) himself noted "*ramis undique setoso-pilosis, foliis...supra hispide pilosis...*" Fig. 2 shows the similar hypanthium scale character but different leaf upper surface indumentum in these two species. These morphological differences, together with the high elevation distribution of *Melastoma normale*, and in the absence of any phylogenetic work to indicate otherwise, suggest that Corner (1939) and Meyer (2001) were hasty in synonymising or changing the rank of the taxon. As such, *Melastoma normale* is still considered a distinct species here.

Additionally, a number of other taxa relegated to the synonymy of *Melastoma malabathricum* by Meyer (2001) also seem quite distinct from it, not having the flat

narrowly triangular-lanceolate scales covering the hypanthium, as in *M. malabathricum* (Fig. 2A, C). Included are the following

- (i) Hypanthium with dense filiform (bristly) scales: *Melastoma clarkeanum* Cogn. – TYPE: Burma, Tenasserim, 1000 m, *Helper 2241* (K, P); *Melastoma homostegium* Naudin – TYPE: Philippines, *Cuming 927* (BM, K, P); *Melastoma robustum* Bakh.f. – TYPE: Indonesia, Riau, Lingga, Gunung Walker, *Bünnemeijer 6585* (L); *Melastoma roemeri* Mansf. – TYPE: Papua New Guinea, Madang, Hellwig-Gebirge, 1000–1500 m, *Von Roemer 1123* (L). The relationship among these taxa require study but nonetheless form recognisable entities with a very different hypanthium scale type.
- (ii) Hypanthium with narrow-lanceolate scales with extended bristle-like cauda: *Melastoma pelagicum* Naudin – TYPE: Solomon Islands, Isle Ysabel, *Hombron s.n.* (P).
- (iii) Hypanthium with sparse, subulate and subentire scales: *Melastoma scabrum* Ridl. – TYPE: Malay Peninsula, Kedah, Langkawi, Telaga Tujuh, *Ridley 15813* (K).

There are other taxa placed in the synonymy of *Melastoma malabathricum* by Meyer (2001) that, although they have the imbricately arranged serrate hypanthium scales of *M. malabathricum*, differ in other characteristics. An example is *Melastoma stenophyllum*, which differs by its solitary flowers, a broad-triangular hypanthium scale type that is less than three times as long as broad (Fig. 1L), and near-glabrous upper leaf surfaces.

### Rheophytic taxa and their morphological distinction

Rheophytes are plant taxa adapted to conditions within the flood zone of swift-flowing streams and rivers, and typically have highly dissected or narrow leaf blades (the latter 'stenophylly'), assumed to be adapted to reduce damage by providing less resistance to swift waters during inundation (Van Steenis, 1981). These plants most often grow on sandy or stony stream banks or islands, and from rock crevices and at rapids, developing strong root holdfasts and easily resprouting or branching. Van Steenis (1981) noted that Northwest Borneo is particularly rich in rheophyte diversity.

A number of *Melastoma* taxa are also rheophytic in adaptation. Despite their superficial morphological similarity, typically being low, much-branched shrubby forms with very narrowly elliptic to linear leaves, and their shared preference for a similar ecology within the flood zone of swift-flowing streams, they can be distinguished by the form of the hypanthium scales, as described in Wong & Low (2015), as well as a number of other characters. Such rheophytic taxa were either overlooked or have not been studied for the last revision of the genus by Meyer (2001).

Here we present a key to the Southeast Asian rheophytic species, compared with *M. malabathricum*, with which they could be confused because the latter also includes rheophytic variants. A new rheophytic species, *Melastoma kahayanense*, is described

that has the *M. malabathricum* hypanthium scale type (flat, triangular to lanceolate, serrate) (Fig. 1M) but with consistently solitary flowers and upper leaf surfaces that are subglabrous or with very minute hairs, in addition to stenophyllous leaves and a rheophytic distribution.

#### Key to Southeast Asian *Melastoma* rheophytes

- 1a. Hypanthium scales quite flat, margins irregularly serrate to short-ciliate but not deeply incised towards their base. Calyx without conspicuous intersepal lobes, often only a low protuberance (1–1.5 mm high) bearing 1–few prolonged scales 1–2(–3) mm long ..... 2
- 1b. Hypanthium scales basally thickened or inflated, margins subentire to sparsely denticulate or the scale deeply incised almost to base to form several linear segments. Calyx with or without conspicuous, well-formed intersepal lobes ..... 4
- 2a. Flowers (1–)3–7(–9) in a cyme. Upper leaf surface hairs appressed-suberect and scabrid, typically up to 0.5 mm long, rarely to 1 mm long, but always conspicuous with  $\times 10$  magnification (India to SE Asia and the Pacific, including Malesia) ..... *M. malabathricum*
- 2b. Flowers solitary. Upper leaf surface subglabrous to minutely scabrid, hairs very tiny and barely emergent from leaf surface, requiring  $\times 50$  magnification to see clearly (Borneo, Sumatra) ..... 3
- 3a. Leaf blades (2.5–)5.5–7(–9) cm long, (0.4–)0.8–1(–1.2) cm wide. Flowers in dried material with open corolla spanning 4.5–5 cm, hypanthium 0.5–0.6 cm diameter, calyx lobes 7–8 mm long; hypanthium scales broadly triangular, their length less than 3 times the width (Sumatra) ..... *M. stenophyllum*
- 3b. Leaf blades only up to 4 cm long, 0.6 cm wide. Flowers in dried material with open corolla spanning 2.5–3 cm, hypanthium not more than 0.5 cm diameter, calyx lobes 3.5–6 mm long; hypanthium scales narrowly triangular to lanceolate, their length 3 times the width or more (E Kalimantan) ..... *M. kahayanense*
- 4a. Hypanthium scales subulate, subentire to sparsely denticulate (occasionally with small teeth near the scale apex). Calyx without distinct intersepal lobes, often just low protuberances bearing 1–few prolonged scales to 2 mm long. Upper leaf surface mostly glabrous or sometimes with minute hairs barely emergent from leaf surface, requiring  $\times 50$  magnification to see clearly (NW Borneo: Brunei, Sarawak, W Kalimantan) ..... *M. ariffinii*
- 4b. Hypanthium scales deeply divided almost to base to form several linear segments. Calyx with conspicuous, well-formed narrowly triangular intersepal lobes 4–5 mm long. Upper leaf surface totally glabrous (Brunei: Ingei River) ..... *M. ashtonii*

### Rheophytic *Melastoma* enumerated

**1. *Melastoma ariffinii*** K.M.Wong, Gard. Bull. Singapore 67: 71 (2015). – TYPE: Brunei, Tutong, Ramba, Ulu Tutong, down valley to SW of helicopter pad LP 239, 150–200 m asl, 8 May 1992, *Johns, Niga, Shanang & Han 7547* (holotype BRUN; isotype K).

*Melastoma polyanthum* var. *linearifolium* Bakh.f., Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 91: 69 (1943). – TYPE: Borneo [West Kalimantan], Gunong Narik, Mt Kelam, May 1894, *Molengraaff B3460* (lectotype L, designated in Wong & Low, 2015).

*Additional specimens examined.* BRUNEI: **Temburong:** First big waterfall on R. Temburong, c. 500 ft, 6 Nov 1959, *Ashton BRUN 759* (BRUN, K, SING). SARAWAK: **5th Division:** Ulu Lawas, Kota Forest Reserve, on bank of Sg. Kota, 21 Oct 1971, *Chai & Ilias S 31110* (A, K, L, SAN, SAR, SING). **Kapit Division:** Balleh, Ulu Mengiong, Sg. Entejum, 27 Oct 1988, *Othman, Rantai & Jugah S 56078*, (K, KEP, L, SAR, SING); Sg. Belaga at upper rapids, 12 Apr 1963, *Ashton S 18242* (K, L, SAR, SING).

This occurs in the Northwest Borneo region, including Brunei, Sarawak and W Kalimantan.

**2. *Melastoma ashtonii*** K.M.Wong, Gard. Bull. Singapore 67: 74 (2015). – TYPE: Brunei, Belait, Sg. Ingei, rocky river bank, 21 January 1959, *Ashton BRUN 5639* (holotype BRUN; isotypes K, L, SING).

*Additional specimens examined.* BRUNEI: **Belait:** Falls just upstream from Batu Melintang, 4 Jan 1989, *Wong WKM 680* (BRUN, K, SING).

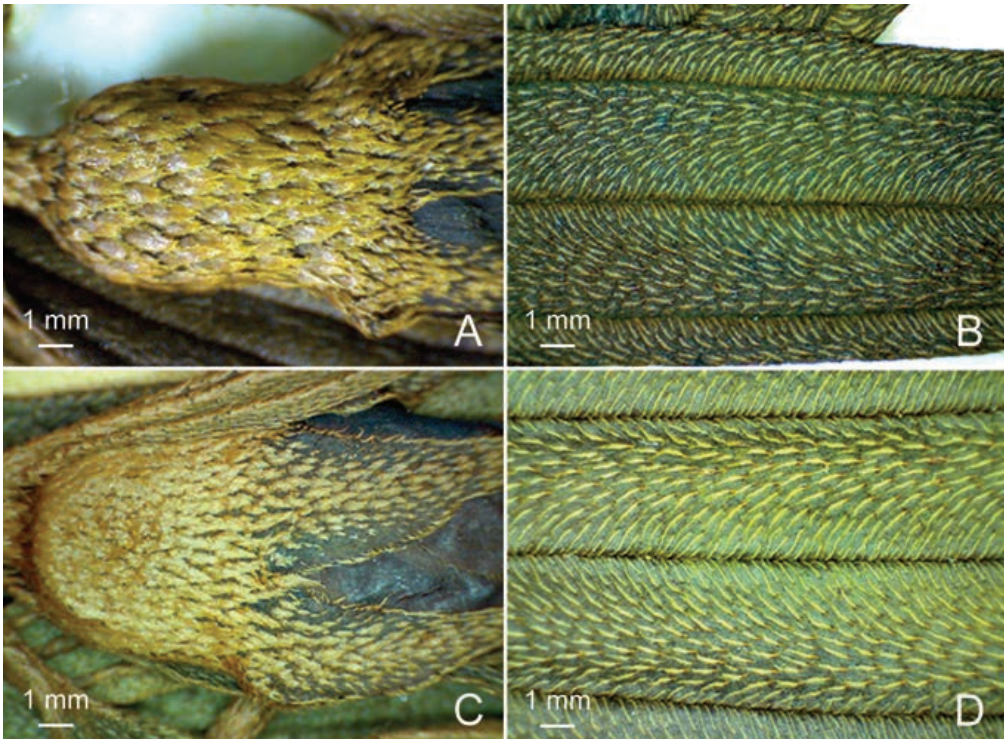
This species seems to be restricted to the Sungai Ingei area in Brunei.

**3. *Melastoma kahayanense*** K.M.Wong, **sp. nov.**

This species resembles *M. malabathricum* in its flat, irregularly serrate, imbricate hypanthium scales but differs by its solitary flowers and near-glabrous upper leaf surfaces, in addition to its stenophyllous leaves and rheophytic habit. – TYPE: Borneo, E Kalimantan, headwaters of Sungai Kahayan, 0°28'S 113°44'E, 200 m asl, 30 March 1988, *Mahyar 890* (holotype SING; isotypes A, BO). (Fig. 3A, B)

**Rheophytic bush** to 2 m high. **Twigs** with a dense covering of appressed triangular to ovate-lanceolate flat and finely serrate-edged scales. **Leaves** with petioles 0.2–0.4 cm long, c. 0.05–0.1 cm diameter; blades linear, 1.2–4 cm long, 0.2–0.6 cm wide, the 3 longitudinal veins sunken on the upper surface and prominent on the lower surface, covered by a mixture of larger lanceolate appressed scales (c. 0.5 mm long) and smaller appressed lanceolate scales (<0.2 mm long), lamina on the upper surface in dried





**Fig. 3.** Hypanthium scale types and upper leaf surface detail. **A, B.** *Melastoma kahayanense* K.M.Wong. **A.** Hypanthium scale narrowly triangular-lanceolate, the length 3 times or more the width. **B.** Upper leaf surface with conspicuous pale elongate spicule-like rows of crystalliferous cells, most of which are barely emergent as minute hairs. **C, D.** *Melastoma stenophyllum* Merr. **C.** Hypanthium scale broad-triangular, the length less than 3 times the width. **D.** Upper leaf surface with conspicuous pale elongate spicule-like rows of crystalliferous cells, most of which are barely emergent as minute hairs. A, B from *Mahyar 890* (SING); C, D from *Rahmat Si Boeea 7000* (SING). (Photomicrographs courtesy of Y.W. Low)

material with abundant conspicuous elongate spicule-like rows of crystalliferous cells which are typically immersed or proximal to minute hairs barely emergent from leaf surface and requiring  $\times 50$  magnification to see clearly, on the lower surface with minute appressed scabrid hairs up to 1.5 mm long. **Flowers** solitary, pedicel 2.5–4 mm long; hypanthium 4–6 mm long, 3–4 mm diameter, brownish green, densely provided with scales, the scales flat, narrowly triangular to lanceolate, 0.3–0.8(–1) mm long, the length 3–4 times the width, with finely short-serrate margins (the serrations less than 0.1 mm deep), lobes 5, triangular, 3.5–6 mm long, 1.5–2.5 mm wide, without conspicuous intersepal lobes; petals obovate, 1.3–1.5 cm long, 0.8–1 cm wide, noted as purple; stamens 10, 5 longer and 5 shorter. **Fruits** c. 6–8 mm long, 4–5 mm diameter.

**Etymology.** The species is named after its type locality, the Kahayan River in East Kalimantan, Indonesian Borneo.

*Additional specimens examined.* BORNEO: **East Kalimantan:** headwaters of Sungai Kahayan, 5 km NE of Haruwu Village, 0°28'S 113°44'E, 200 m asl, 3 Apr 1988, *Burley et al.* 574 (A, BO, SING).

*Distribution and habitat.* Apparently restricted to the Kahayan river basin in E Kalimantan, on the banks and rocks of swift-flowing streams.

*Provisional IUCN conservation assessment.* Data Deficient (DD) because it is documented only from one expedition and its current status is unknown.

#### 4. *Melastoma malabathricum* L. rheophytic variants

*Melastoma polyanthum* var. *angustifolia* Ridl., Fl. Malay Pen. 1: 765 (1922). – TYPE: [Peninsular Malaysia], Pahang, Kuala Tahan, February 1921, *Seimund* 952 (lectotype SING, designated here).

Similarly, the names *M. longifolium* Naud. (TYPE: Singapore, July 1939, *Guillou* s.n. (P)) and *M. obvolutum* var. *angustifolium* Cogn. (TYPE: Sarawak, 1965–68, *Beccari* 3974 (K)) are also synonyms of *M. malabathricum*; in fact the leaves of their type specimens do not depart significantly from the smallish elliptic leaves typical of *M. malabathricum* and are not immediately reminiscent of the leaves of rheophytic taxa. Van Steenis (1981) accepted *Jacobs* 5580 from Brunei (Temburong river, 30 Sep 1958 (L)) as a true rheophyte because that specimen grew in rocky islets along the Temburong river, and identified it as *M. borneense* Bakh.f. That name (TYPE: Borneo, without date, *de Vriese* 168 (L: barcode L0008992)) is a synonym of *M. malabathricum*, which is also the identity of the *Jacobs* specimen; these specimens, too, do not have unusually stenophyllous leaves.

The following additional collections also amply illustrate rheophytic variants of *Melastoma malabathricum*. MALAY PENINSULA: **Kelantan:** Gunong Stong, Lata Jari, 13 Oct 1934, *Symington* KEP 37820 (KEP, SING). **Pahang:** Kuala Tahan, Feb 1921, *Seimund* 555 (SING), 956 (SING); Kuala Teku, Feb 1921, *Seimund* 419 (SING), 426 (SING), 427 (SING); Sungai Tahan, 7 Sep 1937, *Corner* s.n. (SING), 2 Mar 1977, *Ng* FRI 27026 (KEP, SING), rocky islets in Tahan River, 1891, *Ridley* 2664 (SING); Sungai Teku, 20 Feb 1968, *Shah* MS 1333 (SING).

*Note.* Ridley (1922) merely cited “collected on the Tahan River by Seimund” but there are a number of such collections in the SING herbarium. One of these is designated as the lectotype here.

#### 5. *Melastoma stenophyllum* Merr., Mich. Acad. Sci. Arts Letters 24: 83 (1938). – TYPE: Sumatra, near Hoeta Bagasan, 7 September 1934–4 February 1935, *Rahmat Si Boeea* 7000 (holotype MICH; isotypes A, L, SING, US).

This species is restricted to Sumatra. Van Steenis (1981) wrongly identified *Ashton S 18242* from Sarawak and *Molengraaff B3460* from West Kalimantan as this species (both specimens are *M. ariffinii*; see above). The hypanthium scales (Fig. 1L) and features of the leaf upper surface are also shown in Fig. 3C & D.

### Possibility of interspecific hybridisation and introgression

There is molecular evidence for natural hybridisation among *Melastoma* species, attributed to overlaps in distribution and flowering time, as well as shared pollinators (Liu et al., 2014). There are also species of hybrid origin, such as one in China (probably mistakenly) identified as *Melastoma affine* D. Don (the type of which has not been traced but is of a provenance originally stated as “India Orientalis”) that is intermediate in morphological characteristics between *M. candidum* D. Don and *M. sanguineum* Sims (Liu et al., 2014), and *M. intermedium* Dunn that has been shown to have most nuclear gene haplotypes shared with *M. candidum* and *M. dodecandrum* Lour. and chloroplast spacer sequences identical to either putative parental species (Dai et al., 2012). Thus in the sorting of “variable” taxa, the present work adopts the approach that the character-state combinations found to be common to the most number of collections is taken to represent a natural species, whereas odd character-state combinations could be regarded as possible hybrids or introgression products of the species with the same floral hypanthium scale features. It is, of course, possible that a number of distinct, established species occur with the same hypanthium scale type (e.g., *Melastoma malabathricum* and *M. stenophyllum* discussed above; Fig. 1D–J, L), but then these differ in more than one character. In both the Malay Peninsula and Borneo, the odd possibilities of hybrids or introgression products are comparatively few and overlaps are within the range of putative parental species. Notwithstanding, other consistent character-state combinations in Borneo (where there is greater physiographic and edaphic differentiation, and possibly more effective reproductive barriers among populations) are considered to represent distinct species, especially when the ecology or distribution differs from that of similar species. With this approach, at least any variants that are considered significantly different are then identified, and the morphological assessment results in a taxonomy that attempts a hypothesis for further work on the phylogenetic relationships.

Using this approach, a comparatively small number of collections from Malesia (lowlands to mountains up to only around 1800 m) were found to have the hypanthium scale type of *Melastoma malabathricum* but which differ in small vegetative characters, including having twigs with spreading scales (otherwise of the same form) or upper leaf surfaces with longer hairs (0.5–1.2 mm). These are regarded as representing possibly hybrid material or introgression products. Below, we list the specimens known as such.

Recommendation H.2A of the Melbourne Code (McNeill et al., 2012) notes that names or epithets in a hybrid formula should preferably be in alphabetical order or place the female parent first, or indicate female and male parents using symbols, emphasising that if a non-alphabetical sequence is used, its basis should be clearly

indicated. However, in the cases we consider below, the direction of the crosses are not determined, but it is of relevance to note which species is thought to have contributed the hypanthium scale characters and which the stem and branch scale type or upper leaf surface hair type. Thus in our case we do not use hybrid formulas with a multiplication sign ( $\times$ ) as prescribed but indicate the hybridity differently, using a plus sign (+) between the putative donor of the hypanthium scale type (named first) and the donor of the other character(s) considered (named second).

(i) Putative hybrid or introgression products of *Melastoma malabathricum* + *M. muticum* Ridl.

(Twig scales triangular, ovate or lanceolate, serrate, appressed (as in both species); upper leaf surface with long hairs, 0.5–0.8(–1.2) mm long, intermixed with shorter minute hairs, as in *Melastoma muticum*; hypanthium scales as in *M. malabathricum*). The possibility of *Melastoma muticum* hybridising has been considered before by experienced collectors. There is a note on *Stone 10828* (KLU), collected at 1036 m along the then new Genting Highlands road (with its attendant corridor of disturbance) up the Peninsular Malaysian Main Range, originally identified as *Melastoma muticum* but which we regard here as a putative *Melastoma muticum* + *M. velutinosum* Ridl. (see below), that states: "*M. malabathricum* just reaches this altitude; they are here found growing together. Do they [*M. muticum* and *M. malabathricum*] hybridize?"

MALAY PENINSULA: **Johore:** Gunung Blumut, West Ridge, 2900 ft asl, 14 May 1968, *Whitmore FRI 8716* (KEP, SING). **Pahang:** Cameron Highlands, between Gunung Brinchang and Green Cow Area, 1600–2000 m asl, 19 Oct 1967, *Shimizu et al. M 13479* (KEP, KYO, SING). **Perak:** Gunung Korbu FR, 22 Jul 1933, *Symington KEP 32240* (KEP, SING); Maxwell Hill, summit of Gunung Hijau, 4500 ft asl, 4 Dec 1965, *Shah & Sidek MS 1105* (SING). SUMATRA: **North Sumatra:** Brastagi, Dec 1930, *Symington KEP 23985* (SING).

All these collections are from montane areas where the distribution of *Melastoma malabathricum* and *M. muticum* Ridl. (which has a characteristic mixed indumentum on the upper leaf surface) overlap.

(ii) Putative hybrid or introgression products of *Melastoma malabathricum* + *M. sanguineum*

(Twig scales sparse, small and ovate-appressed and sometimes mixed with larger or longer suberect-erect bristly scales, as in *M. sanguineum*; upper leaf surface and hypanthium scales as in *M. malabathricum*).

MALAY PENINSULA: **Kedah:** Gunong Jerai, 3200 ft, *Burkill HMB 3345* (SING); Langkawi, Pulau Ular, 22 Nov 1941, *Corner* s.n. (SING). **Penang:** Air Itam Dam Reserve, 3 Mar 1965, *Hardial & Samsuri 227* (SING); enroute from Penang Hill to Waterfall Botanic Garden, c. 550 m asl, 14 Oct 1967, *Shimizu et al. M 12990* (KYO, SING); 'top of Hill', Dec 1895, *Ridley* s.n. (SING), 1520 ft, Mar 1881, *King's Coll. 1540* (SING). **Perlis/Thai border:** Setul [=Satun], Mar 1910, *Ridley 15056* (SING). **Selangor:** Ulu Gombak, 18 m.s., 15 Jun 1966, *Carrick JC 1486* (SING).

(iii) Possible hybrid or introgression products with parent species unidentified: *Melastoma malabathricum* + unknown taxa

(Twig scales suberect-spreading, not appressed as in *Melastoma malabathricum*; other characteristics including hypanthium scale characters as in *M. malabathricum*).

**BORNEO: Sabah:** Sipitang, 5 miles from Kampung Mendulong, road to Meligan, 4 Sep 1983, *Lee SAN 96893* (A, SAN, SING). **Sarawak:** Mulu National Park, along Sg. Melinau, south of Long Birar, 4°00'N, 114°50'E, 100 m asl, 12 Apr 1978, *Stone 13681* (KLU, SAR).

**MALAY PENINSULA. Kedah:** Koh Mai Forest Reserve, 4 Apr 1938, *Kiah SFN 37397* (SING); Kuala Pegang to Kg. Ibul, 6 Feb 1968, *Whitmore FRI 4631* (KEP, SING); Langkawi, Guard Regiment Camp, 10 Dec 1960, *Alphonso & Samsuri A 131* (SAN, SAR, SING); Kuah, 4 Aug 1961, *Samat 26* (KLU, SING); Langkawi, south coast 4 miles west of Kuah, 10 Dec 1969, *Whitmore FRI 12976* (KEP, SING). **Kelantan:** Gua Musang, 18 Aug 1971, *Boey 302* (KLU); Kota Bahru, 23 Apr 1937, *Corner s.n.* (SING). **Kuala Lumpur:** University of Malaya, around Jabatan Botani, 11 Sep 1986, *Rosmawati 3* (KLU); University of Malaya, wasteland in campus, 6 Sep 1974, *Jayamohan s.n.* (KLU). **Pahang:** Tasek Bera, north end, Kuim, 30 m asl, 8 Mar 1969, *Flenley 58* (KLU); Ulu Sg. Krau, NE Gunung Benom, 800 ft asl, 1 Mar 1967, *Whitmore FRI 3138* (KEP, SING). **Perak:** Batu Gajah, 26 Jun 1924, *Burkill & Haniff SFN 13362* (SING); Kuala Kangsar, 14 Jun 1925, *Haniff SFN 14919* (SING); Kuala Kangsar, Lubok Merbok, 21 Oct 1924, *Haniff SFN 16007* (SING). **Selangor:** Kepong, Bukit Beruang, 18 Nov 1927, *Pawanche KEP 13422* (SING); Klang Gates quartz ridge, 19 Mar 1960, *Carrick 650* (KLU); ibidem, 18 Nov 2006, *Lee & Wong s.n.* (KLU); Pudu, 16 Aug 1922, *Seimund FMS Museums 10327* (SING); Ulu Gombak 18 mile stone, 6 Mar 1968, *Teo T&P 51* (K, L, SING); Ulu Kuang, May 1972, *Provencher Nr.T.51* (KLU). **Trengganu:** Kuala Berang, 29 Apr 1937, *Corner SFN 33490* (SING). **Singapore:** Changi Reserve, 11 Mar 1889, *Goodenough s.n.* (SING); Seletar Reservoir, 10 Mar 1971, *Anthony 259* (SING).

A number of such collections have odd characters noted: having witches broom (*Goodenough s.n.*) or galls (*Anthony 259*), chlorotic (*Burkill & Haniff SFN 13362*), or with white flowers (*Seimund FMS 10327*). It is not possible to determine without appropriately designed studies if these could be related to recessive conditions such as produced in a hybrid swarm.

Possible hybrid or introgression products of *Melastoma muticum* + *M. malabathricum* also exist. This material has hypanthium scales resembling those of *Melastoma muticum* (very narrow, near-filiform scales with length 5–8 times the width, and sparse inconspicuous short cilia on the margin); twig scales triangular-ovate and appressed as in *M. malabathricum*; upper leaf surface with long and very minute hairs intermixed as in *M. muticum*.)

**MALAY PENINSULA: Pahang:** Cameron Highlands, Gunong Brinchang, 5 Nov 1960, *Poore 453* (KLU); ibidem, summit, 6500 ft, 11 May 1965, *Stone 5612* (KLU).

Also, there are specimens that are possibly the hybrid or introgression products of *Melastoma muticum* + *M. velutinosum* (which have the hypanthium scale type of *M. muticum* but suberect bristles covering the twigs as in *M. velutinosum*); both species are found in the Main Range mountains of the Malay Peninsula.

MALAY PENINSULA: **Pahang**: Genting Highlands, 3400 ft [1036 m] asl, 8 Jul 1972, *Stone 10828* (KLU); Ulu Kali, 1 Dec 2012, *Sugumaran SM 345* (KLU).

It may seem, from this listing, that a good number of collections are considered of hybrid or introgression origin. In fact, such variation has not been detected for all species, and for some species less widespread than *Melastoma malabathricum*, the number of such odd taxa is very small, represented by 1–few collections. It would stand to reason that in a very widespread species, such as *Melastoma malabathricum*, distributed from Sri Lanka through Malesia and mainland Southeast Asia to north Australia and the Pacific region, and from near sea level to around 1800 m on mountains, there would be more collections of putative hybrids or introgression products to be expected.

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### References

- Cogniaux, C.A. (1891). Melastomaceae. *Monogr. Phan.* 7: 314–1183.
- Corner, E.J.H. (1939). Notes on the systematy and distribution of Malayan phanerogams III. *Gard. Bull. Straits Settlements* 10: 239–329.
- Dai, S., Wu, W., Zhang, R., Liu, T., Chen, Y., Shi, S. & Zhou, R. (2012). Molecular evidence for hybrid origin of *Melastoma intermedium*. *Biochem. Syst. Ecol.* 41: 136–141.
- Don, D. (1825). *Prodromus Florae Nepalensis*. London: J. Gale.
- Hansen, C. (1977). The Asiatic species of *Osbeckia*. *Ginkgoana* 4: 1–150.
- Hooker, J.D. (1879). *Flora of British India*, vol. 2. London: L. Reeve & Co.
- Jarvis, C.E., Barrie, F.R., Allan, D.M. & Reveal, J.L. (1993). *A List of Linnaean Generic Names and Their Types. Regnum Vegetabile* 127. Königstein: Koeltz Scientific Books.
- Li, H.-L. (1944). Studies in the Melastomataceae of China. *J. Arnold Arbor.* 25: 1–41.
- Liu, T., Chen, Y., Chao, L., Wang, S., Wu, W., Dai, S., Wang, F., Fan, Q. & Zhou, R. (2014). Extensive hybridization and introgression between *Melastoma candidum* and *M. sanguineum*. *PLOS One*, DOI: 10.1371/journal.pone.0096680.
- McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (2012). *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code)*. *Regnum Vegetabile* 154. Königstein: Koeltz Scientific Books.
- Meyer, K. (2001). Revision of the Southeast Asian genus *Melastoma* (Melastomataceae). *Blumea* 46(2): 351–398.
- Naudin, C. (1850). Melastomacearum quae in Musaeo Parisiensi continentur monographicae descriptionis et secundum affinitates distributionis tentamen. XXVIII. *Melastoma. Ann. Sci. Nat.* 13: 273–296.

- Ridley, H.N. (1922). *The Flora of the Malay Peninsula*, vol. 1. Polypetalae. London: L. Reeve & Co. (*Melastoma*, Pp. 763–766)
- Van Steenis, C.G.G.J. (1981). *Rheophytes of the World: An Account of the Flood-Resistant Flowering Plants and Ferns and the Theory of Autonomous Evolution*. Alphen aan den Rijn, The Netherlands: Sijthoff & Noordhoff.
- Wong, K.M. & Low, Y.W. (2015). Novitates Bruneienses, 3. Eight new woody plants in the Brunei flora, including five new species. *Gard. Bull. Singapore* 67: 69–84.

