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THE MALLOTUS WRAYI COMPLEX (EUPHORBIACEAE)

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SUMMARY

The *Mallotus wrayi* King ex Hook.f. complex on the Sunda Shelf of the Malay Archipelago (Malay Peninsula, Sumatra, Java, Borneo) appeared to comprise four species instead of a single, very heterogeneous one. Two synonyms (*M. caudatus* Merr. and *M. lancifolius* Hook.f.) are resurrected and a new species, *M. spinifructus*, is described. Important characters can be found in the density of the hairs (glandular scale-like, simple or stellate), type of stellately bundled hairs, lengths of inflorescences, bracts, and bracts of the terminal bud, and in the stigma width and hairiness.

Key words: Euphorbiaceae, *Mallotus*, Sunda Shelf, Malesia.

INTRODUCTION

Mallotus wrayi King ex Hook.f. is usually identified by one pair of large extrafloral nectaries on the upper surface near the petiole insertion of the blade and an apically very distinctly pulvinate (kneed) petiole with the blade diagonally attached to it. The species is restricted to the Sunda Shelf: Malay Peninsula, Sumatra, West Java, and Borneo. Several names are usually synonymised with *M. wrayi*: *Mallotus caudatus* Merr. (Borneo), *M. lancifolius* Hook.f. (Malay Peninsula), and *M. laevigatus* (Müll. Arg.) Airy Shaw (Sumatra, Java).

The amount of specimens collected is overwhelming, but appears to be very heterogeneous. There are at least four different, in size overlapping morphs in the fruit: one smaller, three larger, of which one very hairy, one rather glabrous, and one with many spines and long hairs. The leaf margins are entire to laxly dentate/serrate; the density and type of indumentum is extremely variable, from distinctly present to seemingly absent; the presence of extrafloral nectaries (next to the two basal ones) is variable, the amount of glandular scale hairs per leaf varies from conspicuous to almost absent, and the lengths and hairiness of the inflorescences, bracts, and scales of the terminal buds vary from short to long, and from subglabrous to densely hairy.

A close inspection of the material learns that *M. wrayi* is a complex of several species. Typical for the real *M. wrayi* is a special kind of stellately bundled (fascicled) hairs, which are very soft and all pointing in one plane, parallel to the blade surface (2-dimensional) (Fig. 1a). Other characters can be found in the lengths of the inflorescences and bracts, and the glabrous abaxial midrib (see Table 1). *Mallotus wrayi* s.s. is found on the Malay Peninsula, Sumatra, and Borneo (Map 4).

Table 1. Differences between the species in the *Mallotus wrayi* King ex Hook.f. complex.

	Mallotus caudatus	*Mallotus lancifolius*	*Mallotus spinifructus*	*Mallotus wrayi*
Stellately bundled hairs	soft to stiff, 3-dimensional	stiff, 3-dimensional	stiff, 3-dimensional	soft, 2-dimensional
Leaf blade margin	entire to shortly serrate	(entire to) coarsely serrate	entire	entire
Extrafloral nectaries along basal part of adaxial midrib	often present	absent	absent	absent (to seldom one)
Hairs on abaxial midrib	densely hairy	sparsely hairy	hairy	(sub)glabrous
Glandular scales abaxially	distinct	almost absent	distinct	distinct
Length bracts terminal buds	4–5.5 mm	2–10 mm	c. 1.5 mm long	to 4.5 mm long
Male inflorescence length	up to 19 cm	up to 10 or up to 25 cm	up to 6 cm long*	up to 5(–11) cm
Inflorescence bract length	(2.3–)3.3–10 mm	2–8 mm	5.5–6 mm	0.7–2.8(–3.3) mm
Stamens number	(24–)35–60	30–65	c. 30?	25–40
Female inflorescence length	up to 26 cm	up to 14 cm	up to 7.5 cm	up to 4(–11) cm
Stigma width	0.6–1 mm	0.2–0.7 mm	c. 1 mm	0.2–0.7 mm
Hairiness stigma abaxially	tomentose (visible by eye)	not dense	subglabrous	not dense
Spines in groups / separate	groups on young ovary	separate	separate	separate
Hairiness of spines	completely tomentose	only basally	completely, loosely	only basally

*) Flowers still in bud, but all buds already well-developed and well-spaced along the rachis; therefore it is not expected that the inflorescences will grow longer than the measure given.

Soft, stellately bundled hairs can also be found in part of the material that appears to be *M. caudatus*, but here the hairs are arranged in all directions, also perpendicular to the leaf blade (3-dimensional) (Fig. 1b). The specimens with soft hairs usually have extra extrafloral nectaries along the basal part of the midrib. Part of the *M. caudatus* material also has stiff stellate hairs. The abaxial midrib is always (densely) hairy, the inflorescences are long and hairy, the bracts idem and the spines on the ovary/fruit are also very tomentose. The spines on the ovary in young flowers are united in groups (resembling almost wing-like structures) and become separate once the ovary starts to develop into a fruit (just starting to separate in Fig. 2b). The union of the spines may have a purely mechanical cause, due to limited space in the buds the spines are packed tightly within each sepal and because of the dense stellate hairs the spines remain together after the flower opens till the ovary starts to enlarge. The stigmas are broader than in all other species and also distinctly hairy (Table 1). The leaf blade margins of *M. caudatus* vary between entire to laxly serrulate. *Mallotus caudatus* is only found on Borneo (Map 1).

A third group usually has serrate/dentate leaves, though the margins can be entire too. This group has a hardly hairy abaxial midrib with very short, stellately bundled hairs and the glandular scales are almost lacking. The fruits are like those of *M. wrayi* s.s. (rather glabrous, spines never grouped on the ovary), but smaller. Typical for this species are the usually very long bracts of the terminal buds. This group is found under the names *M. lancifolius* and *M. laevigatus*, and should be called *M. lancifolius*. This species is present on the Malay Peninsula, Sumatra, West Java, and Borneo (Map 2).

A fourth group of only a handful of specimens appeared to constitute a new species. Typical is the indumentum, with normal stiff, yellowish stellately bundled hairs and many long silvery simple hairs. These hairs are especially remarkable on the staminate buds. The fruits are large, like in *M. caudatus*, but the number of spines is higher. The spines lack the tomentose stellate indumentum of *M. caudatus*, but have typical, patent long simple hairs. This group will be newly described as *M. spinifructus* and is found on the Malay Peninsula and Borneo (Map 3).

Within the classical subdivision of *Mallotus* (e.g., Airy Shaw, 1975) the species of the *M. wrayi* complex should be classified in section *Rottleropsis* (opposite leaves, blades trinerved, fruits with spines). However, recent molecular research (Kulju, pers. comm.) shows that section *Rottleropsis* usually intergrades with section *Axenfeldia* (same characters except leaf blades penninerved) and that the two sections together are probably even polyphyletic in their origin. Of the *M. wrayi* group only *M. caudatus* was sampled and this specimen, depending on the analysis, grouped with species of section *Stylanthus* or with a species of section *Philippinenses*, thus always outside the large group of *Rottleropsis*/*Axenfeldia* species. In conclusion, a clear view of the exact position of the *M. wrayi* complex within *Mallotus* is still lacking, but work is progressing.

KEY TO THE SPECIES IN THE MALLOTUS WRAYI COMPLEX

1a. Stigmas broad, 0.6–1 mm wide, densely yellowish stellately hairy beneath (Fig. 2b). Spines on ovary in groups, completely densely tomentosely hairy (Fig. 3j). Bracts (2.3–)3.3–10 mm long. Pistillate inflorescences up to 26 cm long; staminate

ones up to 19 cm. Upper leaf base often with several pairs of extrafloral nectaries along midrib (Fig. 3k) . . . . . **1. M. caudatus**

b. Stigmas narrow (0.2–0.7 mm wide) or broad, c. 1 mm wide, not hairy beneath by eye (Fig. 2a). Spines on ovary loose, upper part glabrous or loosely hairy (Fig. 3h, i). Bracts 0.7–8 mm long. Pistillate inflorescences up to 14 cm long; staminate ones up to 11 or up to 25 cm long. Upper leaf base without extrafloral nectaries along the midrib or sometimes a single one (Fig. 3b) 2

2a. Midrib glabrous on lower surface. Stellately bundled hairs soft, in a horizontal plane (2-dimensional) (Fig. 1a), usually providing a silver sheen abaxially. . . . . **4. M. wrayi**

b. Midrib sparsely hairy to hairy on lower surface. Stellately bundled hairs stiff, pointing all directions (3-dimensional) (Fig. 1b), giving no silvery reflection . . 3

3a. Margin (entire to) serrulate to serrate. Bracts of terminal buds 2–10 mm long. Stipules early caducous. Spines of fruit only basally hairy (Fig. 3i) . . . . . **2. M. lancifolius**

b. Margin entire. Bracts of terminal buds c. 1.5 mm long. Stipules present along upper few leaves, late caducous. Spines of fruit completely loosely hairy (Fig. 3h) . . . . . **3. M. spinifructus**

DESCRIPTIONS

1. Mallotus caudatus Merr. — Fig. 1b, 2b, 3j, k; Map 1

Mallotus caudatus Merr. (1918) 83; (1921) 338; (1929) 157. — Type: *Villamil 376* (holo PNH† (photo in A); iso K), British North Borneo (Sabah), Marauti watershed near Tawau.

Mallotus wrayi auct. non King ex Hook.f.: Airy Shaw (1963) 349, p.p. (*M. caudatus*); Meijer (1967) 52, p.p. (*M. caudatus*); Airy Shaw (1975) 171, p.p. (*M. caudatus*).

Shrubs to trees, up to 8(–15) m high, clear bole up to 10 m high, dbh up to 8 cm; flowering branchlets 3–5 mm thick, flattened and somewhat ridged when dry, hairy, glabrescent. *Indumentum* present on most parts, stiff simple hairs and stellate groups of very soft and thin whitish hairs on the leaf blades, glabrescent; glandular scales yellowish to orangey to dark brown. *Outer bark* smooth, (green to) white to white-brown to grey, to spotted red to dark brown, c. 0.5 mm thick; inner bark whitish to yellowish to green to brownish (to black?), c. 2 mm thick; sapwood medium hard to very hard, fairly fine grained, white to yellow to pale orange to brown. *Stipules* and bracts of terminal buds triangular, 4–5.5 by 1.7–2 mm, hairy, caducous. *Leaves* opposite, similar shape, one usually somewhat smaller; petiole 1.3–8 cm long, round, somewhat hairy, basally and especially apically strongly pulvinate, upper pulvinus oblique; blade partly over upper pulvinus (pseudo-subpeltate), ovate to elliptic, 3.9–44.5 by 1.8–11 cm, length/width ratio 2.2–6, symmetric, membranous to subcoriaceous; base cuneate, very base narrowly cordate, margin entire or with one to few glandular teeth per margin or laxly denticulate, usually somewhat undulate, apex cuspidate to caudate; upper surface with stellate soft hairs when young, basally one pair of extrafloral nectaries on basal nerves, elliptic, c. 1 mm diam., additional extrafloral nectaries often present (up to 9 pairs) along the basal part of the midrib (sometimes only in some leaves) and in the apical third, a few cm from the margin on the nerves and larger veins, circular, c. 0.3 by 0.3 mm;

lower surface smooth, not to somewhat lighter green than upper surface, subglabrous to mainly hairy on the midrib and (basal) nerves, hair tuft domatia present, but not very distinct, glandular scales present, orangey yellowish; venation triplinerved, slightly raised above, raised beneath and of lighter colour than lamina, nerves 7–9 per side up to the apex, looped and closed near margin, veins scalariform, veinlets laxly reticulate to almost scalariform. *Inflorescences* racemes, axillary to terminal, single to seven together when staminate, greenish brown to white, hairs mainly straight, patent, ferruginous,

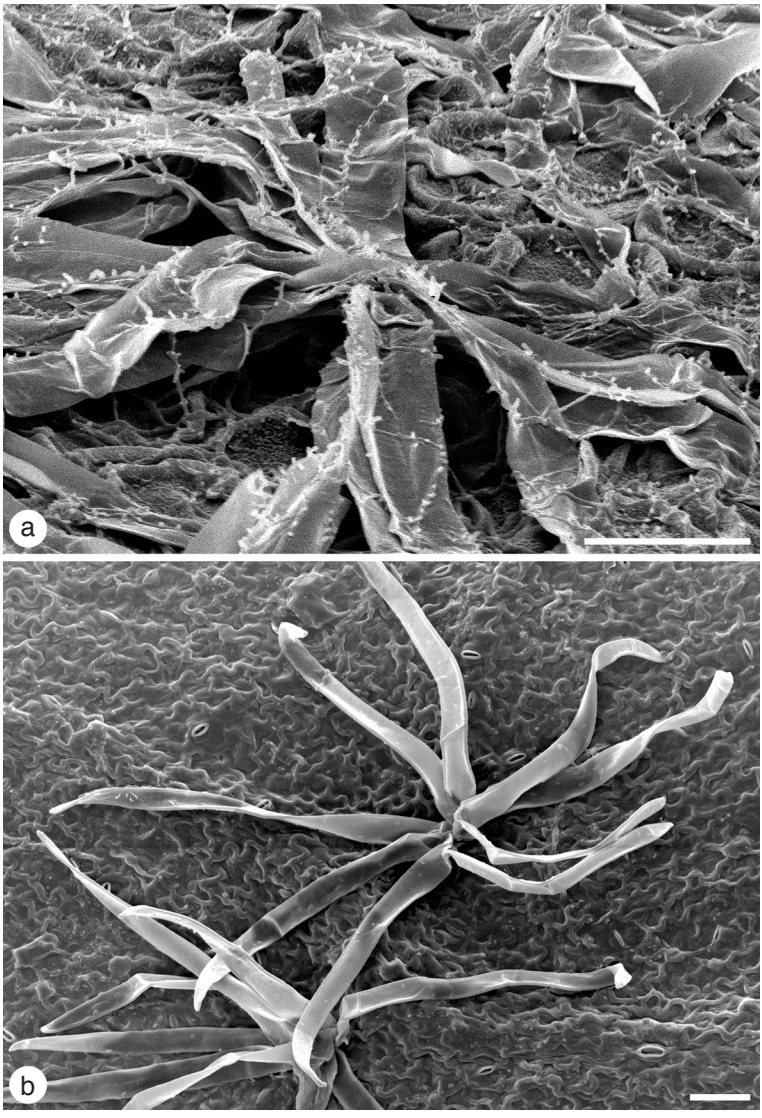
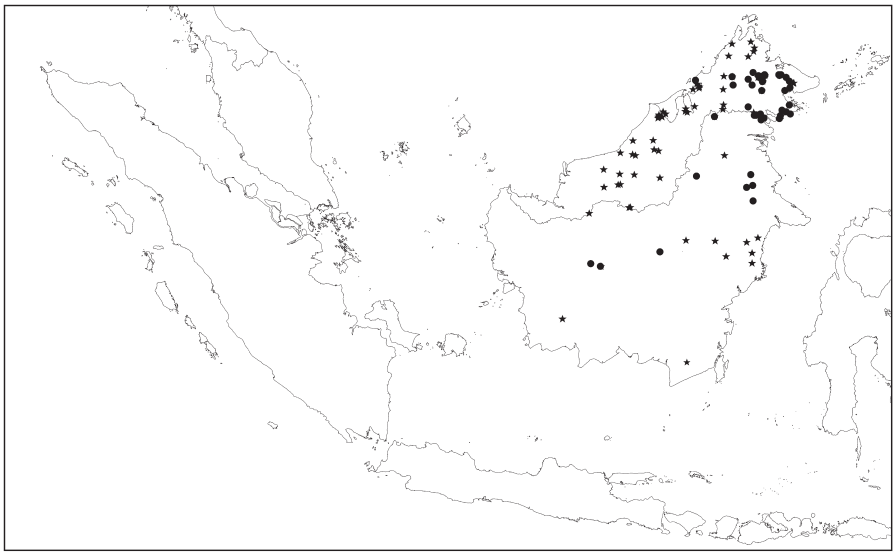


Fig. 1. Stellate bundled or fascicled hairs. a. Flat hair of *Mallotus wrayi* King ex Hook.f.; b. three-dimensional hair of *M. caudatus* Merr. — Scale bars = 25 μm (a: *S (E. Wright) 32300*; b: *SAN (Madani) 47168*; all L).

glabrescent; staminate ones up to 19 cm long, 0.5–2.2 mm thick, with cymosely flowering groups of more than 15 flowers per node, pistillate ones up to 26 cm long, 1.7–2.5 mm thick, with few flowers, one per node; bracts ovate to elliptic, (2.3–)3.3–10 by 1.3–3 mm, outside hairy, inside glabrous. *Staminate flowers* 2–4.5 mm diam., green to white to yellow, fragrant; buds mainly obovoid; pedicel 2.2–3.4 mm long, hairy; sepals 3 or 4, ovate to elliptic, 2.5–3 by 1.5–2 mm, reflexed, hairy, especially outside, glandular scales only outside; stamens (24–)35–60, filaments up to 2.6 mm long, glabrous, anthers c. 0.3 by 0.2 mm, thecae separated from each other by connective, yellow, top of connective with a few large cells (perhaps glandular). *Pistillate flowers* 7–7.5 mm diam., greenish to white to (greenish) yellow; pedicel up to 3 mm long with an abscission zone subbasally; sepals splitting variously, (2–)4 or 5 (or 6), ovate, 3–5 by 1.3–3 mm, mainly hairy outside, glandular scales only outside; ovary 3-locular, 1.2–2.5 by 1.8–2 mm, spines up to 1 mm long, dense, in 6 groups (2 per locule), tomentose, purple; style 1.3–3 mm long, stigmas up to 9 mm long, 0.6–1 mm wide, densely papillate above with branching papillae more than 1 mm long, abaxially densely (yellowish when dry) stellately tomentose. *Fruits* lobed capsules, (11–)12.5–17 by 7–10 mm, reddish green to white (to light blue?), spines up to 4 mm long, tomentose, breaking off; wall woody, inner part c. 1.2 mm thick; column T-shaped, up to 4 mm high. *Seeds* globose, 6–7.5 mm diam., brown to black, shiny.

Distribution — Borneo. Most specimens either show soft hairs or stiff hairs (but many are more or less in between). The soft-haired ones usually have additional extrafloral nectaries along the basal part of the adaxial midrib. Initially it seemed that these forms were geographically separate, but Map 1 shows this not to be the case.

Habitat & Ecology — In understorey of primary and dipterocarp forest, riverine forest, kerangas forest, selectively logged forest, mainly on undulating land and ridges



Map 1. Distribution of *Mallotus caudatus* Merr. • = specimens with soft stellately bundled hairs; ★ = specimens with stiff(er) stellately bundled hairs.

of hills; soil yellow to brown sand or red clay, laterite; bedrock: Belait Series, sandstone, Setap Shales. Altitude: sea level up to 500(–1100) m. Flowering and fruiting: throughout the year through. Flowers much visited by bees.

Vernacular names — Brunei: Bantas (Brunei, Iban); Enserai (Iban). Kalimantan: Kroti. Sabah: Babalitak (Tidong); Balek balek angin bini (Brunei); Bongbong, Mingkig pateh (Dusun); Labah, Lambukan, Limbukan, Minungbong (Dusun Kinabatangan); Kandang jagong (Kadayan); Kemenyan (Suluk); Kolokos (Tengara); Lamba; Romi romi; Singa kapot; Tola tola, Toloo toloo (Sungai); Rendang jagong, sagar-sagar (Malay). Sarawak: Bantas, Retih (Iban); Sekayah (Kenyah).

Uses — Wood is excellent firewood.

Note — *SAN (Amin et al.) 69332* is exceptional in having pistillate flowers with staminodes.

2. Mallotus lancifolius Hook.f. — Fig. 2a, 3i; Map 2

Mallotus lancifolius Hook.f. (1887) 434. — Lectotype (proposed here): *Maingay KD 1451* (holo K; iso K), Malaya.

Mallotus moritzianus Müll.Arg. var. *laevigatus* Müll.Arg. (1865) 191. — *Mallotus laevigatus* (Müll. Arg.) Airy Shaw (1965) 328; Meijer (1967) 52; Airy Shaw (1975) 160; (1981) 326; Chakrab. (1985) 496. — *Macaranga laevigata* (Müll.Arg.) Backer & Bakh.f. (1968) 649, nom. inval. ('*laevigatus*'; see note 3) — Lectotype (proposed here): *Zollinger 1554* (holo L; iso BM, FI, G (2x), M, S, ZT), Java.

Rottlera glaberrima auct. non Hassk.: Rchb.f. & Zoll. (1856) 313; Miq. (1859) 393 (all p.p., excl. type). — *Mallotus glaberrimus* auct. non (Hassk.) Müll.Arg.: J.J. Sm. (1910) 435; Pax & K. Hoffm. (1914) 192; Merr. (1921) 338; Backer & Bakh.f. (1963) 484 (all p.p., excl. type). See note 2.

Mallotus wrayi auct. non King ex Hook.f.: Whitmore (1973) 115, p.p. ('*M. lanceifolius*').

Shrubs to trees up to 13 m high, dbh up to 20 cm, crown up to 5 m high; flowering branchlets 2–3 mm thick, flattened and somewhat ridged when dry; apical parts stellately hairy, glabrescent, mainly remaining hairy on nodes. *Indumentum* usually not dense, long simple hairs and stiff, short stellate hairs, glandular scales orange or yellowish. *Outer bark* smooth to shallowly, finely fissured, whitish to yellow-brown to pale brown to reddish grey-brown to brown-black, 0.5 mm thick, fibrous; inner bark c. 4 mm thick, hard, pale greenish to pinkish to ochre to pale brown to outside brown-red, striped; sapwood white to straw, hard. *Stipules* and bracts of the terminal buds triangular, 2–10 by 2–3 mm, usually long, appressed hairy outside, especially on the central part, margins becoming glabrous and more or less translucent cartilaginous, stipules very early caducous. *Leaves* opposite (alternate in young stages), similar in shape, one somewhat smaller; petiole 0.8–5(–8.5, see note 5) cm long, round, basally and apically pulvinate, upper pulvinus relatively thin to oblique with blade base partly overlaying, slightly hairy; blade ovate to elliptic (to obovate), 5–28 by 2.3–10 cm, length/width ratio 1.9–4.3, symmetric, membranous to subcoriaceous; base (emarginate, see note 5, to) rounded to attenuate to cuneate, very base usually narrowly cordate, margin (entire to) serrulate to serrate in upper two-third with usually coarse teeth, apex (acute to) caudate; upper surface basally with one pair of extrafloral nectaries, up to 1.3 by 0.5 mm, in upper third usually several, usually deep, extrafloral nectaries (mainly 0.3 by 0.3 mm) on and in between nerves (*S 63606* exceptional in having additional small extrafloral nectaries along basal part of midrib), at most slightly hairy (to hairy) on midrib and basal nerves; lower surface sparsely hairy on venation, glabrescent, glandular

scales very few, almost absent, hair tuft domatia present; venation triplinerved, flat to slightly raised above, raised below, 8–12 nerves per side, veins scalariform, veinlets reticulate. *Inflorescences* racemes, axillary to (pseudo)terminal, mainly single, reddish, slightly to densely covered with stiff hairs; staminate ones short, up to 10 cm long, or long, up to 25 cm long, diameter 0.8–1.4 mm, with cymosely groups of more than 10 flowers; pistillate ones up to 14 cm long, 1.2–2.1 mm thick, a single flower per node; bracts ovate to triangular, 2–8 by 1–2.5 mm, often stiff and patent, later recurved, densely hairy on back with usually glabrous to glabrescent margins. *Staminate flowers* 3–4 mm diam., greenish to white (to pale yellow), buds ovoid; pedicel 3–6 mm long, with abscission zone in basal two-third, hairy, less so above abscission zone; sepals 3(–5), ovate to elliptic, 2.3–4.3 by 0.8–2.2 mm, reflexed, hairs and glandular scales outside; stamens 30–65, filaments up to 1.7–4 mm long, glabrous, anthers 0.5–0.7 by c. 0.3 mm, thecae distinctly separated from each other by connective, latter with apically glandular cells. *Pistillate flowers* 2.5–3 mm diam., quickly increasing in size, yellowish; pedicel 1.8–4.5(–7 in fruit) mm long, abscission zone ± halfway, densely hairy; sepals breaking up to about 4 or 5, triangular, 2.5–6 by 0.4–1.7 mm, few to many stellate hairs outside, reflexed; ovary 3-locular, c. 2.8 by 1.7 mm, hairy outside, covered with not very dense spines up to 2 mm long, latter dark red, pointing in all directions, with few hairs, especially basally; style 0.5–1.5 mm long, bright red, stigmas 2.7–8.3 mm long, 0.2–0.7 mm wide, bright red, with usually branching papillae above, less than 1 mm long, somewhat sericeous beneath. *Fruits* lobed capsules, 8–16 by 4–9 mm, yellow-green, spines up to 2.5 mm long, breaking off; wall woody, 1.2–1.5 mm thick; column T-shaped, up to 4 mm high. *Seeds* subglobose, 5.8–9.5 by 5.2–9 by 5–5.2 mm, shiny.

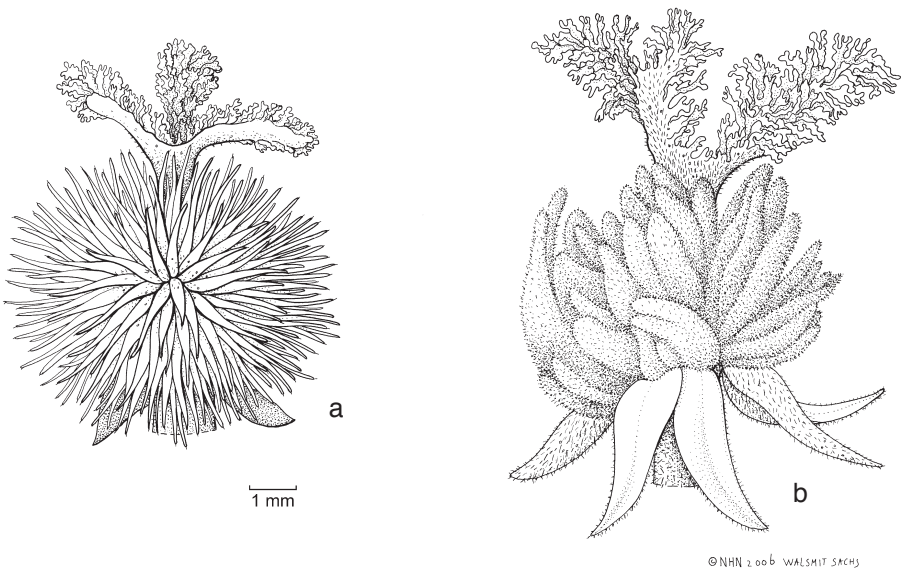
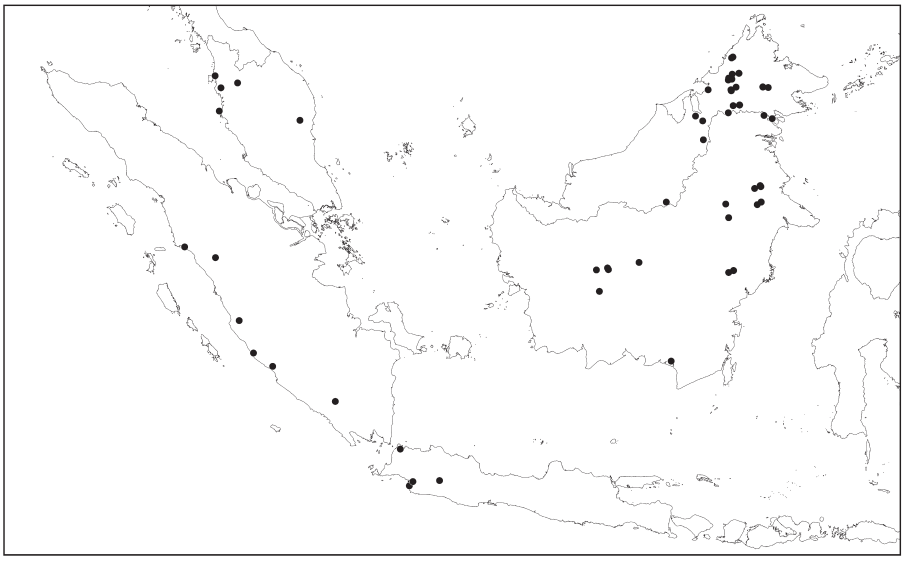


Fig. 2. a. *Mallotus lancifolius* Hook.f., pistillate flower with spines in all directions. — b. *Mallotus caudatus* Merr., pistillate flower with grouped spines on ovary (a: *Church et al. 907*; b: *Kostermans 21077*; all L).



Map 2. Distribution of *Mallotus lancifolius* Hook.f.

Distribution — Malay Peninsula, Sumatra, Java, Borneo. According to Chakrabarty (1985) also on the Andaman and Nicobar Islands.

Habitat & Ecology — In understorey of primary dipterocarp, secondary, submontane, and montane forest, selectively logged forest; soil moist, yellow clay, volcanic rocks, sandstone. Altitude 30–1650 m. Flowering: January to April, July, August, October to December; fruiting: January, March, June, August to November.

Vernacular names — Sumatra: Eroepeka (Enggano); Talog (Malay Palembang). Borneo: Sarawak: Bantas.

Notes — 1. The epithet *laevigatus* is the oldest (Müller Argoviensis, 1865), but it was first used on an infraspecific level; only much later Airy Shaw (1965) was the first to use it as a species epithet. This makes the epithet *lancifolius* the oldest epithet on the species level (Hooker, 1887).

2. Airy Shaw (1965) clearly explains the wrong interpretation of the species *Rottlera glaberrima* as described by Hasskarl (1842). Hasskarl's description is extremely brief, but shows the leaves to be alternate. Airy Shaw identified it as a *Macaranga* species (*Macaranga glaberrima* (Hassk.) Airy Shaw). Reichenbach & Zollinger (1856) incorrectly identified a specimen from the Bogor Botanical Garden with Hasskarl's name. Their specimen is a true *Mallotus* with opposite leaves (one smaller than the other). Several authors (e.g., Pax & Hoffmann, 1914; Backer & Bakhuizen van den Brink, 1963) considered the name and description by Reichenbach & Zollinger as a later homonym, but this is not the case, because Reichenbach & Zollinger clearly refer to Hasskarl. Müller Argoviensis (1865) interpreted Reichenbach & Zollinger's description correctly as a *Mallotus* and created the new combination *Mallotus glaberrimus*. He too referred to Hasskarl, which means that this name is also a synonym of *Macaranga glaberrima* (Hassk.) Müll.Arg. Luckily, Müller Argoviensis (1865) also described a

new variety (*laevigatus*) under *Mallotus moritzianus* Müll.Arg., which is the same taxon. Therefore, the combination *Mallotus laevigatus* (Müll.Arg.) Airy Shaw is the correct name.

3. Unfortunately, Backer & Bakhuizen van den Brink, in their addenda to the Flora of Java (1968) accidentally reversed the solution of Airy Shaw and they unintentionally created a new combination: *Macaranga laevigatus*. Luckily, an invalid name because references are missing.

4. The leaves on Java and partly on Borneo are narrower and ovate, on Sumatra more elliptic and larger, while many specimens on Borneo have relatively broad leaves. The fruits on Java are smallest, those on Sumatra and Borneo are usually larger.

5. Two specimens from the Malay Peninsula have extra large leaves and long petioles (up to 8.5 cm long): *SF 30028* and *SF 30147*. The base of the leaves is rounded to even emarginate. The two specimens are sterile and might be suckers.

3. Mallotus spinifructus Welzen & S.E.C. Sierra, *spec. nov.* — Fig. 3a–h; Map 3

> *Malloto wrayi* similis, stipulis angustis ad 10 mm longis serotine caducis infra in costa et nervis pilis stellatis strictis, gemmis staminatis pilis stellatis brevibus flavescentibus et simplicibus cinereis admixtis, stigmate glabro satis lato, fructibus spinis multis tenuissimus differt. — Typus: *Leighton 92* (L), Borneo, East Kalimantan, East Kutai Reserve, vicinity of Sengata and Mentoko Rivers, 0°30' N, 117°20' E.

Trees, up to 10 m high, dbh up to 12 cm; flowering branchlets 3–4 mm thick, flattened and somewhat ridged when dry, apical parts stellately hairy, glabrescent; bracts of the terminal buds triangular, c. 1.5 by 0.7 mm. *Indumentum* of simple and stiff, stellately bundled hairs, glandular scales yellowish. *Outer bark* grey to greyish pale brown, firm, smooth; inner bark dull brown, coarsely fibrous. *Stipules* triangular, basally usually quickly decreasing in width, 7–10 by 1–1.7 mm, rather late caducous, outside hairy. *Leaves* opposite, similar in shape, one somewhat smaller; petiole 1–6 cm long, round, hairy, basally and apically pulvinate, especially upper pulvinus well-developed, oblique with blade base partly overlaying; blade ovate to elliptic, 14.5–24.3 by 5–9.5 cm, length/width ratio 2.6–2.9, symmetric, membranous, base cuneate, very base narrowly cordate, margin entire, apex caudate, upper surface basally with one pair of somewhat elliptic extrafloral nectaries, up to 1.1 by 0.9 mm, in upper third usually several small extrafloral nectaries (mainly 0.3 by 0.3 mm) on the nerves, at most slightly hairy on the midrib; lower surface hairy on venation, glandular scales distinct, hair tuft domatia present; venation triplinerved, flat and somewhat indistinct above, raised and distinct beneath, yellowish, 8 or 9 nerves per side, veins and veinlets scalariform. *Inflorescences* racemes, axillary to (pseudo)terminal, single, densely hairy; staminate ones only seen in bud, up to 6 cm long, c. 0.8 mm wide, with groups of up to c. 10 buds, pistillate inflorescences up to 7.5 cm long, a single flower per node; bract triangular, 5.5–6 by 1.3–1.8 mm, densely hairy outside, almost floccose, recurved. *Staminate flowers* only seen in bud, buds globose, pedicelled; pedicel densely hairy; calyx apparently splitting into three sepals, densely hairy outside; stamens perhaps c. 30, anthers separated by connective. *Pistillate flowers* c. 7.5 mm diam., subsessile when young, in fruit pedicel up to 8? mm long, hairy; sepals 5, triangular to ovate, 4.5–5 by 1.3–2 mm, hairy outside, reflexed; ovary 3- (or 4-)locular, densely long spiny, spines not in groups but pointing

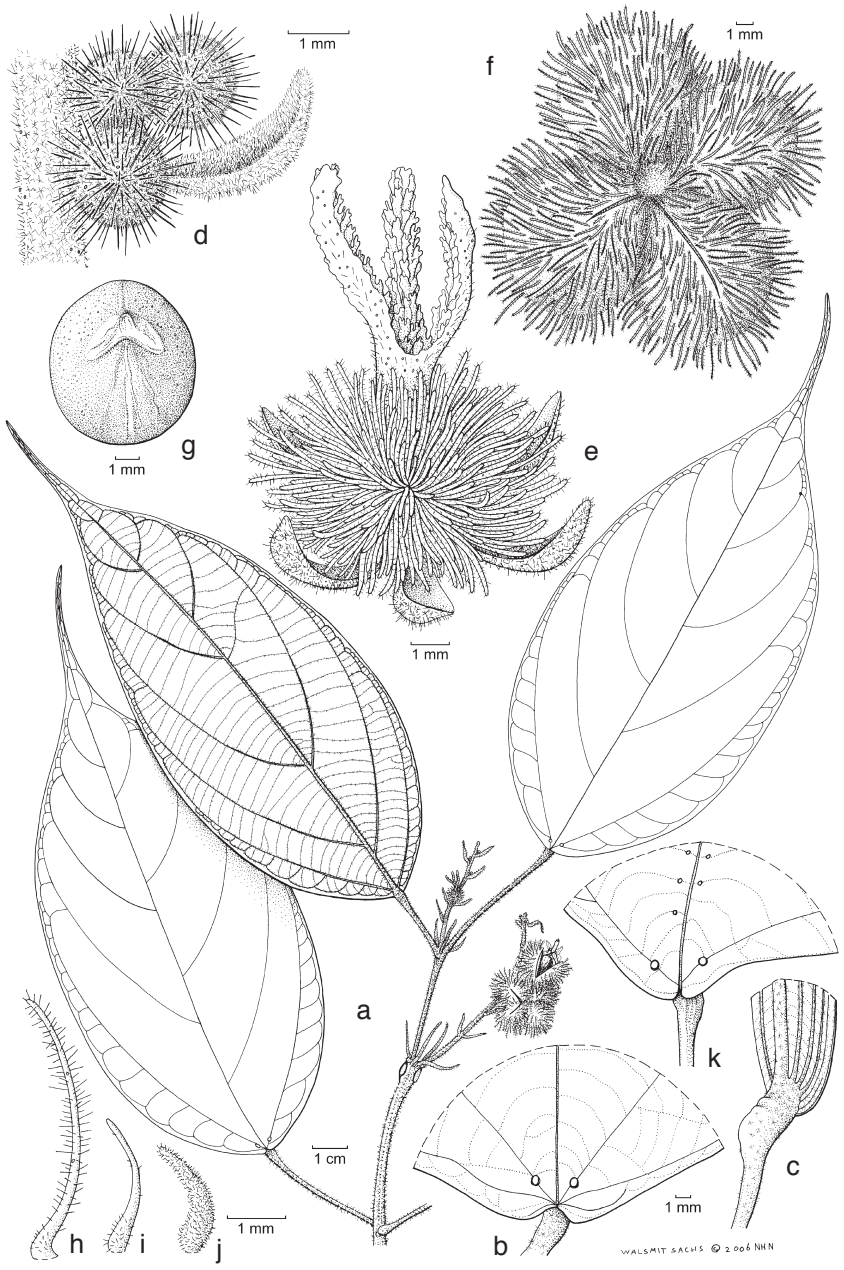
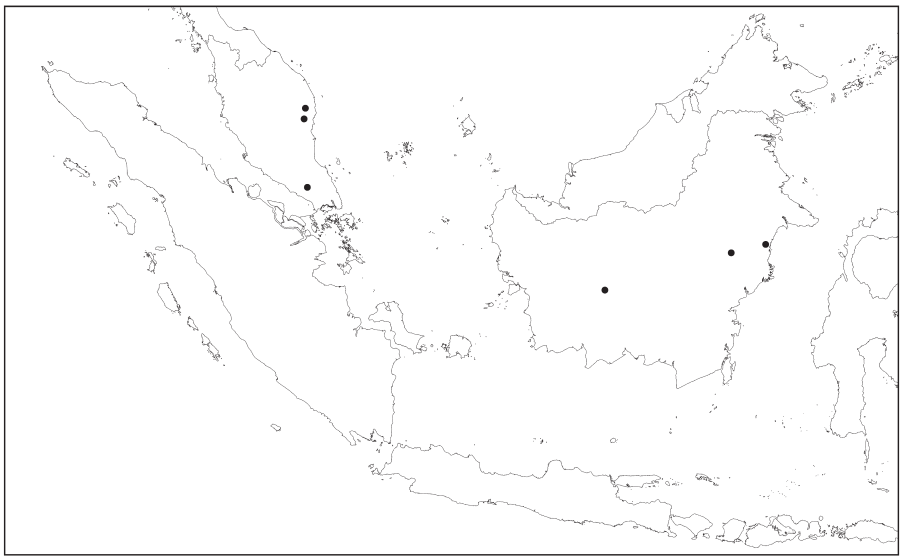


Fig. 3. a–h. *Mallotus spinifructus* Welzen & S.E.C. Sierra. a. Habit; b. base of blade with two extrafloral nectaries; c. abaxial blade attachment; d. staminate buds; e. pistillate flower; f. fruit; g. seed; h. spine of fruit. — i. *Mallotus lancifolius* Hook.f. Spine of fruit. — j, k. *Mallotus caudatus* Merr. j. Spine of fruit; k. basal portion of blade with additional extrafloral nectaries along midrib (a–c, e, f, h: *Leighton 92*, L; d: *J.L. Campbell 48*, BO; g: *Mogea 4335*, L; i: *Church et al. 907*, L; j: *S (Chai) 18902*, L; k: *Kostermans 21077*, L).



Map 3. Distribution of *Mallotus spinifructus* Welzen & S.E.C. Sierra.

all directions, with loose long patent white hairs, glandular scales present; style c. 1.5 mm long, stigmas c. 7 mm long, c. 1 mm wide, with long, branching papillae above, (sub)glabrous beneath. *Fruits* lobed capsules, 1.8–1.9 by 1–1.1 cm, green when immature, spines up to 4.5 mm long, very slender; wall woody, basally c. 0.7 mm thick, apically c. 1.7 mm thick; column broadly T-shaped to obtriangular, c. 5.5 mm long. *Seeds* subglobose 6–8 by 5–7 mm, shiny.

Distribution — Malay Peninsula and Borneo (Central & East Kalimantan).

Habitat & Ecology — (Logged) riverine forest, alluvial soil, well-drained. Altitude 200–300 m. Flowering: September; fruiting: November to January.

Vernacular names — Borneo: Kreh merah (Kutai National Park).

4. Mallotus wrayi King ex Hook.f. — Fig. 1a; Map 4

Mallotus wrayi King ex Hook.f. (1887) 433; Ridl. (1924) 287; M.R. Hend. (1939) 71; Airy Shaw (1960) 361; (1963) 349, p.p. excl. *M. caudatus*; Meijer (1967) 52, p.p. excl. *M. caudatus*; Whitmore (1973) 115, p.p. excl. *M. lancifolius*; Airy Shaw (1975) 171, p.p. excl. *M. caudatus*; (1981) 330; Slik, Priyono & Welzen (2000) 64, f. 43; (2001) 100, f. 5.47. — Lectotype (selected here): *King's collector 3456* (holo K; iso BM, G, SING), Malaya, Perak, at Larut.

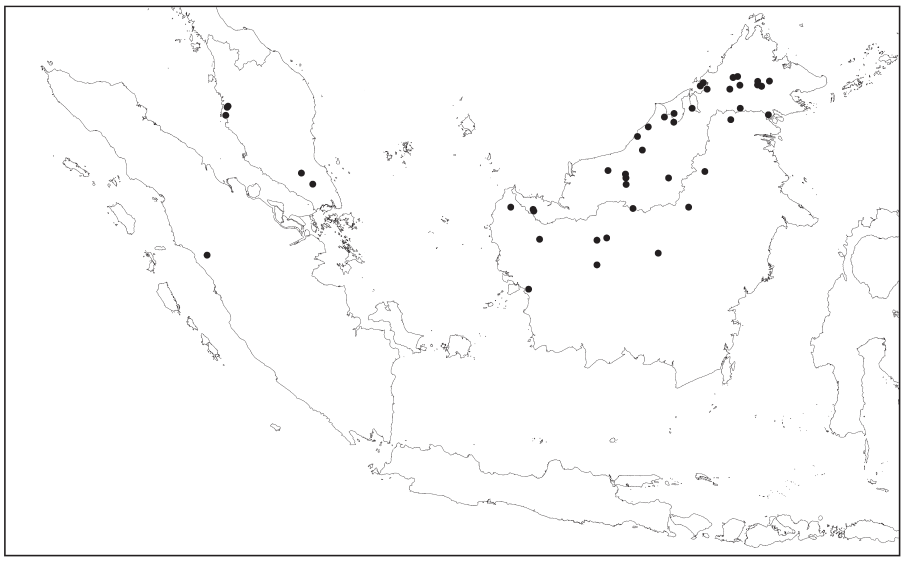
Kunstlerodendron cuspidata Ridl. (1924) 283. — Type: *Ridley 7911* (holo K? n.v.; iso BM, SING), Malaya, Telok Sera, Dindings, February 1896.

Shrubs to trees, up to 8(–23) m high, clear bole up to 15 m high, dbh up to 10(–40) cm; flowering branchlets 2–4 mm thick, flattened and somewhat ridged when dry, (sub)glabrous; bracts of the terminal buds up to 4.5 mm long. *Indumentum* mainly absent, lower leaf blade surface with very thin, translucent white stellate hairs with only horizontal branches; inflorescences with curly brownish simple to stellately grouped

hairs; glandular scales few, yellowish to orangey to dark red. *Outer bark* whitish to grey to green to brownish, smooth; inner bark whitish to yellowish to yellowish brown to pink to brownish red or orange-brown; sapwood white to yellowish to pale orange to pale brown. *Stipules* triangular, c. 8 by 2 mm, very early caducous. *Leaves* opposite, similar shape, one usually somewhat smaller; petiole 0.7–10(–32) cm long, round to adaxially slightly flattened in transverse section, (sub)glabrous, basally and especially apically strongly pulvinate, upper pulvinus oblique; blade partly over upper pulvinus (pseudo-subpeltate), ovate to elliptic (to slightly obovate), 4.5–27 by 1.8–11 cm, length/width ratio 2.3–5, symmetric, membranous to subcoriaceous; base mainly broadly cuneate, very base narrowly cordate, margin entire, usually somewhat undulate, apex cuspidate to caudate; upper surface glabrous, dark green, basally one pair of extrafloral nectaries on basal nerves, elliptic, 0.3–1.3 by 0.2–0.8 mm, sometimes an additional, smaller one along the midrib in basal third, in upper third small extrafloral nectaries on the nerves, circular, c. 0.3 by 0.3 mm; lower surface smooth, somewhat bluish, venation glabrous, in between veins subglabrous to densely hairy (then with silvery sheen), hairs flat against surface, hair tuft domatia present, few glandular scales; venation triplinerved, slightly raised above, raised beneath, nerves 6–9 per side up to the apex, looped and closed near margin, veins scalariform, veinlets laxly reticulate to almost scalariform. *Inflorescences* racemes, axillary to terminal, single to seven together when staminate, greenish brown, hairs curly, patent, ferruginous, glabrescent; staminate ones up to 5(–11) cm long, 0.4–1.2 mm thick, with cymosely flowering groups of up to 5 flowers per node, pistillate ones up to 4(–11) cm long, 0.9–2 mm thick, with few flowers, one per node; bracts ovate, 0.7–2.8(–3.3) by 0.7–1 mm, outside hairy, inside glabrous. *Staminate flowers* 3–4.7 mm diam., whitish to yellowish; buds round to ovoid (see note); pedicel 2–4(–7.8) mm long, hairy; sepals 3 or 4, ovate to elliptic, 2.3–3.2 by 1.2–2 mm, reflexed, hairy, especially outside, glandular scales only outside; stamens 25–40 (high numbers in Malay Peninsula), filaments 0.8–2.2 mm long, glabrous, anthers 0.3–0.4(–0.7) by c. 0.3(–0.7) mm (see note), thecae slightly to very distinctly separated from each other (sometimes in same flower). *Pistillate flowers* c. 3.7 mm diam., green; pedicel up to 4 mm long with an abscission zone in basal half; sepals 3, finally splitting into 5 parts, ovate, 3.5–4 by 0.8–2 mm, yellowish green, mainly hairy outside, glandular scales only outside; ovary (2- or) 3-locular, c. 2 by 2 mm, spines up to 1 mm long, pointing in all directions (not grouped in rows), moderate to dense, purple, mainly glabrous (base excepted); style c. 1.2 mm long, stigmas up to 7 mm long, 0.2–0.7 mm wide, densely papillate above with branching papillae of usually less than 1 mm long, narrow strip of hairs on abaxial side (indistinct by the naked eye). *Fruits* lobed capsules, 13–23 by 6–12 mm, yellow to light orange to purple-orange turning brown to brownish grey, spines up to 5.5 mm long, breaking off; wall woody, inner part 1–1.5 mm thick; column T-shaped, up to 6 mm high. *Seeds* subglobose, 7–9 by 6.5–9 by 6–8.5 mm, brown, shiny.

Distribution — Malay Peninsula, Sumatra (Riau), Borneo.

Habitat & Ecology — Primary (dipterocarp) forest, pole dipterocarp forest, swamp forest, felled forest, secondary forest, hill side, valley side, along rivers; soil brown, yellow (sandy) or red clay, yellow sandy loam; sedimentary rock, basalt, granite derived soil. Altitude 10–1000 m. Flowering: February to April, June to October; fruiting: February, April to July, September to December.



Map 4. Distribution of *Mallotus wrayi* King ex Hook.f.

Vernacular names — Malay Peninsula: Balek angin. Borneo: Brunei: Luta. West Kalimantan: Krotis, Mpore, Sampa. Sabah: Mangki. Sarawak: Bantas.

Notes — 1. *BRUN (Ahmad et al.) 15713* from Brunei is not only exceptional in its extremely long leaves, but more so in its large ovoid staminate buds with very big anthers (c. 0.7 by 0.7 mm instead of c. 0.3 by 0.3 mm).

2. The leaf size and shape is rather variable. Usually the leaves are large, but especially in Sarawak and West Kalimantan many specimens with small, more slender, almost rheophytic leaves are found. These specimens also tend to have somewhat smaller fruits. Specimens show a gradual transition from small and narrow to large and relatively broad. Moreover, there is also no geographical cline as small-leaved specimens are also present in Sabah and large-leaved ones in Sarawak. Therefore, no taxonomic significance is given to the smaller-leaved form.

3. Fruits on Borneo are usually less hairy than those on the Malay Peninsula.

4. The leaves usually only have one basal pair of extrafloral nectaries, sometimes an additional smaller pair is found slightly above the base along the midrib. *Ambriansyah AA 774* (East Kalimantan, Long Sungai Barang) is exceptional in having leaves with often many smaller extrafloral nectaries, a situation usually found in *Mallotus caudatus*.

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IDENTIFICATION LIST

1 = *Mallotus caudatus* Merr
2 = *Mallotus lancifolius* Hook.f.
3 = *Mallotus spinifructus* Welzen & S.E.C. Sierra
4 = *Mallotus wrayi* King ex Hook.f.

Afriastini 612: 2 — Ahmad & Shukor 424: 4 — Ambriansyah AA 774: 4 — Ambriansyah & Arifin Berau 978: 2; Berau 1048: 1 — Arbainsyah AA 304: 1 — Axelius 283: 1.
Backer 16951: 2; 17083: 2 — Balajadia 7074: 1; 7075: 1 — Beccari PS 684: 4 — Bogor Botanical Garden IX.C.25: 2 — BRUN series 3022: 1; 3311: 1; 15346: 1; 15713: 4; 15778: 1; 18132: 1 — Burley, Tukirin et al. 543: 2 — Burut Ho 1759: 1 — Buwalda 6434: 4.
J.L. Campbell 48: 3 — Christensen 1179: 1 — Church 69: 4; 235: 4; 385: 4; 429: 1 — Church et al. 907: 2 — Clemens & Clemens 21259: 1; 30535A: 2; 31766: 2; 32155: 2 — Clemente 4598: 1 — Cuadra A 1002: 1; A 1128: 1; A 2214: 1 — C. Curtis 684: 2.

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Elmer 3735: 2; 5173: 1; 20271: 1; 20314: 1; 21076: 1 — Enggoh 10183: 1; 10642: 1 — Evangelista 726: 1; 922: 1.
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Hallier 3051: 2 — C. Hansen 738: 1 — Haviland 469: 1; 470: 1 — Haviland & Hose 3233: 4 — Hochreutiner 1810: 2 — Hotta 12608: 1 — D. Hou 203: 1.
Ismaël 72: 2.
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Kadir A 27: 1; A 2573: 1 — Kamis 4765: 1 — Kato & Wiriadinata B-4772: 2 — Kato, Okamoto & Walujo B-10212: 2; B-11441: 2 — Keith 7089: 1 — KEP series 95008: 2 — KEP FRI series 3914: 3; 8650: 4; 11585: 4; 13053: 4; 13721: 2; 13740: 2; 13749: 2; 13771: 2; 15871: 4; 17575: 2; 36712: 2 — Keßler et al. Berau 701: 1; Berau 831: 1; Berau 856: 2; Berau 889: 2; PK 1473: 2; PK 2831: 2 — King's collector 3165: 4; 3456: 4; 6628: 4; 7251: 4 — Kirkup 218: 1 — Koorders 2550: 2; 2551: 2; 34294: 2; 40114: 2 — Kostermans 21077: 1; 21092: 2; 23805: 2.
Laman, Rachman & Mirmanto 354: 4; 1174: 4 — Lanjouw 41: 2 — Laumonier 40: 2; 6032: 2; 6062: 2; 6071: 2; 6539: 2 — Leeuwenberg & Rudjiman 13377: 1 — Leighton 92: 3 — Lütjeharms 4358: 2.
Mahyar 907: 2 — Maiden 2433: 1 — Mail 1837: 1 — Maingay KD 1451: 2 — Maliau Basin Conservation Area 594: 4 — McDonald & Ismail 3456: 4 — Meijer 4027: 2 — Mogea 4140: 2; 4335: 3 — Murata, Iwatsuki, Kato & Mogea B-941: 1.
Native Collector 560: 4 — Nicholson Tree 204: 1 — Nooteboom 1446A: 2; 1645: 1; 4062: 2; 4063: 1; 4184: 1; 4351: 4; 4352: 2; 4469: 2.
Ogata 10853: 1 — Ogata et al. Og-B208: 1 — Okada, Mori & Kubo 1363: 4.
Puasa 6797: 1.
Richards 1366: 1 — Ridley 7911: 4 — Ridsdale 2013: 1; PBU 6: 4 — Rutten 62: 1.
S series 4094: 4; 14371: 4; 16494: 1; 18902: 1; 20938: 4; 21739: 1; 21824: 4; 22470: 4; 22838: 1; 22937: 1; 23006: 1; 23080: 1; 23260: 1; 26063: 1; 27240: 1; 27753: 4; 29052: 1; 29697: 1; 32250: 4; 32300: 4; 35436: 2; 41209: 1; 42777: 1; 43044: 4; 43605: 1; 44093: 4; 44329: 4; 46587: 4; 48994: 4; 50175: 1; 54656: 4; 63606: 2; 66209: 1; 66210: 1; 66211: 1; 81286: 4 — Sales 3858: 1 — Sam A 1877: 1 — SAN series 16007: 1; 17803: 1; 19274: 1; 19629: 1; 20818: 1; 21123: 1; 21223: 1; 21378: 1; 21461: 1; 21529: 1; 21708: 1; 26068: 1; 26189: 4; 26273: 1; 26699: 1; 27418: 1; 29771: 1; 30214: 4; 31437: 2; 32496: 1; 33400: 1; 34081: 1; 34863: 1; 34994: 1; 35129: 1; 35566: 1; 36530: 1; 36596: 1; 36702: 1; 36710: 1; 36714: 1; 39950: 1; 44589: 4; 46110: 1; 47168: 1; 47635: 1; 51228: 4; 54535: 1; 56202: 1; 57699: 1; 62293: 1; 62758: 1; 62836: 1; 64954: 1; 65265: 1; 65484: 1; 67029: 1; 67486: 2; 69332: 1; 69364: 4; 72290: 1; 73892: 1; 74476: 2; 74595: 4; 75679: 1; 76060: 1; 76772: 1; 78058: 4; 78080: 4; 78222: 4; 78380: 1; 79240: 1; 82396: 1; 82743: 1; 82805: 1; 83248: 2; 83972: 2; 86904: 1; 89599: 1; 90394: 4; 92018: 4; 96460: 2; 96595: 1; 96951: 1; 97107: 4; 97329: 1; 97657: 4; 99233: 4; 100318: 1; 105341: 2; 109170: 2; 109543: 1; 110032: 1; 110082: 2; 110428: 4; 110911: 2; 111190: 2; 111889: 1; 112336: 1; 114845: 1; 115057: 1; 116945: 1; 117657: 1; 118709: 2; 119478: 2; 120032: 1; 120392: 2; 121222: 1; 124504: 4; 125359: 4; 126005: 4; 126624: 1; 126637: 4; 127037: 1; 128444: 2; 129920: 1; 137000: 2 — Schatz et al. 3247: 1 — SF series 9366: 3; 18960: 1; 27144: 2; 30028: 2; 30147: 2; 39098: 2 — Sidiyasa 1157A: 1 — Sidiyasa et al. Berau 1275: 1 — Simbut A 1618: 1 — Simpson 2141: 4; 2196: 1 — Slik Berau 584: 2 — Slik et al. 13: 2.
Tan, Balslev, Nielsen & Poulsen 74: 4; 115: 4; 141: 4; 182: 4; 295: 4; 346: 4; 352: 4 — TFB series 1201: 2.
Villamil 376: 1.
Warburg 1356: 2 — Wiriadinata 595: 1; 612: 1; 715: 1; 811: 1 — K.M. Wong 2658: 4 — Wood A 2988: 1; A 4111: 1 — Wood & Wyatt-Smith A 4363: 2.
Zollinger 1554: 2; 3704: 2.