

## ARACEAE OF PEAT SWAMP FORESTS

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### INTRODUCTION

Although regarded as ecologically significant, Bornean peat swamps are curiously depauperate of representatives of the Araceae, a family otherwise contributing a substantial percentage of the mesophytic flora of the low to mid-elevation forests of Borneo. Of an estimated total for Borneo of 600 species in 39 genera (Boyce *et al.*, 2010), the peat swamp forests of Sarawak claim only 19 species from 13 genera. Contextually this total is for species occurring in peat swamp alone, and explicitly excludes species from heteroecological habitats that occur within peat swamps, for example karst stacks emerging from oligotrophic water systems (such as occurs at Mulu and Merirai), which carry their own highly specific aroid floras.

Although aroids do not contribute a significant percentage of the floristic biome of peat swamp, a few species may be locally dominant. For example, *Homalomena rostrata* Griff. often forms extensive pure stands, outcompeting any but the most vigorous other species.

Species of *Cryptocoryne*, too, are often found in very large colonies, and furthermore are important indicators of forest quality as they are highly intolerant of suspended alluvium and steep increases in dissolved nutrients that accompany extensive habitat disturbances.

Peat swamp aroids fall into two broadly-defined ecological categories. A minority of species occur in permanently inundated situations. Of these a few occur in open areas and are always helophytic (i.e., *Alocasia sarawakensis* M.Hotta, *Homalomena rostrata*, *Lasia spinosa* (L.) Thwaites). Others favour shaded situations, either occurring as lianes (*Rhaphidophora lobbii* Schott), mesophytes (*Podolasia stipitata* N.E.Br.), or aquatics (*Cryptocoryne*) in forest pools fed by slow-moving oligotrophic streams, or in the streams themselves. However, most aroid species in peat swamp occur on podzols that are at least seasonally drier.

Aroids occurring in Sarawak peat swamp forest are: *Aglaonema nebulosum* N.E.Br., *A. nitidum* (Jack) Kunth, *Alocasia longiloba* Miq., *A. minuscula* A.Hay, *A. sarawakensis*, *Amydrium medium* (Zoll. & Moritz) Nicolson, *Cryptocoryne cordata* Griff. *sensu lat.*, *C. longicauda* Becc. ex Engl., *C. pallidinervia* Engl., *Cyrtosperma ferox*, *Hestia longifolia* (Ridl.) S.Y.Wong & P.C.Boyce, *Homalomena rostrata*, *Lasia spinosa*, *Podolasia stipitata*, *Pothos scandens* L., *Rhaphidophora lobbii* Schott, *Scindapsus coriaceus* Schott *sensu lat.*, *S. pictus* Hassk., and *S. treubii* Engl.

*Alocasia minuscula*, all the *Cryptocoryne*, *Homalomena rostrata* and *Podolasia stipitata* are restricted to peat swamp forest.

*Alocasia minuscula*, *A. sarawakensis*, *Cyrtosperma ferox*, and *Scindapsus coriaceus* are endemic on Borneo.

The definitive floristic account of Bornean peat swamp remains that of Anderson (1963). Of the aroids Anderson lists nine species in nine genera, all from Phase Communities 1 & 2 (Anderson, 1963, 1964). Since these publications there have been nomenclatural and taxonomic changes affecting Anderson's listing. These are tabulated in Table 1.

**Table 1:** Comparison of Araceae listed in Anderson's "The flora of the peat swamp forests of Sarawak and Brunei. Including a catalogue of all recorded species of flowering plants, ferns and fern allies" [Gardens' Bulletin Singapore 20(2):131–228 (1963)], with current taxonomic application.

Anderson, 1963	Current identification	Comments
<i>Aglaonema pictum</i> (Roxb.) Kunth	<i>Aglaonema nebulosum</i> N.E.Br.	Misidentified in Anderson (1963). <i>Aglaonema pictum</i> is restricted to upper hillforest on Sumatera. Clarified by Nicolson (1969).
<i>Alocasia longiloba</i> Miq.	<i>Alocasia longiloba</i> Miq.	-

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<i>Alocasia beccarii</i> Engl.	<i>Alocasia minuscula</i> A.Hay	<i>Alocasia beccarii</i> sensu Engler & Krause (1920) is a species' complex of several ecology-obligated taxa. See Hay (1998).
<i>Cryptocoryne pallidinervia</i> Engl.	<i>Cryptocoryne pallidinervia</i> Engl.	-
<i>Cyrtosperma lasioides</i> Griff.	<i>Cyrtosperma ferox</i> N.E.Br.	Hay (1988) showed <i>C. lasioides</i> to be synonymous with <i>C. merkusii</i> Griff., and in this also included <i>C. ferox</i> . See notes under <i>C. ferox</i> .
<i>Epipremnopsis media</i> Engl.	<i>Amydrium medium</i> (Zoll. & Moritzi) Nicolson	Nicolson (1968) showed <i>Epipremnopsis</i> Engl. and <i>Amydrium</i> Schott to be synonymous.
<i>Homalomena rostrata</i> Griff.	<i>Homalomena rostrata</i> Griff.	-
<i>Podolasia stipitata</i> N.E.Br.	<i>Podolasia stipitata</i> N.E.Br.	-
<i>Rhaphidophora lobbii</i> Schott	<i>Rhaphidophora lobbii</i> Schott	-

**KEY TO ARACEAE OF PEAT SWAMP IN SARAWAK**

- 1a. Lianas . . . . . 2
- 1b. Plants not climbing . . . . . 7
- 2a. Leaves perforated or pandurately lobed; infructescence comprised of separate berries ripening white . . . . . *Amydrium medium*
- 2b. Leaves entire; infructescence a monstercarp with sloughing styler plates or, if individual berries, then these ripening red . . . 3
- 3a. Leaves resembling those of *Citrus*, with the petiole expanded and blade-like; leaf blade with the primary lateral veins on each side of the midrib traversed by one or more intramarginal veins . . . . .  
 . . . . . *Pothos scandens*
- 3b. Petiole not blade-like; primary lateral veins not traversed by intramarginal veins . . . . . 4
- 4a. Leaf blade cordiform; blade epidermis scintillating, almost always with jagged silver blotches; stems markedly scabrid . . . . .  
 . . . . . *Scindapsus pictus*
- 4b. Leaf blade widely to very narrowly elliptic; blade epidermis not scintillating and never with jagged silver blotches, although occasionally with grey banding; stems smooth or weakly scabrid . . . . . 5

- 5a. Leaf blade very strongly unequal; petiole less than 1/5 as long as the blade; petiolar sheath persistent; juvenile plants often with the leaf blades grey-banded. . . . . *Scindapsus treubii*
- 5b. Leaf blade not unequal; petiole more than 1/3 as long as the blade; petiolar sheath marcescent; juvenile plants uniformly coloured leaf blades . . . . . 6
- 6a. Leaf blades stiffly coriaceous; abaxial surface with primary lateral veins not differentiated from the interprimaries; stems terete, smooth . . . . . *Scindapsus coriaceus*
- 6b. Leaf blades softly coriaceous; abaxial surface with primary lateral veins well differentiated from the interprimaries; stems sulcate, weakly scabrid . . . . . *Rhaphidophora lobbii*
- 7a. Plants prickly; spadix with bisexual, tepalate flowers . . . . . 8
- 7b. Plants not prickly; spadix with unisexual, atepalate flowers . . 10
- 8a. Stems suffruticose, erect to decumbent, usually with prickly conspicuous internodes; leaves hastate to pinnatifid; spathe very long and narrow, spiral, opening only slightly at the base, dull yellow to brown; fruit spinulose . . . . . *Lasia spinosa*
- 8b. Stem a condensed rhizome, rarely with distinct internodes, and these then unarmed; leaves entire, sagittate to hastate; spathe not very long, opening flat; fruit smooth. . . . . 9

- 9a. Spathe interior white, infructescence nodding, fruits barely emerging from between the tepals, ripening dull purple; plant with spines mixed straight and up-turned . . . *Cyrtosperma ferox*
  
- 9b. Spathe interior red-purple, infructescence erect, fruits emerging fully from between the tepals, ripening bright red. Plant with spines mixed straight and down-turned . . . *Podolasia stipitata*
  
- 10a. Plants fully aquatic . . . . . 11
  
- 10b. Plants mesophytic or helophytic. . . . . 13
  
- 11a. Terminal part of spathe limb reflexed, not drawn out into a greatly extended tail. . . . . 12
  
- 11b. Terminal part of spathe limb hooded, drawn out into a greatly extended tail; dark purple . . . . . *Cryptocoryne longicauda*
  
- 12a. Limb of spathe rough, usually yellow . . . *Cryptocoryne cordata sens. lat.*
  
- 12b. Limb of spathe red with numerous protuberances . . . . .  
 . . . . . *Cryptocoryne pallidinervia*
  
- 13a. Colonial helophytes with strongly aromatic vegetative tissues; leaf blades very variable, ranging from linear-lanceolate to broadly sagittate; spathe with a marked constriction between the lower part and the limb; entire limb persistent into ripe fruit; mature fruits small, yellow-green . . . . . *Homalomena rostrata*

- 13b. Solitary to clumping mesophytes or helophytes, vegetative tissues odourless; leaf blades of any one species not variable in shape; spathe with or without a strong constriction; spathe falling prior to fruiting, or the lower part persistent and the limb falling . . . 14
- 14a. Plants suffruticose . . . . . 15
- 14b. Plants clumping. . . . . 16
- 15a. Large plants (to ca. 1 m tall); leaf blades oblong with the mid-rib impressed; all veins obscure; spathe ellipsoid, persisting until after anthesis; spadix cylindrical. . . . . *Aglaonema nitidum*
- 15b. Small plants (to ca. 25 cm tall); leaf blades elliptic, with the mid-rib raised; primary lateral veins impressed; spathe globose, falling during anthesis; spadix clavate . . . . . *Aglaonema nebulosum*
- 16a. Leaf blades sagittate to hastate-sagittate . . . . . 17
- 16b. Leaf blades oblong or peltate-elliptic . . . . . 18
- 17a. Massive helophytes; leaf blades very large (ca. 1.5 m long), abaxially pubescent with conspicuously raised interprimary veins; petioles green with scattered dark red glands; inflorescences many together; infructescences with a large (ca. 4 cm long) ellipsoid white persistent lower spathe . . . . . *Alocasia sarawakensis*
- 17b. Moderate mesophytes; leaf blades medium large (up to ca. 50 cm long), abaxially glabrous with interprimary veins flush or only slightly raised; petioles with conspicuous snakeskin patterning;

inflorescences solitary or three together; infructescences with a small (ca. 2 cm long) globose green persistent lower spathe . . .  
 . . . . . *Alocasia longiloba*

18a. Leaf blades oblong, base cuneate; inflorescences many together on a very thin, nodding peduncle; infructescences with persistent lower spathe disintegrating to reveal very small (ca. 3 mm) pale green berries. . . . . *Hestia longifolia*

18a. Leaf blades peltate elliptic; inflorescences solitary on a relatively stout, erect peduncle; Infructescence with persistent lower spathe splitting to reveal large (ca. 5 mm) bright red berries . . . . .  
 . . . . . *Alocasia minuscula*

## SPECIES DESCRIPTIONS

**1. *Aglaonema nebulosum*** N.E.Br., Ill. Hort. 34: 67, t.24. 1887; Nicolson, Smithsonian Contr. Bot. 1: 30–32, Fig.11. 1969. — *Aglaonema minus* Hook.f., Fl. Brit. India 6: 530. 1893. — *A. nanum* Hook.f., Fl. Brit. India 6: 530. 1893. — *A. scortechinii* Hook.f., Fl. Brit. India 6: 530. 1893. — *A. minus* var. *nanum* (Hook.f.) Ridl., Mat. Fl. Malay. Penins. 1907. — *A. minus* var. *scortechinii* (Hook.f.) Ridl., Mat. Fl. Malay. Penins. 1907. — *A. obovatum* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 322. 1922. — *A. pictum* var. *nanum* (Hook.f.) Ridl., Fl. Malay Penins. 5: 102. 1925. — *A. pictum* var. *scortechinii* (Hook.f.) Ridl., Fl. Malay Penins. 5: 102. 1925. — *A. nebulosum* f. *nanum* (Hook.f.) Nicolson, Smithsonian Contr. Bot. 1: 31. 1969.

Small, rather slender weakly suffruticose to decumbent, evergreen herb to 30 cm tall, but usually much less. *Stem* erect, 10-60 cm tall,

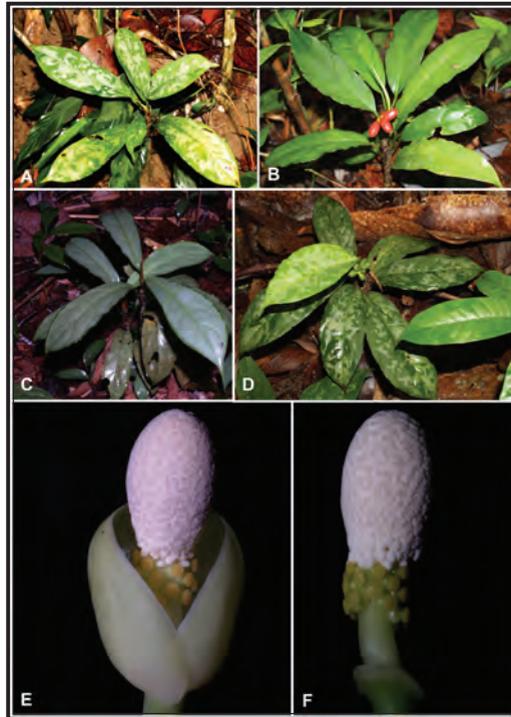
0.5-1.0 cm thick. *Leaves* few together, clustered at the tips of the stems; *petioles* 2-5 cm long, (0.1) 0.2-0.4 times as long as the leaf blade; *petiolar sheath* membranous, ca. over one-third as long as the petiole, 0.5-1.5 (2) cm long; *leaf blade* oblanceolate to narrowly elliptic-oblong, rarely obovate to elliptic, (6.5) 9-18 (20) cm long, (2.5) 3-5.5 (7) cm wide; base obtuse to cuneate; apex often apiculate, acuminate to abruptly acuminate; dull above, either plain or variegated in ashy or silvery irregular blotches, rarely nearly entirely ashy grey with a narrow green margin; *primary lateral veins* usually strongly differentiated into 5-10 or more pairs and adaxially with the midrib strongly blunt-raised. *Inflorescence* solitary, rarely 2 together; *peduncle* 2-4.5 cm long, equalling the petioles; *spathe* globose, apiculate, very light green to white at anthesis, 1.7-2.7 cm long, decurrent for 0.2-0.5 cm, caducous during anthesis; *spadix* clavate, exerted from spathe for 0.5 cm at anthesis, 1.2-2.0 cm long; *stipe* 0.3-1.0 cm long; *pistillate zone* 0.3-0.6 cm long, ca. 0.6 cm thick, *staminate zone* 0.9-1.5 cm long, 0.3-0.4 cm thick at base, × ca. 0.8 cm wide at or above middle, white. *Fruits* ellipsoid, ripening from dark green to dark red. **Figure 1.**

*Distribution.* — Peninsular Malaysia, Singapore, islands off the east coast of Sumatra, Borneo.

*Habitat.* — Peat and freshwater forests, on raised podzols.

*Notes.* — *Aglaonema nebulosum* originally was described from vegetative material cultivated by Linden in Belgium, and reported to have originated on Jawa. All available evidence is against this source, with three other cultivated specimens sent earlier to Brown by Linden and Bull were noted as having originated from Borneo; the species is not known to reach Java. Hooker (1893) did not include *A. nebulosum*, but had three non-variegated collections of material

assignable to this species, each of which he recognized as the type of a new species: *A. minus*, *A. nanum*, and *A. scortechinii*. Ridley (1907) reduced *A. nanum* and *A. scortechinii* to varieties of *A. minus*. Engler (1915), not cite Ridley's work and recognized all the four species: *A. nebulosum*, *A. minus*, *A. nanum*, and *A. scortechinii*, noting that *A. nebulosum* and *A. scortechinii* were "Species imperfecte cognita." Ridley (1925) added a new element of confusion when he reduced *A. minus* to synonymy with *A. pictum* and recognized *A. nanum* and *A. scortechinii* as varieties of *A. pictum*. *Aglaonema pictum* is, to be sure, closely related to *A. nebulosum* but distinct. In *A. pictum* the petiolar sheath is consistently well over half the petiole length while in *A. nebulosum* the sheath is rarely over one-third as long as the petiole. Apparently Ridley confused the species because variegation patterns in the two species are almost identical.



**Figure 1: *Aglaonema nebulosum* N.E.Br.** A-D In various leaf forms, either plain or variegated in ashy or silvery irregular blotches, rarely nearly entirely ashy grey with a narrow green margin. E. At female anthesis. F. Spathe artificially removed to reveal the spadix.

**2. *Aglaonema nitidum*** (Jack) Kunth, Enum. Pl. 3: 56. 1841; Nicolson, Smithsonian Contr. Bot. 1: 33–37, Fig.7 & 13. 1969. — *Calla nitida* Jack, Malayan Misc. 1(1): 24. 1820. — *Arum integrifolium* Link, Enum. Pl. 2: 394. 1822. — *Aglaonema oblongifolium* Schott, Wiener Z. Kunst 1829: 829. 1829. — *A. integrifolium* (Link) Schott in Schott & Endl., Melet.

Bot.: 20. 1832. — *A. princeps* Kunth, Enum. Pl. 3: 55. 1841. — *A. helferi* Hook.f., Fl. Brit. India 6: 529. 1893. — *A. oblongifolium* var. *curtisii* N.E.Br., Gard. Chron., III, 21: 70. 1897. — *A. oblanceolatum* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 322. 1922. — *A. oblanceolatum* f. *maximum* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 323 1922. — *A. nitidum* f. *curtisii* (N.E.Br.) Nicolson, Baileya 15: 126. 1968. — *A. nitidum* var. *helferi* (Hook.f.) Nicolson, Smithsonian Contr. Bot. 1: 37. 1969. — *A. nitidum* f. *cinereum* Jervis, Aglaonema: 31. 1980.

Medium to large, somewhat robust, pachycaul or decumbent, evergreen herb, to 2 m tall. *Stem* erect or with lower part reclining on ground in larger plants, 0.5–5 cm thick. *Leaves* several to rather many together, usually restricted to the terminal portion of stems in larger plants; *petioles* deeply channelled, (8–)11–26(–29) cm long; *petiolar sheath* extending to the petiole tip, margins scarious; *leaf blade* narrowly elliptic to narrowly oblong or oblanceolate, 11–50 × 4–20 cm, base cuneate to attenuate, rarely broadly acute, apex acuminate to broadly acute or shortly acuminate, apiculate, coriaceous, usually plain green, sometimes with grey variegation either in bars following the venation or in rather irregularly scattered blotches; *venation* barely or not differentiated in fresh and dry material but sometimes *primary veins* weakly differentiated into 5–9 or more primary lateral veins. *Inflorescences* 2–5 together; *peduncle* 5–21 cm long, equalling or surpassing the subtending petiole; *spathe* oblong, 3–8.5 cm, decurrent for 4–20 mm, white at anthesis, becoming green during fruiting, persistent until fruit full-sized but still green, then marcescent; *spadix* cylindrical, equalling or slightly exceeding spathe, 1.3–7 cm, stipitate; *stipe* 0.2–0.9 cm long; *pistillate zone* (0.2–)0.5–1.0 cm long with 16–37 flowers; *staminate zone* 1.1–6.0 × ca.1.5 cm, white. *Fruits* ellipsoid, green, changing to white then pink and finally red. **Figure 2.**

Distribution. — Thailand, Peninsular Malaysia south to Sumatera, and Jawa, and west to Borneo.

Ecology. — Lowland to upper hill evergreen gallery forest wet or dry evergreen forest, and peat-swamp forest.

Vernacular. — Not recorded.

Notes. — A distinctive species immediately identifiable in the field by the large smooth leaves with the primary lateral veins very obscure. There has been considerable confusion in herbaria between *A. nitidum* and *A. simplex*, although the latter is readily identifiable by the thinly textured leaves with strongly differentiated primary lateral veins, and a spathe limb caducous at the onset of staminate anthesis.

Populations of *A. nitidum* in peat swamp forest are almost always silver-grey variegated adjacent to the primary veins. These plants equate to *A. nitidum* f. *curtisii*.

See Nicolson (1969) for the complex typification details.



**Figure 2: *Aglaonema nitidum* (Jack) Kunth.** A. Evergreen forest population B. At female anthesis. C. The fruits mature from green through white to pink and finally scarlet.

**3. *Alocasia longiloba*** Miq., Fl. Ned. Ind. 3: 207. 1856; Hay, Gard. Bull. Singapore 50: 299. 1998. — *Alocasia cuspidata* Engl., Bot. Jahrb. Syst. 25: 25. 1898. — *Alocasia amabilis* W.Bull, Cat. 143: 9. 1878. — *Alocasia cochinchensis* Pierre ex Engl. & K.Krause in Engl., Pflanzenr. IV, 23E (Heft 71): 103. 1920. — *Caladium veitchii* Lindl., Gard. Chron. 1859: 740. 1859. — *Alocasia veitchii* (Lindl.) Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 125. 1863. — *Alocasia lowii* var. *veitchii* (Lindl.) Engl. in A.DC.

& C.DC., Monogr. Phan. 2: 508. 1879. — *Alocasia amabilis* W. Bull, Retail List 143: 9. 1878.

Small to moderately robust, evergreen to sometimes seasonally dormant, terrestrial (occasionally lithophytic) herbs to 150 cm tall. *Stem* usually rhizomatous, erect to decumbent, often completely exposed, ca. 8–60 × 2–8 cm, bearing remains of old leaf bases and cataphylls. *Leaves* often solitary, occasionally up to 3 together, each subtended by conspicuous lanceolate papery-membranaceous often purplish-tessellate cataphylls degrading to papery fibres; *petioles* terete, ca. 30–120 cm long, sheathing in the lower ca. ¼ or less, glabrous, purple-brown to pink to green, strikingly obliquely mottled chocolate brown (snakeskin pattern); *leaf blade* pendent, hastate-sagittate, rather narrowly triangular, 27–85 × 14–40 cm, dark to very dark green, usually with the major venation grey-green adaxially, and abaxial surface either green or flushed purple, posterior lobes peltate for (5–)10–30% of their length, acute; anterior costa with 4–8 *primary lateral veins* on each side, the proximal ones diverging at ca. 60–100°; *axillary glands* conspicuous; *secondary venation* initially widely spreading, then deflected towards the margin; *interprimary collective* veins weakly formed and zig-zagging at widely obtuse angles. *Inflorescences* solitary to paired, up to 4 pairs in succession without interspersed foliage leaves; *peduncle* 8–18 cm long, resembling petioles, erect at first, then declinate; *spathe* 7–17 cm long, abruptly constricted ca. 1.5–3.5 cm from the base; lower spathe ovoid to subcylindrical, green; *spathe limb* lanceolate, canoe-shaped and longitudinally incurved, 5.5–7.5 cm, eventually reflexing after staminate anthesis, membranous, pale green; *spadix* somewhat shorter than to subequalling the spathe, ca. 6–13 cm long, stipitate, *stipe* conical, to 5 mm long, whitish; *pistillate zone* 1–1.5 cm; *interstice* 7–10 mm, narrower than the fertile zones, corresponding with the

spathe constriction; *staminate zone* subcylindrical, somewhat tapered at the base, 1.2–2.5 × 4.5–8 mm, ivory white; *synandria* 4–6-merous, more or less hexagonal, ca. 2 mm diam.; *appendix* 3.5–9 cm long, about the same thickness as the staminate zone, demarcated from it by a faint constriction, subcylindrical, distally gradually tapering to a point, very pale orange to bright yellow; *fruits* globose-ellipsoid, ca. 1.5 × 0.75 cm, green, ripening orange-red. **Figure 3.**

Distribution. — Cambodia, Laos, S Vietnam north to S.W. China, south to Peninsular Malaysia, Sumatera, Jawa and Borneo.

Ecology. — Rainforest and regrowth understory, in swampy areas and well drained slopes, occasionally on rocks. 0–500 m asl.

Notes. — The leaf blades of *Alocasia longiloba* are highly variable. There exist numerous local populations, of which some have been described as separate species, often from cultivated plants. However, peat swamp populations in Sarawak seem remarkably uniform.

For discussion of the extensive and complex synonymy see Hay (1998).



**Figure 3:** *Alocasia longiloba* Miq. A & B. Leaf blade pendent, hastate-sagittate, rather narrowly triangular, dark green. C. Petiole snakeskin-like. D. Synflorescence. E. Inflorescence at female anthesis. F. Infructescence brightly orange, bird dispersed.

**4. *Alocasia minuscula*** A.Hay, Gard. Bull. Singapore 50(2): 320. 1998.

Diminutive herb 10–20 cm tall. *Stem* suberect, ca. 1 cm diam., condensed, rooting along its length and clothed in old leaf bases and marcescent cataphylls. *Leaves* several to 9 together, interspersed with papery-membranous cataphylls to ca. 5.5 m long (these occasionally bearing reduced petiole and blade); *petiole* 5–10 cm long, sheathing in

the lower ca.  $\frac{1}{2}$ ; *leaf blade* narrowly ovate to oblanceolate,  $8 \times 2-13 \times 3$  m, peltate, coriaceous, pale abaxially, anterior lobe 7-10.5 cm long, the tip acuminate for ca. 1 cm; anterior costa with *primary lateral veins* 8-10 on each side, diverging at  $60-45^\circ$  then somewhat up-curved and joining a marginal vein, posterior lobe almost completely united save for a ca. 2 mm incision at the extrema base of the leaf, combined posterior lobes attenuate, 1–2 cm long. *Inflorescence* solitary; peduncle about the same length as the petioles at anthesis, later extending somewhat; *spathe* 3.5-4 cm long; *spadix* shorter than the spathe, ca. 2 cm long, *stipe* ca. 3 mm, the fertile zones entirely within the lower spathe; *pistillate zone* 3 mm long; *interstice* ca. 2 mm long; *staminate zone* 5 mm long; *appendix* ca. 6 mm long, cylindric. *Fruiting spathe* ca. 1.5 m diam., berries red-orange.

Distribution. — Endemic to Borneo; Sarawak.

Ecology. — In lowland peat swamp forest.

Notes. — *Alocasia minuscula* can be readily distinguished from *A. beccarii* and *A. peltata*, which it closely resembles, in its narrow peltate leaf shape and reduced posterior lobes, in its diminutive stature, by the distinctive pattern of leaf venation. The primary veins are much more numerous, and characteristically some appear, in the dried state, not to reach the midrib. *Alocasia minuscula* appears restricted to peat swamp forest, while *A. beccarii* and *A. peltata* are hill forest species.

**5. *Alocasia sarawakensis*** M.Hotta, Acta Phytotax. Geobot. 22: 159. 1967; Hay, Gard. Bull. Singapore 50(2): 247–249. 1998.

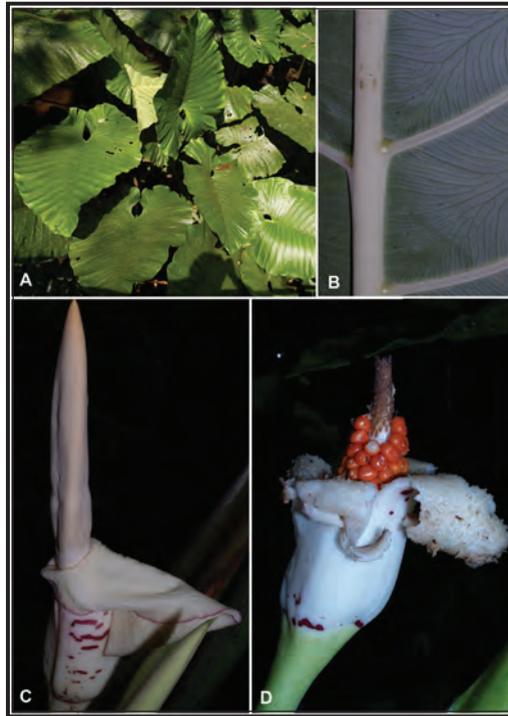
Massive arborescent herb. *Stem* more or less erect, to c. 15 cm diam., to 70 cm tall. *Leaves* several together with the blades erect to oblique; *petiole* to 130 cm long, sheathing in the lower  $\frac{1}{3}$ - $\frac{2}{5}$ , pale dull green, very slightly rough, with numerous glands mainly in the sheathing portion; *leaf blade* somewhat glossy mid-green above, paler below, glabrous in adult plants, abaxially hairy in juveniles, cordato-sagittate, c. 90 cm × 80 cm; anterior lobe c. 60 cm long, with the margins slightly undulate; posterior lobes c. 35 cm long, rounded, held somewhat above the plane of the anterior lobe; posterior costae diverging at c. 80-90°, naked in the sinus for c. 2 cm; *primary lateral veins* 10-12 on each side of the anterior costa diverging at c. 45°; secondary veins forming very well-defined interprimary collective veins; glands conspicuous in axils of primary veins and very large at junction of petiole with costae, yellowish green. *Inflorescence* very numerous, to c. 40 crowded in the centre of the leaf crown from within the cataphylls, with a few scattered glands, pale dull green, c. 2 cm diam; *spathe* c. 19 cm long; lower spathe 7 cm × 2.5 cm and somewhat flattened, white with a basal ring of confluent glands, these at first shiny white, becoming purple, the remainder of the lower spathe with scattered ellipsoid glands aligned transverse to the long axis of the spathe and somewhat clustered at about  $\frac{2}{3}$  of the way up the lower spathe; spathe limb white, to 12 cm long, erect at pistillate anthesis, then sharply reflexed and rolled back at staminate anthesis, broadly lanceolate, to 5 m wide, horizontally wrinkled abaxially; *spadix* to c. 16 cm long, stipitate for c. 5 mm, *stipe* white; *pistillate zone* 2.5 m long c. 1.5 cm wide at base, distally somewhat tapering; *staminate zone* 3 cm × 1 cm, partly within the

lower spathe chamber; synandria  $\pm$  hexagonal, opening by apical pores not overtopped by synconnective, 6-8-merous, ivory; *appendix* apricot coloured, 9 cm long, 1.5 cm diam., tapering to a point, the surface covered with horizontally elongate, sinuous staminodes. *Fruiting* spathe white, dehiscing longitudinally; fruits red. **Figure 4.**

Distribution. — Endemic to Borneo; in Sabah and Sarawak.

Ecology. — Common in open swampy places; often seen in roadside ditches; encountered in swampy places in forest as a hairy juvenile; from sea level to c. 1200 m altitude.

Notes. — This species is easily distinguished from *A. robusta* and *A. macrorrhizos*, which sometimes all occur together and resemble each other in the very large broad leaves and preference for open habitats, by the very prominent venation on the abaxial side of the leaf blade, forming well defined interprimary collective veins. It can be distinguished further from *A. robusta* by having the posterior costae naked in the sinus and the abaxial side of the lamina not glaucous (Hay, 1998).



**Figure 4: *Alocasia sarawakensis* M.Hotta.** A. Massive arborescent herb. B. Leaf blade abaxially pubescent with numerous glands. C. Inflorescence with reflexed spathe limb. D. Infructescence revealing orange fruits.

**6. *Amydrium medium*** (Zoll. & Moritzi) Nicolson, *Blumea* 16: 124. 1968. — *Scindapsus medius* Zoll. & Moritzi in H.Zollinger, *Syst. Verz.*: 82. 1854. — *Anadendrum medium* (Zoll. & Moritzi) Schott, *Bonplandia* 5(3): 45. 1857. — *Rhaphidophora huegelii* Schott, *Prodr. Syst. Aroid.*: 384. 1860. — *Scindapsus huegelii* (Schott) Ender, *Index Aroid.*: 74. 1864. — *Epipremnum medium* (Zoll. & Moritzi) Engl. in A.DC. & C.DC., *Monogr. Phan.* 2: 250. 1879. — *Rhaphidophora korthalsiana* Engl. in

A.DC. & C.DC., Monogr. Phan. 2: 250. 1879. — *Epipremnopsis media* (Zoll. & Moritzi) Engl. in Engl., Pflanzenr. IV. 23B (Heft 21): 1. 1908. — *E. huegelii* (Schott) Engl. in Engl., Pflanzenr. IV, 23B (Heft 21): 138. 1908. — *Epipremnum truncatum* Engl. & K.Krause in Engl., Pflanzenr. IV, 23B (Heft 21): 63. 1908. — *Epipremnopsis subcordata* M.Hotta, Acta Phytotax. Geobot. 22: 2. 1966.

Evergreen, medium-sized, somewhat robust, hemiepiphytic lianes to 10 m. *Stem* (adult) root-climbing, producing long flagelliform shoots with reduced cataphylls and scattered foliage leaves. *Leaves* remote from one another, the nodes between foliage leaves bearing papery cataphylls, although foliage leaves a few together at the tips of stems; *petiole* 15–35 cm, pulvinate apically and basally; *petiolar sheath* very short, barely exceeding the basal pulvinus; *leaf blade* (adult) ovate-cordate or pandurate–trilobed, 12–45 × 9–25 cm, largest leaves with several to many round to oval perforations near midrib, (juvenile) entire to once or twice perforated, rarely pinnatisect; deep glossy green to markedly greyish or strikingly bluish; *primary lateral veins* pinnate, running into marginal vein; *higher order venation* wholly reticulate. *Inflorescence* 1–several in each floral sympodium; *peduncle* erect, much shorter than petiole, 4–10 cm, subtended by several membranous, later papery cataphylls; *spathe* conchiform to ovate, apiculate, reflexed at anthesis and then caducous, very occasionally marcescent, ca. 9 × 7 cm, white; *spadix* stipitate, ca. 4–6 × 1 cm, white to cream, stipe obliquely inserted onto spadix, 0.5 cm, green; *pistillate zone* obpyramidal or obconoid, tetragonal; *stylar region* broader than ovary, ca. 3.5 × 2 mm, slightly prominent centrally below stigma, otherwise ± truncate; *stigma* small, hemispherical to transverse-linear. *Infructescence* comprising individual subglobose berries, these ca. 1 cm diam., domed at apex, ripening white. **Figure 5.**

Distribution. — S Burma and S Thailand through Peninsular Malaysia and Sumatera to Jawa, Borneo, and the Philippines.

Ecology. — Perhumid to wet primary to disturbed evergreen and peat swamp forest on a wide variety of substrates. 0–450 m asl.

Notes. — The ovate-cordate leaves with pandurate lobing and large perforations are immediately diagnostic. The pendent infructescences comprised of large discrete berries ripening white are unmistakable.



**Figure 5: *Amydrium medium* (Zoll. & Moritzj) Nicolson.** *Amydrium medium* is unusual among hemi epiphytic monsteroids in remaining small, usually climbing less than 4 m, and thus flowering low on the tree trunk. Adult plants have the leaves both perforated and pinnately divided (A). Juvenile plants have less elaborately divided leaves (B). As in most Monstereae the spathe is shed during anthesis (C), but unlike most the fruits are indehiscent berries (D).

**7. *Cryptocoryne cordata*** Griff., Not. Pl. Asiat., 3: 138. 1851 & Icon. Pl. Asiat., 3: tab. 172. 1851; Ridley, Fl. Malay Pen. 5: 86. 1925. — *C. kerrii* Gagnep., Notul. Syst. 9,3: 132. 1941. — *C. siamensis* var. *kerrii* (Gagnep.) Rataj, Revision of the Genus *Cryptocoryne* Fischer, Stud. Ceskoslov. Akad. Ved., č. 3, 93. 1975. — *C. stonei* Rataj, Revision of the Genus *Cryptocoryne* Fischer, Stud. Ceskoslov. Akad. Ved., č. 3, 95. 1975.

*Rhizome* somewhat rugged and slender. *Runners* slender. *Cataphylls* sometimes present in non-flowering specimens. *Leaves* variable, smooth to somewhat bullate, upper surface dark green with markings to purplish or purple, lower surface paler with reddish veins or shades to dark red; *leaf blade* narrowly ovate to cordate, (3–) 5–15 (–20) × 2–12 cm; *petiole* 5–50 cm long, longest in continuously submerged specimens from slow-running water. *Spathe* 7–35 (–50) cm long, white on the outside, sometimes brownish/greenish towards the apex; *peduncle* 2–5 cm; *kettle* white inside, 1–3 cm long; *tube* 4–40 cm long, white inside; *limb* more or less flat, 2–5 cm long, more or less backwards twisted, ovate with a shorter or longer point, surface more or less smooth, yellow to red-brownish shaded, if shaded, then more intensively so towards the margins and the apex; *collar* broad, yellow, gradually merging into the white tube; *pistillate flowers* 5–8 whitish; *stigma* rounded, ovate to emarginate, occasionally three-partite, and more or less upright; *olfactory bodies* round to irregular, somewhat rugose on the upper surface, yellowish; *staminate flowers* 30–60 (–80). *Infructescence* more or less purplish, ovoid, broad and shortly pointed, 1.5–2 cm long, surface smooth or with rounded protuberances. *Seeds* brownish, rugose, 5–10 mm long; endosperm present, embryo conical with an undifferentiated plumula.

Distribution (*C. cordata* sensu lat.). — Peninsular Thailand, Peninsular Malaysia, Sumatera, Borneo

Ecology. — Small or large streams with slow or more quickly running water under acid conditions in lowland peat swamp forests, where it usually occurs submerged.

Notes. — The identity and circumscription of *C. cordata* has been a matter of discussion for a number of years. Recently *C. grabowskii* Engl. (Borneo), *C. zonata* De Wit (Borneo), and *C. diderici* De Wit (Sumatra), all with a *chromosome number* of  $2n = 68$ , have been referred to *C. cordata* at the variety level (Jacobsen, 2002).

**8. *Cryptocoryne longicauda*** Becc. ex Engl., Bull. Soc. Tosc. Ort. 4: 302. 1879. — *C. johorensis* Engl., Pflanzenreich IV, 23, F: 244. 1920.

*Rhizome* rather slender; plants from deep water with long internodes. *Runners* long and slender. *Cataphylls* only present in flowering specimens. *Leaves* green, occasionally evenly purple; *leaf blade* ovate, with a cordate base, 3-15 cm long, 3-10 cm broad, surface smooth to rough to strongly bullate, margin entire to finely undulate; *petiole* 5-30 cm long (largest specimens in deep, slow running water; smaller specimens more or less emerged in forest pools). *Spathe* 20-50 cm long, sometimes long pedicellate; *kettle* 1-2 cm long, white; *tube* 8-20 cm long, the upper part more or less purple on the outside; *limb* 15-30 cm long, caudate; collar present, dark red to black purple, sometimes yellowish; limb dark red to black purple, rugose, the tail sometimes whitish; *pistillate flowers* 5-7, *stigmas* ovate to elliptic, the upper part more or less emarginated; *staminate flowers* 30-50, smooth, olfactory bodies whitish, rounded. *Infructescence* ovoid, seeds brownish, more or less smooth; endosperm present, embryo in the fully developed seed with several plumular processes. **Figure 6.**

Distribution. — Peninsular Malaysia (Johor), Sumatera, Borneo.

Ecology. — Forming large stands in more or less slow running rivers, or in lowland forest pools, mostly in deep mud. In small forest streams, the plants can form luxurious growths that cover the whole bottom and sides while, in forest pools, the specimens are smaller and more scattered (Jacobsen, 1985).



**Figure 6:** *Cryptocoryne longicauda* Becc. ex Engl. A. In its natural habitat at Mulu National Park. B. Spathe long pedicellate C. Spathe artificially removed to reveal the spadix.

**9. *Cryptocoryne pallidivenia*** Engl., Bull. Soc. Tosc. Ort. 4: 301. 1879. — *C. venemae* De Wit, Belmontia 13: 279. 1970. — *C. pallidivervia* Engl. ssp. *venemae* (De Wit) De Wit, Aquarium planten 219. 1983.

*Rhizome* rather slender. *Runners* slender. *Cataphylls* only present in flowering specimens. *Leaves* green, ovate with a cordate base; *leaf blade* 3-7 cm long, 24 cm broad, surface smooth to strongly bullate, margin some- times finely undulate, appearing denticulate; *petiole* 5-10 cm long. *Spathe* 6-10 cm long; *kettle* ca. 1 cm long, black purple inside; *tube* 3-8 cm long, brownish, white outside; *limb* ca. 1 cm long, ovate, more or less re- curved, surface with red protuberances; collar zone present, yellowish with small red spots that become smaller towards the throat; *pistillate flowers* 4-7, stigmas ovate to somewhat emarginated, olfactory bodies yellowish, rounded; *staminate flowers* 30-50, smooth, situated on a short sterile spadix immediately above the olfactory bodies. *Infructescence* unknown.

Distribution. — Endemic to Borneo.

Ecology. — A plant of lowland forests where it grows in slow running rivers and streams, and in seasonally inundated forest pools.

Notes. — *Cryptocoryne pallidinervia* is characterized by the cordate, more or less bullate leaves. The spathe has a long tube, the limb is red with protuberances, and the collar zone is yellowish with red spots. The spadix has the staminate and pistillate flowers situated adjacent to each other.

**10. *Cyrtosperma ferox*** N.E.Br. & L. Ill. Hort. 39: 59, t.153. 1892.

Large to massive rhizomatous herbs. 1 m or more tall, usually solitary, sometimes clump-forming, rhizome thick, condensed, creeping. *Leaves* several, held spreading; *petiole* sometimes very long, mottled and usually heavily armed, spines mixed straight and up-turned, sheath short. *Leaf blade* deeply sagittate, hastate-sagittate; veins sometimes aculeate on lower surface; basal ribs very well-developed, *primary lateral veins* pinnate, running into marginal vein, higher order venation reticulate. *Inflorescence* solitary, appearing with the leaves; *peduncle* long, similar to petioles; *spathe* marcescent, erect, blackish purple, interior white, convolute in lower part, upper part rarely somewhat fornicate, long-acuminate and twisted; *spadix* stipitate; *flowers* bisexual, perigoniate; tepals 4–6, somewhat thickened at apex, fornicate; *pistillate flowers* 1-locular, ovules 1–many, stelar region short or inconspicuous, stigma subhemispheric, exuding droplet at anthesis; *staminate flowers* 4–6, free, filaments free, flat and broad, connective slender, thecae oblong-ovate, dehiscent by apical slit. *Infructescence* nodding, fruits barely emerging from between tepals, ripening dull purple. **Figure 7.**

Distribution. — Endemic to Borneo.

Habitat. — Lowland freshwater swamp forest margins, sometimes persisting in flooded pasture, or in swampy areas of lowland perhumid broadleaf evergreen tropical forest, sometimes on kerangas.

Notes. — The majority of *Cyrtosperma* occur in Papuasia, with only one or two species in Borneo. The most commonly met with is *C. merkusii* (Hassk.) Schott, a large plant (2 m or more tall) plant almost always found in open swampy places in association with habitation, has leaves held erect and petioles normally only lightly armed.

Occasionally, much more heavily armed smaller plants with spreading leaves are encountered in wet areas in forest, often along water courses, and these equate to *C. ferox* N.E.Br. The most recent revision (Hay, 1988) merges *C. ferox* and *C. merkusii*, although in Sarawak at least they are consistently distinct in terms of morphology and ecology (Boyce *et al.*, 2010).



**Figure 7: *Cyrtosperma ferox* N.E.Br.** A. Young plant showing the distinctive leaves. B. Detail of the petiole bases with their distinctive ascending prickles. C. Inflorescence at pistillate anthesis. Note the conspicuous stigma droplets. D. Mature infructescence. The nodding posture, marcescent-persistent spathe, and fruits barely emerging from the surrounding tepals are diagnostic in Borneo.

**11. *Hestia longifolia*** (Ridl.) S.Y.Wong & P.C.Boyce., Bot. Studies. 51: 252. 2010. —*Schismatoglottis longifolia* Ridl. J. Bot. 40: 37. 1902.

Herbaceous mesophyte. *Stem* pleioanthic, epigeal, erect to decumbent. *Leaves* few to many, often clustering terminally; petiole usually glabrous, sometimes minutely puberulent, leaf sheath fully attached, tapering, persistent to slowly degrading in the marginal distal part; *leaf blade* oblanceolate to ovato-sagittate, sometimes variegated, glabrous adaxially and abaxially, basal cuneate to sagittate, apex acute to long acuminate; *primary and secondary venation* bipinnate, tertiary venation obscure. *Inflorescence* solitary or synflorescence, up to 5 together; spathe long, up to 20 cm; lower spathe, ovoid, differentiated from the spathe limb with gradual or abrupt constriction; spathe limb oblong-lanceolate, upper spathe persistent until well after anthesis, then delisquescing, opening only slightly, the distal portion remaining convolute, with only the ventral part of the staminate zone exposed; *spadix* equaling or less than spathe; *pistillate zone*, more or less cylindrical, obliquely inserted to adnate for up to  $\frac{1}{3}$  of its length; *interstice* prominent, mostly naked with a few groups of small more or less sessile staminodes; *staminate zone* cylindrical to slightly tapering, the lower part corresponding with the spathe constriction; *appendix* present. *Fruiting spathe* urceolate.

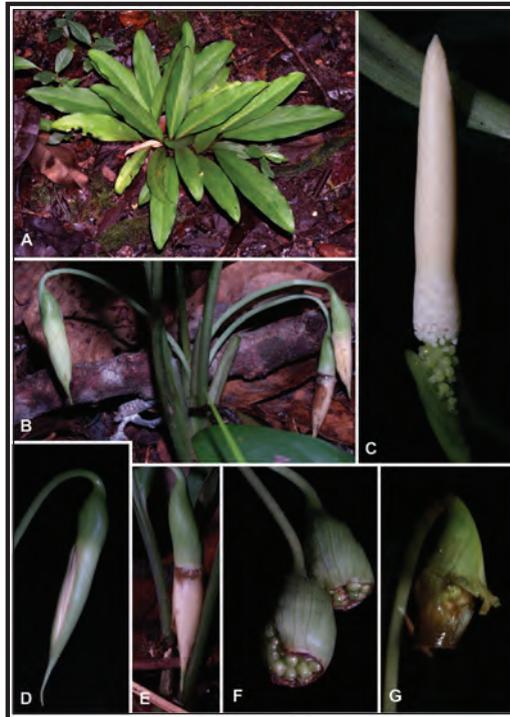
**Figure 8.**

*Distribution.* — Disjunct between the Malay Peninsular, where it is known to only from Perak, and Borneo, where it is known from numerous but widely scattered localities in Sarawak and Brunei.

*Ecology.* — In kerangas formations in lowland rain forest and lowland hill forest, and regrowth, always occurring on raised podsols in swampy areas, sometimes near streams to c. 250 m alt.

Notes. — This is a very distinctive genus easily recognised by the rather numerous nodding inflorescences on relatively very long slender wiry peduncles. There is only a weak constriction present between the lower spathe and upper spathe and the orifice of the lower spathe is open during fruiting. The entire non-pistillate portion of the spadix often dries and adheres to the spathe limb with the whole combined unit shedding.

*Hestia longifolia* has vegetative modules that readily disarticulate from the deep-seated rhizome. The function of the disarticulation in this podsol-obligated species is not clear, but it is speculated that it may be an adaption to fire resistance in a highly fire-prone habitat. Perhaps enabling the shoot unit to be destroyed in some way prevents damage to the main perennating system (Wong and Boyce, 2010).



**Figure 8: *Hestia longifolia* (Ridl.) S.Y.Wong & P.C.Boyce.** A. Plant in habitat on podsol. B. Nodding inflorescences, the inflorescence to the left at pistillate anthesis; upper right at staminate anthesis, lower right post-anthesis with spathe beginning to degrade prior to being shed. C. Spadix with the spathe removed artificially to reveal the pistillate and staminate flower zones. D. Spathe slightly gaping at pistillate anthesis. E. Inflorescence post-anthesis with spathe limb rotting at junction of lower spathe, later to be shed together with spent part of spadix. F. Infructescences with the distinctive narrowly campanulate lower spathe. G. Fruits.

**12. *Homalomena rostrata*** Griff., Not. Pl. Asiat. 3: 154. 1851 ('*roshalum*'); Wong *et al.*, Gard. Bull. Singapore 62 (2): 106–112, Fig.3. 2011. — *Cyrtocladon sanguinolentum* Griff., Not. Pl. Asiat. 3: 147. 1851. — *Chamaecladon sanguinolentum* (Griff.) Schott, Prodr. Syst. Aroid.: 316. 1860. — *Homalomena sagittifolia* Jungh. ex Schott, Prodr. Syst. Aroid.: 311. 1860. — *H. miqueliana* Schott, Ann. Mus. Bot. Lugduno–Batavi 1: 126. 1863. — *H. propinqua* Schott, Ann. Mus. Bot. Lugduno–Batavi 1: 280. 1864. — *H. beccariana* Engl., Bull. R. Soc. Tosc. Ort. 4: 296. 1879. — *H. paludosa* Hook.f., Fl. Brit. India 6: 53. 1893. — *H. sagittifolia* var. *pontederiifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 172. 1905. — *H. ridleyana* Engl., Bot. Jahrb. Syst. 37: 123. 1907. — *H. teysmannii* Engl. in Engl., Pflanzenr. IV, 23Da (Heft 55): 68, Fig.43. 1912. — *H. raapii* Engl. in Engl., Pflanzenr. IV, 23Da (Heft 55): 73, Fig.69. 1912. — *H. triangularis* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 181. 1922. — *H. sagittifolia* var. *Sumaterana* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 192. 1922. — *H. ensiformis* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 335. 1922. — *H. miqueliana* var. *truella* Alderw., Bull. Jard. Bot. Buitenzorg, III, 4: 336. 1922. — *H. sagittifolia* var. *angustifolia* Furtado, Gard. Bull. Straits Settle. 10: 228. 1939.

Medium to large, usually robust, colony-forming, strongly aromatic (pinene) helophyte to 1 m tall, but usually less. *Stem* hypogeal, stoloniferous, 1–3 cm thick. *Leaves* few together; *petioles* 10–25 cm, rather spongy, deep green; *petiolar sheath* 3–4 cm, margins membranous; *leaf blade* very variable, ranging from linear-lanceolate through ovate-lanceolate to strongly hastate, 6–35 × 3–20 cm, base cuneate to truncate to cordate or strongly hastate, apex blunt to long acuminate, with a 2–5 mm tubular mucro, rubbery–coriaceous, deep green; *primary lateral veins* 4–11 per side; *interprimary veins* much finer, striate; *secondary venation* almost invisible. *Inflorescences* 1–2 together; *peduncle* 15–25 cm, green to purple-brown; *spathe* with a

moderate constriction between the lower part and the spathe limb, 8–14 cm long; *lower part* ovoid-ellipsoid, 2–4 × 1–1.5 cm; *spathe limb* lanceolate to lanceolate-elliptic, 6–9 × 2–3.5 cm, spreading at anthesis, then closing again; *spadix* tapering-cylindrical, 6–10 cm, subequalling spathe, stipitate; *stipe* ca. 1 cm long; *pistillate flower zone* 1.5–3 × 1 cm; *ovary* depressed ovoid-globose, ca. 1 mm diam., with an associated clavate staminode ca. equalling the height of the ovary; *stigma* sessile, capitate, ovary pale green, staminode white; *sterile interstice* ca. 1 cm long, with a few scattered staminodes, these ovoid, compressed, white, axis of interstice pale green; *staminate flower zone* 4.5–5.5 cm × 3 mm; *staminate flowers* rhombohexagonal in plan view, ca. 1–2 mm diam., each with two stamens overtopped by a large connective, white. *Fruits* ripening dull yellow. **Figure 9.**

Distribution. — Peninsular Thailand, Peninsular Malaysia, Sumatera, N.W. Borneo.

Ecology. — Lowland freshwater swamp forest and peat swamp forest.

Notes. — *Homalomena rostrata* is highly polymorphic in terms of leaf lamina shape, and overall plant size, even within a single population, and has attracted a considerable synonymy as a result. Flowering size plants range in height from barely 20 cm to over 1 m, with the largest plants generally occurring in areas of abundant nutrient availability, for example along the margins of freshwater swamp forest, while smaller plants are generally confined to nutrient-poor soils, especially on white sand and peat kerangas, or along oligotrophic stream systems. Smaller plants tend to have sagittate leaves. For a detailed discussion of typifications of *H. rostrata* see (Wong *et al.*, 2011).



**Figure 9: *Homalomena rostrata* Griff.** A - C Plants in habitat showing variation in leaf lamina shape. D. Inflorescence at pistillate anthesis with the presence of two individuals of *Parastasia* sp. E. Mature inflorescence with spathe artificially removed. F. Pistillate zone.

**13. *Lasia spinosa*** (L.) Thwaites, Enum. Pl. Zeyl.: 336. 1864; Hay, Blumea 33: 458–462, Fig.15 & 16 (1988). — *Dracontium spinosum* L., Sp. Pl.: 967. 1753. — *Lasia aculeata* Lour., Fl. Cochinch.: 81. 1790. — *Pothos heterophyllus* Roxb., Fl. Ind. 1: 457. 1820. — *Pothos lasia* Roxb., Fl. Ind. 1: 458. 1820. — *Pothos spinosus* (L.) Buch.–Ham. ex Wall., Numer.

List: 4447 C. 1831. — *Lasia heterophylla* (Roxb.) Schott in Schott & Endl., Melet. Bot.: 21. 1832. — *Lasia loureirii* Schott in Schott & Endl., Melet. Bot.: 21. 1832, *nom. illeg.* — *Lasia roxburghii* Griff., Not. Pl. Asiat. 3: 155. 1851. — *Lasia hermannii* Schott, Bonplandia (Hannover) 5(8): 125. 1857. — *Lasia jenkinsii* Schott, Bonplandia (Hannover) 5(8): 125. 1857. — *Lasia zollingeri* Schott, Bonplandia (Hannover) 5(8): 125. 1857. — *Lasia desciscens* Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 127. 1863. — *Lasia spinosa* var. *hermannii* (Schott) Engl. in A.DC. & C.DC., Monogr. Phan. 2: 274. 1879. — *Lasia crassifolia* f. *angustisecta* Engl., Exsicc. (Arac.): 194. 1883. — *Lasia crassifolia* f. *latisecta* Engl., Exsicc. (Arac.): 194. 1883. — *Lasia crassifolia* Engl., Bot. Jahrb. Syst. 25: 15. 1898.

Robust, colony-forming, stoloniferous, evergreen helophytes to 1.5 m. *Stem* thick, prickly, rarely unarmed, erect to decumbent, epigeal or submersed, green. *Leaves* several together; *petiole* to 100 cm long, aculeate, weakly pulvinate apically, sheath relatively short; *leaf blade* (juvenile) sagittate to hastate-sagittate, (adult) deeply pinnatifid in anterior division, with posterior divisions pedatifid, sometimes simple, 18–75 × 6–35 cm; major veins aculeate on lower surface; *primary lateral veins* pinnate in anterior division, pedate in posterior divisions; *higher order venation* reticulate. *Inflorescence* solitary; *peduncle* subequal to petiole, to 45 cm tall, aculeate; *spathe* linear, 25–55 × 2–4 cm, very long and narrow, thick and spongy, spirally twisted, marcescent, basal part enclosing spadix, gaping at anthesis, yellow to purple or brownish; *spadix* shortly cylindrical, 4–5 × 1 cm, obtuse, sessile; *gynoecium* ovoid to ellipsoid, ca. 2 mm diam. *Infructescence* stoutly cylindrical, to 7 × 2 cm; *fruits* quadrangular, apically densely muricate to spinose, ca. 1.5 cm diam., green when ripe. **Figure 10.**

Distribution. — Widespread throughout tropical Asia from southern India and Sri Lanka eastwards as far as New Guinea and north to southern China.

Ecology. — Open wet areas in deciduous and evergreen forest, along rivers and in ditches; frequently remaining after land clearance; on a variety of substrates but not recorded from limestone.

Uses. — The emerging leaves and inflorescences are used locally as a green vegetable (recorded by several collectors).

Notes. — For discussion of typifications see Hay, *Blumea* 33: 427–469. 1988.



**Figure 10: *Lasia spinosa* (L.) Thwaites.** A. Flowering plant. B. The greatly attenuated spathe limb opening only at the base. C. Young emerging leaf lamina. D. Inflorescence. E. Ripe infructescence. Note the spinulose berries.

**14. *Podolasia stipitata*** N.E.Br., Gard. Chron., ser.2, 18: 70. 1882; Hay, Blumea 33: 463–465, Fig.17(1988).

Small clumps, rhizomatous herbs. *Stem* erect to decumbent, internodes distinct, unarmed. *Leaves* several; *petiole* long, geniculate apically, aculeate, spines straight and/or pointing downwards, sheath short; *leaf blade* unarmed, sagittate to hastate, coriaceous, posterior divisions  $\pm$  equalling anterior, sometimes longer; basal ribs well-

developed; *primary lateral veins* mostly arising near petiole insertion, long-arcuate towards division apex and running into margin, higher order venation reticulate. *Inflorescence* solitary; *peduncle* subequal to petiole and similar in appearance; *spathe* ovate lanceolate, fully expanded, persistent, red brown, interior red-purple; *spadix* shorter or equalling spathe, cylindric, stipitate, *stipe* basally adnate to spathe, flowering sequence basipetal; *flowers* bisexual, perigoniate; tepals 4–6, fornicate; *pistillate flowers* cylindric to obovoid, ovary 1-locular, ovule 1, anatropous, placenta parietal to subbasal, stigma discoidhemispheric; *staminate flowers* 4–6, free, filaments oblong, flattened, connective slender, thecae ellipsoid, dehiscing by longitudinal slit. *Infructescence* erect; *fruits* emerging fully from between the tepals, ripening bright red. **Figure 11.**

Distribution. — One species occurring disjunctly in Sumatera, Peninsular Malaysia, and Borneo.

Ecology. — Lowland peat swamp forest, usually on slightly raised peat deposits (podzols) but still subject to seasonal inundation.

Notes. — *Podolasia stipitata* is very sporadic in distribution throughout its range, although it is frequently locally abundant (as at Batang Ai)



**Figure 11: *Podolasia stipitata* N.E.Br.** A. Flowering and fruiting plant in habitat. B. Inflorescence at staminate anthesis. Note the terminal portion of the spadix is differently coloured, this zone comprises flowers that are post anthesis and will proceed down the spadix until post anthesis the entire spadix is purple. C. Detail of the spadix base near to completion of anthesis. Note that only a small area of white spadix remains. D. Infructescence nearing maturity. Note that the fruits are almost wholly exerted from between the tepals. When ripe the berries are scarlet.

**15. *Pothos scandens*** L., Sp. Pl.: 698. 1753; Boyce & Hay, Telopea 9: 461. 2001. — *Batis hermaphrodita* Blanco, Fl. Filip. ed. 1: 791. 1837. — *Pothos hermaphroditus* (Blanco) Merr., Sp. Blancoanae: 90. 1918. — *P. angustifolius* C.Presl, Epimel. Bot.: 243. 1849. — *P. chapelieri* Schott, Aroideae: 22, t. 35. 1856–1857. — *P. exiguiflorus* Schott, Aroideae: 21, t. 41. 1856–1857. — *P. cognatus* Schott, Aroideae: 22, t. 42. 1856–1857. — *P. scandens* L. var. *cognatus* (Schott) Engl. in A.DC. & C.DC., Monogr. Phan. 2: 84. 1879. — *P. zollingerianus* Schott, Oesterr. Bot. Wochenbl. 5: 19. 1855. — *P. horsfieldii* Miq., Fl. Ned. Ind. 3: 178. 1856. — *P. decipiens* Schott, Bonplandia (Hannover) 7(11): 165. 1859. — *P. fallax* Schott, Prodr. Syst. Aroid.: 560. 1860.

Moderate to rather large, slender to moderately robust, homeophyllous, root-climbing secondary hemiepiphyte to 6 m. *Stem* 10 mm diam., weakly four-angled or slightly compressed-terete in cross-section. *Leaves* dense; *petiole* 2–14 cm × 5–20 mm, broadly winged, obovate-oblong to linear-oblong, with 2–3 secondary veins and numerous veinlets per side, base decurrent, apex truncate, rounded or auriculate; *leaf blade* 2–10 × 1–4 cm, ovate to elliptic or lanceolate with 2 intramarginal veins per side, base rounded to acute, apex attenuate-mucronate, leathery. *Flowering shoot* much abbreviated, arising from most of the mid- to distal leaf axils of fertile shoots, bearing a minute prophyll and a few 3–10 mm, sequentially longer, cataphylls. *Inflorescence* solitary; peduncle slender, 3–15 × 0.5–2 mm, erect to spreading, green to purple-tinged; *spathe* 4–8 × 4–7 mm, ovate, concave, margins variously in-rolled, base short or somewhat long-clawed, apex rounded to acute with a tiny rather stout mucro, greenish to maroon; *spadix* stipitate; *stipe* terete in cross-section, 5–10 × ca. 1 mm, erect, the distal part erect to bent through 270°, greenish to maroon; *fertile portion* globose or ovoid to subclavate, 4–10 × 3.5–10 mm, yellow green to off-white; *flowers* ca. 12 mm diam.

*Infructescence* with 1–5 berries; *fruit* obclavate, 1–1.75 × 1–1.5 cm, mid-green ripening to deep scarlet. **Figure 12.**

*Distribution.* — Madagascar to India and Sri Lanka, through Bangladesh and Burma, Thailand and Indo-China to SW China, south through Indonesia (Sumatera, Jawa to Bali) through Peninsular Malaysia to Borneo, and the Philippines.

*Ecology.* — On trees and rocks in primary and secondary wet to dry lowland to hill evergreen tropical to subtropical forest, rare in peat swamp forest, occasionally on sea cliffs, on a variety of substrates including clay, limestone or granite. 0–2100 m asl.

*Notes.* — *Pothos scandens* is unmistakable in its typical aspect, carrying numerous rather small inflorescences on diagnostically bent peduncles.



**Figure 12: *Pothos scandens* L.** A. Root-climbing plant with its leathery leaf blades. B. Petiole broadly winged. C. Several small inflorescences.

**16. *Rhaphidophora lobbii* Schott, Bonplandia (Hannover) 5(3):45. 1857; Boyce, Gard. Bull. Singapore 51: 223–226, Fig.10. 1999. — *Scindapsus lobbii* (Schott) Ender, Index Aroid. 74. 1864.**

Small to moderate, somewhat slender, leptocaul, homeophyllous secondary hemiepiphyte to 5 m. *Stems* puberulent-scabrid to asperous, especially on older growth, climbing stems weakly rectangular to  $\pm$  terete in cross-section, free stems  $\pm$  terete in cross-section, often branching extensively and growing to moderate lengths, hanging

under their own weight, dull brown, without prophyll, cataphyll and *petiolar sheath* fibre. *Leaves* weakly spiralled and often sparsely arranged on adherent and proximal portions of free shoots, densely spirally–distichous distally on flowering shoots; *petiole* grooved adaxially, 4–9.5 × 0.2–0.3 cm, smooth, with moderate apical and prominent basal pulvini; *petiolar sheath* slightly prominent, extending beyond the apical pulvinus by two ligules, very soon drying and falling in strips to leave a continuous scar from the petiole base, around the top of the apical pulvinus and back to the base; *leaf blade* entire, narrowly elliptic to elliptic-lanceolate to oblong or oblanceolate, 6–24 × 2–10 cm, very softly coriaceous, upper surfaces slightly glossy, lower surfaces pale satin-matte, drying markedly discolourous, dark brown above, pale brown below, base cuneate to acute or sub-ovate, briefly decurrent, apex acute to ovate-acuminate, with a prominent apiculate tubule; *midrib* slightly raised abaxially, slightly sunken adaxially; *primary venation* pinnate, slightly raised abaxially, prominent (dark veins against pale lamina) in dried material. *Inflorescence* solitary, subtended by a fully developed foliage leaf and a very quickly falling cataphyll; *peduncle* compressed-cylindrical, 1.5–5 × 0.15–0.4 cm; *spathe* ovate-elliptic, stoutly long-beaked, 3–5 × 0.4–1 cm, thickly fleshy, exterior minutely puberulent, dull yellowish at anthesis, soon falling to leave a substantial, slightly oblique scar; *spadix* slender cylindrical, sessile, inserted level on peduncle, 3–3.5 × 0.4–0.5 cm, dull yellow-white; *anthers* barely exerted at anthesis. *Infructescence* oblong-cylindrical, 2.5–4 × 1–1.2 cm, ripening dirty white, stilar plates sloughing away to reveal amber coloured pulp and pale grey seeds. **Figure 13.**

*Distribution.* — S Peninsular Thailand, Peninsular Malaysia, Singapore, Sumatera, throughout Borneo extending to the Philippines (Palawan), and Sulawesi.

Ecology. — Lowland to hill dipterocarp forest on wet to inundated soils, peat swamp and freshwater swampforest. 10–200 m asl.

Notes. — A distinctive climber by the combination of the slender, asperous stems and softly leathery leaves, and minutely pubescent spathe exterior. Dry material is remarkable by the strongly discoloured leaves, and primary veins prominently darker than the abaxial leaf surface.



**Figure 13: *Rhaphidophora lobbii* Schott.** A. Adult plant. B. Solitary inflorescence, subtended by a fully developed foliage leaf, spathe ovate-elliptic, stoutly long-beaked, and thickly fleshy. C. Cylindrical spadix. D. Infructescence ripening dirty white, stylar plates sloughing away to reveal amber coloured pulp and pale grey seeds.

**17. *Scindapsus coriaceus*** Engl., Bull. Soc. Tosc. Ort. 4: 271. 1879.

Medium sized scandent or climbing herbs. *Stem* terete, smooth. *Leaves* often forming tufts of foliage at the tips of active shoots with the preceding leaves scattered; *petiole* 5-10 cm long, pulvinate apically; *petiolar sheath* extending the to petiole tip, marcescent, degrading to fibres; *leaf blade* narrowly elliptic, oblique, oblong-lanceolate, stiffly coriaceous; *primary lateral veins* hardly differentiated from the interprimaries, pinnate, running into marginal vein, all other venation obscure *Inflorescence* always solitary; *peduncle* shorter than petiole; *spathe* boat-shaped, white to yellow, gaping at anthesis; *spadix* cylindrical, a little shorter than spathe; *flowers* bisexual, perigone absent; pistillate flowers, ovary short, compressed; *staminate flowers* 4, free. *Fruits* berry.

Distribution. — Endemic on Borneo.

Ecology. — Raised podzols in peat swamp forest, kerangas.

Notes. — *Scindapsus* has not been revised in its entirety since 1908 (Engler and Krause, 1908), and not treated for Malaysia since Ridley's accounts for the flora (Ridley, 1907, 1925), when he recognized 5 species: *Scindapsus beccarii* Engl., *S. hederaceus* Miq., *S. perakensis* Hook.f., *S. pictus* Hassk., and *S. scortechinii* Hook.f. Since Ridley, fieldwork has revealed two further species: *S. treubii* Engl., a widespread species from Sumatera to Borneo, and *S. lucens* Bogner and P.C.Boyce, described in 1994. *Scindapsus coriaceus* is a species complex.

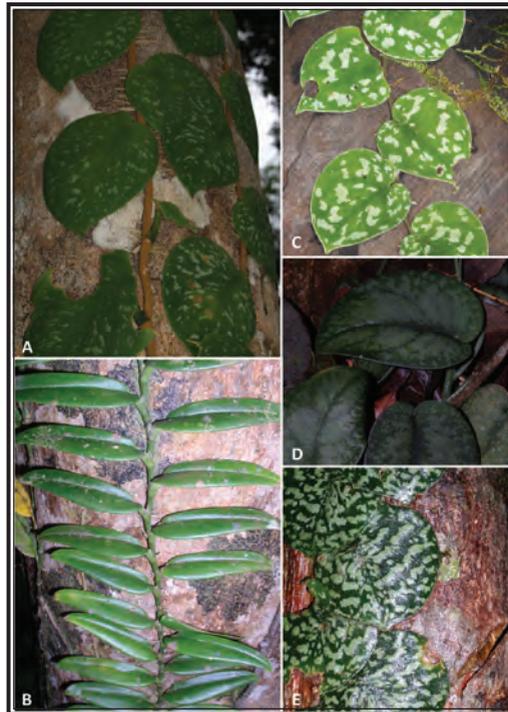
**18. *Scindapsus pictus*** Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 164. 1842. — *Pothos argenteus* W.Bull., Cat. 1887: 11. 1887. — *Pothos argyraeus* Engl., in A.DC. & C.DC., Monogr. Phan. 2: 255. 1879. —

*Scindapsus argyraceus* Engl., in A.DC. & C.DC., Monogr. Phan. 2: 255. 1879. — *Scindapsus pictus* var. *argyraeus* (Engl.) Engl., Bot. Jahrb. Syst. 25: 13. 1898. — *Scindapsus pictus* var. *oblongifolius* Engl., Bot. Jahrb. Syst. 25: 13. 1898. — *Scindapsus pothoides* Schott, Prodr. Syst. Aroid.: 394. 1860.

Small to large, moderately robust lianes. *Juvenile and pre-adult stems* with the leaves arranged in an overlapping (or nearly so) shingle pattern; adult stems with leaves distichously arranged. *Stem* long, at most scabrid, older portions with conspicuous orange-brown brittle epidermis. *Leaves* many; *petiole* ca. 2 cm long; *petiolar sheath* narrow; *leaf blade* 8–12 cm × 2–2.5 cm, ovate-cordiform (juvenile and pre-adult) to falcate (adult), adaxially matte to somewhat scintillating, medium green, usually with silvery jagged spots or with these coalescing into larger areas; *primary lateral veins* hardly differentiated, pinnate, running into marginal vein; higher order venation obscure. *Inflorescence* solitary; *peduncle* shorter than petiole, 0.5 to 1 cm long; *spathe* 4–8 cm long, ovate-cuspidate, thickly leathery, white; *spadix* stout ca. 2 cm long, white; *flowers* bisexual, perigone absent; pistillate flowers, ovary sometimes short, compressed ± cylindrical; stamens flowers 4, free, filaments oblong, flattened, broadish, connective slender, thecae oblong-ellipsoid, dehiscing by apical slit. *Infructescence* a monstercarp ca. 7 cm long × 2.45 cm wide, pale grey-green, glaucous, styler plates sloughing at maturity to reveal the orange pulp cavity. **Figure 14.**

*Distribution.* — Peninsular Malaysia, Sumatera, Jawa, Borneo, Philippines, and Sulawesi.

Ecology. — In a variety of habitats in the lowlands to mid-elevation. Not rare, but almost always encountered as a juvenile shingling climber. The rarely encountered adult plants form extensive curtains of much-branched stems pendent from the tops of tall forest trees, with the inflorescences born on the tips of the stems.



**Figure 14:** A. *Scindapsus treubii* Engl. Note the subsucculent, strongly oblique leaf blade, and smooth stem. B-E. *Scindapsus pictus* Hassk. B. Primary axis showing the diagnostic and older portions with conspicuous orange, brittle scabrid epidermis. C-E. A selection of leaf markings typical of *S. pictus*. Notes the somewhat scintillating quality particularly in C & E.

**19. *Scindapsus treubii*** Engl., Bot. Jahrb. Syst. 25: 13. 1898. — *Pothos enderianus* N.E.Br. Gard. Chron., n.s., 1884(1): 711, 1884.

Small to large, moderately robust lianes. *Juvenile and pre-adult stems* with the leaves arranged in an almost overlapping pattern; adult stems with leaves distichously arranged; *Stem* smooth, terete. *Leaves* many; *petiole* short, petiolar sheath persistent; *leaf blade* narrowly elliptic to very narrowly falcate oblanceolate (juvenile and pre-adult), to oblique-elliptic (adult), concolorous deep green, although juvenile plants often with the leaf blades grey-banded; *primary lateral veins* hardly differentiated, pinnate, running into marginal vein. *Inflorescence* solitary; *peduncle* shorter than petiole, ca. 2–3 cm long; *spathe* boat-shaped, 3.5 – 6 cm long, rather thickly (2–3 mm) leathery, gaping slightly, yellow; *spadix* cylindric, narrowly ellipsoid, shorter than spathe, 3–4.5 cm long, ca. 7 mm diam., white; *flowers* bisexual, perigone absent; pistillate flowers, ovary short, compressed; stamens 4, free. *Infructescence* a monstercarp ca. 10 cm long × 2.5 cm wide, pale grey-green, somewhat glaucous, stelar plates sloughing at maturity to reveal the pale yellow pulp cavity. **Figure 14.**

Distribution. — Peninsular Malaysia, Sumatera, Jawa and Borneo.

Ecology. — Usually in well drained subtropical and tropical perhumid to everwet broadleaf subtropical and tropical forest at low to mid elevations.

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