Studies on the *Alocasia* Schott (Araceae-Colocasieae) of Borneo: I Two new species from Sarawak, Malaysian Borneo

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Abstract

Two new species of *Alocasia*, *A. chaii* P.C.Boyce and *A. infernalis* P.C.Boyce from Kapit Division, Sarawak, Malaysian Borneo, are described and included into an updated key to Bornean *Alocasia*. Both species are illustrated.

Introduction

Publications on *Alocasia* for tropical Asia (Hay, 1994, 1998, 1999, 2000; Hay & Wise, 1991; Hay *et al*., 1997; Yuzammi & Hay, 1998) have considerably alleviated the previous problems of accurately naming *Alocasia* species and, moreover, provided a stable platform from which to describe further novelties without the concern that obfuscated species names are being overlooked.

Prior to the onset of work on Bornean *Alocasia* by Hay and co-authors (Hay, 1998, 2000, Hay *et al*., 1997), the species complement for Borneo stood (uncritically) at 16 species. Post publication of Hay's accounts for West Malesia & Sulawesi (Hay, 1998) and the subsequent naming of an additional species [*A. nebula* A.Hay (Hay, 2000) - treated as insufficiently known by Hay, 1998] the total for Borneo stands at 21 species formally recognized. Allowing for synonymization, this represents an increase of more than 45% of the species diversity post 1997.

Since the publication accounts of *Alocasia* in Malesia and Sulawesi (Hay, 1998, 2000) the author of has been fortunate to be able to spend a considerable period of time undertaking fieldwork in Sarawak, frequently in areas that have received little or no botanical investigation in recent years, if ever. One result of this fieldwork has been the discovery of a significant number of

additional novel *Alocasia*, such that it is estimated that the total number of Bornean *Alocasia* species will eventually exceed 40, all endemic. Although at the present time there is insufficient fertile material for the preparation of types for all of the taxa considered to be undescribed; as the preparation of types becomes possible from plants flowering in cultivation, it is intended to produce a series of papers dealing with formal recognition of the ca 20 novelties found to date, along with updates on the status of pre-existing described taxa. This paper is the first in this intended series.

1. Alocasia chaii P.C.Boyce, *sp. nov.*
Ab Alocasia scabriscula sed stature valde parviore, folii lamina peltato et spathae fructiferorum extus in toto magenteus vividus differt – TYPUS: Sarawak, Kapit Division, Pergunungan Hose, foothills of Bukit Batu, Camp E, 01° 51' 33.6"; 114° 06' 49.6", 20 Oct. 2000, *C.Lee AL-41* (holo, SAR; iso, SING). Plates 1 & 2.

Small robust **herb t**o ca 40 cm tall, stem shortly erect to decumbent, eventually forming a short rhizome; wild plants with rather few leaves (up to 4, usually less), cultivated plants with several **leaves** (up to 7); petioles stout, *ca* 20 cm long, sheathing in the lower ca 1/4, puberulent, pale green with scattered deep red spots and speckles in the lower half; sheath persistent, ± closed; lamina broadly ovato-elliptic, up to 40 cm long but frequently much less and typically reaching c. 23 cm x 10–15, exceptionally up to 25 cm wide, thickly coriaceous to subsucculent, almost completely peltate save for a shallow retuse notch between the tips of the connate posterior lobes, margins reflexed to form a raised smooth rim abaxially, apex acute to obtuse and mucronate for ca 1 cm, lamina adaxially pale matt grey, abaxially greenish white, anterior costa with 1–3 primary lateral veins on each side, diverging at *ca* 90° (proximal ones) to 30° (distal ones); primary veins adaxially somewhat raised proximally to the mid-rib and impressed distally, flush to very slightly impressed with deep red axillary glands abaxially; secondary venation impressed adaxially, more or less flush with the lamina abaxially, forming defined interprimary collective veins when fresh, this decidedly obscure in dried material; posterior lobes about 1/3 – 1/4 the length of the anterior, with the posterior costae diverging at ca 30°; **inflorescences** several together (up to 4 on vigorous plants), each subtended by a short, broad prophyll and a single cataphyll; peduncle short, more or less hidden within cataphyll; *spathe ca* 7 cm long, externally white with a scattered red flecks on the lower part, interior uniformly glossy white; lower spathe 2.5–3.5 cm long, ovoid, separated from limb by a rather weak oblique constriction; limb erect even after anthesis, narrowly lanceolate-triangular, 3–5 cm long; *spadix ca*

Plate. 1. *Alocasia chaii* P.C.Boyce. **A**. Adult plant in habitat; note the few leaves, typical of *A. chaii* in the wild; **B**. Cultivated plant produced from tissue culture introduction; note the many additional leaves and the deep red blands on the visible abaxial leaf surface. Photograph 1A [copyright Chien Lee, used with permission].

2/3 the length of the spathe, *ca* 4.5 cm long, briefly stipitate; stipe cylindrical, *ca* 2–5 mm tall, glossy white; *female zone* about 1/4 of the length of the spadix, pistils moderately densely arranged; ovaries ovoid, *ca* 1.5 mm diam., facing diagonally up, pale greenish white; style ± absent; stigma white, single, bilobed, sometimes trilobed (all variations present in a single inflorescence); sterile interstice absent or represented by a few (less than 5) synandrodia; *male zone* held entirely within the lower spathe, cylindric to barrel-shaped, about 1/4 the length of the spadix, about 2/5 as wide as long, ivory; synandria densely arranged, more or less square in plan view, *ca* 1.5 mm wide, the thecae very slightly overtopped by synconnective; appendix about 1/3 of the length of the spadix, narrowly conic; *fruiting spathe* broadly ovoid, c. 2.5 cm long, erect, glossy brilliant magenta with a few scattered darker spots and streaks at fruit maturation, then splitting longitudinally into several unequal strips, these reflexing to reveal the ripe berries; **berries** bright orange to red, globose, *ca* 0.5 cm diam., each with 1-3 seeds; **seeds,** ca 3mm diam., pace brown.

Distribution: Sarawak, Kapit Division, to date known only from the foothills of Gunung Bukit Batu, Hose Mountains and Ulu Kapit.
Ecology: Steep to precipitous leaf litter-covered red clay-loam slopes beneath open to rather dense canopy of moist upper hill forest in light to moderate shade, 540–760 m asl.

Notes: *Alocasia chaii* belongs to the informal *Alocasia scabriscula* group (see Hay, 1998), notable for coriaceous, leathery to subsucculent leaves and the spathe usually constricted at a level above the sterile interstice of the spadix, thus, including the all or at least the majority of male flower zone within the lower spathe. *Alocasia chaii* is most similar to *A. scabriscula* N.E.Br. in overall morphology, differing in the considerably smaller, but hardly less robust habit, the peltate leaves and the persistent lower spathe that turns bright magenta at fruiting. In general stature and by the grey leaves *A. chaii* also vaguely resembles Sabahan *A. melo* A.Hay, P.C.Boyce & K.M.Wong, although the latter is readily distinguished by the rugose and bullate adaxial lamina surface and the fruiting spathe white with slight red speckling. *Alocasia melo* is confined to ultramafic substrates.

There appear to be two closely allied species involved here, one in the lowlands (up to 150 m asl) that has not as yet found fertile, and a higher elevation element (occurring above 500 m asl), here described as *A. chaii*. Aside from the altitudinal differences noted, the lowland element has the leaves proportionately longer than broad (ovato-triangular in outline), lacks the deep red abaxial leaf glands (glands concolorous with the abaxial lamina

Plate. 2. *Alocasia chaii* P.C.Boyce. A. Ripe infructescences; note the bight magenta colour of the lower spathe and the contrasting orange fruits.

surface in the lowland element), and is overall a less robust plant occurring in open habitats. The occurrence of related attitudinally differentiated/ morphologically distinct taxa has been noted elsewhere in *Alocasia*, as for example, *A. beccarii* Engl. (lowland) & *A. peltata* M.Hotta (highland).

Etymology: *Alocasia chaii* is named for Dr Paul P.K. Chai former Forest Botanist, now with ITTO, Forest Department, Sarawak.

Other specimens examined: SARAWAK: **Kapit Division:** Pergunungan Hose, foothills below Bukit Batu, 02° 14' 47.2"; 113° 41' 24.9", 23 April 2004, *P.C.Boyce & Jeland ak Kisai AL-51* (SAR); Ulu Kapit, Sungai Nai, near Punan Bah, 23 Sept. 1973, *P.Chai et al. S.33339* (SAR); Pergunungan Hose, Ulu Sungai Temiai, 5 July 2003, *C.Lee et al., S87433* (SAR).

2. Alocasia infernalis P.C.Boyce, *sp. nov.*
Ab alli Alocasii borneensibus stature parviore, foliis ascendentis, folii lamina atropurpureus vel purpureonigris, nitentibus distinguitur – TYPUS: Sarawak, Kapit Division, Nanga Gaat, Rejang Wood Concession, Batang Baleh, 01° 38', 113° 09', 2 April 1998, *C.Lee AL-16* (holo, SAR; iso, SING,). Plates 3 & 4.

Small robust **herb** to *ca* 55 cm tall, stem slender, erect to ultimately decumbent with the active shoot tip ascending; **leaves** several together in nature, in cultivation up to 12, spreading in juveniles but erect in adult plants; petioles slender, spreading to ascending, *ca* 20 cm long, sheathing in the lower *ca* ½, minutely puberulent (lens required), bronze-green to purple-green depending on exposure, stronger light inducing a weak snake-skin marking, particularly on the interior of the sheath; sheath fleshy-membranous, open and recurving in the lower part; lamina ovato-triangular, up to 25 cm long but frequently much less and typically reaching *ca* 15 cm x 10–12 cm, thinly and somewhat weakly coriaceous, juveniles almost completely peltate except for a shallow retuse notch between the tips of the connate posterior lobes, adult leaves strongly peltate but with a 1–2 cm deep notch in the sinal tissue, margins smooth, apex acute, acuminate for *ca* 1 cm, adaxially glossy, very deep purple, abaxially deep purple, anterior costa with *ca* 3 primary lateral veins on each side, diverging at *ca* 60° (proximal ones) to 45° (distal ones); primary veins impressed distally adaxially, prominently raised abaxially; secondary venation obscure adaxially, abaxially forming strongly defined and raised interprimary collective veins; all veins running to a prominently raised (abaxially) inframarginal collecting vein; posterior lobes about ¼ the length of the anterior, posterior costae diverging at *ca*. 20°. **Inflorescences** 2 together, each subtended by a short, broad prophyll and a single cataphyll; peduncle long, *ca* 4–6 cm, pale green or purple flushed; *spath*e 4–9.5 cm long, lower spathe pale green, spathe limb externally glossy purple with the margins pale green; lower spathe 1.5–2.5 cm long, ovoid, separated from limb by a moderate constriction; limb narrowly lanceolate-triangular, at first erect then soon strongly reflexing and twisting with the margins inrolled, 2–6.5 cm long; *spadix* ca 1/2 the length of the spathe, *ca* 4.5 cm long, very briefly stipitate; stipe umbonate, *ca* 2 mm tall, glossy white; *female zone ca* 1/3 of the length of the spadix, pistils moderately densely arranged; ovaries compressed-globose, *ca* 2 mm diam., facing diagonally up, pale greenish white; style absent; stigma white, mostly trilobed, sterile interstice with a few scattered, compressed white synandrodia; *male zone* partially held within the lower spathe, cylindric, *ca* 1/3 the length of the spadix, ivory; synandria somewhat laxly arranged, transversely oblong in plan view, *ca* 2 x 1 mm, thecae extending slightly from the edge of the synconnective; appendix about 1/3 of the length of the spadix, narrowly conic, pointed, white; *fruiting spathe* broadly ovoid, *ca* 2.5 cm long, pendent by reflexing of the peduncle, dull mid-green at fruit maturation, splitting longitudinally into several unequal strips, these reflexing to reveal the ripe berries; **berries** bright orange to red, globose, *ca* 0.5 cm diam., each with 1–3 seeds; **seeds** compressed ovoid, *ca* 2.5 diam., medium brown.

Plate. 3. *Alocasia infernalis* P.C.Boyce. **A**. Juvenile plant in habitat; **B**. Seedlings, Nanga Gaat; note the iridescent leaf surface and also the variability in the intensity of the purple colouration.

Plate 4. *Alocasia infernalis* P.C.Boyce. **A**. Plant flowering in cultivation; **B**. Deep purple-black leaves of a plant in cultivation produced from tissue culture; **C**. Flowering size plant in cultivation..

Distribution: Sarawak, Kapit Division. To date known only from the Sungai Gaat watershed.

Ecology: Valley bottoms in moist to ever-wet lowland forest on deeply leaf litter-covered red sandstone-derived clay-loams in heavy shade,182–249m asl.

Notes: *Alocasia infernalis* belongs to the *Alocasia scabriscula* group (see Hay, 1998) by virtue of the pubescent petioles and the positioning of the spathe constriction above the base of the male zone of the spadix such that all or at least the basal part of the male zone is held within the lower spathe chamber. However, it is not at all apparent to which other species in the group *A. infernalis* is most closely allied since by the leaf texture and deflexing infructescences it is unique in the group. In overall appearance (leaves rather membranous more-or-less completely peltate, spadix distinctly shorter than the spathe) it is superficially similar to species in the *Alocasia cuprea* (C.Koch & Bouché) C.Koch group but is readily distinguished by the leaves *not* interspersed with cataphylls.

The metallic-purple leaves of the seedlings and juvenile plants is remarkable while the lustrous deep purple-black of the ascending leaves of mature plants, coupled with the dwarf habit, is unmatched by any other species. *Alocasia infernalis* is perhaps the most horticulturally significant species of Bornean *Alocasia* yet discovered.

Etymology: From the Latin, 'Hellish' in fanciful allusion to the remarkable deep purple-black leaves of mature plants; the epithet is inspired by the no-less remarkable vampyromorphoid cephalopod, *Vampyroteuthis infernalis*.

Other specimens examined: SARAWAK: **Kapit Division:** Nanga Gaat, Rejang Wood Concession, km 65 road to Camp Gahada, 01° 42' 01.1", 113° 31' 14.8", 12 May 2004, *P.C.Boyce, Jeland ak Kisai & Jipom ak Tisai AL-57* (SAR); Nanga Gaat, Rejang Wood Concession, km 55 road to Camp Gahada, 01° 44' 44.5", 113° 28' 32.3", 13 May 2004, *P.C.Boyce, Jeland ak Kisai & Jipom ak Tisai AL-66* (SAR); Nanga Gaat, Rejang Wood Concession, km 65 road to Camp Gahada, 01° 41' 59.7", 113° 31' 13.7", oblong leaves, 16 Dec 2004, *P.C.Boyce, Jeland ak Kisai & M.Gibernau AL-123* (SAR).

Conservation

Both species here newly described occur as scattered small populations in restricted habitats. Fortunately all known populations of both species are

in remote and inaccessible locations and for the moment probably safe from the deprivations of unscrupulous plant collectors. *Alocasia chaii* and *A. infernalis* were among those species the subject of a joint tissue culture project between Malesiana Tropicals and UNIMAS funded under MOSTI-IGS (IGS R&D Proj. No. 16/03), together with a further 14 Sarawakian *Alocasia* species and representatives of several other aroid genera that are now in Sarawak Forestry Department licensed commercial tissue culture production in Kuching laboratory of Malesiana Tropicals Sdn Bhd.

Key to Bornean *Alocasia* species

1. Leaf blades not peltate in adult plants …….. **2**
1a. Leaf blades distinctly (shallowly to completely) peltate in adult plants **14**

2. Secondary venation distinctly prominent abaxially *and* forming well-defined interprimary collective veins ..... ***A. sarawakensis***
2a. Secondary venation not prominent abaxially, or, if prominent, then *not* forming well-defined interprimary collective veins ….....…. **3**

3. Leaf blade membranous, often immense, abaxially waxy-glaucous …….
.....……..... ***A. robusta***
3a. Leaf blade of various sizes and textures, not waxy-glaucous (though sometimes abaxially grey-green) ……..... **4**

4. Male zone of spadix completely exerted from lower spathe chamber (always in association with human disturbance) ……..... ***A. macrorrhizos***
4a. Male zone of spadix partly or wholly within lower spathe chamber (plants of natural forested habitats) …… **5**

5. Leaf blade narrowly to broadly ovato-sagittate, nearly always stiffly leathery to subsucculent .....…. **6**
5a. Leaf blade hastato-sagittate, triangular in outline, mostly rather thinly leathery …….....…… **10**

6. Adaxial leaf blade grey-green and distinctly dark green about main veins …….....…… **7**
6a. Adaxial leaf blade of various colours but not variegated ……..…….. **8**

7. Abaxial leaf blade purple; anterior costa with c. 6 primary lateral veins on each side, with conspicuous subsidiary veins (geology & origin unknown) ....

.....*A. nebula*
7a. Abaxial leaf blade not purple; anterior costa with 2--3 primary lateral veins on each side; subsidiary veins absent (limestones: SE Sarawak) .... ***A. reversa***

8. Inflorescence pairs solitary *and* secondary venation adaxially impressed (limestones: Mulu) ..... ***A. reginae***
8a. Inflorescence pairs clustered or if solitary then secondary venation not impressed ……..... **9**

9. Posterior lobes ca 1/2 or more the length of the anterior; blade stiffly leathery (lithophytic on or terrestrial in close association with limestone (limestones: SE Sarawak) …….....…. ***A. ridleyi***
9a. Posterior lobes less than to ca 1/2 the length of the anterior; blade thickly coriaceous to subsucculent; terrestrial and not especially associated with limestone (widespread in Borneo) .....…… ***A. scabriuscula***

10. Plants terrestrial, not limestone associated .....…….... **11**
10a. Plants lithophytic on limestone ……..... **12**

11. Petioles mottled with wavy oblique zones of dense brown lines, occasionally scabrid; spathes mostly dusky brownish mauve, the limb darker; lower spathe narrowly ovoid; limb mostly narrowly lanceolate (Sabah) ..... ***A. wongii***
11a. Petioles variously and more or less haphazardly marked with lines and/or dots, smooth or occasionally faintly bumpy (glands), but not scabrid; spathes mostly ivory to yellowish ivory, variously marked or not with pink to purple, and/or purple-margined; lower spathe broadly ovoid; limb more or less oblong (widespread in Borneo) ..... ***A. princeps***

12. Male zone of spadix completely within lower spathe chamber; leaf blades distinctly grey-green adaxially (limestones: Sabah, E. Kalimantan) .... ***A. principiculus***
12a. Male zone of spadix partly exserted from lower spathe chamber; leaf blades dark to bright green adaxially (Sabah) **13**

13. Leaf blade bright green adaxially; inner side of posterior lobe ovate; male zone more or less adjunct to female zone or interstice short, not attenuate, formed of 1-2 whorls of synandrodia, resembling synandria (limestones: Gua Madai) ..... ***A. puteri***
13a. Leaf blade dark green adaxially; inner side of posterior lobe elliptic to narrowly ovate; interstice elongate, partly naked, with neuter organs resembling staminodes below and resembling synandria above (limestones:

Gua Madai) ..... ***A. pangeran***

14. Leaf blades ± membranous and pendent, often solitary or only 2--3 together, often adaxially dark green with whitish major veins (sometimes adaxially concolorous), often purple-backed, shallowly to deeply peltate; stigma stellate with pointed lobes; interstice corresponding with spathe constriction and male zone completely exerted .... ***A. longiloba* complex** (see Hay, 1998)
14a. Leaf blades variously coriaceous, pendent or not, few to several together, deeply to almost completely peltate; stigma not lobed or lobes rounded; interstice and part or all of male zone within lower spathe cham …..... **15**

15. Leaf blades metallic greenish brown adaxially, bullate between primary veins; lower primary veins diverging at first at more than 90° (Sabah & NE Sarawak) ……..…. ***A. cuprea***
15a. Not this combination ……...…… **16**

16. Adaxial leaf surface strongly and minutely rugose with the tertiary venation raised (ultramafics: Sabah) ……..... ***A. melo***
16a. Adaxial leaf surface smooth or with secondary venation impressed **17**

17. Adaxial leaf laminae very dark black-green with white impressed primary and secondary venation; spadix with appendix reduced (limestone: Bukit Tabin) ……..…….....…..... ***A. reginula***
17a. Adaxial leaf laminae not variegated, or if variegated then main veins and neighbouring blade darker than the rest; appendix well developed **18**

18. Leaf blades with conspicuous intramarginal vein and marginal vein; laminae broadly to narrowly elliptic, with the base cuneate; male zone wholly within the lower spathe (above 800 m, Borneo) ..... ***A. peltata***
18a. Leaf blades with more or less conspicuous marginal vein only; laminae various; male zone wholly or partly within the lower spathe (mostly below 500 m, Borneo) **19**

19. Primary lateral veins numerous, 8-10 on each side of midrib; secondary venation striate; in peat swamp forest (peat swamp forest: Sarawak) .... ***A. minuscula***
19a. Primary lateral veins much fewer; secondary venation clearly colocasioid, but not forming interprimary collective veins **20**

20. Leaf blades thickly coriaceous to subsucculent; male zone of spadix within lower spathe chamber …….....… **21**

20a. Leaf blades thinly coriaceous or sub-membranous; male zone only partly included within the lower spathe chamber **22**

21. Leaf laminae broadly ovato-elliptic, adaxially pale matt grey, abaxially greenish white with conspicuous deep red axillary glands abaxially; petioles puberulent; fruiting spathe magenta (Kapit, evergreen upper hill forest on sandstones above 500 m asl) ..... ***A. chaii***
21a. Leaf blade narrowly elliptic to ovate to narrowly obovate, mid green above, slightly paler with inconspicuous pale green axillary glands; petioles glabrous fruiting spathe pale green (NW Borneo, kerangas below 500 m) .... ***A. beccarii***

22. Laminae ascending (adult plants) to weakly spreading (juveniles), thinly and weakly coriaceous, lustrous deep purple-black; petioles minutely puberulent; infructescences deflexed (Kapit: sandstones) ..... ***A. infernalis***
22a. Laminae pendent to weakly spreading (adult & juvenile plants), thinly, stiffly coriaceous; never deep purple-black; petioles glabrous; infructescences erect (limestones) **23**

23. Leaf blades dark green throughout and somewhat darker around mid-veins; inflorescences to ca 6 together; stigma mostly tri-lobed (limestones: Gua Niah) ..... ***A. venusta***
23a. Leaf blades grey-green and dark blue-green around veins; inflorescences solitary to paired; stigma mostly bi-lobed (limestones: SE Sarawak) .... ***A. reversa***

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