ISSN 1346-7565 Acta Phytotax. Geobot. 61 (3): 131–137 (2011)

Studies on Schismatoglottideae (Araceae) of Borneo XVI: A New Species and a New Informal Taxon (the Multinervia Complex) of *Schismatoglottis* from Sarawak

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Schismatoglottis hayi S. Y. Wong & P. C. Boyce is described as a new species endemic to forested limestone outcrops at Niah National Park, NE Sarawak. It is morphologically most similar to *S. multinervia* M. Hotta, a species here redefined as being endemic to Mulu N.P., where it is obligated to limestone. Together these two species are proposed as constituting a new informal taxon, the Multinervia Complex, defined by the combination of vegetative tissues aromatic (terpenoids) when crushed, a fully adnate petiolar sheath, petioles and major veins abaxially pubescent, spathe limb darkening internally rapidly at onset of anthesis and thence splitting longitudinally into wide recurving strips, an hourglass-shaped spadix, and large staminodes in 1–2 rows at the junction of the pistillate zone with the spathe. *Schismatoglottis hayi* is, by modification to the existing key, included into a key to Bornean *Schismatoglottis*. Both species are illustrated. Previous confusion between *S. hayi* and *S. puberulipes* Alderw. is highlighted and clarified.

Keywords: Araceae, Borneo, limestone, Malaysia, Multinervia Complex, Mulu N.P., Niah N.P., Sarawak, *Schismatoglottis*

A recent study visit to Herbarium Bogoriense (BO) and the Gardens Herbarium of the Kebun Raya, Bogor (BOKR), enabled examination of the lectotype of *Schismatoglottis puberulipes* Alderw., highlighting a problem with application of that name to plants from Gua Niah (NE Sarawak), as had been proposed by Hay & Yuzammi (2000). Later examination of Niah-orignated *A. Hay & al. 9369* (K), and subsequent observations of flowering plants from Niah, and also of *S. multinervia* M. Hotta from Mulu, in cultivation in Sarawak, convinced us that the Niah plants represented a novel species, allied to but clearly distinct from the plants from Mulu, and that neither of these species is a close match for Alderwerelt's *S. puberulipes*. The latter, indeed, maybe a junior synonym of *S. gamoandra* M. Hotta, but this requires further investigation, not least because *S. puberulipes* Alderw. was described without exact locality, and the type is very incomplete, and in a genus with such a high level of local endemics such as *Schismatoglottis* assigning early, poorly documented species names has to be approached with particular caution.

Recognition of two morphologically similar but nonetheless distinct species led us to look at the shared characters. It soon became clear that these potential apomorphies defined the species by the combination of vegetative tissues aromatic (terpenoids) when crushed, a fully adnate petiolar sheath, petioles and major veins abaxially pubescent, spathe limb darkening internally rapidly at onset of anthesis and thence splitting longitudinally into wide recurving strips, an hourglass-

shaped spadix, and large staminodes in 1–2 rows at the junction of the pistillate zone with the spathe.

Species of the Multinervia Complex shares aromatic tissues with the Nervosa Complex (Wong 2010), and a rapidly darkening glossy spathe limb with the Hottae Complex (Boyce, Wong & Low, in press), but in all other morphologies are not at all similar.

Hotta (1966) proposed an informal 'Group of *Schismatoglottis calyptrata*' for "most species of the genus", including then newly-described *S. gamoandra*, *S. multinervia*, *S. colocasioidea* M. Hotta and *S. muluensis* M. Hotta, The defining character for his Calyptrata Group being the fully attached petiolar sheath (cf Hay & Yuzammi 2000). However, the four species assigned by Hotta above fall into two robustly-defined morphotaxa based on their shoot architecture: *S. colocasioidea* and *S. muluensis* have hapaxanthic modules (see Hay 1996, Hay & Yuzammi, 2000), while the other two species are pleionanthic. Furthermore, the two pleionanthic species are not closely related. *Schismatoglottis gamoandra* has anthocyanin-rich vegetative tissues that are not aromatic, and has a spathe limb that opens and remains white, whereas *S. multinervia* has aromatic tissues and a pale green, soon-darkening spathe limb.

In the same paper (Hotta 1966) the 'Group of *Schismatoglottis barbata*' was proposed for species with a wide stigma and "ferrugineous" hairs. Two species were explicitly included, *S. cordifolia* M. Hotta (≡ *S. hottae* Bogner & Nicolson, in Bogner 1979) and *S. rubiginosa* M. Hotta (= *S. barbata* Engl). However, they differ markedly in their morphology, notably the nature of their indumentums, and especially in details of their spadix morphology and inflorescence senescence mechanics. *Schismatoglottis barbata* and its allies were detailed by Hay & Yuzammi (2000); *S. hottae* and concomitant morphotaxon is the subject of Boyce, Wong & Low (in press).

Schismatoglottis hayi may be fitted into the key for Borneo (Hay & Yuzammi 2000) by the following modification to couplet 36:

Key to the Multinervia Complex

36a. Leaf blade broadly ovate, ca. up to 15 cm long, 10 cm wide, abaxially glaucescent, with tertiary venation forming a rather indistinct tessellate reticulum, never forming adventitious plantlets. Spadix with interstice staminodes short, mushroom-shaped. Lithophytic on limestone, rarely terrestrial on clay but even then limestone associated; Gunung Mulu N.P., Sarawak ..... *S. multinervia*

36b. Leaf blade oblong-lanceolate, 8–14 cm long, 3.2–5.5 cm wide, abaxially green with tertiary venation forming a conspicuous tessellate reticulum, often with adventitious plants present. Spadix with interstice staminodes conspicuously elongate-cuneate, ca. 3.5 mm long. Lithophytic on limestone; Niah N.P, Sarawak ..... **S. hayi**

Schismatoglottis multinervia M. Hotta—Fig. 1

S. multinervia M. Hotta Mem. Coll. Sci. Univ. Kyoto, Ser. B, 32: 237, fig. 6, G–N (1966); Hay & Yuzammi, Telopea 9(1): 72–73 (2000). —Type: Sarawak, Marudi, at foot of Gunung Mulu, along Sg. Payau, 22 Mar 1964, *M. Hotta 15297* (holo- KYO).

Herb to ca. 30 cm tall with vegetative tissues aromatic (terpenoids) when crushed. *Stem* epigeal, older plants with the stem becoming ascending and rhizome-like, ca. 1 cm diam., pleionanthic. *Leaves* up to 15 together; petiole to ca. 18 cm long, sheathing in the lower 1/3, dull green, the older portions somewhat brown-tinged, minutely and densely greyish puberulent; wings of the sheath fully attached, persistent, tapering and finally narrowly truncate at the apex; blade adaxially somewhat metallic dark green, abaxially

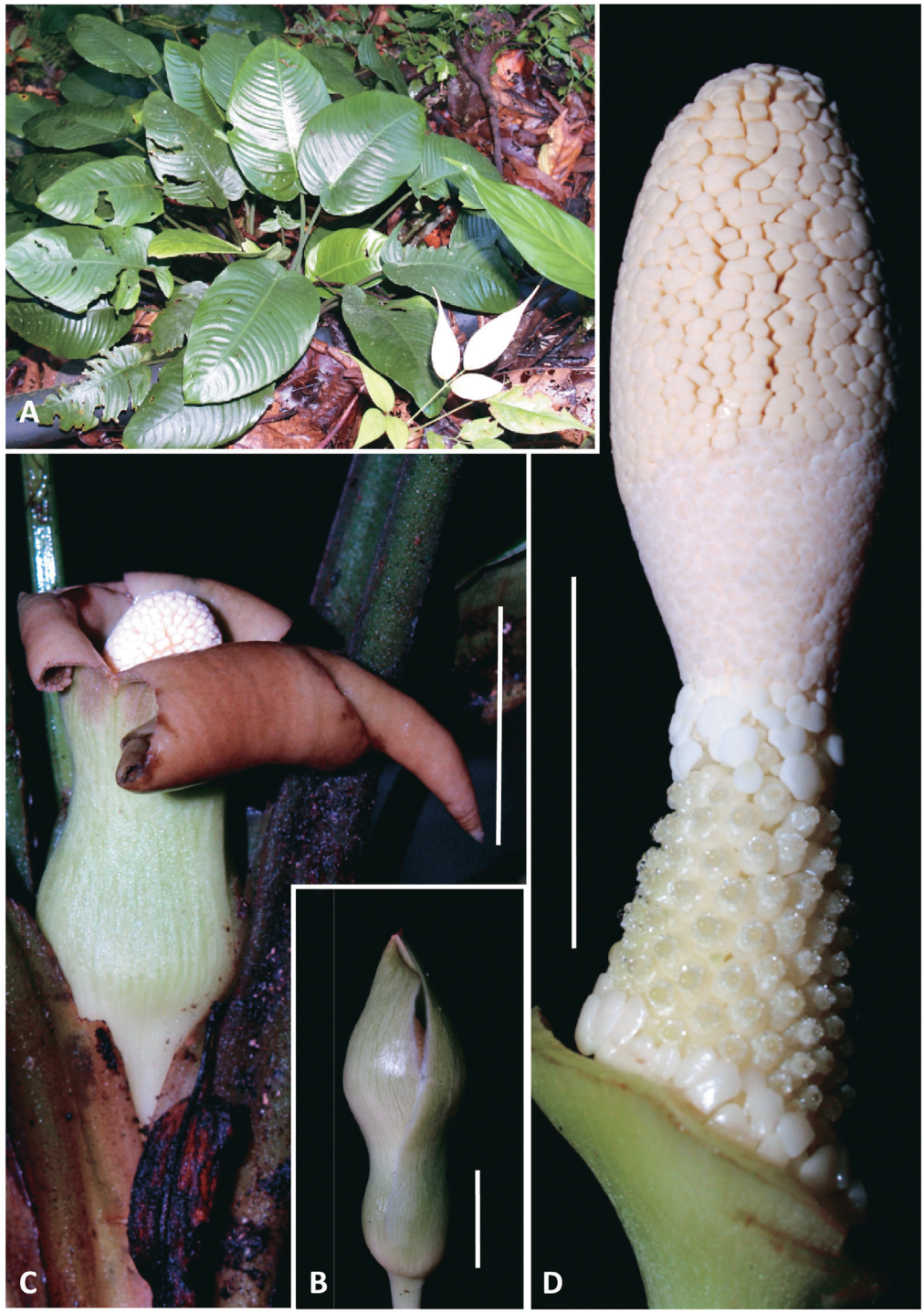

FIG. 1. *Schismatoglottis multinervia* M. Hotta. A: Plants in habitat. B: Inflorescence at onset pistillate anthesis; note the small gap that is created by the expansion of the spathe limb. C: Inflorescence at onset of staminate anthesis. The spathe limb has expanded and split longitudinally, at the same time darkening. The pubescent petiole is clearly visible. D: Spadix at pistillate anthesis with the spathe artificially removed. Note that the interstice staminodes are short and have rounded tops. Note too distal part of the staminate zone is the same diameter at the base of the appendix, and that the appendix is blunt. All from *P. C. Boyce & al. AR-1932*. Photographs by P. C. Boyce & S. Y. Wong. Scale bar = 1 cm.

paler and glaucescent, broadly and shortly oblong-ovate, up to 15 cm long, 10 cm wide, base cordate with rounded posterior lobes up to 2 cm long, apex obtuse, very shortly (ca. 1 mm) apiculate; midrib abaxially prominent, adaxially more or less flush with the lamina, with ca. 16 primary lateral veins on each side, these alternating with lesser interprimaries and diverging at ca. 80°; secondary venation arising from the midrib and the basal parts of the primary veins; tertiary venation forming a rather obscure tessellate reticulum. *Inflorescence* solitary; peduncle short, not exserted from the leaf bases and cataphylls. *Spathe* ca. 4 cm long; lower spathe ellipsoid, inserted obliquely onto peduncle, ca. 1.5 cm long, 1 cm wide, differentiated from the limb by a somewhat weak constriction, very thick-walled (ca. 3 mm); spathe limb ca. 2.5 cm long, more or less ovate and distally shortly acuminate, initially inflated over the appendix and opening by a longitudinal slit at pistillate anthesis, exterior and interior at onset of pistillate anthesis pale green with obscure darker longitudinal veins, later in pistillate anthesis spreading and reflexing, at the same the interior darkening and becoming very glossy, at onset of staminate anthesis limb splitting into irregular longitudinal wide strips and thence deliquescing. *Spadix* sessile, up to 3 cm long, weakly hourglass-shaped; pistillate zone ca. 1.3 cm long, adnate to the spathe in the lower half, the free part narrowly conoid, distally 4 mm diam. (fresh), very pale cream; pistils crowded, subglobose, ca. 1 mm diam.; stigma sessile, button-like, somewhat impressed centrally, about 1/2 the diameter of the ovary; interpistillar staminodes only very occasional among the pistils, otherwise confined to 1–2 irregular rows along the spathe/spadix adnation and crowded in the interstice, shortly stipitate, broad- and flat-topped (mushroom-shaped), slightly broader than and about the height of the pistils, glossy ivory; sterile interstice ca. 3 mm long, isodiametric with the top of the pistillate zone (dry), composed mostly of crowded interpistillar staminodes of similar structure and colour to those at the base of the pistillate zone, distally with some crowded abortive stamens; staminate zone obconic, ca. 6 mm long, distally ca. 5 mm diam.; stamens crowded, truncate, flat-topped, dumbbell-shaped, ca. 1 mm across, the rims of the thecae cleft on the outer side, dull ivory; appendix more or less bullet-shaped, up to 1 cm long, equalling the top of the staminate zone, the apex blunt; staminodes of appendix irregularly polygonal with sharp angles, flat-topped, 0.5–1 mm diam., cream. *Fruiting spathe* urceolate, the rim obscured by the remnants of the liquefied spathe limb. *Fruit* unknown.

Distribution. Sarawak. Endemic to Mulu National Park, where known to occur only on or close to limestone outcrops.

Ecology. Lithophytic on limestone beneath moist lowland evergreen forest, rarely terrestrial in moist clay under lowland riparian forest, but always associated with limestone. 30–100 m asl.

Other specimens examined. MALAYSIA. **Sarawak.** Miri: Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 04°02′23.8″N; 114°48′54.6″E, 5 Aug. 2006, *P. C. Boyce & al. AR-1932* (SAR); Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 04°02′02.0″N; 114°49′00.0″E, 6 Aug. 2006, *P. C. Boyce & al. AR-1944* (SAR); Marudi Long Lama, Mulu N.P., trail from Clearwater Cave, 04°03′49.2″E; 114°49′51.7″ N, 8 Aug. 2006, *P. C. Boyce & al. AR-1962* (SAR). —Limbang: Nanga Medamit, Mulu N.P., trail from Kuala Likut to Camp 5, 04°07′02.3″N; 114°49′26.9″E, 28 Sept. 2007, *P. C. Boyce & al. AR-2210* (SAR); Nanga Medamit, Mulu N.P., trail from Camp 5 to Kuala Terikan, 04°12′58.0″N; 114°53′20.1″E, 29 Sept. 2007, *P. C. Boyce & al. AR-2235* (SAR).

Note: *Schismatoglottis multinervia* is evidently closely related to *S. hayi*, sharing the puberulent petioles and abaxial main veins, closely spaced and wide-spreading primary veins, and a robust sterile interstice. Vegetatively *S. multinervia* differs in the leaf shape, and in not developing adventitious plantlets from the tip and distal-most portion of the abaxial mid-vein, and in having the leaf blades abaxially glaucescent, with the tertiary veins forming only a weak reticulum. Florally *S. multinervia* lacks the long, cuneate interstice staminodes that are diagnostic for *S. hayi*, while the appendix is terminally rounded (not pointed). There are differences between the species, too, in spathe mechanics during anthesis. At female anthesis the spathe limb in *S. multinervia* inflates to produce a narrow longitudinal gap,

whereas that of *S. hayi* opens widely, and while both species eventually have the limb splitting into longitudinal strips, the limb of *S. multinervia* deliquesces to a much more extensively than does that of *S. multinervia*.

Schismatoglottis hayi S. Y. Wong & P. C. Boyce, **sp. nov.**—Fig. 2

Schismatoglottis puberulipes sensu Hay & Yuzammi, Telopea 9(1): 77–79, fig. 9 (2000), *descr. p. maj. p. excl. typ. non* Aldwer. (1922)

Schismatoglottis hayi facile a *S. multinervia* distinguenda foliis longioribus (20 cm vs. 10 cm) proportione angustioribus (5 cm vs. 10 cm) ad apicem propagula gerentibus, laminis adaxialiter viridibus nec glaucescentibus reticulo prominentiore venis tertiariis facto. Species insignis staminodiis elongatocuneatis inter zonas pistillatas et staminatas.

Typus. Malaysia, Miri, Niah National Park, Batu Niah, 5 Feb. 1994, *Hay & al. 9369* ex Cult. RBG Sydney, Acc. No. 940520 sub. *Herscovitch s.n.* (holo- K!; iso- KEP!, L!, NSW, SAR!, US).

Small herb to ca. 22 cm tall with vegetative tissues strongly aromatic (terpenoids). *Stem* condensed, epigeal, slender, ca. 5 mm diam., older plants with stems erect-ascending and rooting. *Leaves* several together (to ca. 6); petiole 5–14 cm long, slender, stiff, densely and minutely puberulent with short straight colourless hairs, sheathing in the lower 1/3–2/5 (sometimes sheathing for the entire length in the leaf below an inflorescence); wings of sheath almost fully attached except for a blunt apical free portion ca. 5 mm long, membranous, spreading, sometimes somewhat crisped, abaxially puberulent; blade oblong-lanceolate, 8–20 cm long, 3.2–5.5 cm wide, very dark green glossy adaxially, paler abaxially, sometimes distinctly bullate, the base slightly but distinctly cordate with rounded posterior lobes 1–2 cm long and overlapping each other or nearly so, the tip acute to obtuse, not acuminate, and often with adventitious plants present at the tip and distally-abaxially, these occasionally attaining rooted into substrate and flowering size while still remaining attached to the parent plant; midrib abaxially prominent and pubescent like the petiole, distally with one to several prominent tooth-like projections with adventitious properties; primary lateral veins 11–16 on each side of the midrib, alternating with lesser interprimaries, diverging at 70–90(–100)° (always some ca. 90°) at first, then rather sharply acropetally deflected before reaching the margin, adaxially somewhat prominent near the midrib, abaxially puberulent near the midrib; secondary venation arising from both the midrib and the bases of the primary veins; tertiary venation abaxially forming a conspicuous tessellate reticulum. *Inflorescence* solitary, subtended by a cataphyll usually with reduced but well-differentiated petiole and blade; peduncle very short, hidden within the leaf bases. *Spathe* ca. 4 cm long, glossy pale green with darker longitudinal veins; lower spathe ovoid, ca. 1.5 cm long, differentiated from the limb by a distinct constriction; spathe limb broadly ovate, the tip apiculate, initially inflated over the appendix of the spadix, initially dirty white at onset of female anthesis, then rapidly darkening internally and becoming semi-glossy before crumbling-deciduous and deliquescing slightly somewhat above the constriction to about level with the top of the staminate zone. *Spadix* ca. 2.8 cm long, sessile, pistillate zone slightly conic, pale yellow; pistils crowded, subglobose, ca. 1 mm diam.; stigma subsessile, button-like, papillate, about half the diameter of the ovary; subpistillar staminodes confined to a single row around the base of the pistillate zone tongue-shaped, attached at the narrower end, ca. 1 mm wide; sterile interstice ca. 4 mm long, isodiametric with top of pistillate zone (fresh), slightly thicker than top of pistillate zone (dry), somewhat attenuate at junction with staminate zone, clothed with elongate-cuneate, staminodes attached by the narrow end, these ca. 3.5 mm long, 1 mm wide at the tip, white and tending to be smaller distally and there some thin L-shaped abortive staminodes sometimes present; staminate flower zone obconoid, ca. 1 cm long, basally ca. 2 mm diam., apically ca. 4 mm diam., dirty white; stamens crowded, ca. 0.5 mm diam., more or less dumbbell-shaped, truncate with broad elevated rims around the pores; appendix rather broadly ellipsoid, widest slightly above junction with staminate zone, ca. 8 mm long × 4 mm wide, composed of irregularly po-

FIG. 2. *Schismatoglottis hayi* S. Y. Wong & P. C. Boyce. A: Plants in habitat. B: Adventitious plantlets on the tip of the leaf blade. C: Inflorescence just prior to anthesis. D: Inflorescence at onset of pistillate anthesis. Note that the spathe limb had opened, darkened, and begun to split. E: Inflorescence at male anthesis. The spathe is beginning to deliquesce and turn glossy. Note the clearly visible pubescent petioles. F: Spadix at staminate anthesis with the spathe artificially removed. Note that the interstice staminodes are long and have flat tops. Note too distal part of the staminate zone is narrower than the base of the appendix, and that the appendix is pointed. All from *P. C. Boyce & al. AR-1880*. Photographs by P. C. Boyce & S. Y. Wong. Scale bar B, D–F = 1 cm; C = 1.5 cm.

lygonal more or less flat-topped staminodes ca. 0.7 mm diam. *Fruiting spathe* broadly urceolate, ca. 1.5 cm diam.

Distribution. Sarawak. Endemic to Niah National Park, where it is restricted to limestone outcrops.

Ecology. Lithophytic on limestone in swampy evergreen moist forest. 30–55 m asl.

Etymology. Named for Alistair Hay, formerly of the RBG Sydney, who has authored many excellent papers dealing with numerous remarkable novel species of aroid.

Other specimens examined. Miri: Niah Suai, Niah N.P., Madu Trail, 03°48′57.9″N; 113°46′18.3″E, 13 July 2006, *P. C. Boyce & al. AR-1879* (SAR); *AR-1880* (SAR).

Note. *Schismatoglottis hayi* is readily distinguished from *S. multinervia* by longer, proportionately narrower leaf blades developing adventitious plantlets from the tip and distal-most portion of the abaxial mid-vein, and in the leaf blades abaxially green, not glaucescent, with a more prominent reticulum formed by the tertiary veins. Florally the long, cuneate interstice staminodes of for *S. hayi* are diagnostic, and the narrowly conical appendix distinctive. At female anthesis the spathe limb of *S. hayi* opens widely, as opposed to opening initially as a narrow gap.

Excluded Collections

Hay & Yuzammi (2000) cite four additional collections under *S. puberulipes*, three from Bintulu, and one from Kapit. Of these Bintulu-collected *J. W. Purseglove P5376* (L!) and *P. S. Ashton S.18179* (SAR!), and Kapit-collected *W. M. A. Brooke 9107* (SAR!) are referable to *S. gamoandra*. We have not seen *M. Hirano & M. Hotta 1460* (Bintulu, eastern ridge of Bukit Kana).

Two as yet unflowered collections in our nursery at the Botanical Research Centre, Kuching originate from Bintulu: Bukit Merirai and may be either referable to *S. hayi*, or may represent an additional novel species.

The study visits to the herbaria mentioned in this paper were funded under the first author's ITTO Fellowship Ref. 026/09A. This is part of an on-going research which is funded by the Ministry of Higher Education, Malaysia by fundamental research grant scheme vote: FRGS/01(12)/709/2009(25). Many thanks are extended to the Directors or Curators of FI, K, L, M, BO and BOKR for allowing access to the material and to their staffs for kindly facilitating the observations. Research and fieldwork in Borneo was, most recently, under Sarawak Forestry Department Research Permit No. NPW.907.4.4(V)-77 & Park Permit No. 34/2009. The continuing collaboration and support of the Forest Department Sarawak and Sarawak Forestry Corporation are gratefully acknowledged.

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Received September 22, 2010; accepted October 29, 2010