

Cryptocoryne wongsoi (Araceae), a new species from Sumatera, Indonesia

Jan D. Bastmeijer
Oude Roswinkelerweg 72
NL-7822 AG Emmen
The Netherlands.

Hendra Budianto
Komunitas *Cryptocoryne* Indonesia
Raya Sawo Gg. III/33
Surabaya 60221, Indonesia.

Isa B. Ipor
Department of Plant Science & Environmental Ecology
Faculty of Resource Science & Technology
Universiti Malaysia Sarawak
94300 Kota Samarahan
Sarawak, Malaysia.

Marian Ørgaard & Niels Jacobsen*
Section of Organismal Biology
Department of Plant- and Environmental Sciences
University of Copenhagen
Thorvaldsensvej 40
1871 Frederiksberg C, Denmark.
nika@plen.ku.dk
*corresponding author

ABSTRACT

Cryptocoryne wongsoi is described and illustrated as a new species from northwestern Sumatera, Indonesia. *Cryptocoryne wongsoi* differs from other species with similar leaves and habitat type

by having a hispidulous lower leaf surface, a 15 – 25 cm long spathe with an upright backwards-bent limb which later becomes forward bent or obliquely spirally twisted; the kettle is cylindrical without a distinct narrowing of the inner wall; the chromosome number is $2n = 34$.

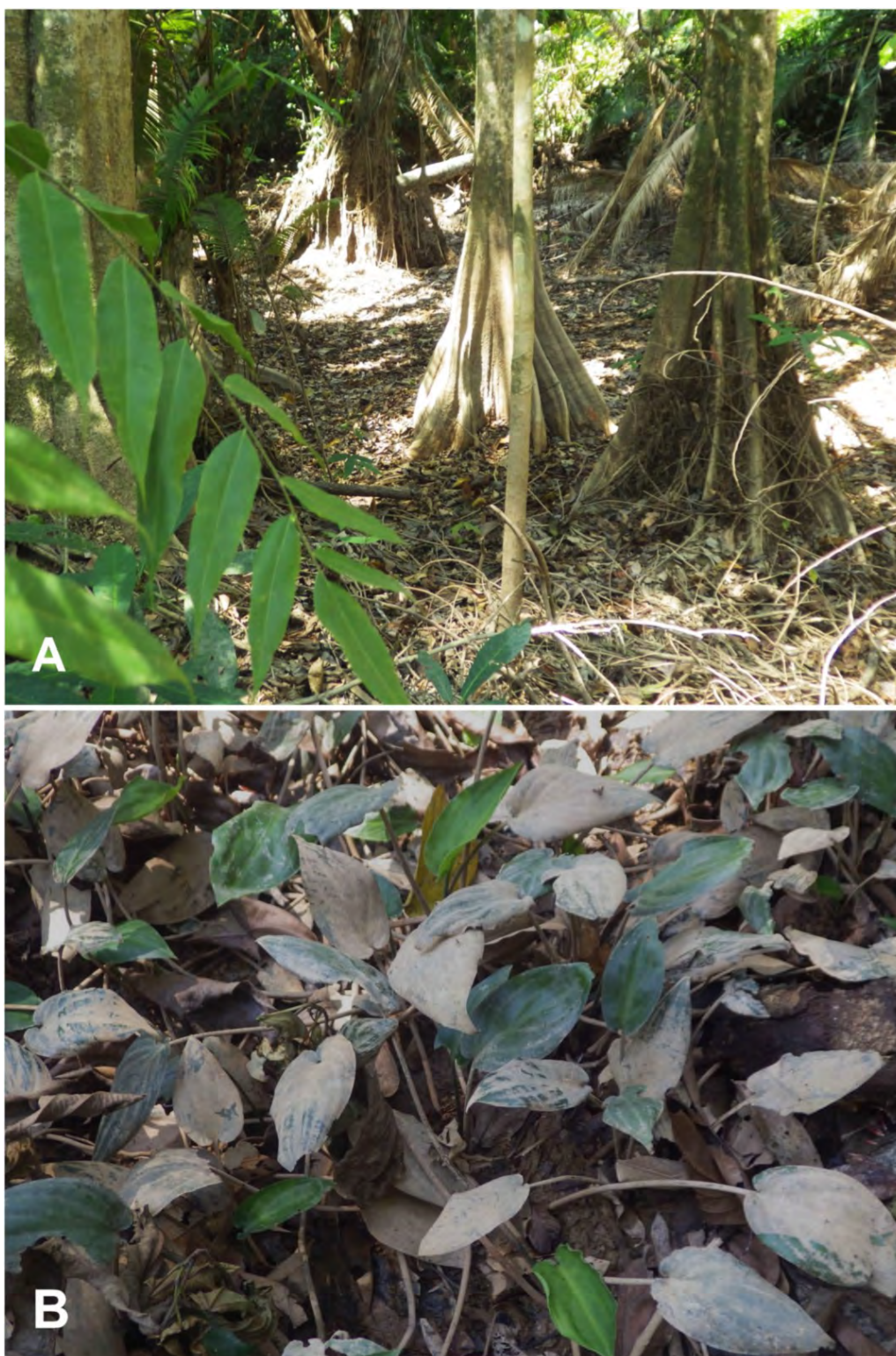


Figure 1. *Cryptocoryne wongsoi* I. B. Ipor. **A.** Showing the natural habitat in the dried out swamp forest SE of Meulaboh, Sumatera. **B.** A close up of the stand shown in figure A. Images © S. Wongso.



Figure 2. *Cryptocoryne wongsoi* I. B. Ipor. Showing the cultivation in a partly filled 5-liter tank, still with mud on the leaves from the natural habitat. Image © S. Wongso.

KEY WORDS

Aroids, chromosome number, taxonomy, Sumatera

INTRODUCTION

The Indonesian island of Sumatera and the close-by Riau Islands (Karimun, Batam, Bintan, Lingga, Singkep, Bangka, and Belitung) have for some time been known to harbor a number of *Cryptocoryne* species: Thirteen all together (six endemic - E): *C. bangkaensis* Bastmeijer (2007, E (Bastmeijer & Jacobsen, 2007)), *C. ciliata* (Roxburgh) Schott (1832), *C. cordata* Griffith var. *diderici*

(De Wit) N. Jacobsen (1970/2002, E), *C. fusca* De Wit (1970), *C. griffithii* Schott (1856), *C. longicauda* Engler (1879), *C. minima* Ridley (1910), *C. moehlmannii* De Wit (1983, E (Bastmeijer & Duyfjes, 1997; Jacobsen, 1988))), *C. nurii* Furtado var. *nurii* (1935), *C. pontederiifolia* Schott (1863, E (van Bruggen & Bastmeijer, 1995.), *C. schulzei* De Wit (1971), *C. scurrielis* De Wit (1962, E (Reitel & al., 2012)), and *C. villosa* N. Jacobsen (1980, E (Jacobsen, 1980)) (Bastmeijer, 2016; de Wit, 1990); and additionally three, yet unnamed natural interspecific hybrids with the working names: *C. Sg. Pelan*, *C. Sg. Pijoan*, *C.*

Sumatera 2 (Jacobsen & al., 2016). This list of species including year of publication shows that just less than half of the *Cryptocoryne* have been known for more than 80 years (six) while the rest (seven – now eight) have been described within the last 55 years, as knowledge of the flora has increased.

The island of Sumatera, with more than 470,000 km² of land area, is over three times the size of adjacent Peninsular Malaysia, which has nine *Cryptocoryne* species and four natural hybrid combinations (Bastmeijer, 2016; Jacobsen & al., 2016): the diversity of *Cryptocoryne* in Sumatera is apparently lower than might be expected.

Until recently, *Cryptocoryne* of Sumatera has only been investigated sporadically by a few people (for overview see Bastmeijer, 2016).

Early in 2015, I. B. Ipor and S. Wongso had the opportunity to visit the west coast of the northern Aceh province of Sumatera, a region where you may find the habitats of the *C. pontederiifolia* – *C. moehlmannii* complex (see Bastmeijer, 2016).

In a dried-out swamp forest near the river, was found a *Cryptocoryne* with leaf blades similar to those of *C. pontederiifolia* and *C. moehlmannii*, however, no flowering specimens were found. When it flowered afterwards in cultivation the plants proved to have a spathe with a long tube, quite unlike that found in *C. pontederiifolia* and *C.*

moehlmannii. Until we had made a closer investigation of the plant, we speculated that it could be a *C. pontederiifolia* with a long spathe tube, but turned out to have the distinguishing characters, as per the diagnoses. The only other species with hairs on the lower surface of the leaf blades are *C. ferruginea* Engl. from Borneo and *C. fusca* De Wit, which is found mainly on Borneo but extends to the island of Belitung (see Bastmeijer, 2016). The hairs of these two species are longer than those found in the plant from SE of Meulaboh. The Meulaboh plant also proved to have a chromosome number of $2n = 34$, while *C. moehlmannii* and *C. pontederiifolia* have $2n = 30$ (Jacobsen, 1977; Arends & al., 1982).

On the basis of the comparison of the Meulaboh plant to other known *Cryptocoryne* species, it is clear that it represents a new species, with the distinguishing characters outlined here.

***Cryptocoryne wongsoi* I.B. Ipor, sp. nov.**
Type: Indonesia, Sumatera, Aceh, Nagan Raya Regency, SE of Meulaboh, 31 January 2015, S. Wongso & I. B. Ipor, SW 1507, cultivated (BO holotype, C, L isotypes).
Figure 1–7.

Diagnosis

Cryptocoryne wongsoi is similar to *C. pontederiifolia* Schott and *C. moehlmannii* De Wit by the general appearance of the leaves, but differs by having the lower leaf surface hispidulous with minute, short hairs



Figure 3. *Cryptocoryne wongsoi* I. B. Ipor. Flowering plant grown emergent in a pot. Scale units 1 cm.
Image © J.D. Bastmeijer.



Figure 4. *Cryptocoryne wongsoi* I. B. Ipor. **A.** Showing a detached spathe on the opening day with an upwards, backwards bent limb. **B.** Showing a detached spathe on the second day of opening with a forward, spirally coiled limb. Scale units 1 cm. Images © J.D. Bastmeijer.

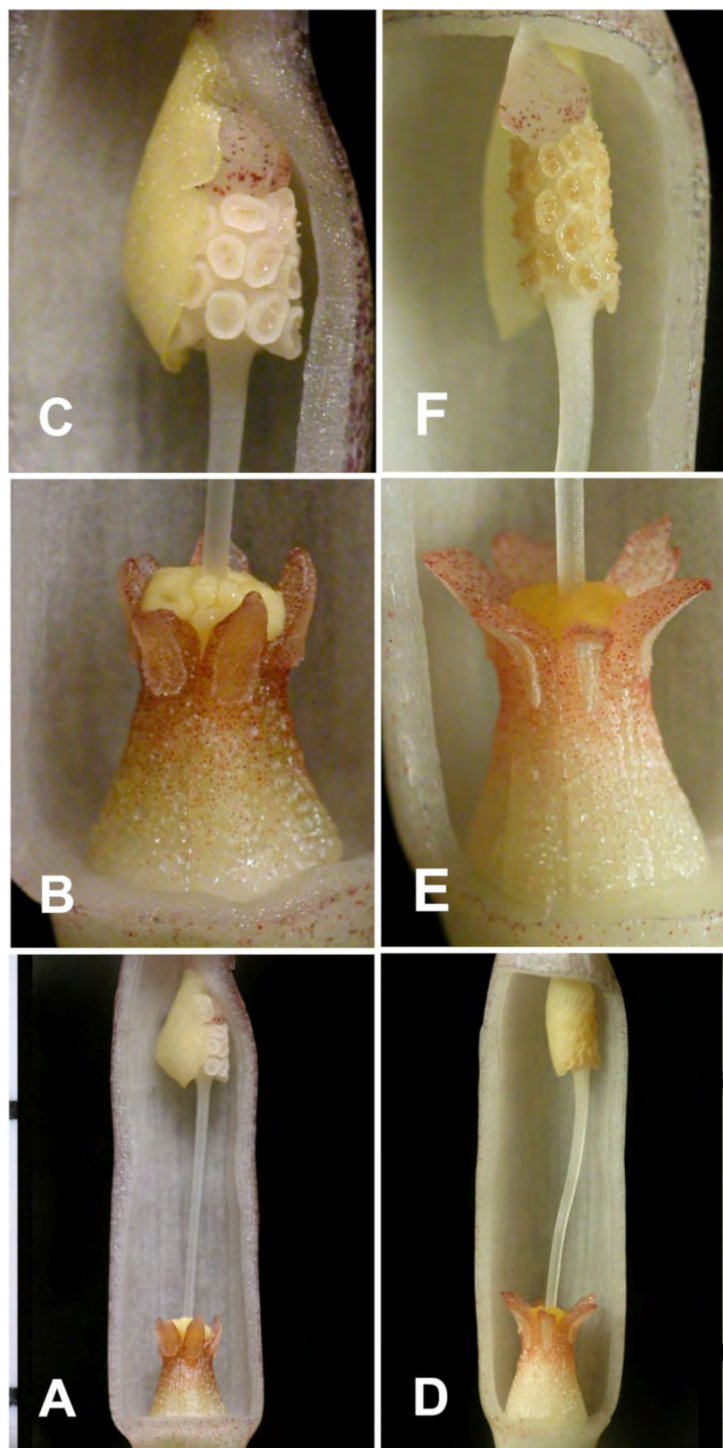


Figure 5. *Cryptocoryne wongsoi* I. B. Ipor. **A, B, C** Showing elements from the same spathe as in figure 3A. **A.** Kettle cut open showing the male and female flowers. **B.** Showing the female flowers with the receptive stigmas. **C.** Showing the not yet mature male flowers. **D, E, F** Showing elements from the same spathe as in figure 3B. **D.** Kettle cut open showing the male and female flowers. **E.** Showing the female flowers with the dried, non-receptive stigmas. **F.** Showing the mature male flowers. Scale units 1 cm. Images © J.D. Bastmeijer.

(glabrous in *C. moehlmannii* and *C. pontederiifolia*); the spathe has a 10 – 18 cm long tube (about 1 cm in *C. moehlmannii* and *C. pontederiifolia*), with an upright limb that later becomes forward bent or spirally twisted, lacks a distinct collar zone (collar in *C. moehlmannii* and a collar zone in *C. pontederiifolia*); the kettle is c. 2 cm long, cylindrical, without a distinct narrowing on the inner wall at 2/3 from the bottom (*C. moehlmannii* and *C. pontederiifolia* have a c. 1 cm long kettle with a constriction 2/3 from the bottom); the chromosome number is $2n = 34$ ($2n = 30$ in *C. moehlmannii* and *C. pontederiifolia*).

Description

Amphibious herb with a stout rhizome and long, robust subterranean stolons. **Leaves** 4 – 8, 15 – 45 cm long, leaf **blades** up to 8×17 cm, cordate, spreading more or less horizontally from the more or less upright petiole, above smooth with 3 pairs of veins somewhat impressed above, dark green; lower surface pale green, hispidulous, covered with minute, short hairs also present along blade margin when viewed from above; **cataphylls** 4 – 6 cm long, dark brownish green, often present even when not flowering. **Spathe** 15 – 25 cm long, in the upper outer part red-brownish; **kettle** c. 2 cm long, cylindrical, inside white; **tube** 10 – 18 cm long, more or less twisted; the upright backward bent **limb** later becoming forward-bent or obliquely spirally twisted, 3 – 5 cm long, inside yellow around the tube, opening turning reddish towards apical part, and a reddish line along the margin, smooth

without a distinct collar zone, at late anthesis limb unfolding and bending downwards. **Spadix** c. 2 cm long, with mostly 6 **female** flowers upwards purplish sprinkled, with narrow **stigmas** which change shape from narrowly ovate to obovate during anthesis, and become narrower than the somewhat red spotted styles; **olfactory bodies** rounded, some with a sunken center, yellowish; **male flowers** 25 – 35, white becoming yellowish; **appendix** white, spotted red; valve yellowish. **Infructescence** not observed. **Pollen** fertility: 100 %. **Chromosome number.** $2n = 34$, reported here.

Distribution — Endemic to Sumatera, known only from the type locality in Aceh, SE of Meulaboh, but probably also occurring along the whole river and possibly also in other rivers in the region.

Habitat — The type specimen was collected in a forest swamp near the main river and only receives dappled sunlight during the day.

Conservation status – Data Deficient (DD) (IUCN/SPS, 2014): only known from the type locality, more observations are needed in order to outline a conservation assessment. The habitat of *C. wongsoi* is rather inaccessible except in very dry seasons, which might help to preserve it.

Eponymy — Named after Dr Suwidji Wongso of Surabaya, who has contributed

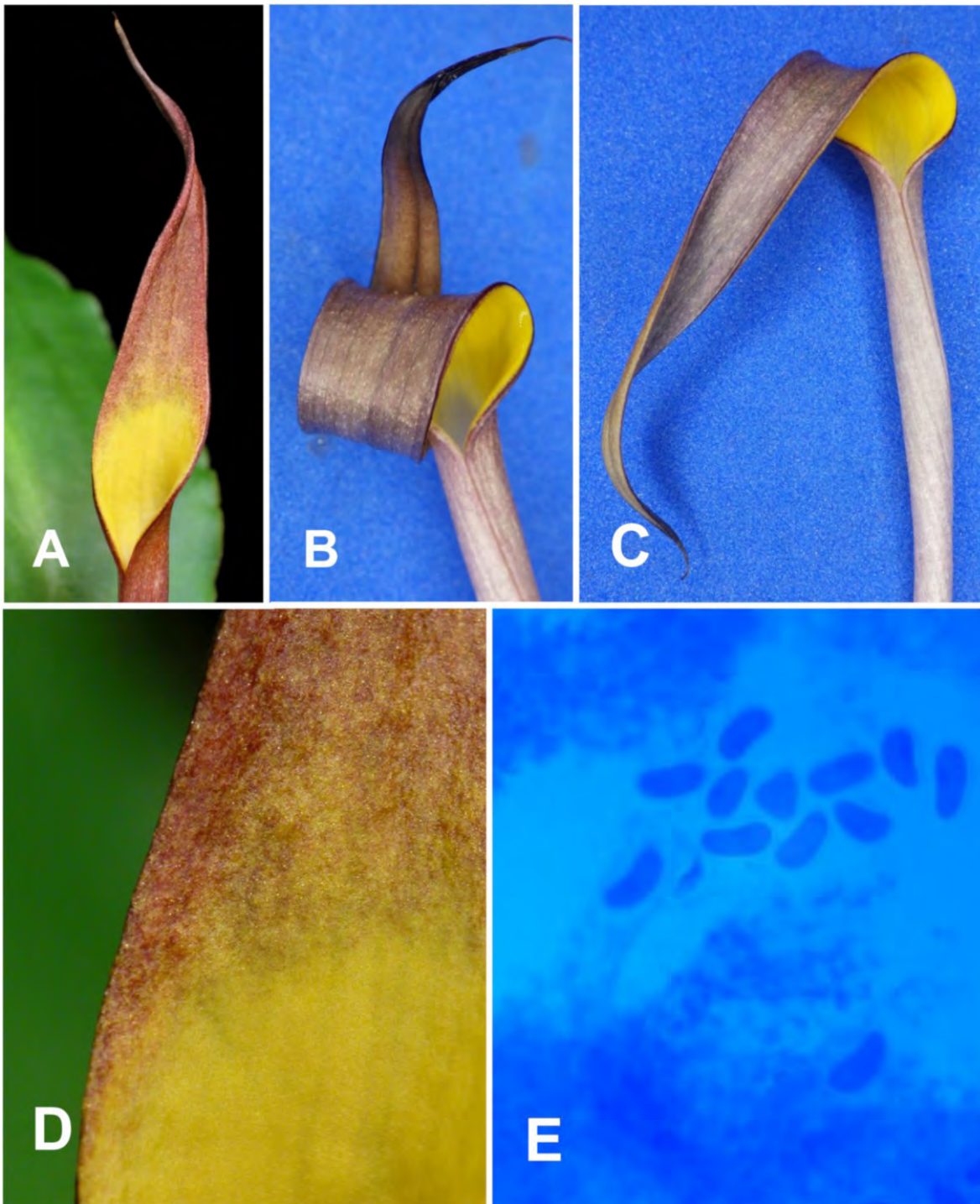


Figure 6. *Cryptocoryne wongsoi* I. B. Ipor. **A.** Showing the limb of a spathe on the opening day, which is upwards, backwards bent. **B.** Showing the limb of a spathe on the second day of opening, which is forward, spirally coiled. **C.** Showing the limb of a spathe on the second - third day of opening, which is forward bent. **D.** Close-up of the limb of the spathe at the tube opening. **E.** The Cotton Blue stained fertile pollen (length c. 40 μm). Images © A, D-E J.D. Bastmeijer; images B-C © S. Wongso.

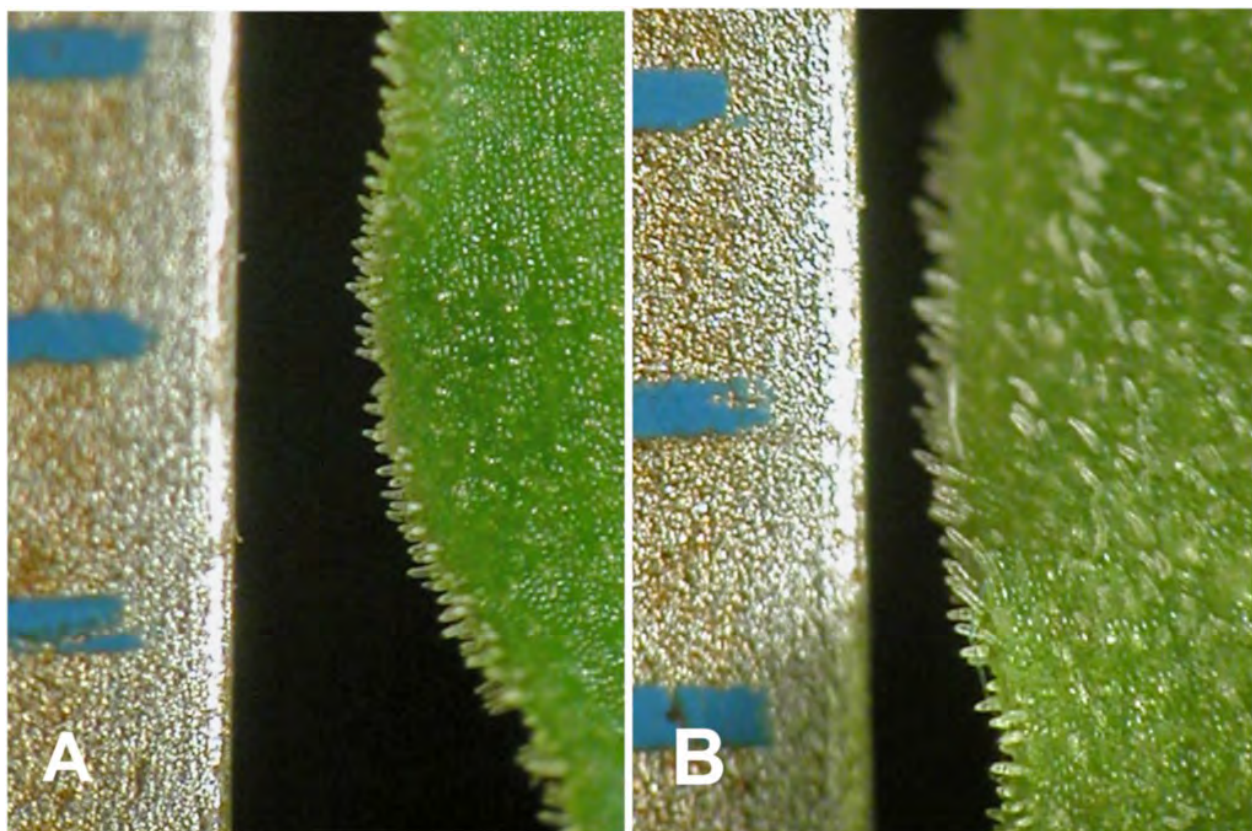


Figure 7. *Cryptocoryne wongsoi* I. B. Ipor. **A.** Upper leaf surface showing the scabrous margin of the leaf with the short hairs. **B.** Showing the scabrous lower surface of the leaf with the numerous short hairs. Scale units 1 mm. Images © J.D. Bastmeijer.

so much to the knowledge of the Indonesian *Cryptocoryne*.

Cultivation — *Cryptocoryne wongsoi* is easily cultivated emergent in a slightly acid layer of leaf litter of the European beech tree (*Fagus sylvatica*) with some addition of some mineral soil at temperatures between 22 and 27 (–30) °C. Even in a simple mixture of sand and peat litter, it grows as easily as some of the more common and hardy Sri Lankan species, e.g., *C. wendtii* De Wit (Bastmeijer, 2016). Light intensity seems to be unimportant. The plants propagate well

by runners, and under appropriate conditions becomes almost weedy.

Acknowledgements

We would like to thank the authority of University Malaysia Sarawak for allowing Prof Dr Isa B. Ipor to participate in the field sampling. Mrs. Karen Rysbjerg Munk prepared the chromosome slides. The editor and two anonymous reviewers are also thanked for their useful and constructive comments on an earlier draft of this paper.

References

- Arends, J.C., J.D. Bastmeijer & N. Jacobsen. 1982. Chromosome numbers and taxonomy in *Cryptocoryne* (Araceae) II. - *Nordic Journal of Botany* 2(5): 453–463.
- Bastmeijer, J.D. 2016. The Crypts Pages. <http://crypts.home.xs4all.nl/Cryptocoryne/index.html> - accessed May 26th, 2016.
- Bastmeijer, J.D. & B.E.E. Duyfjes. 1997. Zwei *Cryptocorynen* aus dem Gunung-Leuser-Nationalpark (Sumatra, Indonesien), 2. Teil. *Cryptocoryne moehlbmannii* De Wit. *Aqua Planta* 22(2): 43–50.
- Bastmeijer, J.D. & N. Jacobsen. 2007, *Cryptocoryne bangkaensis* Bastmeijer, ein neuer Name für eine gut bekannte *Cryptocoryne* von Sumatra (Indonesien). *Aqua Planta* 32(2): 41, 44–55.
- Bruggen, H.W.E. van & J.D. Bastmeijer. 1995. *Cryptocoryne pontederiifolia* Schott (1863). *Die Aquarien und Terrarien Zeitschrift* 48(5): 302–303.
- IUCN/SPS. 2014. Guidelines for using the IUCN Red List categories and criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. – Published at <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>
- Jacobsen, N. 1977. Chromosome numbers and taxonomy in *Cryptocoryne* (Araceae). *Botaniska Notiser* 130: 71–87.
- Jacobsen, N. 1980. A new species of *Cryptocoryne* from Sumatra. *Aroideana* 3(4): 118–119.
- Jacobsen, N. 1988. Die Geschichte der *Cryptocoryne moehlbmannii* De Wit. *Aqua Planta* 13(3): 90–95.
- Jacobsen, N., J.D. Bastmeijer, H.B. Ganapathy, T. Idei, I.B. Ipor, A.S. Othman, J. Siow, S. Wongso & M. Ørgaard. 2016. Hybrids and the Flora of Thailand – 2: Hybridization in the Southeast Asian genus *Cryptocoryne* (Araceae). *Thai Forest Bulletin (Botany)* 44: submitted.
- Reitel, S., K. Nakamoto & J.D. Bastmeijer. 2012, Die echte *Cryptocoryne scurrilis* De Wit (Araceae), *Aqua Planta* 37(4): 135–142.
- Wit, H.C.D. de. 1990. *Aquarienpflanzen*, 2. Auflage. Ulmer, Stuttgart. ISBN 3–8001–7185–6.

Studies on Schismatoglottideae (Araceae) of Borneo LIII – *Schismatoglottis larynx* and *S. rejangica*, new species allied to *S. petradox*

Wong Sin Yeng*

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

University Malaysia Sarawak

94300 Kota Samarahan

Sarawak, Malaysia

sywong@frst.unimas.my

Associate Researcher

Harvard University Herbaria

22 Divinity Avenue

Cambridge, MA 02138. USA

*
corresponding author

Peter C. Boyce

Honorary Research Scientist

Ludwig–Maximilians–Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München, Germany

boyce@biologie.uni-muenchen.de

ABSTRACT

Schismatoglottis larynx S. Y. Wong & P. C. Boyce and *S. rejangica* S. Y. Wong & P. C. Boyce are described, illustrated, and compared with *S. petradox* S. Y. Wong & P. C. Boyce, the species to which they are most closely similar. A key to all three species is provided.

KEY WORDS

Rheophyte, shale ecology, *Schismatoglottis* Tecturata Group

INTRODUCTION

Schismatoglottis petradox S. Y. Wong & P. C. Boyce (Wong & Boyce 2014) is a perplexing

plant that, whereas overall highly reminiscent of species of the *Schismatoglottis* Multiflora Group (Hay & Yuzammi 2000), is distinguished by the shoot modules comprising a single foliage leaf, a petiolar sheath reduced to a very short collar with its protective role homeotically taken by the subtending prophyll, and leaf blades with tessellate secondary venation, all characteristics that are absent from the Multiflora Group. At the time of publication no further species combining this combination of characteristics was known to exist, and *S. petradoxa* was considered to be an isolated species.

Recently two further species have flowered that share the defining characteristics of *S. petradoxa* but which are

also obviously distinguished from it. We here describe these as taxonomic novelties: ***Schismatoglottis larynx* S. Y. Wong & P. C. Boyce sp. nov.** and ***S. rejangica* S. Y. Wong & P. C. Boyce sp. nov.** The result is that there is now a species cluster of three morphologically similar (and molecularly allied) species occupying an isolated position within *Schismatoglottis* sens. lat. (Low et al., in prep.).

Dimensions in the descriptions are derived from fertile (i.e., mature) plants. Seedlings have overall smaller measurements.

In verifying geological occurrences for this paper we have been much assisted by the excellent geological map of Tate (2001).

KEY TO THE SPECIES OF THE *SCHISMATOGLOTTIS PETRADOXA* CLADE

- 1a. Leaf blades pendulous; thick, brittle; spadix weakly clavate-cylindric, 5.5–7 cm long 2
- 1b. Leaf blades arching-erect, leathery; spadix stoutly clavate, 4–4.5 cm long ***Schismatoglottis larynx* S. Y. Wong & P. C. Boyce**
- 2a. Leaf blades** up to 45 cm long × 14 cm wide; petioles up to 27 cm long; leaf blade abaxially conspicuously ribbed (ribs corresponding to the primary lateral veins); mid-rib pale creamy yellow contrasting with remainder of blade matte olive-green; inflorescences in groups of three; spadix 6–7 cm long; stigmas narrower than pistil ***Schismatoglottis petradoxa* S. Y. Wong & P. C. Boyce**
- 2b. Leaf blades** up to 26 cm long × 7 cm wide; petioles up to 11 cm long; leaf blade abaxially not conspicuously ribbed; mid-rib concolorous with remainder of blade; inflorescences solitary; spadix ca. 5.5 cm long; stigmas wider than pistil ***Schismatoglottis rejangica* S. Y. Wong & P. C. Boyce**

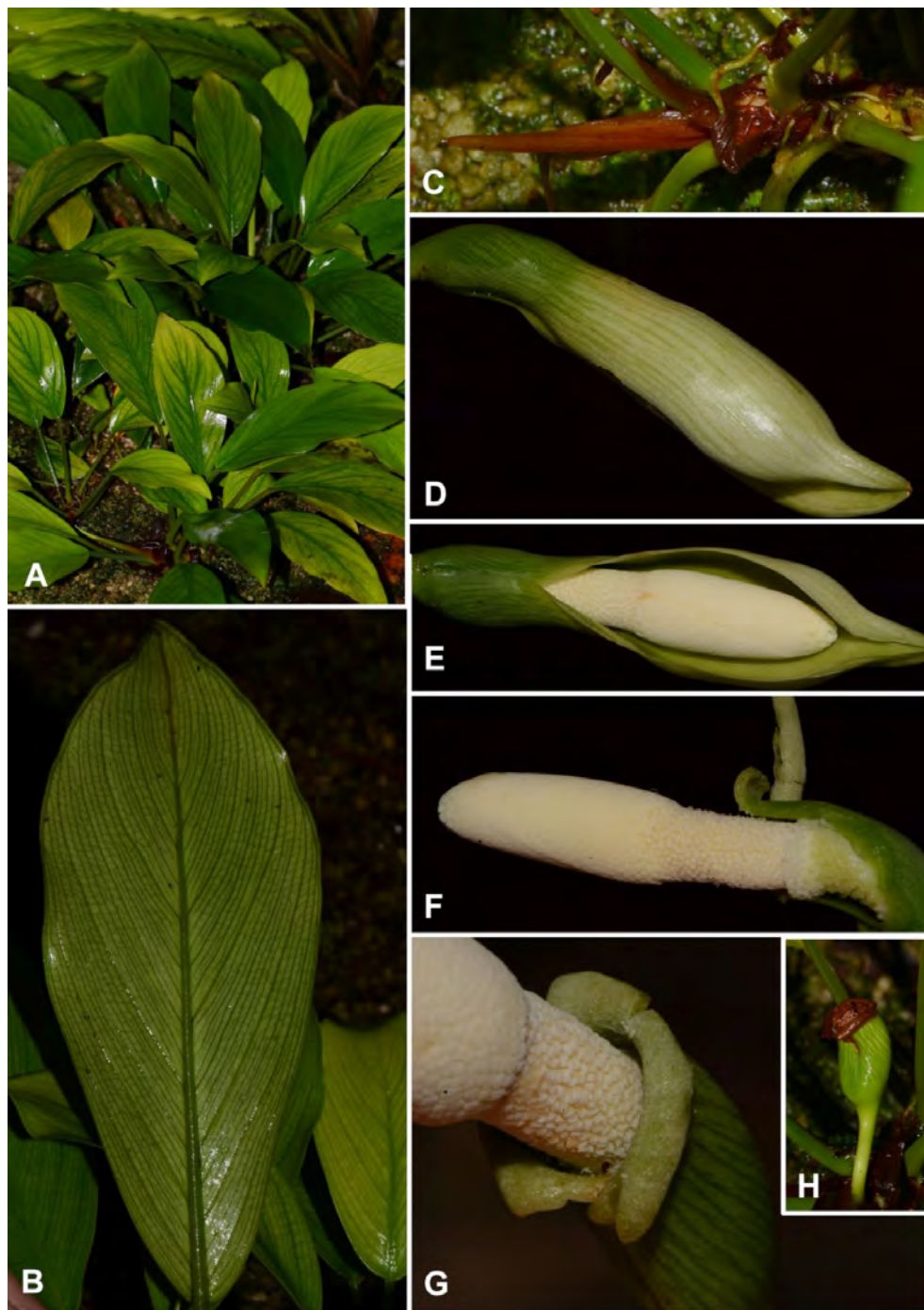


Figure 1. *Schismatoglottis larynx* S. Y. Wong & P. C. Boyce

A. Cultivated plant. **B.** Leaf blade, abaxial surface showing tessellate veins. **C.** Active shoot tip showing each leaf subtended by a protective cataphyll; note that petiolar sheath is reduced to a short collar with no protection function of emerging leaf. **D & E.** Inflorescence at pistillate anthesis; the posture in **D.** is as in nature. **F.** Spadix at onset of staminate anthesis, nearside portion of spathe artificially removed, note expanded interstice staminodes spathe limb shed, leaving recurved remnants around orifice of lower spathe. **G.** View of the recurved remnants of the spathe limb at orifice of lower spathe, inflorescence at onset of staminate anthesis. **H.** Developing infructescence; note that the peduncle has reflexed to bring the infructescence upright. **A–H** from *AR-4186*. Images © P.C. Boyce.

Schismatoglottis larynx S. Y. Wong & P. C. Boyce, **sp. nov.** Type: Malaysian Borneo, Sarawak, Betong, Saratok, Sungai Kabo, 01°46'37.1"N 111°28'26.1"E", 15 Jul 2013, *M. Lo* AR-4186 (holotype SAR!; isotypes M!, SAR!, SING! – all alcohol preserved). **Figure 1.**

Diagnosis

Schismatoglottis larynx is distinguished from *S. petradoxa* and *S. rejanica* by arching-erect (not pendulous) leathery (not thick, brittle) leaf blades, and by a stoutly clavate spadix 4–4.5 cm long (vs slender clavate-cylindric, 6–7 cm long). *Schismatoglottis larynx* is further differentiated from *S. petradoxa* by the much smaller leaf blades (up to 26 × 7 cm vs up to 45 × 14 cm), without a discoloured midrib, shorter petioles (up to 11 cm long vs up to 27 cm long), and solitary inflorescences (vs inflorescences in threes).

Description

Creeping rheophytic herb to ca. 15 cm tall. **Stem** condensed, rhizome-like, densely rooting along its length, internodes to 1 cm long, ca. 4 mm diam. **Leaves** numerous, each alternating with soon-marcescent, tapering lanceolate weakly scabrid cataphyll to 3.5 cm long; **petiole** shorter than blade, erect, 5–8 cm long, dorsally flattened with blunt ridges running along the dorsal margins, dull green, minutely scabrid, sheathing only at very base, petiolar sheath reduced to an obscure collar; **blade** oblanceolate, 9–11.5 cm long × 3.5–4 cm wide, leathery, adaxially matte olive-green,

much slightly paler, base cuneate to very narrowly rounded, apex acuminate and apiculate for ca. 1 mm; **midrib** adaxially more or less flush with blade, abaxially prominent; **primary lateral veins** ca. 8 on each side, diverging at 45–60°, adaxially hardly impressed, abaxially somewhat raised; interprimary veins more numerous than primaries, ca. half width; **secondary venation** abaxially forming a conspicuous dark green tessellate reticulum; **tertiary venation** invisible. **Inflorescence** nodding, solitary, subtended by lanceolate membranous cataphylls, smelling very faintly sweet-esteric at pistillate anthesis; **peduncle** cylindric, and subtended almost obscured by a conspicuous prophyll, up to 4 cm long × 3 mm wide, pale green. **Spathe** with a strong constriction between the lower part and the limb, limb inflating and gaping at pistillate anthesis, opening further at staminate anthesis, 5–6 cm long; **lower spathe** narrowly ovoid and markedly asymmetric, dorsally shallowly flattened-convex corresponding to the adnation of the pistillate flower zone, glossy medium green with fine darker longitudinal veins, dorsally ca. 1 cm long, ventrally 1.5 cm long, persistent; **spathe limb** exterior pale greenish while with fine darker green longitudinal lines at pistillate anthesis, interior dirty whitish, rather glossy, broadly lanceolate 4–4.5 cm long, bluntly rostrate for ca. 1 cm, upper half opening at pistillate anthesis and initially via a narrow terminal slit, then wide-gaping (ca. 2 cm wide), and weakly fornicate, limb margins reflexing during staminate anthesis, limb caducous to leave a rim of recurved degraded tissue at

the lower spathe insertion. **Spadix** 4–4.5 cm long, stoutly clavate; **pistillate zone** ca. 3.5 mm (dorsal side) to 8 mm long (ventral side), weakly conic, obliquely inserted, distally ca. 4 mm diam., light green; **pistils** somewhat crowded, and upwardly oriented with relation with the spadix axis, ca. 0.7 mm diam., slightly depressed-globose, light green; **stigma** briefly stipitate, capitate, narrower than top of pistil, ca. 0.2 mm tall $\times$ 0.4 mm wide, papillose; **interpistillar pistillodes** very few, occurring at junction of peduncle and pistillate flower zone with peduncle, ca. 2 mm long, compressed-clavate, white; **sterile interstice** with about 2 rows of staminodes; **interstice staminodes** weakly columnar-polygonal ca. 1 mm across, dull-white, initially equalling the height of pistils, later (late pistillate anthesis) staminodes lengthening to create a ring ca $1/3$ wider than fertile zones; **staminate zone** cylindric-weakly conical, ca. 1.5 cm long $\times$ 0.4–0.5 cm diam., cream; **stamens** irregularly densely crowded, individual flowers impossible to distinguish, rectangular dumb-bell shaped from above, truncate with narrow connective slightly pointed-elevated above thecae, thecae opening by a single pore, creamy white; **appendix** stoutly clavate, blunt, proximally slightly wider than top of staminate zone, 2–2.4 cm long, widest part ca. 7 mm diam., distally tapering and narrowly obtuse, white; **appendix staminodes** very dense, weakly polygonal in plan-view with a weak central depression, pale cream. **Fruiting spathe** erect by flexing of the peduncle, oblique-urceolate with the rim bearing recurved

spathe limb remnants, deep glossy green. **Fruits** and **seeds** not seen.

Ecology — Occurring on semi-shaded shale rocks beside a small forest waterfall. 60 m asl.

Distribution — *Schismatoglottis larynx* is known only from the type locality, where it is very locally plentiful.

Etymology — The trivial epithet is suggested from the form of the human larynx and its resemblance to the manner in which the lower spathe tightly grips the pistillate portion of the spadix as far as the expanded zone of interstice staminodes.

Notes — Although mono(folia)phyllous shoot modules, a condensed petiolar sheath, and protective subtending prophyll are all typical of the *Schismatoglottis* Tecturata Group (Boyce & Wong 2013), *S. larynx* differs from *S. tecturata* and its allies by leaf blades with tessellate secondary venation, and pendent inflorescences each on a long peduncle (**Figure 3**).

Molecular analyses (Low et al, in prep.) fails to retrieve as monophyletic the *Schismatoglottis* Tecturata Group, with multiple accessions of the representative species [*S. tecturata* (Schott) Engl.] falling together outside of *Schismatoglottis* sens. strict. It is perhaps significant that Schott (1865) recognized a separate genus, *Colobogynium* Schott, for the plant now called *Schismatoglottis tecturata*.

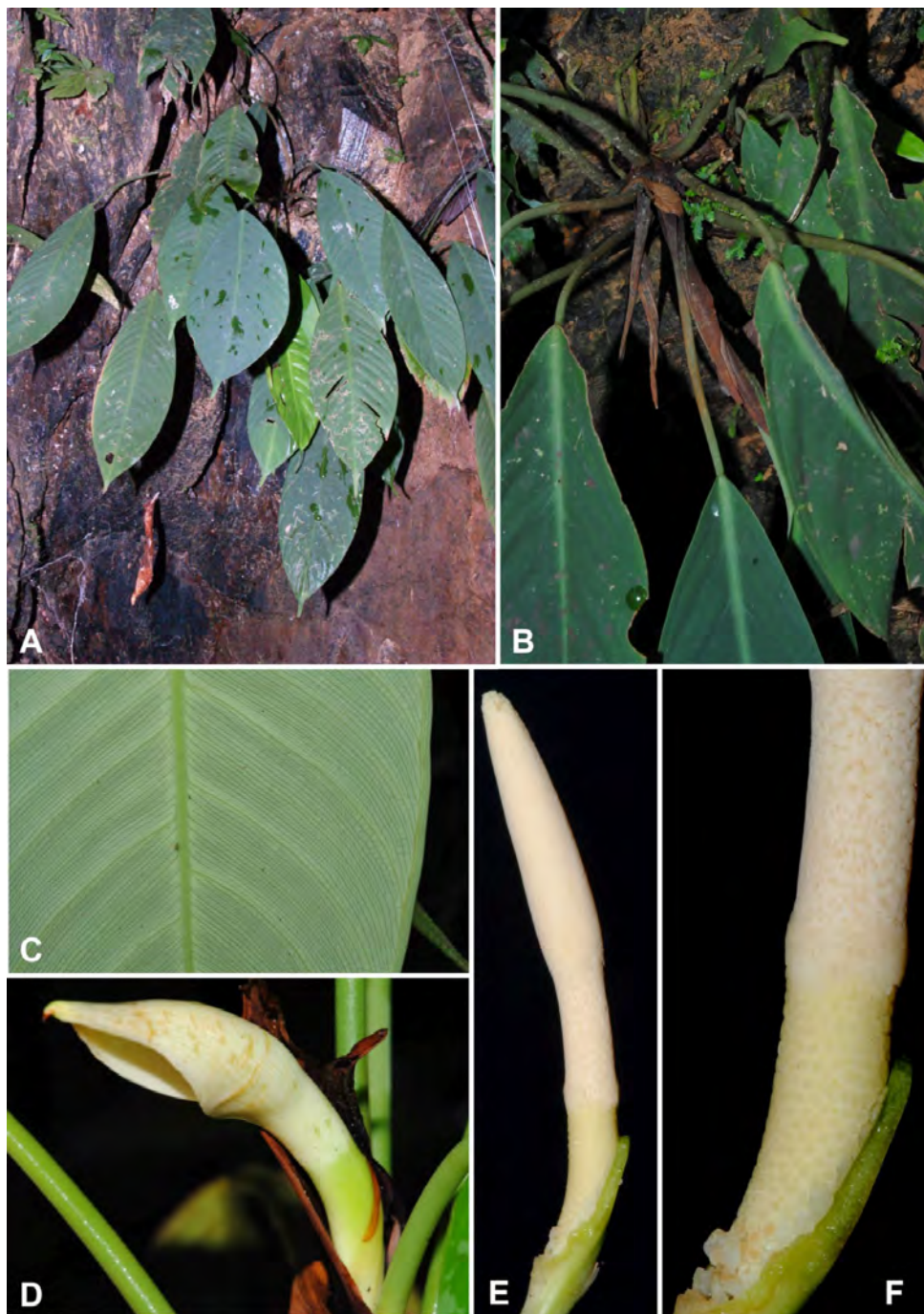


Figure 2. *Schismatoglottis rejangica* S. Y. Wong & P. C. Boyce

A. Plants in habitat. **B.** Detail of plant showing each leaf subtended by a protective cataphyll; note that petiolar sheath is reduced to a short collar with no protection function of emerging leaf. **C.** Leaf blade, abaxial surface showing tessellate veins. **D.** Inflorescence at pistillate anthesis. **E.** Spadix at onset of staminate anthesis, spathe artificially removed, note expanded interstice staminodes spathe limb shed, leaving recurved remnants around orifice of lower spathe. **F.** Detail of lower spadix, pistillate flower zone separated by expanded interstice staminodes, and lower portion of staminate flower zone; note the large pistillodes at the junction of the pistillate flower zone with the spathe adnation. **A–C** from *AR-1758*; **D–F** from *AR-353*. Images © P.C. Boyce.

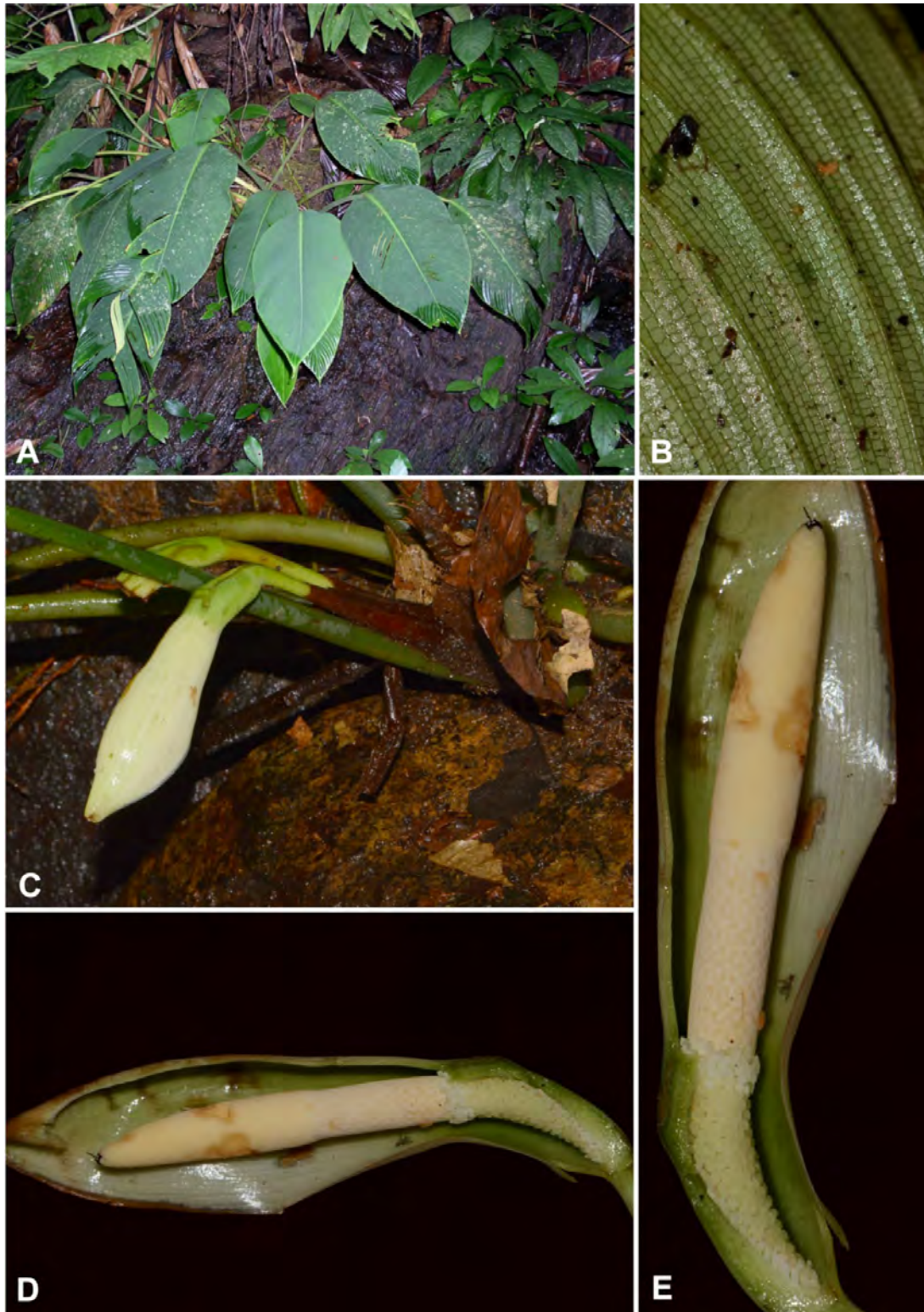


Figure 3. *Schismatoglottis petradoxia* S. Y. Wong & P. C. Boyce

A. Plants in habitat. **B.** Detail of tessellate secondary venation. **C.** Inflorescence at pistillate anthesis. **D & E.** Inflorescence at late pistillate anthesis, nearside spathe artificially removed. Note that the interstice staminodes have lengthened. **A** from *AR-464*; **B - E** from *AR-4894*. Images © P.C.Boyce.

Schismatoglottis rejangica S. Y. Wong & P. C. Boyce, **sp. nov.** Type: Malaysian Borneo, Sarawak, Kapit, Nanga Gaat, Rejang Wood Concession, km 65 road to Camp Gahada, 01° 42'01.1"N 113°31'14.8"E, 12 May 2004, *P. C. Boyce, Jeland ak Kisai & Jepom ak Tisai AR-353* (holotype SAR!; isotypes M!, SAR!, SING! – all alcohol preserved). **Figure 2.**

Diagnosis

Schismatoglottis rejangica is distinguished from *S. petradoxa* by the much smaller leaf blades (up to 26 cm × 7 cm vs up to 45 × 14 cm), without a discoloured mid-rib, lacking conspicuous abaxial ribbing, less conspicuous tessellate secondary venation, by shorter petioles (up to 11 cm long vs up to 27 cm long), and solitary inflorescences (vs inflorescences in threes) with a spadix ca. 5.5 cm long (vs 6–7 cm long).

Description

Pendent rheophytic herb to ca. 25 cm. **Stem** condensed, with internodes to 1 cm long, 1–2 cm diam. **Leaves** several together alternating soon-marcescent, somewhat brittle tapering lanceolate weakly scabrid cataphylls to 8 cm long; **petiole** shorter than blade, arching to almost pendent, 6–11 cm long, sub-terete, proximal third, dull medium green, minutely scabrid, sheathing only at very base, with the petiolar sheath reduced to an obscure collar; **blade** broadly lanceolate, 16–26 cm long × 4–7 cm wide, thick, adaxially matte medium green, paler and matte abaxially, base cuneate to very

narrowly rounded, apex acuminate and apiculate for ca. 1 cm; **midrib** adaxially more or less flush with blade, abaxially prominent; **primary lateral** veins ca. 12 on each side, diverging at 45–60°, abaxially slightly raised, adaxially impressed; **secondary venation** adaxially invisible, abaxially forming a slightly conspicuous darker tessellate reticulum; **tertiary venation** invisible. **Inflorescence** pendulous, solitary, subtended by lanceolate chartaceous cataphylls, with a weak esteric odour at pistillate anthesis; **peduncle** compressed-cylindric, subtended by a conspicuous prophyll or cataphyll, up to 8 cm long × 3.5 mm wide, medium green, minutely scabrid. **Spathe** with a moderate constriction between the lower part and the limb, limb inflating and gaping at pistillate anthesis, opening further at staminate anthesis, 6–6.5 cm long; **lower spathe** compressed ovoid and strongly asymmetric, dorsally flattened-convex corresponding to the adnation of the pistillate flower zone, medium green with very fine darker longitudinal veins, dorsally ca. 1 cm long, ventrally ca. 2 cm long, persistent; **spathe limb** exterior white with very fine darker longitudinal lines at pistillate anthesis, interior dirty whitish green shading dorsally to glossy green broadly lanceolate 5–6 cm long, upper half opening at pistillate anthesis and initially via a narrow terminal slit, then wide-gaping (ca. 2 cm wide), and weakly fornicate, limb margins reflexing during staminate anthesis, then whole limb degrading-caducous with the rim remaining above the lower spathe insertion reflexing somewhat. **Spadix** ca. 5.5 cm long, stoutly

cylindrical-clavate; **pistillate zone dorsally entirely adnate to spathe**, 1 cm long, compressed conic, ca. 6 mm diam., very pale green; **pistils** crowded, ca. 1 mm tall, 0.7 mm diam., narrowly barrel-shaped, pale green; **stigma** sessile, discoid, wider than top of pistil, ca. 0.5 mm tall $\times$ 1 mm wide, papillose; **interpistillar pistillodes** forming a row at junction with peduncle, ca. 1.2 mm long, resembling slender, compressed pistils, whitish green; **sterile interstice** with about 3 rows of staminodes; **interstice staminodes** compressed-cylindrical ca. 1 mm across, dull-white, initially equalling the height of pistils, later (late pistillate anthesis) staminodes lengthening to form a ring ca. 1/3 wider than fertile zones; **staminate zone** cylindric, ca. 1.5 cm long $\times$ 0.4–0.6 cm diam., cream; **stamens** irregularly densely crowded, individual flowers difficult to distinguish, rectangular-dumbbell shaped from above, truncate with thick connective slightly elevated above thecae, thecae opening by a single pore; **appendix** stoutly cylindrical, blunt, proximally as wide as staminate zone, 2.5–3 cm long, widest part 5–8 mm diam., distally slightly tapering and narrowly obtuse, cream; **appendix staminodes** very dense, irregularly rectangular shaped from above, ca. 0.5 mm diam., centrally with a narrow, deep depression, cream. **Fruiting spadix** not seen.

Ecology — Pendulous on vertical shaded forested shale river banks in moist lowland forest between 20–350 msl.

Distribution — *Schismatoglottis rejangica* occurs exclusively in the basin of the Rejang river, from the vicinity of Kapit town eastwards to the junctions ('nanga' in the local Iban language) of the Balleh and Gaat rivers, and north to Pelagus.

Etymology — Named for the Rejang river, in the basin of which *S. rejangica* is widespread and locally abundant.

Notes — *Schismatoglottis rejangica* is highly distinctive in the wild, with the rather thick, pendulous matte olive green lead blades often covering large areas of suitably shaded vertical shale to the exclusion of any other plants. Most populations favour sharp bends in the stream which afford them almost constant shade.

Other material examined: MALAYSIAN BORNEO: **Sarawak: Kapit.** Nanga Gaat, Rejang Wood Concession, Sungai Piat, 01°38'09.1"N 113°24'09.9"E, 14 Oct 2003, *P. C. Boyce & Jeland ak Kisai AR-114 (SAR) & AR-125 (SAR)*; Nanga Gaat, Rejang Wood Concession, stream below Camp Gahada, 01°41'49.4"N 113°26'16.3"E, 15 Oct 2003, *P. C. Boyce & Jeland ak Kisai AR-134 (SAR)*; Nanga Gaat, Rejang Wood Concession, km 65 on road to Camp Gahada, 01°42'01.1"N 113°31'14.8"E, 12 May 2004, *P. C. Boyce, Jeland ak Kisai & Jepom ak Tisai AR-324 (SAR), AR-327 (SAR) & AR-352 (SAR)* & 13 May 2004, *P. C. Boyce, Jeland ak Kisai & Jepom ak Tisai AR-392 (SAR)*; Nanga Gaat, Rejang Wood Concession, km 65 road to Camp Gahada,



Figure 4. Spadix of *Schismatoglottis petradoxa* Complex species compared.

A. *Schismatoglottis petradoxa* S. Y. Wong & P. C. Boyce. **B.** *Schismatoglottis rejangica* S. Y. Wong & P. C. Boyce. **C.** *Schismatoglottis larynx* S. Y. Wong & P. C. Boyce. **A.** from AR-4894; **B.** from AR-353; **C.** from AR-4186. Images A–B © P.C. Boyce.

01°41'59.7"N 113°31'13.7"E, 16 Dec 2004, P. C. Boyce, *Jeland ak Kisai & M. Gibernau* AR-910 (SAR) & AR-915 (SAR); Pelagus Rapids, Rapids Trail to waterfall, 02°11'35.7"N 113°03' 30.08"E, 15 Mar 2005, P. C. Boyce, *Jeland ak Kisai & Jepom ak Tisai* AR-1047 (SAR); Kapit, Taman Rekreasi Seabai, 01°56'45.6"N 112°54'16.8"E, 19 Apr 2006, P. C. Boyce, *Jeland ak Kisai & Wong Sin Yeng* AR-1788 (SAR) & AR-1789 (SAR) & 3 Apr 2009, P. C. Boyce & Wong Sin Yeng AR-2426 (SAR); Kapit, Batang Baleh, 02°01'0.0"N 113°01'0.0"E, 29 May 2013, K. Nakamoto AR-4159 (SAR).

References

- Boyce, P. C & Wong S. Y. 2013. Studies on Schismatoglottideae (Araceae) of Borneo XXXIII – A review of the *Schismatoglottis* Tecturata Group, including description of
- Hay A. and Yuzammi. 2000. Schismatoglottideae (Araceae) in Malesia I – *Schismatoglottis*. *Telopea* 9(1): 1–177.
- Schott, H. W. 1865. Beiträge zur Aroideenkunde. *Oesterr. Bot. Z.* 15(2): 33–35.
- Tate R. B. 2001. The geology of Borneo island CDROM. – Kuala Lumpur: Persatuan Geologi Malaysia / Geological Society of Malaysia.
- Wong S. Y. & P. C. Boyce 2014. Studies on Schismatoglottideae (Araceae) of Borneo
- XXXX: *Schismatoglottis petradoxia* and *S. tseni*, new shale-obligate rheophytes of uncertain affinity. *Aroideana* 37E(2): 17–25.

ACKNOWLEDGEMENTS

This is part of an on-going research project funded by the Ministry of Higher Education, Malaysia by the Exploratory Research Grant Scheme Vote No. NRGS/1089/2013-(03) and Fundamental Research Grant Scheme Vote No. FRGS/STWN10(01)985/2013(26). Fieldwork was most recently under Sarawak Forestry Department Permission to Conduct Research on Biological Resources - Permit No. NCCD.907, 4.4(JLD.12)-51 and Park Permit No 121/2015. The collaboration and support of the Sarawak Forestry Department and the Sarawak Biodiversity Centre are gratefully acknowledged.

Studies on Schismatoglottideae (Araceae) of Borneo LIV - A summary of the species of the *Schismatoglottis* Multiflora Group

Wong Sin Yeng*

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

Universiti Malaysia Sarawak

94300 Kota Samarahan

Sarawak, Malaysia

sywong@frst.unimas.my

*corresponding author

Peter C. Boyce

Honorary Research Scientist

Ludwig-Maximilians-Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München

Germany

boyce@biologie.uni-muenchen.de

ABSTRACT

A taxonomic synopsis, and identification key to species, of the *Schismatoglottis* Multiflora Group is provided. *Schismatoglottis bulbifera* H. Okada, H. Tsukaya & Y. Mori is resurrected from *S. multiflora* Ridl., to which it was relegated, taking the Multiflora Group to 18 species. All species are illustrated from living plants.

KEY WORDS

Rheophytes, shale, sandstone, Malaysia, Indonesia, Sarawak, Kalimantan.

INTRODUCTION

The *Schismatoglottis* Multiflora Group (Hay & Yuzammi 2000; Wong 2010; Wong & Boyce 2014b) is a wholly Bornean morphotaxon currently comprising 18 species, 10 of which have been described since 2000. All Multiflora Group species

have the petiolar sheath attached only at the base with the rest forming a free ligule. In most the ligular portion of the sheath is marcescent, and eventually lost, although *Schismatoglottis erecta* M.Hotta, *S. schottii* Bogner & Nicolson, *S. monoplacenta* M.Hotta, and *S. persistens* S.Y.Wong & P.C.Boyce have the ligular portion long-persistent. Ecology varies from obligate rheophytes (*Schismatoglottis bulbifera* H.Okada, H.Tsukaya & Y.Mori, *S. cyria* P.C.Boyce, *S. hayana* Bogner & P.C.Boyce, *S. iliata* S.Y.Wong & P.C.Boyce, *S. multiflora* Ridl., *S. persistens* and *S. roseospatha* Bogner), to lithophytes on sandstone (*S. maelii* P.C.Boyce & S.Y.Wong, *S. mayoana* Bogner & M.Hotta and *S. nicolsonii* A.Hay), shales (*S. clausula* S.Y.Wong), or forested limestone

(*S. bauensis* A.Hay & Chi.C.Lee, *S. confinis* S.Y.Wong & P.C.Boyce, *S. dulosa* S.Y.Wong and *S. monoplacenta*), to terrestrial mesophytes in gallery forest (*S. erecta*, *S. jitiniae* S.Y.Wong and *S. schottii*).

Molecular analyses (Low et al., in prep.) failed to recover the complete Multiflora Group as a monophyletic unit, though various species assigned to it resolved as clades, notably the *Schismatoglottis mayoana* Complex (Wong & Boyce 2014b). Nevertheless, the Multiflora Group retains utility for field and herbarium studies owing to the distinctive free ligule of the petiolar sheath. Additionally, Multiflora Group species fall into two groups based on the presence or absence of a spadix appendix.

KEY TO THE SPECIES OF THE *SCHISMATOGLOTTIS* MULTIFLORA GROUP

- 1a. Spadix with a terminal sterile appendix 2
- 1b. Spadix fertile to the tip 11
- 2a. Leaf blades with upper surface conspicuously corrugated, bright glossy green *Schismatoglottis maelii* P.C.Boyce & S.Y.Wong
- 2b. Leaf blades with upper surface not corrugated, dull dark to matte olive green 3
- 3a. Ligular portion of petiolar sheath long-persistent 4
- 3b. Ligular portion of petiolar sheath marcescent 5
- 4a. Stem erect, leaf blades pendulous from the tip of the petiole, petiole 20–30 cm long, ligular portion of petiolar sheath to 13 cm long; leaf blade elliptic to oblong elliptic, ca. 30 cm long × 13 cm wide. Vertical karst limestone cliffs. Mulu *Schismatoglottis monoplacenta* M.Hotta
- 4b. Stem creeping, leaf blades erect from the tip of the petiole, petiole 8–12 cm, ligular portion of petiolar sheath ca. 5 cm long; leaf blade broadly oblanceolate to narrowly elliptic, 12–23 cm long × 3–7 cm wide. Rheophyte on clay-loam river banks. Batang Ai *Schismatoglottis persistens* S.Y.Wong & P.C.Boyce
- 5a. Spathe limb marcescent, clasping spadix. Sarawak [Bau]. Limestone *Schismatoglottis dulosa* S.Y.Wong
- 5b. Spathe limb caducous 6
- 6a. Spathe limb shedding in a single piece 7
- 6b. Spathe limb disarticulating into circumferential rings along its length, then collapsing. Sarawak [Sarikei]. Shales *Schismatoglottis clausula* S.Y.Wong

- 7a. Terrestrial herbs with ascending stems; leaf blades more-or-less erect; inflorescences erect on a short peduncle (peduncle obscured by subtending cataphylls); lower spathe walls thick (ca. 3 mm), fleshy-spongy ***Schismatoglottis jitiniae*** S.Y.Wong
- 7b. Rheophytes or lithophytes with creeping, rooting stems; leaf blades pendulous, inflorescences arching to pendulous on a long peduncle; lower spathe walls thin (ca. 1 mm), leathery 8
- 8a. Robust herb to 1.2 m tall; petiole ca. 1 m long; leaf blades to 44 cm long × 24 cm wide; thecae each with a single pore. Shales. Brunei (Temburong) ***Schismatoglottis cyria*** P.C.Boyce
- 8b. Slender herb to 30 cm tall; petiole ca. 13–26 cm long; leaf blades to 25 cm long × 15 cm wide; thecae each with two pores. Sandstones. Sarawak (Kuching) 9
- 9a. Spathe limb white; infructescence erect 10
- 9b. Spathe limb jade-green; infructescence pendulous. Sarawak (Sempadi) ***Schismatoglottis iliata*** S.Y.Wong & P.C.Boyce
- 10a. Spadix ca. 4.5 cm long. Sarawak (Bako & Santubong) ***Schismatoglottis nicolsonii*** A.Hay
- 10b. Spadix ca. 8 cm long. Sarawak (Matang)
. ***Schismatoglottis mayoana*** Bogner & M.Hotta
- 11a. Ligular portion of petiolar sheath long-persistent; stems erect 12
- 11b. Ligular portion of petiolar sheath marcescent; stems creeping and rooting 13
- 12a. Connective deeply 1-grooved from theca to theca; spathe limb exterior coppery-orange. C. Sarawak ***Schismatoglottis erecta*** M.Hotta
- 12b. Connective slightly raised between the thecae, not grooved; spathe limb exterior green. Kalimantan Tengah ***Schismatoglottis schottii*** Bogner & Nicolson

- 13a. Leaf blades abaxially producing bulbils & plantlets along the mid-rib.
 ***Schismatoglottis bulbifera*** H. Okada, H. Tsukaya & Y. Mori
- 13b. Leaf blades not producing bulbils 14
- 14a. Rheophytes 15
- 14b. Terrestrial or lithophytic; not associated with the flood zone of
 rivers 17
- 15a. Spathe distinctly inflated at anthesis 16
- 15b. Spathe unrolling slightly at anthesis but not distinctly inflated; Sarawak
 [Matang & Bau]. Sandstones ***Schismatoglottis multiflora*** Ridl.
- 16a. Spadix ca. 4.5 cm long; spathe pink; leaves abaxially very glossy. Sarawak
 [Rejang Valley]. Shales ***Schismatoglottis roseospatha*** Bogner
- 16b. Spadix ca. 6–7 cm long; spathe white; leaves abaxially slightly glossy.
 Sarawak, Sematan. Sandstones
 ***Schismatoglottis hayana*** Bogner & P.C.Boyce
- 17a. Leaf blades abaxially not glaucous, base obtuse to slightly
 decurrent, secondary and tertiary venation obscure; pore at edge of
 stamen, punctiform (ca. 0.15 mm) with protruding tissue from
 innermost surface, connective elevated, male zone remained white
 basally and stained brown distally in alcohol. Sarawak [Bau].
 Lithophytic on limestones
 ***Schismatoglottis bauensis*** A.Hay & Chi.C.Lee
- 17b. Leaf blades abaxially glaucous, leaf base always decurrent,
 secondary venation prominent, tertiary venation sometimes
 pronouncedly tessellate; pore at inner surface of stamen, oblong (ca.
 0.3 mm), connective flat, male zone completely stained brown in
 alcohol. Sarawak. [Padawan and Serian]. Terrestrial in deep soil on
 limestones and sandstones
 ***Schismatoglottis confinis*** S.Y.Wong & P.C.Boyce

MULTIFLORA GROUP – THE APPENDICULATE SPECIES

Schismatoglottis clausula S.Y.Wong, Gard. Bull. Singapore 61(2): 530[–532], **Figure 1** (2010). Type: Malaysia Borneo, Sarawak, Sarikei, Ulu Sarikei, 01°55'05.4"N; 111°29'35.8"E, 7 Dec 2005, *P.C.Boyce et al.* AR–1582 (holotype SAR!). **Figure 1.**

Notes — *Schismatoglottis clausula* is immediately distinguished by the spathe limb senescing by disarticulating into numerous circumferential rings, then collapsing downwards, and ultimately remaining marcescent post anthesis.

Schismatoglottis cyria P.C.Boyce, Kew Bull. 49: 796[–798], **Figure 2.** (1994); Hay & Yuzammi, Telopea 9: 85–87, **Figure 13** (2000). Type: Brunei, Temburong Dist., Kuala Belalong, Sg. Engkiang, above Kuala Belalong Field Station, 6 May 1991, *G.Argent & D.Mitchell 91203* (holotype E!; isotypes AAU!, BRUN!, K!, L!). **Figure 2.**

Notes — Placement of *S. cyria* in the Multiflora Group is somewhat provisional. The available herbarium material lacks a ligular extension to the adnate portion of the much-shortened petiolar sheath, which Boyce (1994) interpreted as the full extent of petiolar sheathing. Hay & Yuzammi (2000: 87), however, noted that “all along the distal rim of the sheath of the K isotype, there is a break in the tissue, suggesting that an extended [i.e., ligular] portion may be missing. . .”, and speculated

that the ligular portion of the sheath had been lost (i.e., ligule caducous or briefly marcescent). Meanwhile, species of *Schismatoglottis* have become known in which the petiolar sheath is undeniably much reduced and moreover lacks a ligular extension, with the sheath's protective role taken homeotically by a subtending cataphyll (Boyce & Wong 2013; Wong & Boyce 2014a, 2016). Re-collection of *S. cyria* is needed to resolve placement.

Schismatoglottis dulosa S.Y.Wong, Gard. Bull. Singapore 61(2): 532[–535], **Figure 2** (2010). Type: Malaysian Borneo, Sarawak, Kuching, Bau, Kampung Jugan, 01°28'46.4"N; 110°05'08.5"E, 26 Mar 2004, *P.C. Boyce & Jeland ak Kisai* AR–279 (holotype SAR!). **Figure 3.**

Notes — *Schismatoglottis dulosa* is overall generally reminiscent of *S. bulbifera* by the erect inflorescence and marcescent spathe limb, differing by the presence of a spadix appendix, and by leaf blades abaxially lacking adventitious bulbils along the mid-rib.

Schismatoglottis iliata S.Y.Wong & P.C.Boyce, Willdenowia 44: 6[–10], **Figure 1.** (2014). Type: Malaysian Borneo, Sarawak, Kuching, Lundu, Ulu Batang Kayang, 01°27'36"N, 109°53'35"E, 17 Jun 2012, *Jepom ak Tisai* AR–3972 (holotype SAR!; isotypes SAR! [alcohol], BO! [alcohol]). **Figure 4.**

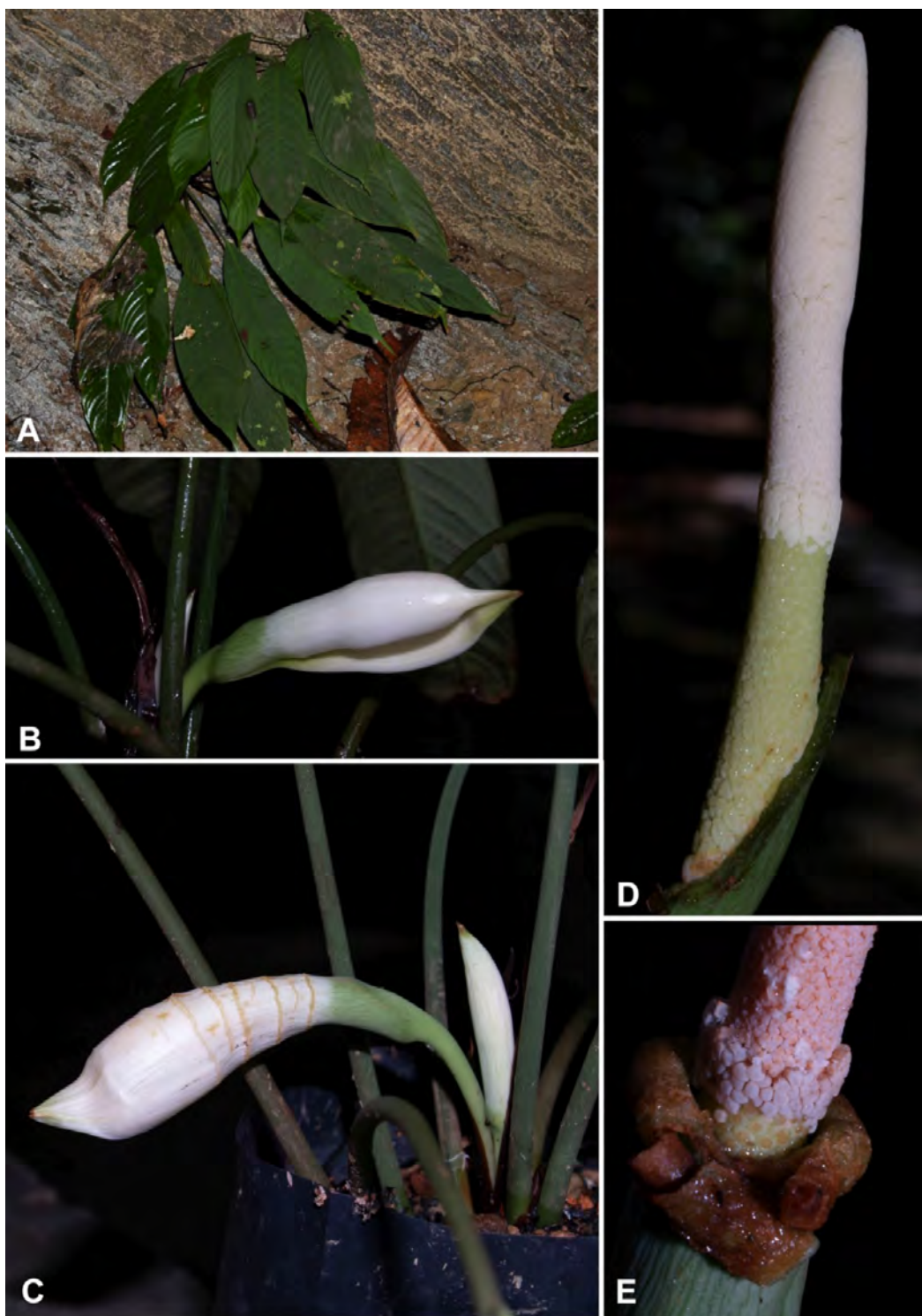


Figure 1. *Schismatoglottis clausula* S.Y.Wong. **A.** Plant in habitat on shale. **B.** Inflorescence at pistillate anthesis. **C** Inflorescence at staminate anthesis with spathe limb degrading into circumferential rings. **D.** Spadix at pistillate anthesis, spathe artificially removed. **E.** Detail of inflorescence at end of staminate anthesis – note the spathe limb remains at top of the persistent lower spathe, and expanded interstice staminodes. **A–G** from *P.C.Boyce et al. AR-1582*. Images © P.C. Boyce.



Figure 2. *Schismatoglottis cyria* P.C.Boyce. **A.** Collected Type plant in habitat, prior to pressing. Image © G. Argent, used with permission.

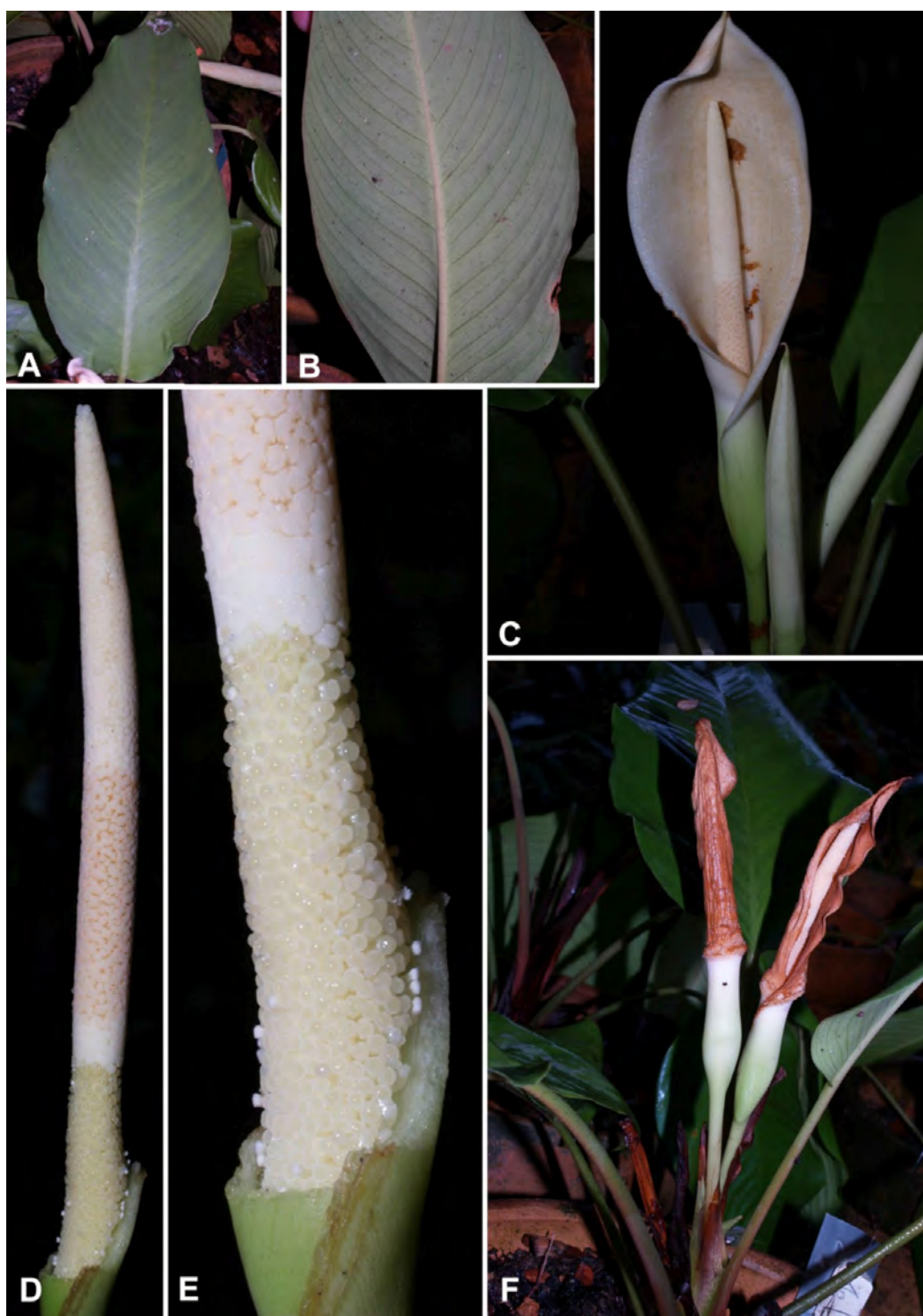


Figure 3. *Schismatoglottis dulosa* S.Y.Wong. **A.** & **B.** Adaxial (**A**) and abaxial (**B**) views of leaf blade. **C.** Inflorescence at late pistillate anthesis, with two developing inflorescences. **D.** Spadix at pistillate anthesis, spathe artificially removed. **E.** Detail lower portion of spadix showing pistillate flower zone, interstice, and lowermost part of staminate flower zone. **F.** Flowering plant in cultivation showing diagnostic erect inflorescences and marcescent spathe limb. **A–F** from P.C. Boyce & Jeland ak Kisai AR-279. Images © P.C. Boyce.

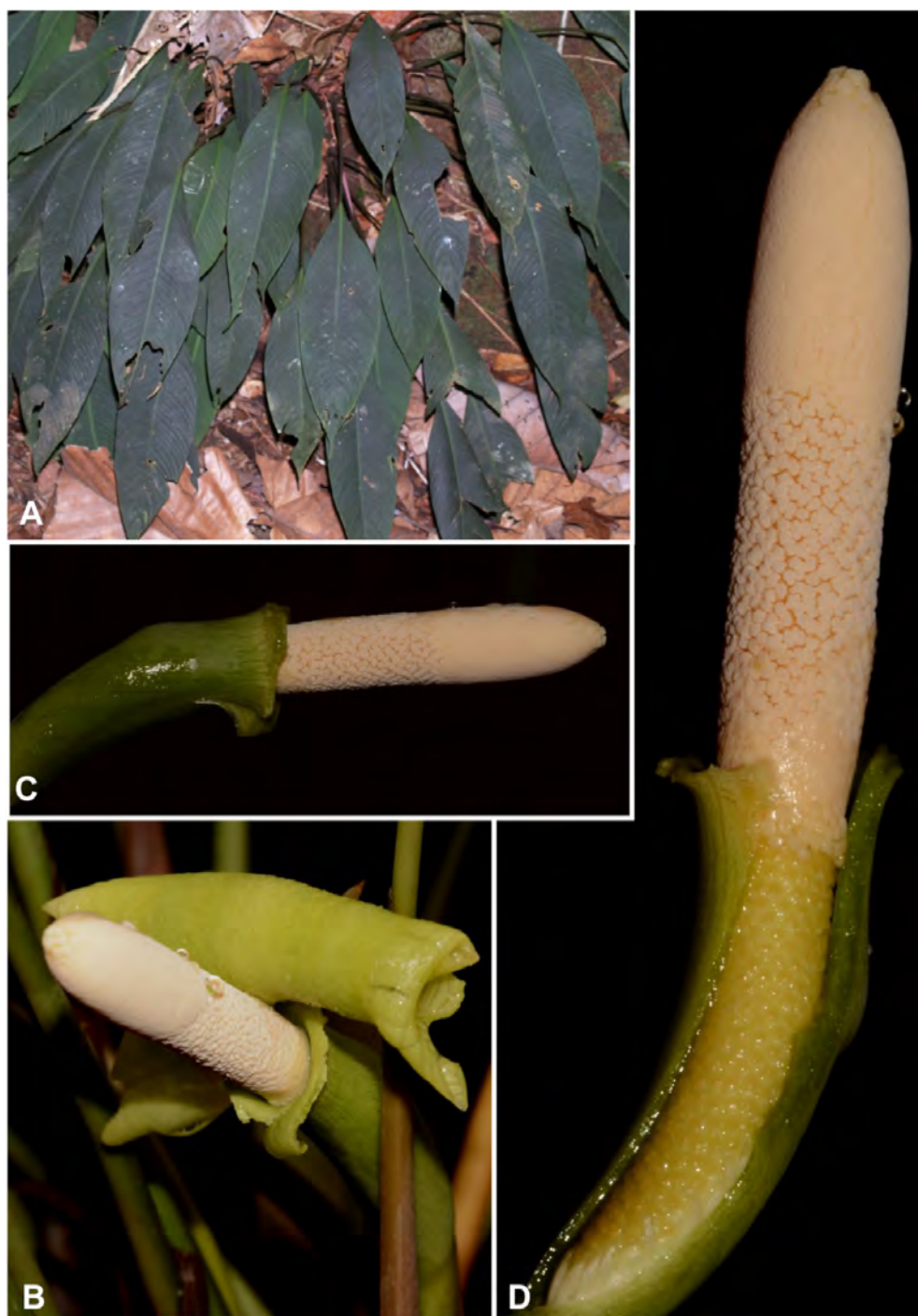


Figure 4. *Schismatoglottis iliata* S.Y.Wong & P.C.Boyce. **A.** Plants in type habitat, shaded sandstone bluff above upper reaches (Ulu) of Batang Kayang. Note pendent leaf blades. **B.** Inflorescence at onset of staminate anthesis, with spathe limb caducous and lower spathe top edges flaring. **C.** Inflorescence at staminate anthesis, with spathe limb fallen. **D.** Spadix at onset of staminate anthesis, with nearside part of lower spathe artificially removed. Note that spathe zones of spadix are uniform in width, but interstice staminodes (just below upper edge of lower spathe) have expanded laterally. **A–D** from *Jepom ak Tisai AR-3972*. Images © P.C. Boyce.

Notes — *Schismatoglottis iliata* forms a clade with *S. mayoana* and *S. nicolsonii* (Low et al., in prep.; Wong & Boyce 2014b), morphologically defined by pendulous leaf blades abaxially with crowded fine pellucid secondary veins, a matt olive green adaxial surface, and stamen thecae each with two pores.

Schismatoglottis jitinia S.Y.Wong, Gard. Bull. Singapore 61(2): 532[–535], Pl. 3 (2010). Type: Malaysia, Sarawak, Kuching, Bau, Kampung Jugan, 01°28'46.4"N; 110°05'08.5"E, 26 Mar 2004, *P.C. Boyce & Jeland ak Kisai AR–279* (holotype SAR!). **Figure 5.**

Notes — *Schismatoglottis jitinia* is distinctive by its elongated and erect aerial stem, the leaf blades basally attenuate and usually unequal, and softly leathery, with the midribs of the innovations longitudinally bright pink abaxially and basally adaxially. Cataphylls are also always pink.

Schismatoglottis jitinia approaches *S. erecta* and *S. schottii* by having erect, elongated stems, but differs by oblanceolate leaf blades with long-decurrent bases, erect stout inflorescences, succulent lower spathe, and the spathe constriction coinciding with the middle part of the male zone.

Schismatoglottis maelii P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58(1): 14[–18], **Figure 2** (2006). Type: Malaysian Borneo, Sarawak, Kuching Division, Bau, Segong, Ulu Sungai Adis, Sungai Bronand, 4

May 2004, *Jeland ak Kisai & Jepom ak Tisai AR–47* (holotype SAR!). **Figure 6.**

Notes — The bright green leaf blades adaxially with very close raised veins have no equal in the genus and are immediately diagnostic. Floral fragrance, reminiscent of crushed raspberries, is quite unlike the strongly esteric odour produced by all other fragrant species of the Multiflora Group.

Schismatoglottis mayoana Bogner & M.Hotta, Acta Phytotax. Geobot. 34(1–3): 48[–50], **Figures 1–2** (1983); Hay & Yuzammi, Telopea 9(1): 91–61, **Figure 12** (2000); Wong & Boyce, Willdenowia 44: 8, **Figure 2.** (2014). Type: Malaysian Borneo, Sarawak, near Matang, 1979, *J. Bogner 1606* (holotype M!; isotypes K!, KYO!, M!, US!). **Figure 7.**

Heterotypic Synonyms

Schismatoglottis beccariana var. *cuspidata* Engl., Bull. Soc. Tosc.ortic. 4: 297 (1879). Type: Malaysian Borneo, Sarawak, Matang, *O. Beccari P.B. 1648* (holo FI!; iso GH!, K!).

Schismatoglottis multiflora var. *latifolia* Ridl., J. Straits Br. Roy. Asiat. Soc. 49: 50 (1907). Type: Malaysian Borneo, Sarawak, Matang, 21 Jun 1893, *E.W. Bartlett 2* (holotype SING!, 2 sheets).

Notes — *Schismatoglottis mayoana*, *S. iliata* and *S. nicolsonii* form a clade (Low et al., in prep.; Wong & Boyce 2014b), morphologically defined by pendulous leaf blades abaxially

with crowded fine pellucid secondary veins, a matt olive green adaxial surface, and stamen thecae each with two pores.

Schismatoglottis monoplacenta M.Hotta, Mem. Coll. Sci. Univ. Kyoto, Ser. B, 32: 227[–229], **Figure 2**, A–H. (1966); Hay & Yuzammi, Telopea 9: 93–94 (2000). Type: Malaysian Borneo, Sarawak, Marudi (‘Mardi’), along Sg. Melinau, between Sg. Tutoh and Lubang Bungan, at foot of G. Mulu, 14 Mar 1964, *M.Hotta 14404* (holotype KYO!). **Figure 8.**

Notes — *Schismatoglottis monoplacenta* is immediately distinguishable by the very long, stiff, persistent ligules of the petiolar sheath. Molecular data (Low et al, in prep.) places *S. monoplacenta* outside of *Schismatoglottis* s.s.

Schismatoglottis nicolsonii A.Hay, Telopea 9: 95[–97], **Figure 13** (2000); Wong & Boyce, Willdenowia 44: 9, **Figure 3**. (2014). Type: Malaysian Borneo, Sarawak, Bako National Park, path to Telok Paku, 7 Aug 1961, *D.H. Nicolson 1308* (holotype US!; isotypes K!, L!). **Figure 9.**

Notes — *Schismatoglottis nicolsonii*, *S. iliata* and *S. mayonana* are related and delimited morphologically by pendulous leaf blades abaxially with crowded fine pellucid secondary veins, a matt olive green adaxial surface, and stamen thecae each with two pores.

Schismatoglottis persistens S.Y.Wong & P.C.Boyce, Willdenowia 44: 247[–250], **Figure 1 & Figure 2B**, D & F (2014). Type: Malaysian Borneo, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Sungai Pedali, 01°11'58.9"N, 112°03'27.0"E, 25 May 2008, *P.C.Boyce, Wong Sin Yeng & Jepom ak Tisai AR-2383* (holotype SAR!; isotypes SAR! [alcohol], SBC! [alcohol], SING!). **Figure 10.**

Notes — It is not readily evident to what *S. persistens* is closely related (see Wong & Boyce 2014c). Although vegetatively most similar to the genus *Phymatarum* M.Hotta, the pistillate and staminate flowers are very different. Persistent ligules are also found in three other species of the *Schismatoglottis* Multiflora Group – *S. erecta*, *S. monoplacenta* and *S. schottii* – but these species are not otherwise obviously similar to *S. persistens*.

MULTIFLORA GROUP –THE EXAPPENDICULATE SPECIES

Schismatoglottis bauensis A.Hay & Chi. C. Lee, Telopea 9(1): 84[–85], **Figure 10** (2000); Wong & Boyce, Gard. Bull. Singapore 60(1): 156–159, **Figure 1** (2008). Type: Malaysian Borneo, Sarawak, Kuching Division (‘1st Division’), Bau, Gua Peri Peri (‘Fairy Caves’), ca. 7 km from Bau, 3 Oct. 1994, *P.C. Boyce 790* (holotype K!; isotype SAR!). **Figure 11.**

Notes — *Schismatoglottis bauensis* and *S. confinis* are evidently very closely similar, although the characteristics given below (under *S.*



Figure 5. *Schismatoglottis jitinae* S.Y.Wong. **A.** Plants in habitat, gallery forest. **B.** Purple-veined form with inflorescence at staminate anthesis; note splitting spathe limb and chrysomelid beetle in attendance. **C.** Inflorescence at pistillate anthesis, with spathe limb gaping. **D.** Spadix at pistillate anthesis, with spathe artificially removed. **E.** Detail of lower portion of spadix showing pistillate flower zone, interstice, and lowermost part of staminate flower zone. **A** from Wong Sin Yeng *et al.* AR-5151; **B** from P.C.Boyce *et al.* AR-1038; **C–E** from P.C.Boyce & Wong Sin Yeng AR-3624. Images © P.C. Boyce.



Figure 6. *Schismatoglottis maelii* P.C.Boyce & S.Y.Wong. . **A.** Plants in habitat. **B.** Detail of leaf blade adaxial surface showing the close, finely raised veins. **C.** Inflorescence at pistillate anthesis, with spathe limb gaping. **D.** Spadix at pistillate anthesis, with spathe artificially removed. **A–D** from *Jeland ak Kisai & Jepom ak Tisai AR-47*. Images © P.C. Boyce.

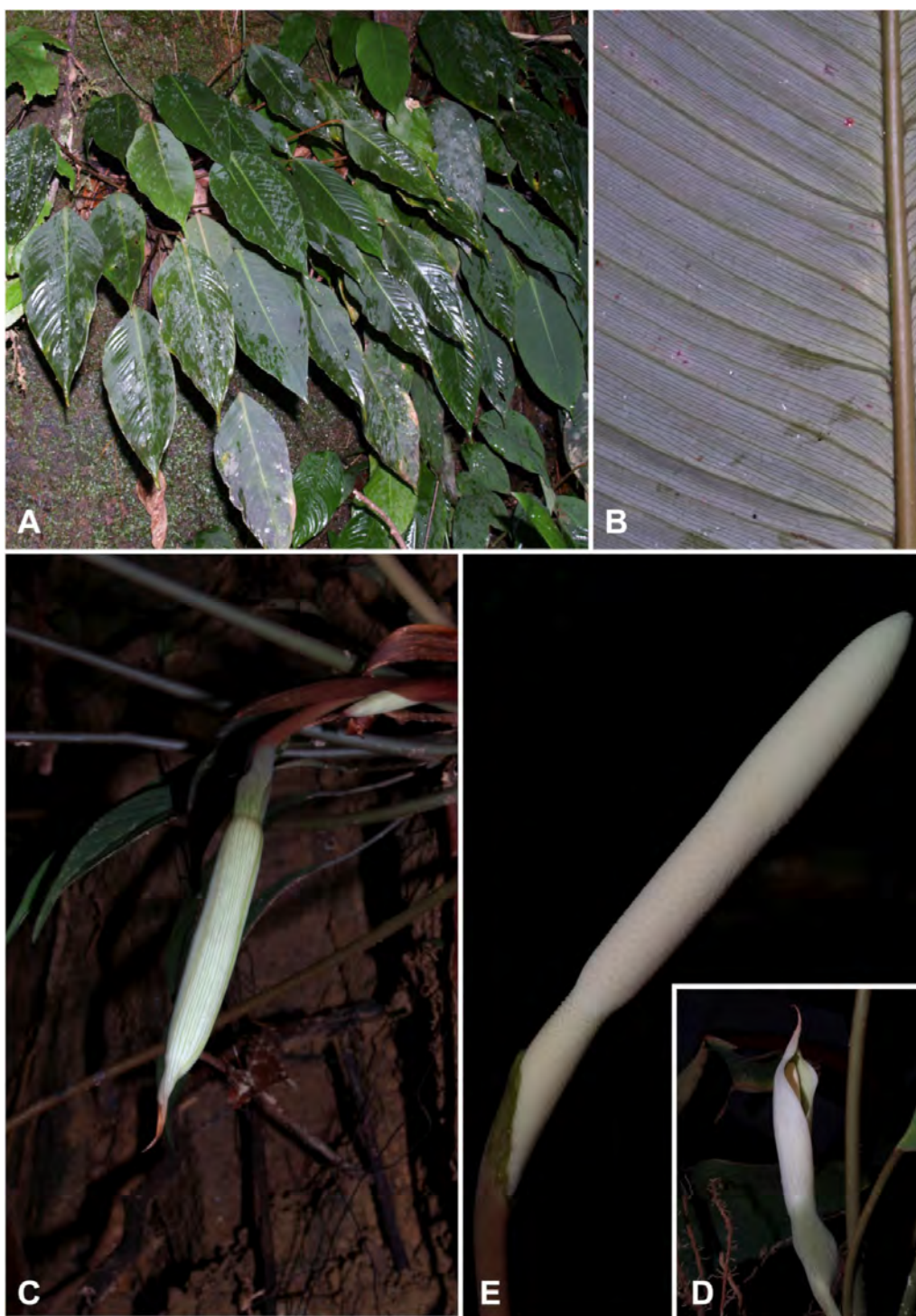


Figure 7. *Schismatoglottis mayoana* Bogner & M.Hotta. **A.** Plants in habitat, edge of sandstone waterfall, Kubah N. P. **B.** Detail of abaxial surface of leaf blade, showing dense pellucid secondary venation. **C.** Plant flowering (very early pistillate anthesis) in habitat. Note matt reddish-suffused peduncle and while spathe limb. **D.** Inflorescence at late pistillate anthesis. Note that in nature inflorescence would be pendent. **E.** Spadix at late pistillate anthesis, with spathe artificially removed. Note that top of pistillate zone is markedly narrower than other zones of spadix. **A–D** from P.C.Boyce & S.Y.Wong AR-1828. Images © P.C. Boyce.

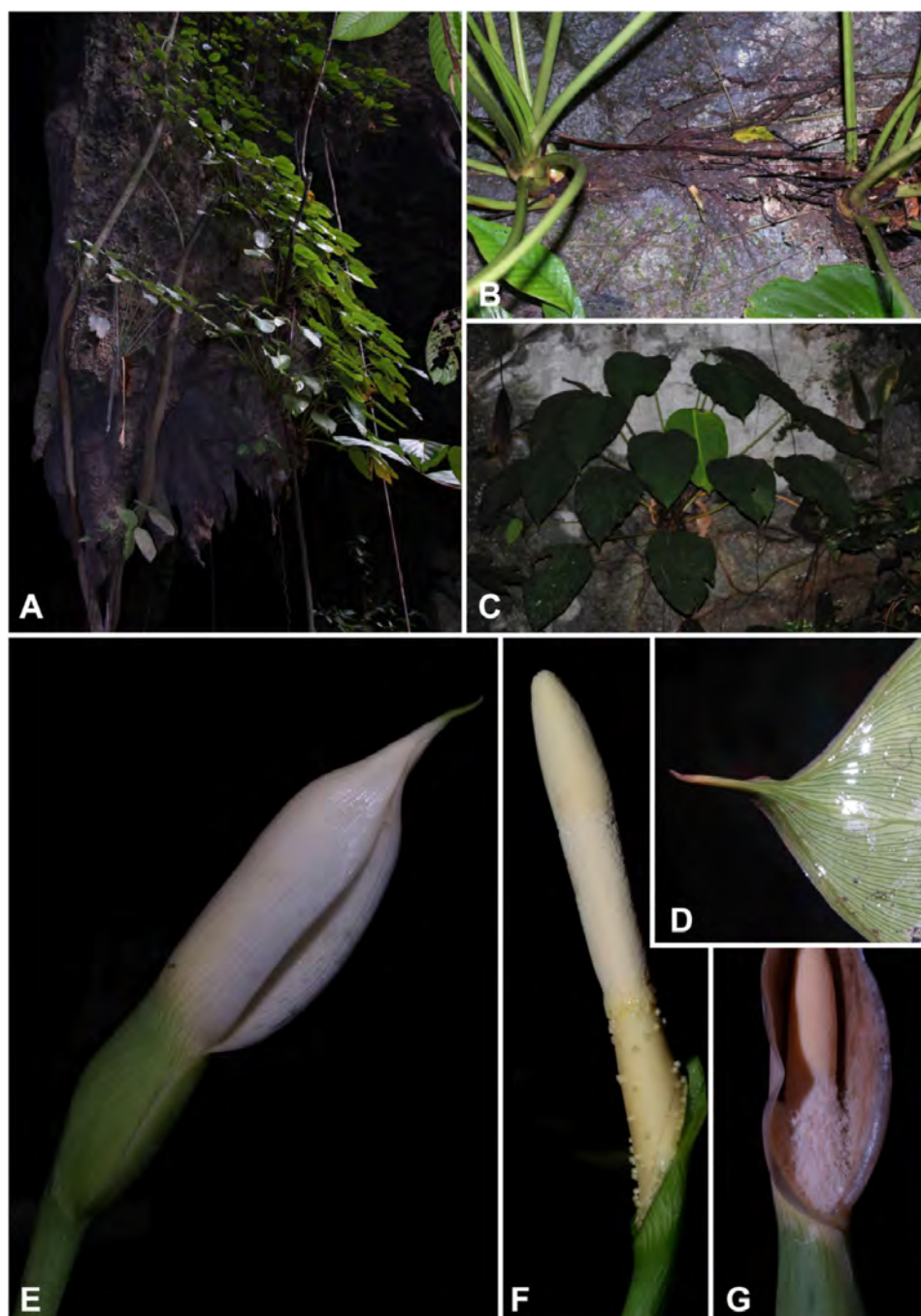


Figure 8. *Schismatoglottis monoplacenta* M.Hotta. **A.** Plants in habitat on karst limestone formations en route to Clearwater Cave, Mulu N.P., Sarawak. **B.** Detail of plants growing on bare limestone. **C.** Limestone deposits (dark green leaf blades, owing to algae growing on limestone coating) as compared with a newly expanded (bright green leaf blade, centre) leaf. Plants in cultivation retain bright green leaf blades. **D.** Detail of leaf tip (abaxial view), showing pronounced drip-tip (ca. 1.5 cm long) and conspicuous pellucid veins. **E.** Inflorescence at pistillate anthesis. **F.** Spadix at pistillate anthesis (spathe artificially removed). **G.** Inflorescence at staminate anthesis, just after pollen release. Strings of pollen are clearly visible on fertile (staminate) portion of spadix. Note that spathe limb has discoloured by onset of staminate anthesis. C–G from P.C.Boyce *et al.* AR-1966. Images © Peter C. Boyce.

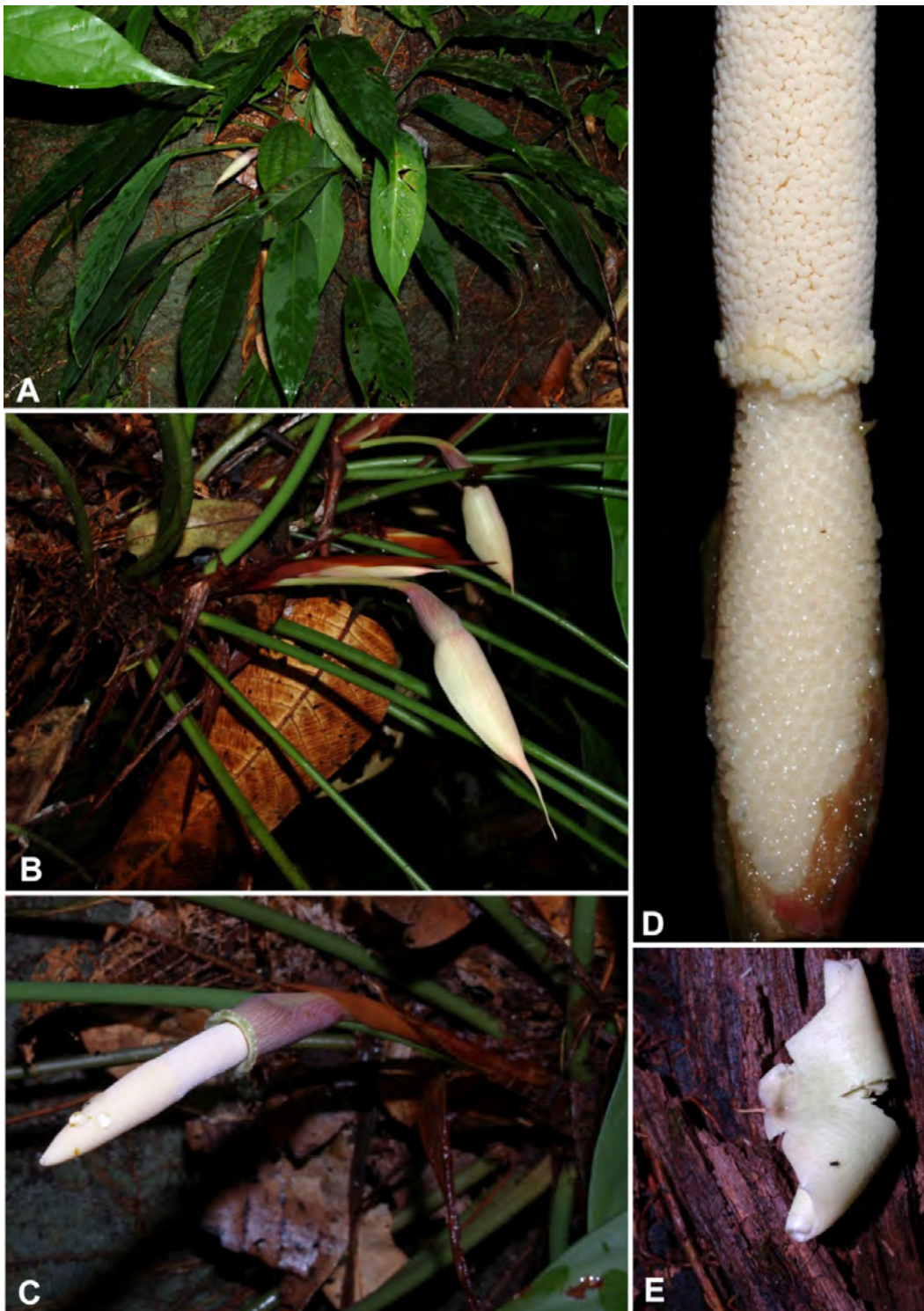


Figure 9. *Schismatoglottis nicolsonii* A.Hay. **A.** Plants in habitat, edge of sandstone waterfall, Bako N. P. **B.** Flowering plant in habitat. **C.** Inflorescence at onset of staminate anthesis, with spathe limb shed. **D.** Detail of pistillate zone and lower part of staminate zone. Note that staminate zone is fertile to base. **E.** Spathe limb shed during onset of staminate anthesis. **A–D** from P. C. Boyce & al. AR-2106. Images © Peter C. Boyce.

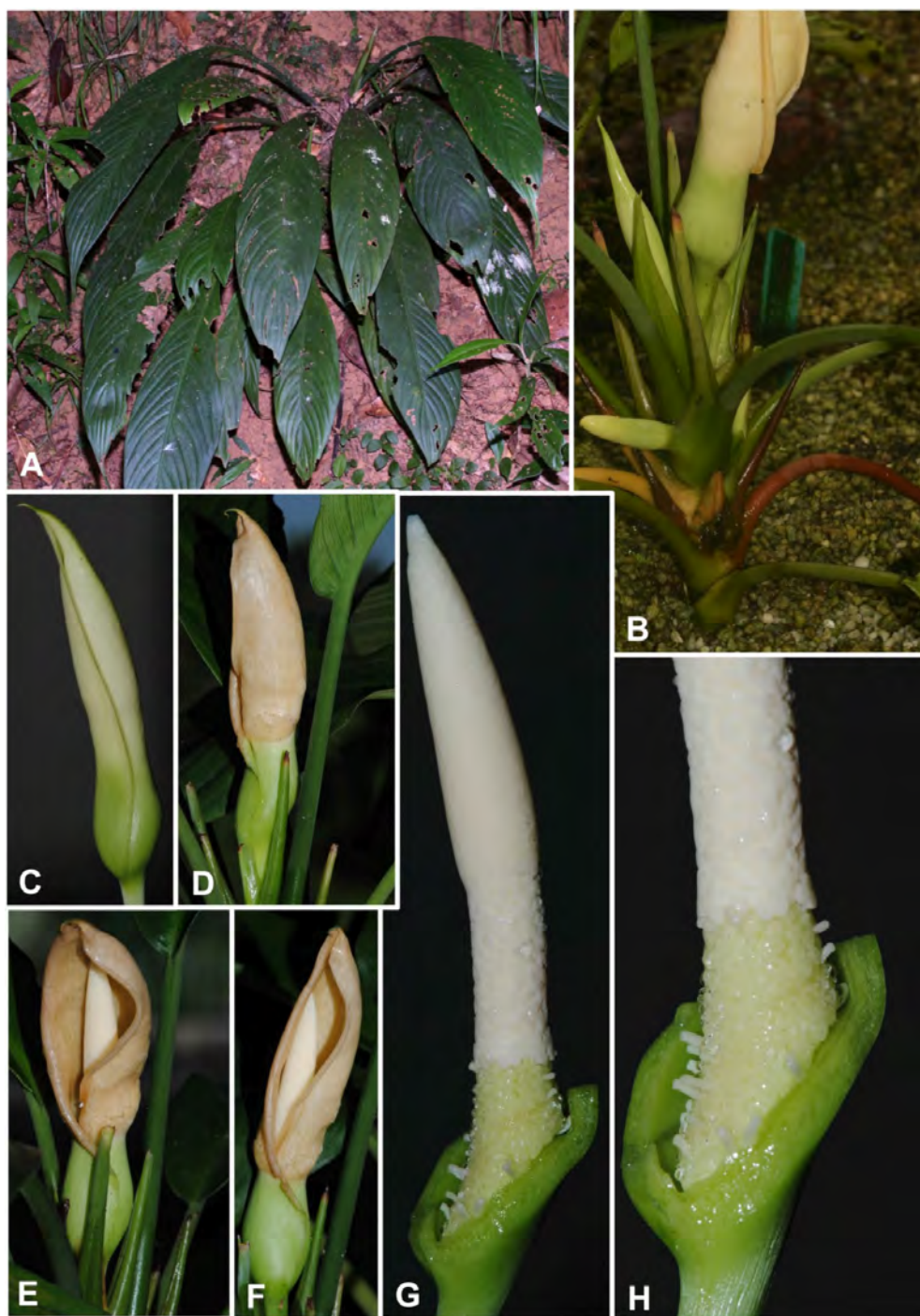


Figure 10. *Schismatoglottis persistens* S.Y.Wong & P.C.Boyce. **A.** Plant in habitat, type locality. **B.** Flowering shoot of cultivated plant at early staminate anthesis; note prophylls and cataphylls alternating with inflorescences; note, too, spathe limb colour. **C.** Inflorescence at pistillate anthesis; note slit-like opening below terminal rostrum. **D, E & F.** Inflorescence at late staminate anthesis; note spathe limb has darkened and is beginning to degrade (cracking) at junction with lower spathe. **G.** Spadix at pistillate anthesis, spathe artificially removed. **H.** Detail from **G**, showing pistillate and staminate flower zones. **A–H** from *P. C. Boyce & al. AR-2383*. Images © Peter C. Boyce.



Figure 11. *Schismatoglottis bauensis* A.Hay & Chi.C.Lee. **A & B.** Plants in habitat, karst limestone, Bau. **C.** Flowering plant in habitat with one inflorescence at staminate anthesis (spathe limb shed) and one developing inflorescence. **D & E.** Inflorescence at onset of pistillate anthesis. **A–D** from P. C. Boyce AR-1503. Images © Peter C. Boyce.

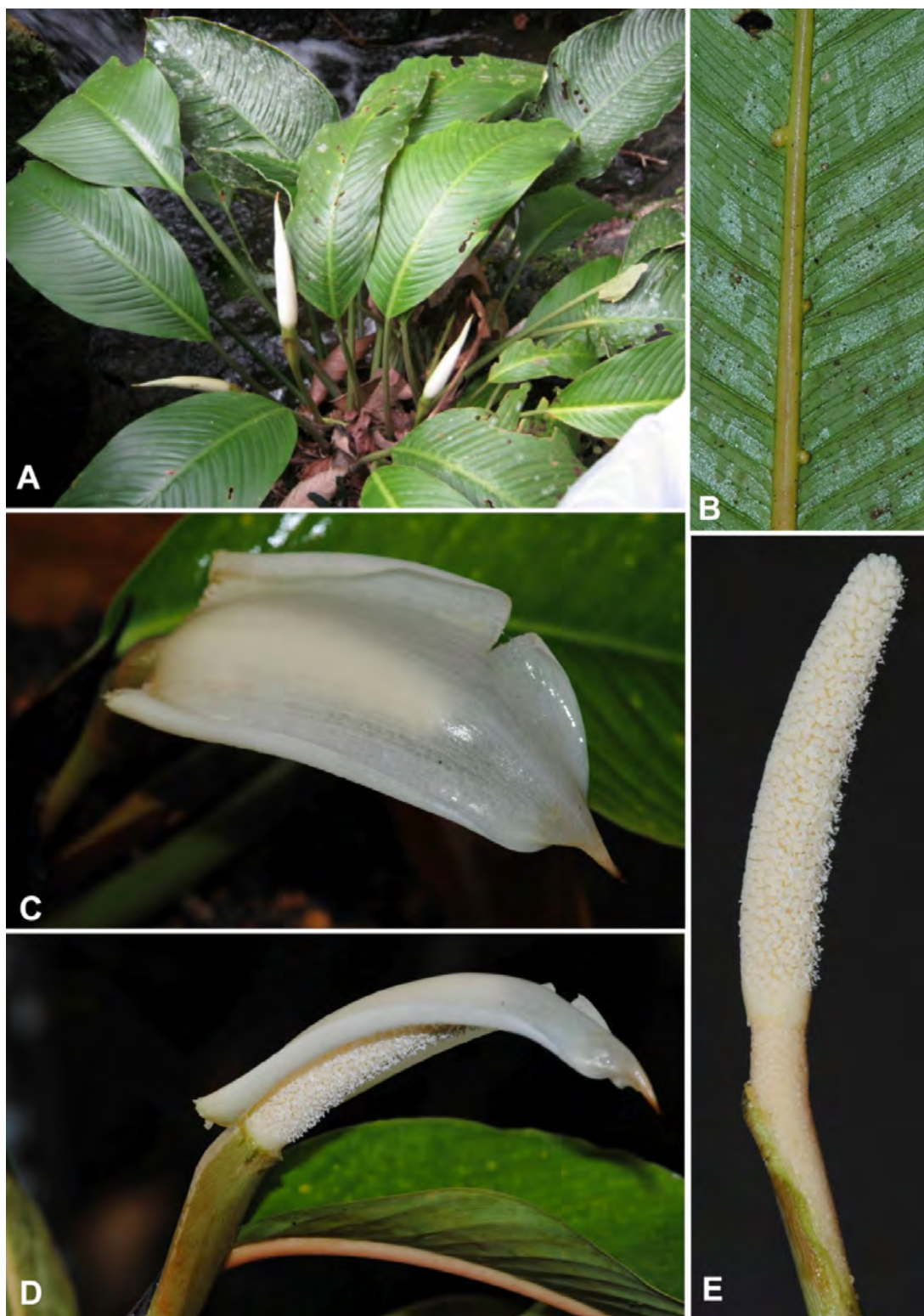


Figure 12. *Schismatoglottis bulbifera* H.Okada, H.Tsukaya & Y.Mori. **A.** Plant in habitat. **B.** Leaf blade abaxial surface showing bulbil development along mid-rib. **C & D.** Inflorescence at staminate anthesis. **D.** Spadix at staminate anthesis, spathe artificially removed. **A–G** from *P.C.Boyce & Wong Sin Yeng AR-3672*. Images © P.C. Boyce.



Figure 13. *Schismatoglottis confinis* S.Y.Wong & P.C.Boyce. **A & B.** Plants in habitat, karst limestone, Serian. **C.** Inflorescence at pistillate anthesis. **D.** Detail of persistent lower spathe and lowest part of spathe limb. **E.** Spadix at staminate anthesis, spathe artificially removed. **F.** Detail of inflorescence at end of staminate anthesis – note the spathe limb has been shed to leave a ragged rim to lower spathe orifice. **A–F** from *Simon Kutub ak Paru AR-926*. Images © Peter C. Boyce.

confinis) are consistently reliable in differentiating them.

Schismatoglottis bulbifera H. Okada, H. Tsukaya & Y. Mori, Syst. Bot. 24(1): 62[–63], **Figure 1–5** (1999). Type: Indonesian Borneo, West Kalimantan, Singkawang, G. Poteng, 12 Dec 1991, *M. Kato et al.* 30432 (holotype TI!; isotypes BO!). **Figure 12.**

Notes — Hay & Yuzammi (2000: 94) treated *S. bulbifera* as a synonym of *S. multiflora*. We have now re-collected *S. bulbifera* from several localities in SW Sarawak and can attest that it differs substantially from *S. multiflora* in floral particulars, including an erect inflorescence, and a spathe limb opening almost flat at staminate anthesis and then becoming marcescent, in addition to the leaf blades abaxially producing bulbils & plantlets along the mid-rib.

Schismatoglottis confinis S.Y.Wong & P.C.Boyce, Gard. Bull. Singapore 60(1): 159[–162], **Figure 2** (2008). Type: Malaysian Borneo, Sarawak, Samarahan Division, Serian, Pichin, Tubih Durud, Ampon Siribu, 15 Dec. 2004, *Simon Kutub ak Paru* AR–926 (holotype SAR!). **Figure 13.**

Notes — *Schismatoglottis confinis* appears to be closely allied to *S. bauensis* but can be distinguished by the leaf abaxial surface, which is glaucous in *S. confinis* but not in *S. bauensis*. The leaf base is always decurrent in *S. confinis* but obtuse to slightly decurrent in *S. bauensis*, while secondary venation is prominent in *S. confinis* but obscure in *S.*

bauensis. The tertiary venation of *S. confinis* is often tessellate. *Schismatoglottis confinis* has pores that are oblong (ca 0.3 mm), deep and located on the inner surface of stamens as compared punctiform pores (ca 0.15 mm) with protruding tissue from innermost surface and located at the edges of stamens in *S. bauensis*. The anther connective is flat in *S. confinis* but elevated in *S. bauensis* while the male zone of *S. confinis* stains brown in alcohol but remains white basally and stains brown distally in *S. bauensis*.

Although *S. confinis* can be found on limestones it always occurs terrestrially in deep soil as compared to *S. bauensis* which occurs lithophytically in humus and litter pockets on limestone boulders and cliffs. *Schismatoglottis confinis* can be found as well on the sandstones of Gunung Ampungan; the distance between this locality and Padawan/Serian limestones is only ca 30 km. Additionally, based on known collections, *S. confinis* occurs at much higher altitudes (near to 600 m asl) as compared to *S. bauensis* which occurs at most at 100 m asl.

Schismatoglottis erecta M.Hotta, Mem. Coll. Sci. Univ. Kyoto, Ser. B, 32: 233, **Figure 5**, A–F, (1966); Hay & Yuzammi, Telopea 9(1): 87–88 (2000); Boyce, Sarawak Mus. J. 87: 348 – 350, Pl. 7 (2009). Type: Malaysian Borneo, Sarawak, Bintulu (‘4th Division’), valley of Sg. Keyan, Ulu Sg. Kakus, 9 Nov. 1963, *M.Hirano & M.Hotta* 479 (holotype KYO!). **Figure 14.**

Notes — The erect and ultimately climbing stems of *Schismatoglottis erecta* and *S. schottii* are immediately distinctive. Both share a nodding inflorescence in which the spathe limb inflates while remaining distally abruptly acuminate, and a clavate staminate flower zone, but readily separable by the differences in the anther connective (deeply 1-grooved from theca to theca in *S. erecta* vs slightly raised between the thecae in *S. schottii*). *Schismatoglottis schottii* consistently has the spathe exterior coppery-orange whereas *S. erecta* has green spathes.

Schismatoglottis hayana Bogner & P.C.Boyce, Gard. Bull. Singapore 60(2): 1[–7], **Figure 1–3.** (2009). holotype Type: Malaysian Borneo, Sarawak, Kuching, Sematan, Teluk Selabang, 10 June 2004, P.C.Boyce *et al.* AR-703 (holotype SAR!; isotypes SING!). **Figure 15.**

Notes — *Schismatoglottis hayana* is readily distinguished from both *S. bauensis* and *S. multiflora* by the thecae, each with two pores. *Schismatoglottis hayana* is further distinctive from *S. bauensis* by the preference of shale (vs. limestone) and rheophytic (vs. lithophytic/chasmophytic) ecology, while *S. hayana* differs additionally from *S. multiflora* by the inflated (vs. only loosened/unfurled) spathe limb, the proportionately shorter, thicker cylindrical spadix and the larger pistillodes situated at the base of the pistillate flowers. Thecae each with two pores also occur in *S. nicolsonii* and *S. mayoana* (both in West Sarawak) but these differ from *S. hayana* by the presence of a sterile appendix and in having leaves

adaxially matte (vs. glossy in *S. hayana*). *Schismatoglottis nicolsonii* and *S. mayoana* are lithophytic on sandstones.

Schismatoglottis multiflora Ridl., J. Straits Br. Roy. Asiat. Soc. 44: 181 (1905); Engler, Pflanzenr. 55 (IV.23Da): 90 (1921); van Steenis, Rheophytes of the World 196. (1981); Hay & Yuzammi, Telopea 9(1): 94–95 (2000). Type: Malaysian Borneo, Sarawak, Matang, July 1903, H.N. Ridley 11582 (holotype SING!; isotype K!). **Figure 16.**

Notes — As here defined *Schismatoglottis multiflora* is restricted to the Matang Massif and adjacent areas in Bau (Kuching, NW Borneo), where it occurs as an obligate rheophyte on rather soft sandstones. The spathe limb barely opens at anthesis and the spathe limb is soon caducous.

Schismatoglottis roseospatha Bogner, Aqua-Planta 88: 96[–97] (3 un-numbered plates) (1988); Hay & Yuzammi, Telopea 9(1): 99; Bogner, Aqua-Planta 3–2004: 86–87 (2004). Type: Malaysian Borneo, Sarawak, Gaad [= Gaat] River, [without date] J. Knüppel & H. Linke, s.n. (holotype M!; isotypes K!, KYO!). **Figure 17.**

Notes — *Schismatoglottis roseospatha* is distinctive by the deep green highly glossy leaf blades and usually pink (occasionally white) spathe limbs. In nature plants either occur as rheophytes, mostly on sunny but constantly water-splashed rocks, or as permanently submerged plants with much smaller and more membranous leaves. The

submerged morph has yet to be found flowering, although plants brought into cultivation and grown emersed will revert to the rheophytic morph and flower.

Schismatoglottis schottii Bogner & Nicolson, *Aroideana* 2: 120 (1979); Hay & Yuzammi, *Telopea* 9(1): 101 (2000). — *Piptospatha acutifolia* Engl., *Pflanzenr.* 55 (IV.23Da): 128, **Figure 76.** (1912). — *Schismatoglottis acutifolia* (Engl.) M.Hotta, *Mem. Coll. Sci. Univ. Kyoto, Ser. B*, 32: 233 (1966) [non *S. acutifolia* Engl. (1912)]. Type: Indonesian Borneo, Kalimantan Barat, Sungei Doho [= Long Deho], 1896 [? 1897], *A. W. Nieuwenhuis 1585* (holotype BO!; isotype B!). **Figure 18.**

Notes — *Schismatoglottis schottii* and *S. erecta* are clearly closely allied, although their different anther connectives reliably separate them (slightly raised between the thecae in *S. schottii* as compared with deeply 1-grooved from theca to theca in *S. erecta*).

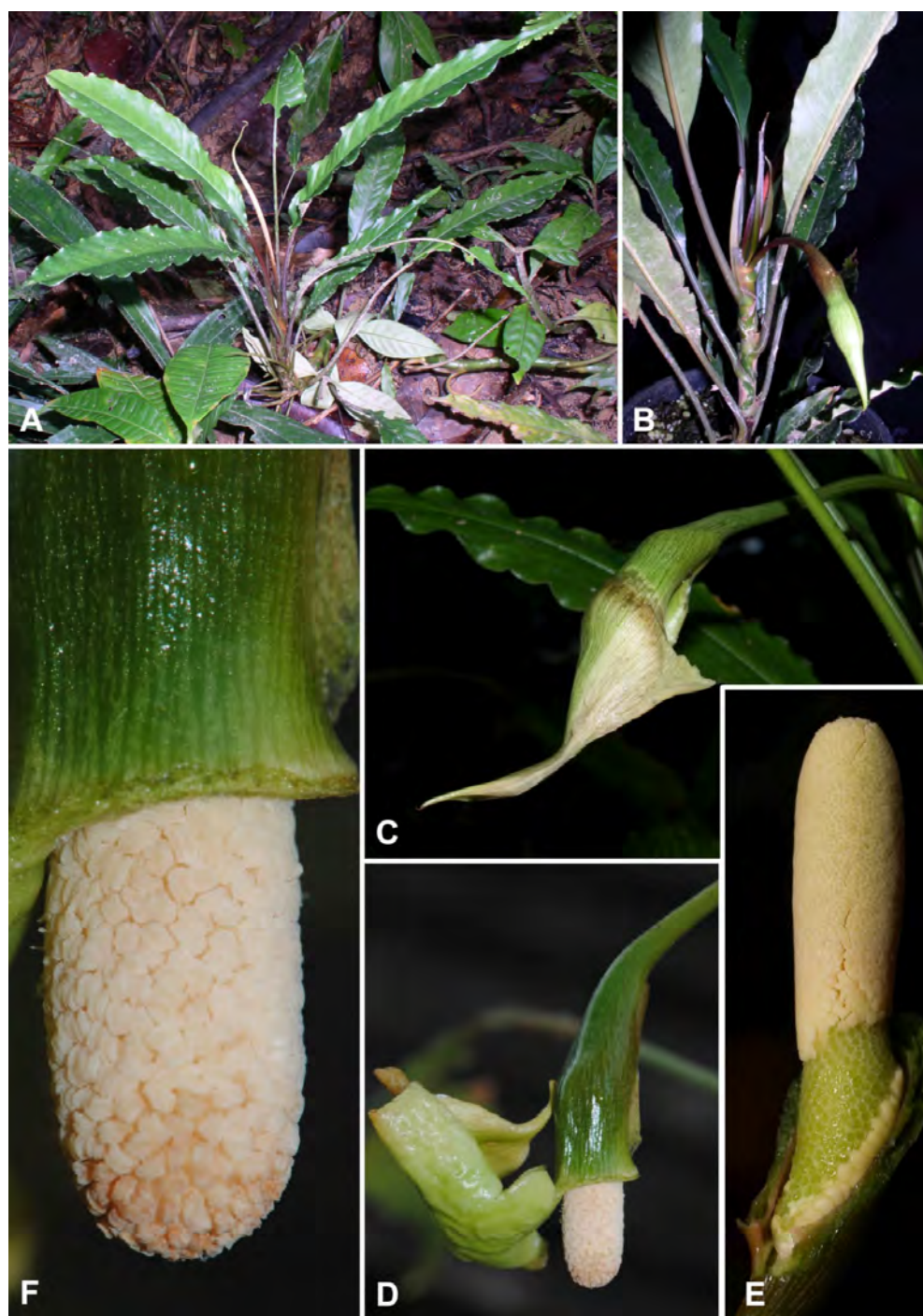


Figure 14. *Schismatoglottis erecta* M.Hotta. **A.** Plants in habitat, gallery forest. **B.** Flowering cultivated plant; note the nodding inflorescence and persistent ligular portion to the petiolar sheath. **C.** Inflorescence at staminate anthesis, with spathe limb beginning to shed. **D.** Inflorescence at end of staminate anthesis, with spathe limb almost fallen; note the groove running between thecae of each stamen. **E.** Spadix at pistillate anthesis, spathe artificially removed. **F.** Detail of staminate flowers with anther connectives deeply 1-grooved from theca to theca. **A & B** from *P.C.Boyce et al. AR-551*; **C** from *P.C.Boyce et al. AR-1452*; **D & F** from *P.C.Boyce et al. AR-2046*; **E.** from *P.C.Boyce et al. AR-1610*. Images © P.C. Boyce.



Figure 15. *Schismatoglottis hayana* Bogner & P.C.Boyce. **A & B.** Plants in habitat on shale rocks. **C & D.** Inflorescence at staminate anthesis; note decayed spathe limb. **E.** Detail of inflorescence at end of staminate anthesis, nearside spathe artificially removed. **A–E** from *P.C.Boyce et al. AR-703*. Images © Peter C. Boyce.



Figure 16. *Schismatoglottis multiflora* Ridl. **A & B.** Plants in habitat on sandstone rocks. **C.** Inflorescence at pistillate anthesis; note spathe limb not opening wide. **D.** Inflorescence at onset of staminate anthesis; note spathe limb beginning to degrade. **E.** Spadix at pistillate anthesis, spathe artificially removed. **F.** Detail of lower portion of spadix showing pistillate flower zone, interstice, and lowermost part of staminate flower zone. **G.** Terminal portion of spadix at staminate anthesis; note pollen strings. **A–F** from *P.C.Boyce et al. AR-240*. Images © Peter C. Boyce.

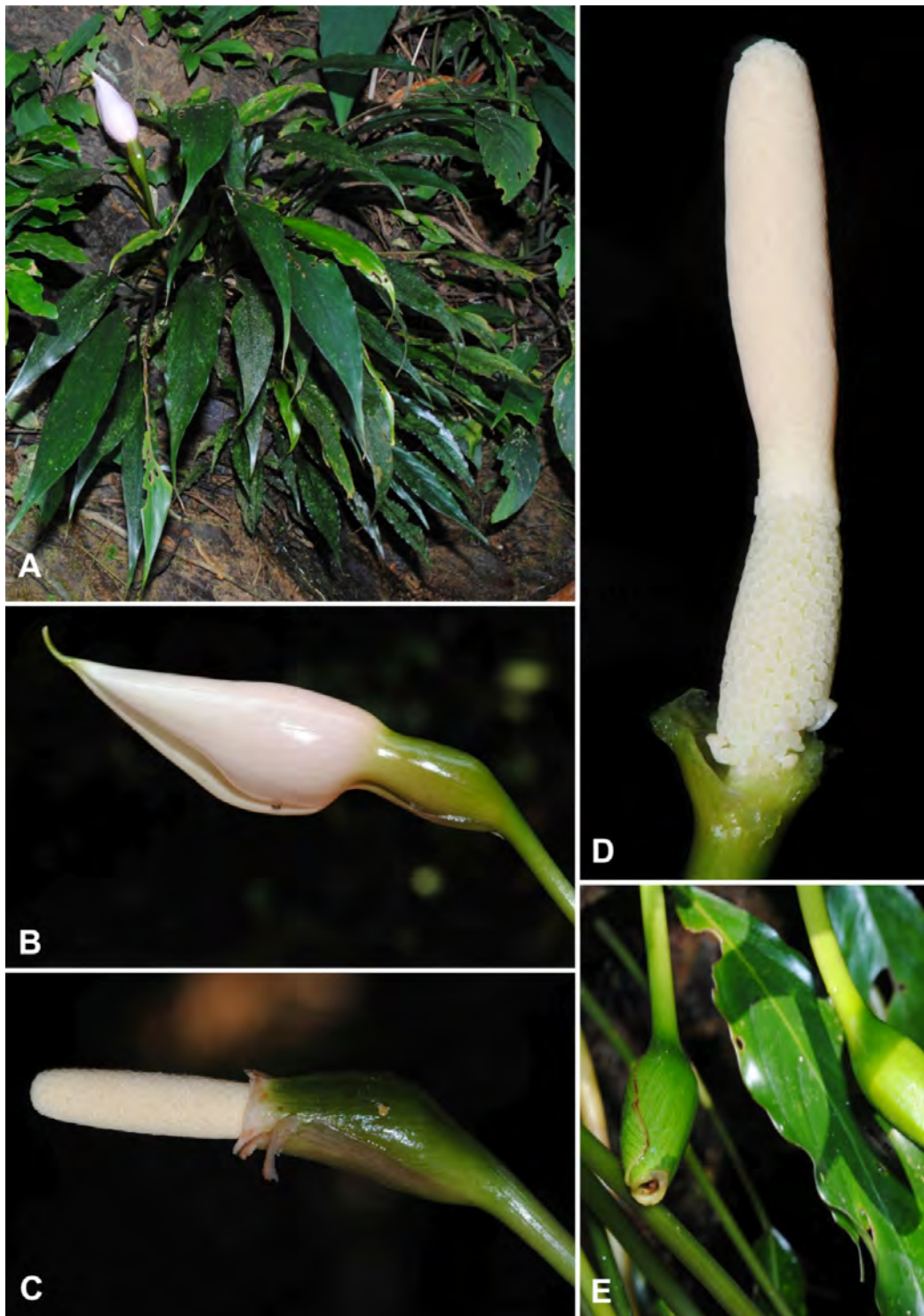


Figure 17. *Schismatoglottis roseospatha* Bogner. **A.** Plants in habitat on shale rocks. **B.** Inflorescence at pistillate anthesis. **C.** Inflorescence at late staminate anthesis; note spathe limb already shed. **D.** Spadix at pistillate anthesis, spathe artificially removed. **E.** Developing infructescences enclosed in persistent lower spathe. **A–E** from *P.C.Boyce et al. AR-1790*. Images © Peter C. Boyce.

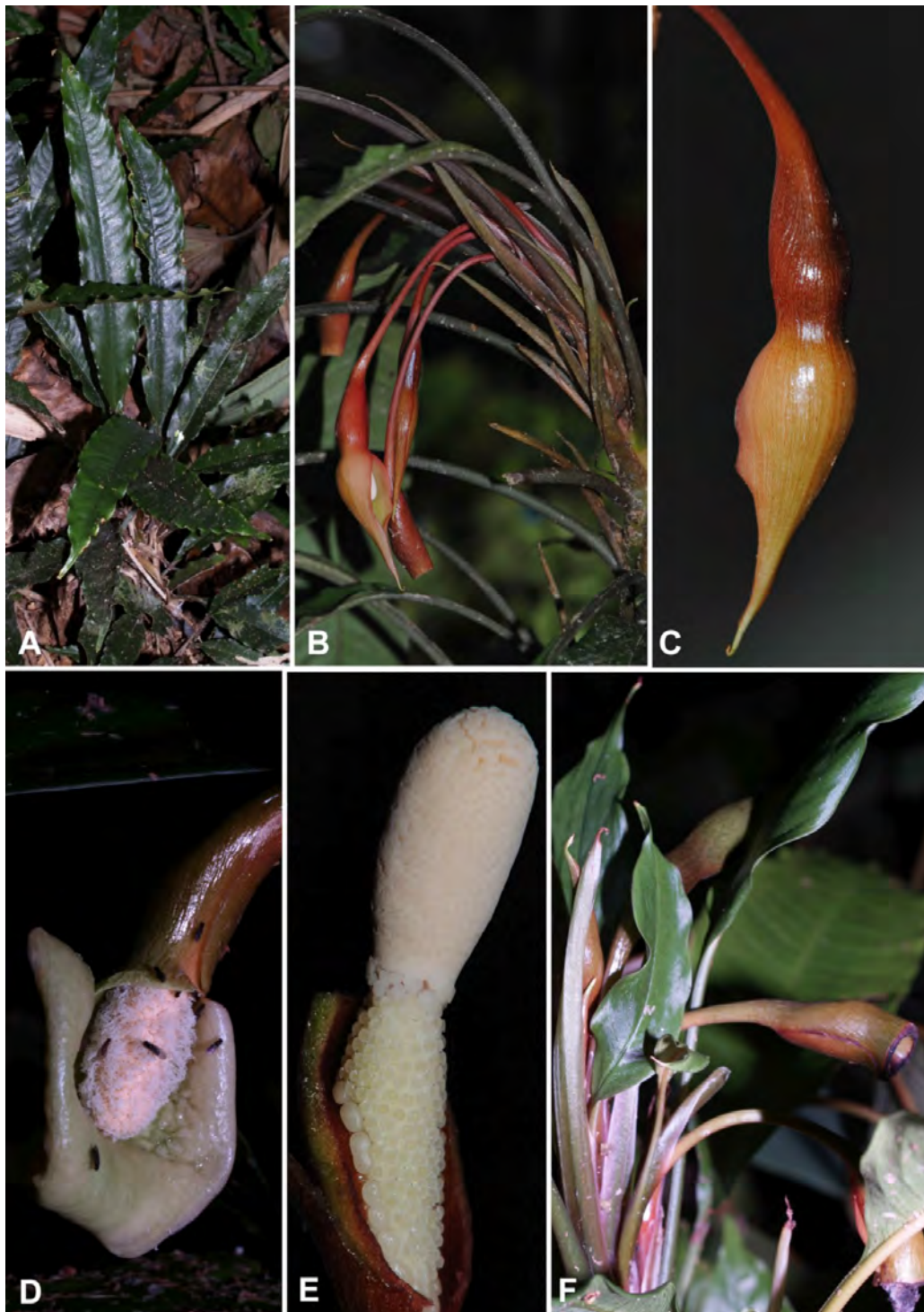


Figure 18. *Schismatoglottis schottii* Bogner & Nicolson. **A.** Plants in habitat, gallery forest. **B.** Flowering cultivated plant; note the nodding inflorescence and persistent ligular portion to the petiolar sheath. **C.** Inflorescence at pistillate anthesis. **D.** Inflorescence at staminate anthesis, with spathe limb shedding; note pollen. **E.** Spadix at pistillate anthesis, spathe artificially removed. **F.** Fruiting cultivated plant; note the persistent lower spathe and persistent ligular portion to the petiolar sheath. **A & F** from *P.C.Boyce & Wong Sin Yeng AR-3695*. Images © P.C. Boyce.

REFERENCES

- Boyce, P.C. 1994. New species of Araceae from Brunei. *Kew Bull.* 49(4): 793–801.
- Boyce, P. C & Wong S. Y. 2013. Studies on Schismatoglottideae (Araceae) of Borneo XXXIII – A review of the *Schismatoglottis* Tecturata Group, including description of a new species, *Schismatoglottis evelyniae*. *Aroideana* 36E(1): 4–15.
- Hay, A. & Yuzammi. 2000. Schismatoglottideae (Araceae) in Malesia I – *Schismatoglottis*. *Telopea* 9(1): 1–177.
- Wong S.Y. 2010. Studies on Schismatoglottideae (Araceae) of Borneo XII: Three new species of *Schismatoglottis* in the Multiflora Group. *Gard. Bull. Singapore* 61(2): 525–540.
- Wong S. Y. & P.C.Boyce. 2014a. Studies on Schismatoglottideae (Araceae) of Borneo XXXX: *Schismatoglottis petradoxa* and *S. tseui*, new shale-obligate rheophytes of uncertain affinity. *Aroideana* 37E(2): 17–25.
- Wong S.Y. & P.C. Boyce. 2014b. Studies on Schismatoglottideae (Araceae) of Borneo XXXIV – *Schismatoglottis iliata*, a new species from NW Sarawak, and notes on the *Schismatoglottis* Multiflora Group and the *Schismatoglottis mayoana* Complex. *Willdenowia* 44: 4–11.
- Wong S.Y. & P.C. Boyce. 2014c. Studies on Schismatoglottideae (Araceae) of Borneo XXXIX: *Schismatoglottis persistens*, a new rhizomatous rheophytic species for the Multiflora Group. *Willdenowia* 44: 247–251.
- Wong S.Y. & P.C. Boyce. 2016. Studies on Schismatoglottideae (Araceae) of Borneo LIII – *Schismatoglottis larynx* and *Schismatoglottis rejangica*, new species allied to *Schismatoglottis petradoxa* *Aroideana* **: ***_***.

ACKNOWLEDGMENTS

This is an output of an ongoing research programme funded by the Ministry of Education Malaysia by the Niche Research Grant Scheme Vote No. NRGS/1089/2013-(03). Fieldwork associated with this paper was most recently under Sarawak Forestry Department Permission to Conduct Research on Biological Resources—Permit No. NCCD.907.4.4(JLD.12)-51 and Park Permit No. 121/2015. The collaboration and support of the Sarawak Forestry Department and the Sarawak Biodiversity Centre are gratefully acknowledged.

Studies on *Schismatoglottideae* (Araceae) of Borneo LVII: *Bucephalandra filiformis* – a new species from Maligan, Sarawak, Malaysian Borneo

Wong Sin Yeng*

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

Universiti Malaysia Sarawak

94300 Kota Samarahan

Sarawak, Malaysia

sywong@frst.unimas.my

*
corresponding author

Peter C. Boyce

Honorary Research Scientist

Ludwig-Maximilians-Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München

Germany

boyce@biologie.uni-muenchen.de

ABSTRACT

Bucephalandra filiformis is described as a new species with uniquely stiff linear leaf blades, illustrated from living plants from the Maligan Range (Sarawak & Sabah, Malaysian Borneo), and inserted into the most recent identification key to *Bucephalandra* species.

KEY WORDS

Rheophytes, sandstone, upper hill forest.

INTRODUCTION

Fieldwork in the Maligan Range (straddling the border of Sarawak & Sabah, Malaysian Borneo) resulted in collection of several puzzling rheophytic aroid species. One of these has now flowered in cultivation and

proven to be a previously undiscovered species of *Bucephalandra*, unique in the genus by the stiff linear leaf blades. It is here described as *Bucephalandra filiformis* S. Y. Wong & P. C. Boyce, **sp. nov.** Recognition of this novelty takes *Bucephalandra* to 30 described species.

Dimensions in the descriptions are derived from fertile (i.e., mature) plants. Seedlings have overall smaller measurements.

Geological occurrences recorded in this paper are verified by the excellent geological map of Tate (2001).

Bucephalandra filiformis may be inserted in the key to *Bucephalandra* species presented in Wong & Boyce (2014a) as follows:

- 2. Appendix staminodes verrucate or brain-like **3**
- Appendix staminodes smooth **7 (“6”)**
- 3. Leaf blades linear, stiff
- ***Bucephalandra filiformis***
- Leaf blades never linear, usually not stiff; if stiff then never linear
- 4, etc., = 5, etc., in Wong & Boyce (2014a).

Bucephalandra filiformis S. Y. Wong & P. C. Boyce, **sp. nov.** Type: Malaysian Borneo, Sarawak, Limbang, Lawas, Maligan Range, Air Terjun Payeh Maga, below Camp 2, 04° 26' 15.1"N 115° 31' 27.9"E, 9 Sep 2014, P. C. Boyce *et al.* AR-4915 (holotype SAR – alcohol!; isotype: M – alcohol!). **Figure 1.**

Diagnosis

Bucephalandra filiformis is immediately distinguished from all other species of the genus *Bucephalandra* by the stiff linear leaf blades.

Description

Small solitary obligate rheophytic herbs to c. 8 cm tall. **Stem** initially erect, later shortly creeping and rooting with active portion sub-erect, c. 5 mm in diam.. **Leaves** up to c. 15 together, spreading to sub-erect; **petiole** 1–2 cm long × c. 2 mm in diam., dorsally narrowly and shallowly canaliculate, ventrally longitudinally ribbed, reddish brown, sheathing at extreme base, wings extended into a very narrowly triangular ligular portion 2–3.5 cm long, light red to brownish; **blade** linear, 7 – 11 cm long × 4 – 6 mm wide, stiff, semi-matte deep olive green adaxially, much paler greenish white with the blade margin finely deep green, base cuneate, apex acute (narrow leaf blades) to aristate (wider leaf blades), apiculate for 2 – 3 mm; **midrib** abaxially and adaxially prominent, adaxially concolorous with blade, abaxially dull red; **primary lateral veins** two, arising from leaf blade base and running along the margin; **interprimary veins** hardly differentiated, together totalling c. 15 per side, diverging at c. 30° and running to a marginal vein; **secondary and tertiary venation** ± obscure. **Inflorescence** solitary; **peduncle** exceeding petioles, 4–7 cm long × c. 1.5 mm in diam., somewhat longitudinally ridged, reddish. **Spathe** slender-fusiform,



Figure 1. *Bucephalandra filiformis* S. Y. Wong & P. C. Boyce

A. & B. Plants in habitat on moss-covered sandstone boulders. **C.** Habitat. **D.** Inflorescence at pistillate anthesis. **E.** Spadix at pistillate anthesis, nearside portion of spathe artificially removed, note that scale-like staminodes of interstice, and staminate flowers, are still erect. **F.** Detail of spadix at staminate anthesis; that the staminate flowers have reflexed and changed to salmon-pink, and that the interstice staminodes have reflexed note, too, that stigmas have darkened and are no longer receptive. **A–H** from *AR-4186*. Images © P.C. Boyce.

not constricted, c. 3 cm long; **lower spathe** obliquely funnel-form, green, persistent; **limb** gaping at pistillate anthesis, then caducous, white shading to green at junction with lower persistent spathe, limb acuminate for c. 1 cm and apiculate for c. 4 mm, apiculum green. **Spadix** 2 – 2.5 cm long; **pistillate zone** c. 5 mm long × c. 1.5 mm in diam., with c. 2 spirals of pistils; **pistils** weakly rhombic-globose, c. 0.5 mm in diam., bright green; **stigma** sessile, umbonate, c. $\frac{1}{2}$ diameter of ovary, producing a conspicuous meniscus-like droplet at anthesis, later (post-anthesis) sunken centrally; **pistillodes** 2–4 at base of pistillate zone, compressed clavate, c. 0.5 mm long and wide, waxy white; **interstice** with 2 rows of **scale-like staminodes**, these c. 2 mm long . 1.5 mm wide, ventrally gibbose, margin spatulate, creamy white, erect during pistillate anthesis, reflexing prior to staminate anthesis; **staminate zone** c. 5 mm long × c. 4 mm in diam., consisting of c. 3 rows of flowers; **staminate flowers** during pistillate anthesis ascending to display almost entire ventral surface, reflexing during staminate anthesis to present ventral surface lowermost, creamy yellow ageing during staminate anthesis to salmon-pink, thecae paler and somewhat translucent; **stamen** comparatively large, c. 2 mm long; **filament** small, stout; **connective** strap-shaped; **thecae** inserted ventrally, ellipsoid, c. 1 mm long × c. 0.5 mm wide, smooth; **thecae horns** c. $\frac{1}{5}$ length of associated theca, setaceous, outward-pointing; **appendix** ellipsoid, 1 – 1.5 cm long × c. 5 mm in diam., cream; **appendix staminodes** obpyramidal, tops

irregularly polygonal, lower ones well-defined, terminal ones coalesced, truncate, 0.5–1 mm in diam., weakly verrucate and somewhat glossy, cream. **Infructescences** not seen.

Ecology — Rheophytic on semi-shaded mossy sandstone boulders in wet upper hill forest at about 850 m asl.

Distribution — *Bucephalandra filiformis* is known only from the Maligan Range.

Etymology — From the Latin feminine adjective *filiformis*, threadlike, denoting the form of the leaf blades.

Notes — The stiff very narrow leaf blades of *Bucephalandra filiformis* have no equal in the genus *Bucephalandra* although similar leaf blades occur in *Fenestratarum culum* P. C. Boyce & S. Y. Wong, *Aridarum montanum* Ridl., and in some forms of the highly polymorphic (and likely polyphyletic) *A. canescens* M. Hotta. All are obligate rheophytes.

Observations of flowering plants revealed that the staminate flowers change colour from creamy white to salmon-pink as anthesis progresses from pistillate (when the staminate flowers are erect with the ventral surface exposed) to staminate (staminate flowers reflexing reflexing to place ventral surface lowermost). These movements are emulated by the scale-like staminodes of the interstice. See Wong & Boyce (2013) for a

summary of the role of the interstice staminodes in *Bucephalandra*.

In general *Bucephalandra* species are plants of low elevations, with rather few of the 30 recognized species occurring about 400 m asl and only three other species occurring at altitudes higher than that of *B. filiformis*: *Bucephalandra kishii* S. Y. Wong & P. C. Boyce, *B. magnifolia* H. Okada & Y. Mori, and *B. tetana* S. Y. Wong & P. C. Boyce (Wong & Boyce 2014a).

Other material examined (Paratype):
MALAYSIAN BORNEO: **Sarawak:**
Limbang, Lawas, Maligan Range, Air Terjun Payeh Maga, below Camp 2, 04° 26' 15.1"N 115° 31' 27.9"E, 9 Sep 2014, P. C. Boyce *et al.* AR-4916 (SAR – alcohol!; M – alcohol!).

REFERENCES

Tate R. B. 2001. *The geology of Borneo island CDROM*. – Kuala Lumpur: Persatuan Geologi Malaysia / Geological Society of Malaysia.

Wong S. Y. & P. C. Boyce. 2013. The role of the interstice staminodes of *Bucephalandra* Schott (Araceae: Schismatoglottideae). *Newslett. Int. Aroid Soc.* 35(2): 11–12.

Wong S. Y. & P. C. Boyce. 2014a. Studies on Schismatoglottideae (Araceae) of Borneo XXX – New species and combinations for *Bucephalandra*. *Willdenowia* 44: 149–199.

Wong S. Y. & P. C. Boyce. 2014b. Studies on Schismatoglottideae (Araceae) of Borneo XXXXI: Additional new species of *Bucephalandra*. *Willdenowia* 44: 415–421.

ACKNOWLEDGEMENTS

This is part of an on-going research project funded by the Ministry of Higher Education, Malaysia by the Exploratory Research Grant Scheme Vote No. NRGS/1089/2013-(03). Fieldwork was most recently under Sarawak Forestry Department Permission to Conduct Research on Biological Resources - Permit No. NCCD.907, 4.4(JLD.12)-51 and Park Permit No 121/2015. The collaboration and support of the Sarawak Forestry Department and the Sarawak Biodiversity Centre are gratefully acknowledged.

Studies on Schismatoglottideae (Araceae) of Borneo LVIII – Further novelties described for the genus *Piptospatha*, and a note on *Piptospatha* Sect. *Gamogyne*

Wong Sin Yeng*

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

Universiti Malaysia Sarawak

94300 Kota Samarahan

Sarawak, Malaysia

sywong@frst.unimas.my

*corresponding author

Peter C. Boyce

Honorary Research Scientist

Ludwig-Maximilians-Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München

Germany

boyce@biologie.uni-muenchen.de

ABSTRACT

Piptospatha bella S. Y. Wong & P. C. Boyce and *Piptospatha lurida* S. Y. Wong & P. C. Boyce are described and illustrated from Sarawak, Malaysian Borneo. Their recognition takes *Piptospatha* to 18 described species. *Piptospatha lurida* is most similar to *P. burbidgei*, a species formerly allotted its own genus, *Gamogyne*, later made into a section of *Piptospatha*. Notes on *Gamogyne* are provided and a correction to published

information on the placentation of *Gamogyne* offered.

KEY WORDS

Rheophyte, sandstones, shales, placentation.

INTRODUCTION

Piptospatha N.E. Br. in our research collection continue to reveal additional

taxonomic novelties. Here we describe two new species that have recently flowered with us for the first time. One of them, here named *Piptospatha bella* S.Y. Wong & P.C. Boyce, **sp. nov.**, has long puzzled us as to its identity since in habit it much better matches species of the genus *Bucephalandra* Schott, although production of numerous adventitious plantlets upon the main roots is reminiscent of *Ooia* S.Y. Wong & P.C. Boyce. The other species, here described as *Piptospatha lurida* S.Y. Wong & P.C. Boyce, **sp. nov.**, was initially assumed to be *Piptospatha burbidgei* (N.E. Br.) M. Hotta so closely does the sterile plant resemble that species, but on flowering proved to be a quite distinct species.

Dimensions used in the descriptions are derived from fertile (i.e., mature) plants. Seedlings have overall smaller measurements.

Interpretation of the intricate geology of Borneo relies as ever on Tate (2001).

Piptospatha bella S. Y. Wong & P. C. Boyce, **sp. nov.** Type: Malaysian Borneo, Sarawak:

Bintulu, Tatau, Sungai Bawang, 02°42'01.6"N 112°40'47.9"E, c. 60 m asl, 9 May 2012, M. Lo 3909 (holo SAR!). **Figure 1, Figure 4B.**

Diagnosis

Piptospatha bella is unique in the genus by the diminutive oblanceolate to spatulate leaf blades with undifferentiated primary lateral veins and by producing stiffened stilt-roots. Among *Piptospatha* species with green syncarpous pistils and a spathe lacking rostral keels (= *Piptospatha* Sect. *Gamogyne*), *P. bella* is distinguished by the above characteristics and (except for *P. burbidgei*) by producing abundant plantlets from the spreading roots.

Tufted rheophytic herb to 10 cm tall. **Roots** composed of several stiffened stilt-roots c. 3 mm in diameter and penetrating deeply into mud and extensive spreading roots from which are produced numerous plantlets. **Stem** condensed, to 5 mm in diameter, obscured by leaf bases. **Leaves** many together, arching, forming a rosette; **petiole** 3–4 cm long, c. 2 mm in diameter, weakly D-shaped in cross-section, minutely scabrous, especially dorsally, with dorsal edges minutely crispulate-alate, dull reddish olive-green; **petiolar sheath** with free ligular portion c. 2 cm long, these briefly marcescent, ultimately deciduous, dark reddish brown; **leaf blades** oblanceolate to somewhat spatulate, stiffy chartaceous, 5–10 cm long × 2–3.5 cm wide, base cuneate, apex subacute with stout tubule c. 5 mm long, margins wavy, semi-glossy medium to deep green adaxially, pale ochre abaxially with newer leaves tinged reddish; **mid-rib** bluntly raised adaxially, rounded-raised and minutely scabrous adaxially; **primary lateral veins** c. 5 per side, parallel pinnate, almost

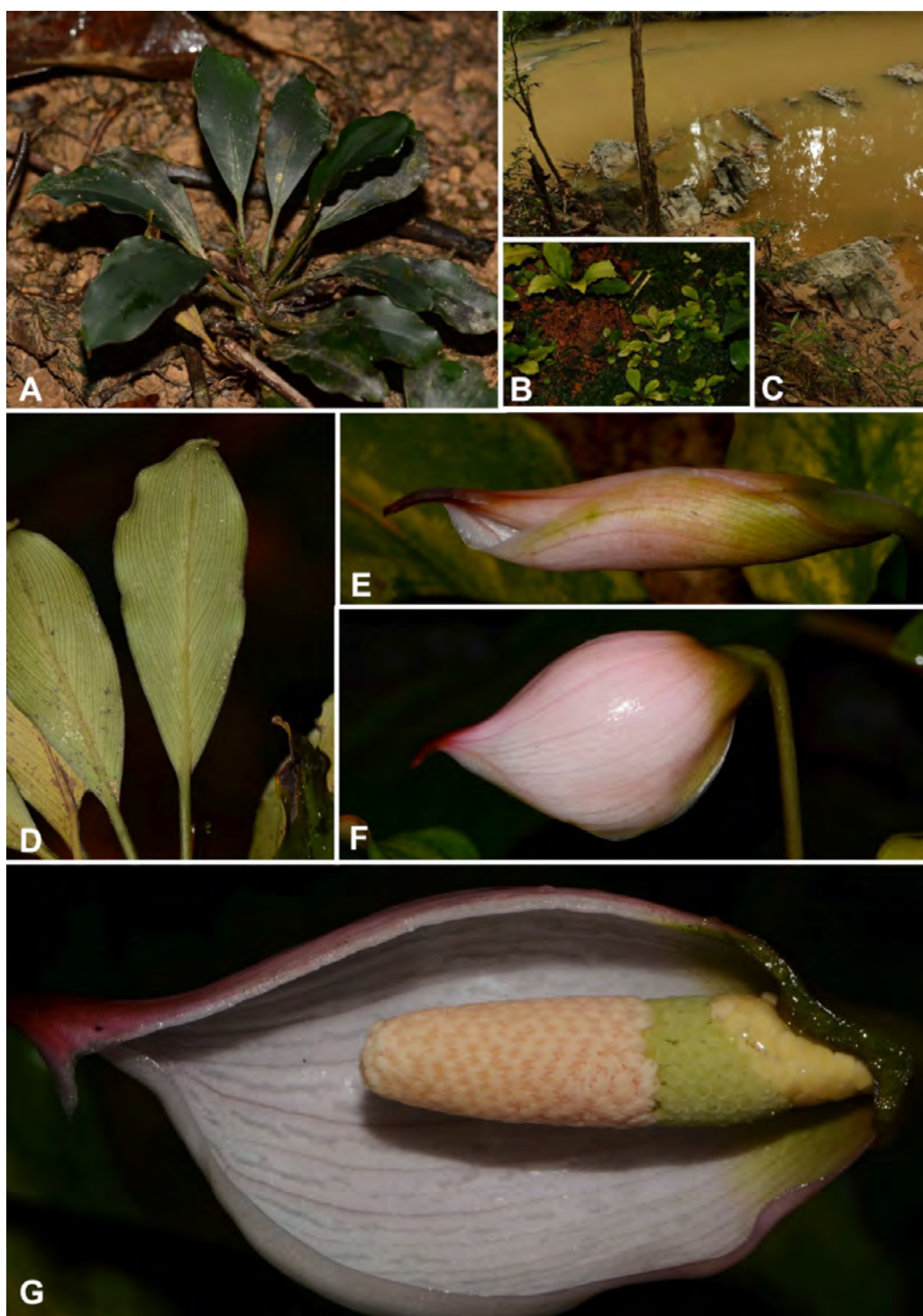


Figure 1. *Piptospatha bella* S. Y. Wong & P. C. Boyce. **A.** Plant in Type habitat. **B.** Detail of adventitious plantlets arising from roots. **C.** Habitat during wet season. *Piptospatha bella* grows on the mud protected by submerged shale rocks. **D.** Leaf blades, abaxial surface. **E.** Inflorescence at pistillate anthesis. The tubular spathe with the oblique terminal orifice is diagnostic. **F.** Inflorescence at late pistillate anthesis. **G.** Spadix at pistillate anthesis, nearside spathe artificially removed. All from P.C. Boyce & S.Y. Wong AR-3909. Images © P.C. Boyce.



Figure 2. *Piptospatha lurida* S. Y. Wong & P. C. Boyce. **A.** Plants in Type habitat. **B.** Habitat during dry season. *Piptospatha lurida* grows at the base of the stratified waterfall. **C.** Leaf blades, abaxial surface. **D.** Inflorescence at pistillate anthesis. **E.** Spadix at finish of pistillate anthesis, nearside spathe artificially removed. All from *M. Lo AR-4917*. Images **A & B** © M.Lo; images **C – E** © P.C. Boyce.

indistinguishable from the more numerous interprimaries, both sets arising at c. 60° from mid-rib and joining a sub-marginal collecting vein. **Inflorescence** solitary, erect; **peduncle** c. 10 cm long, c. 2 mm in diameter, minutely scabrous, dull olive green. **Spathe** initially erect, later held at c. 90° to peduncle, not constricted, dull olive green and pale pink in late bud, spathe limb opening mainly in shades of glossy medium pink with darker staining, with terminal rostrum glossy deep purple-pink and lower spathe and ventral mentum dull olive green; **spathe limb** c. 4 cm long, remaining cylindrical with an oblique terminal orifice for much of pistillate anthesis before inflating to c. 1.5 cm, terminating in a rostrum c. 1 cm long, lacking rostral keels. **Spadix** c. 2 cm long × 5 mm in diameter, strongly obliquely inserted on spathe/peduncle; **pistillate flower zone** pale jade-green, cylindrical, basally obliquely contiguous with infrapistillar pistillode zone, dorsal side c. 3 mm long, ventral side c. 5 mm long, × c. 5 mm in diameter; **infrapistillar staminodes** in c. 2 rows, c. 1 mm diam., truncate, white; **pistils** syncarpous, individually slightly tapering-cylindrical, truncate, c. 0.6 mm diameter; **placentation** parietal; **stigma** capitate, papillate, wider than ovary; pistillate and staminate zones contiguous; **staminate flower zone** pale cream, c. 1 cm long × 5 mm in diameter at base, slightly tapering, apex blunt; **staminate flowers** congested, mostly weakly defined as individual flowers, where distinct then flowers comprised of paired stamens; **stamens** irregularly oblong and very weakly butterfly shaped, c. 0.5 mm

wide × c. 1 mm long, connective broad, truncate, glabrous; **thecae** lateral, c. 0.3 mm, ellipsoid with a narrow rim. **Infructescence** and **fruits** not observed.

Ecology — Obligate rheophyte on seasonally flooded riverine dense mud protected by semi-submerged shale rocks under perhumid lowland forest; c. 60 m. asl.

Distribution — Known only from the Type locality.

Etymology — From Latin adjective, *bellus*, in the feminine nominative form – *bella*: beautiful, coined for the attractive inflorescence of this species.

Notes — *Piptospatha bella* is remarkable by its diminutive size, it is the smallest tufted *Piptospatha* species yet described, the *Bucephalandra*-like stiffly chartaceous spatulate to oblanceolate leaf blades, and uniquely stiffened stilt-roots. The habitat of seasonally inundated bare alluvial consolidated mud to which the species is restricted is extraordinary – in wet weather plants are often submerged by turbid water for several days on end.

Solely on vegetative form it is far from clear to what *P. bella* may be most closely allied since out of flower the plant resembles persuasively species of the genus *Bucephalandra*. On flowering we were surprised to discover that the pistils were connate and that the spathe lacked rostral

keels, indicating placement of *P. bella* in the group of species around *P. burbridgei*.

Brown (1882) based his genus *Gamogyne* on what is now *Piptospatha burbridgei*, comparing it with the then only known species of *Piptospatha* (*P. insignis* N.E. Br.) and citing united ovaries and different stamens (*Piptospatha insignis* has a uniquely extended connective) as the differentiating characteristics. Subsequent additional species discoveries have excluded the staminate flower difference, but the characteristic of the connate pistils remains reliable, and was used by Hotta (1965) in recognizing sect. *Gamogyne* (N.E. Br.) M. Hotta. Based on our observations of many more species, we would add the character of the spathe limb lacking internal rostral keels as a feature for species of Sect. *Gamogyne*.

Brown reported *Gamogyne* to have parietal placentation (as does *Piptospatha*). However, Mayo et al. (1997) depicted *P. burbridgei* with basal placentation (GoA: Plate 50E) and Bogner & Hay (2000: 201) also reported basal placentation for *P. burbridgei*. Examination of the material used for Plate 50 (*P.W. Richards 1091*) reveals it to be incorrectly determined as *P. burbridgei* (it is, in fact, an undescribed species of *Hottarum*, for which basal placentation is perfectly in order). It would appear that the basal placentation statement in Bogner & Hay (2000) resulted directly from this illustration of an erroneously determined collection.

Piptospatha lurida S. Y. Wong & P. C. Boyce, **sp. nov.** Type: Malaysian Borneo, Sarawak: Limbang, Lawas, Maligan, Air Terjun Payeh Maga, near Camp, 04°26'16.3"N 115°30'42.8"E, 820 m asl, 9 Sep 2014, *M. Lo 4917* (holo SAR!). **Figure 2, Figure 4A.**

Diagnosis

Piptospatha lurida most closely resembles *Piptospatha burbridgei* by the deep metallic green leaf blades with undifferentiated primary lateral veins, and blunt-tipped spathe, but is readily distinguished by the spadix lacking pistillodes below the pistillate flower zone, the shorter interstice zone (c. 1/10th vs 1/6th of the entire spadix length), and lax (vs densely arranged) pale orange (vs cream) staminate flowers, and in lacking plantlets arising from the roots.

Solitary rheophytic herb to 20 cm tall. **Roots** strong, adhering to rocky substrate. c. 3 mm in diameter. **Stem** short, condensed, to 20 mm in diameter, obscured by leaf bases. **Leaves** several together, spreading, forming a loose rosette; **petiole** 4–5 cm long, c. 3.5 mm in diameter, almost terete, scabrous, glossy medium olive green; **petiolar sheath** with free ligular portion c. 3 cm long, these caducous, liquefying, rather bright brownish-pink when fresh; **leaf blades** oblong-elliptic to narrowly oblong oblanceolate, 13–22 cm long × 2.5–3.5 cm wide, base cuneate, apex acute with stout tubule c. 5 mm long, glossy dark metallic bluish-green adaxially, paler abaxially; **mid-rib** bluntly raised adaxially, rounded-raised

and scabrous adaxially; **primary lateral veins** c. 10 per side, parallel pinnate, very nearly indistinguishable from the much more numerous interprimaries, although slightly darker than surrounding tissue on abaxial surface of blade, both sets arising at c. 60° from mid-rib and joining a sub-marginal collecting vein. **Inflorescence** solitary, erect; **peduncle** c. 10 cm long, c. 2 mm in diameter, distinctly scabrous, semi-glossy olive-green. **Spathe** initially erect, later held at c. 95° to peduncle, caducous part of limb dirty pinkish tan in late bud, persistent part dull medium olive-green, spathe limb opening mainly in shades clouded brownish pink, with terminal portion paler pink, and rostrum olive-green; **spathe limb**, c. 4.5 cm long, base c. 1 cm wide, mid-way inflated to c. 1.7 cm, blunt-tipped and terminating in a rostrum c. 5 mm long, lacking rostral keels. **Spadix** c. 2.5 cm long × c. 5 mm in diameter, obliquely inserted on peduncle/spathe; **pistillate flower zone** dirty jade-green, slightly fusiform, basally oblique, c. 4.5 mm long (dorsal side), c. 7 mm long (ventral side) × c. 5 mm in diameter; **infrapistillar staminodes** absent; **pistils** syncarpous, individually globose-cylindrical, truncate, c. 0.6 mm diameter; pistillate and staminate zones separated by a zone c. 2 mm long comprised of c. 2 whorls of irregular polygonal, truncate, white staminodes, uppermost ones transitioning to staminate flowers and often with one end fertile and the other sterile; **placentation** parietal; **stigma** discoid, almost as wide as pistil, orangish green; **staminate flower zone** pale orange, very slightly narrower than

pistillate zone in width, c. 1.7 cm long × 4.75 mm in diameter, slightly tapering, apex blunt; **staminate flowers** somewhat lax, not obviously arranged into discrete floral clusters, comprised of paired stamens, irregularly oblong, c. 0.5 mm wide × c. 1 mm long, connective sulcate, glabrous; thecae lateral, c. 0.3 mm, ellipsoid with a conspicuous narrow rim. **Infructescence** and **fruits** not observed.

Ecology — Rheophytic in bright light on sandstone waterfalls in wet upper hill forest at about 850 msl.

Distribution — Known only from the Type locality.

Etymology — From the Latin adjective, *lurida*, dirty brown, a little clouded (Lindley 1839).

Notes — *Piptospatha lurida* is evidently very closely allied to *P. burbidgei* (**Figure 3**) with sterile plants of both virtually indistinguishable. Examination of the roots of *P. burbidgei* reveals the presence of numerous plantlets, unknown in *P. lurida*.

Acknowledgements

This is part of an on-going research project funded by the Ministry of Higher Education, Malaysia by the Exploratory Research Grant Scheme Vote No. NRGS/1089/2013-(03). Fieldwork was most recently under Sarawak Forestry Department Permission to Conduct



Figure 3. *Piptospatha burbidgei* (N.E.Br.) M.Hotta. **A.** Flowering plant in habitat, shales. **B.** Inflorescence at pistillate anthesis. **C.** Inflorescence at onset of staminate anthesis. Note that the spathe limb has begun to senesce and has partly separated from the lower, persistent spathe. **D.** Inflorescence towards end of staminate anthesis. **E.** Spadix (spathe artificially removed) at pistillate anthesis. All from *P.C.Boyce et al. AR-1973*. Images © P.C. Boyce.



Figure 4. Spadix of *Piptospatha lurida* S. Y. Wong & P. C. Boyce (**A**) and *Piptospatha burbidgei* (N.E.Br.) M.Hotta (**B**) compared. Images © P.C. Boyce.

Research on Biological Resources - Permit No. NCCD.907, 4.4(JLD.12)-51 and Park Permit No 121/2015. The collaboration and support of the Sarawak Forestry Department and the Sarawak Biodiversity Centre are gratefully acknowledged.

References

- Bogner, J. & A. Hay. 2000. Schismatoglottideae (Araceae) in Malesia 2: *Aridarum*, *Bucephalandra*, *Phymatarum* and *Piptospatha*. *Telopea* 9(1): 179–222.
- Brown, N. E. 1882. Four new genera of Aroideae. *J. Bot.* 20: 193–197.
- Hotta, M. 1965. Notes on the Schismatoglottidinae of Borneo. I. *Mem. Coll. Sci. Univ. Kyoto, Ser. B*, 32: 19–30.
- Lindley, J. 1839. An Introduction to Botany, 3rd Ed. London.
- Mayo, S. J., J. Bogner & P. C. Boyce. 1997. The Genera of Araceae. Royal Botanic Gardens, Kew xi + 370 pp.
- Tate R. B. 2001: The geology of Borneo island [CDROM]. – Kuala Lumpur: Geological Society of Malaysia / Persatuan Geologi Malaysia.

Studies on Schismatoglottideae (Araceae) of Borneo LIX – A preliminary conspectus of *Schismatoglottis* Calyptrata Complex Clade species for Sarawak

Wong Sin Yeng*

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

sywong@frst.unimas.my

Associate Researcher

Harvard University Herbaria

22 Divinity Avenue, Cambridge, MA 02138, USA

*corresponding author

Hoe Yin Chen

Department of Plant Science & Environmental Ecology

Faculty of Resource Science & Technology

Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

Peter C. Boyce

Ludwig–Maximilians–Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München, Germany

ABSTRACT

A preliminary conspectus of species of the *Schismatoglottis* Calyptrata Complex Clade for Sarawak is presented. Six species are accepted, of which *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce is newly described, and *S. muluensis*

M. Hotta is resurrected from within *S. calyptrata* (Roxb.) Zoll. & Moritzi. Current evidence does not support the presence of *Schismatoglottis calyptrata sens. strict.* in Sarawak, while occurrence on Borneo as a whole is questionable. A modified description of *S. calyptrata*, excluding characteristics of

Bornean taxa hitherto included in synonymy is provided. An identification key to the accepted species for Sarawak is provided, and most are illustrated from living plants.

KEY WORDS

Geological obligation, *Schismatoglottis abmadii*, *Schismatoglottis ardenii*, *Schismatoglottis clarae*, *Schismatoglottis baangongensis*, *Schismatoglottis muluensis*, *Schismatoglottis viridissima*, Araceae

INTRODUCTION

Monographing *Schismatoglottis* Zoll. & Moritzi, Hay & Yuzammi (2000) proposed six informal morphologically defined species' groups, of which one, the Calyptrata Group, is delimited by most species (but see below) having hypogeal hapaxanthic shoot modules (Hay 1996: 2 *et seq.*; Hay & Yuzammi 2000: 9), with all species possessing a fully attached persistent petiolar sheath, and a caducous spathe limb.

Hay & Yuzammi (2000) treated *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi (the generic Type species) as a widespread polymorphic taxon occurring throughout the range of the genus (i.e., SW China to Vanuatu), treating plants from Peninsular Malaysia, Jawa, and New Guinea as a morphologically highly variable species. For Sumatera and Borneo, however, the existence of localized, often geologically or ecologically restricted, morphologically discrete segregate species was acknowledged, as below:

Sumatera

Schismatoglottis ecaudata A. Hay

Borneo – widespread

Schismatoglottis abmadii A. Hay (rheophytic)

S. trivittata Hallier f. – a species complex.

Borneo – Sarawak

Schismatoglottis clarae A. Hay

S. viridissima A. Hay (granites)

Borneo – Kalimantan

Schismatoglottis canaliculata Engl.

S. emarginata Engl.†

S. grabowskii Engl. (ultramafics)

S. maculata Alderw. †

S. modesta Schott.

S. nierenhuisii Engl.†

S. pumila Hallier f. ex Engl.

S. venusta A. Hay (limestone)

S. zonata Hallier f.

† not accepted by Hay & Yuzammi (2000)

Borneo – Sabah

Schismatoglottis clemensiorum A. Hay (granites)

S. decipiens A. Hay (ultramafics)

S. lingua A. Hay (kerangas)

S. moodii A. Hay

S. scintillans Scherberich & P. C. Boyce – described since Hay & Yuzammi (2000) – see Scherberich & Boyce (2013).

S. silamensis A. Hay (ultramafics)

S. trusmadiensis A. Hay

S. venusta A. Hay (limestone)

In addition, a few species with pleionanthic shoot modules were allocated to the Calyptrata Group (Bornean *Schismatoglottis niabensis* A. Hay, and Philippines *S. merrillii* Engl., *S. luzonensis* Engl. and *S. plurivenia* Alderw. (the last also occurring on Sulawesi). Molecular analyses (Low 2016) failed to resolve any of these pleionanthic species within the Calyptrata Clade.

***Schismatoglottis* Calyptrata Clade**

Molecular analyses (Low 2016) retrieved a robust clade of *Schismatoglottis* species largely conforming to Hay & Yuzammi's Calyptrata Group. Within this clade a well-supported subclade (henceforth called "Calyptrata Complex Clade") was retrieved, composed

of Peninsular Malaysian and Bornean species plus *S. calyptrata* (Roxb.) Zoll. & Moritzi from Ambon (the Type locality). The Calyptrata Complex Clade is additionally defined by an hour-glass-shaped spadix, and a stoutly clavate sterile appendix. The internal topography and support values make it apparent that taxa in the Calyptrata Complex Clade do not constitute a single species, with typical *S. calyptrata* (i.e., from Ambon) resolving basal to the remainder of the clade, while the rest divided in two groups, a clade of Bornean taxa (including the Sarawak species which are the subject of the current paper), and a clade of taxa primarily originating from Peninsular Malaysia, to be the subject of a future paper.

Results of floral biology research currently in press (Hoe & Wong, in press) obliges us to publish a preliminary conspectus of the Sarawak species ahead of those for the remainder of Borneo (for which much taxonomic work remains to be done) in order to validate the taxonomically novel species, *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce, **sp. nov.**, which was the subject of that research.

Dimensions in the descriptions are derived from fertile (i.e., mature) plants. Seedlings have overall smaller measurements.

Geological occurrences are confirmed with reference to Tate (2001).

KEY TO SARAWAK SPECIES OF THE *SCHISMATOGLOTTIS* CALYPTRATA CLADE

- 1a. Rheophytes *Schismatoglottis ahmadii* A. Hay
- 1b. Terrestrial mesophytes or lithophytes 2
- 2a. Pistillate flower zone not adnate to spathe; lithophytes of Karst limestone. Mulu N.P.
Schismatoglottis muluensis M. Hotta
- 2b. Pistillate flower zone variously adnate to spathe; Terrestrial mesophytes, if associated with Karst limestone then never occurring epilithically 3
- 3a. Leaf blades glossy brilliant green, rubbery and sub-succulent; spathe limb remaining green throughout anthesis; spadix appendix hemispherical, staminodes closely appressed, polygonal, smooth medium yellow, contrasting with white staminate flowers. NW Sarawak; granites or sandstones
Schismatoglottis viridissima A. Hay
- 3a. Leaf blades semi-glossy green, softly leathery; spathe limb becoming creamy yellow or white and contrasting with green lower spathe during anthesis; spadix appendix conical to bullet-shaped, staminodes somewhat lax, columnar, slightly round-topped, white to pale yellow, never contrasting with staminate flower colour; not granite associated 4
- 4a. Leaf blades cordate to broadly sagittate; limestone-associated forest, Padawan (NW Sarawak) *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce, **sp. nov.**
- 4b. Leaf blades narrowly hasto-sagittate to oblong-lanceolate to narrowly obovate; not limestone-associated, N and C Sarawak 5
- 5a. Leaf blade oblong-lanceolate to narrowly obovate, the base acute to rounded, not at all cordate; pistillate flower zone to adnate to the spathe for ca 1 cm, appendix bullet-shaped; Bintulu & Sarkei . . *Schismatoglottis clarae* A. Hay
- 5b. Leaves narrowly hasto-sagittate; pistillate flower zone not adnate to spathe, appendix conoid; Kapit *Schismatoglottis ardenii* A. Hay

Schismatoglottis ahmadii A. Hay, Telopea 9: 102(–104), **Figure 14**. 2000. Type: Cult. RBG Sydney Acc. No. 960570 ex Malaysian Borneo, Sabah, Maliau Basin, Gunung Rara FR, 2.5 km upstream from main Maliau Falls (orig coll. *A. Hay, Ahmad et al.* 12060), Aug 1998, *Herscovitch s.n.* (holotype SAN!; isotype NSW). **Figure 1**.

Description

Small rheophytic clump-forming herb up to 50 cm tall, but more usually about 20 cm tall. **Stem** condensed, hypogeal (epigeal when occurring on bare rock), modules hapaxanthic, 1–2 cm thick, bright green. **Leaves** few together; **petiole** (6–)12–48 cm long, glabrous, sheathing in the lower 1/3–3/5; **petiolar sheath** wings tapering, fully attached to petiole; **blade** rather tough, elliptic to ovato-sagittate, semi-glossy mid-green, sometimes variegated with a single grey-green central stripe, or spattered grey-green throughout, or (rarely) entirely grey, (6–)10–29 cm long × 3.5–16 cm wide, margins smooth to rather conspicuously crispulate, base obtuse to more or less truncate (this most usually) to somewhat cordate with posterior lobes spreading and up to 5 cm long, tip acute to broadly acute and acuminate for 1.5 cm, longest tips often somewhat circinnate; **midrib** abaxially prominent, adaxially somewhat impressed; **primary lateral veins** adaxially somewhat impressed, abaxially prominent, ca 10 on each side of midrib, alternating with lesser interprimaries and diverging at ca 45–60°, occasionally giving off branches similar in thickness to interprimary veins; **secondary**

venation adaxially obscure, arising from midrib and frequently from the lower parts of the primary veins; **tertiary venation** adaxially obscure, abaxially forming a rather distinct tessellate reticulum. **Inflorescences** 1–8 together, powerfully esteric-smelling at anthesis, subtended by short cataphylls 2–8 cm long, these often but not always bearing reduced but well-differentiated petiole and blade; **peduncle** about half length of petiole at anthesis but inflorescences first exposed when peduncle very short, and this elongating further in fruit; **spathe** 4–7 cm long; **lower spathe** green, narrowly ovoid, 1–2 cm long, differentiated from spathe limb by an abrupt constriction; **spathe limb** white, broadly ovate, inflated over the appendix then abruptly acuminate for 1–1.5 cm, caducous. *Spadix* sessile, more or less hourglass-shaped, ca 3–4 cm long; **pistillate flower zone** ca 2 cm long, adnate to the spathe for about 1/2 its length, ca 4 mm diam. In the middle, distally attenuate; **pistils** subglobose, somewhat lax in lower part of pistillate zone, more so in the attenuate part, ca 1 mm diam.; **stigma** sessile, button-like, papillate, about 1/2 diameter of ovary; **interpistillar staminodes** scattered among pistils, about equalling to slightly taller than pistils, stalked with spreading flat tops ca 0.6 mm across; **sterile interstice** ill-defined, a partly naked distal portion of pistillate zone with scattered interpistillar staminodes and some ?abortive (undersized stigmas) ovaries; **staminate flower zone** obconic (occasionally widest slightly below tip), ca 1 cm long, ca. 3 mm thick at base, 6 mm thick at top; stamens crowded, dumbbell-shaped

with connective very slightly elevated above the thecae, ca 1 mm across (fresh); appendix more or less hemispherical, to 3–7 mm long; staminodes of appendix columnar, irregularly polygonal with rounded angles, more or less flat-topped to somewhat rounded, whitish, very slightly taller than the stamens, ca 0.6 mm diam. **Fruiting spathes** ellipsoidal, to 4 cm long on erect peduncles.

Ecology — Facultative rheophyte on exposed to moderately shaded riverside rocks in lowland to lower montane perhumid to wet forest on sandstones and granites, from 30–1520 m asl.

Distribution — *Schismatoglottis abmadii* is widespread although localized throughout northern central to NE Borneo.

Notes — Since being described *Schismatoglottis abmadii* has proven to be a more widespread than initially believed, occurring, albeit locally, from north central through to NE Borneo from almost sea level, e.g., Bintulu, to over 1500 m on Mount Kinabalu.

The variegated and wholly grey leaf blade examples make handsome and easily grown horticultural subjects.

Other material examined: MALAYSIAN BORNEO: **Sarawak: Kapit.** Pergunungan Hose, 02°14'47.2"N 113°41'24.9"E, 22 Apr 2004, *P.C. Boyce & Jeland ak Kisai* AR-289 (SAR). **Bintulu.** Bintulu, Air Terjun Baloi, 03°08'34.5"N 113°04'17.2"E, 15 Jan 2007,

P.C. Boyce & Wong Sin Yeng AR-2077 (SAR). **Miri.** Marudi, Long Lama, Mulu N.P., Long Langsat, Sungai Langsat, draining into the Sungai Tutoh, 04°00'03.5"N 114°48'49.8"E, 9 Aug 2006, *P.C. Boyce et al.* AR-1979 (SAR); Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 04°01'26.8"N 114°49'32.2"E, 11 Aug 2006, *P.C. Boyce et al.* AR-2001 (SAR). **Limbang.** Nanga Medamit, Mulu N.P., Melinau Gorge, 10 Dec 2011, *Tung Lay Soon et al.* AR-3712 (SAR); Lawas, Ba kelalan, Long Ritan waterall, 03°59'44"N 115°37'21"E, 9 Apr 2012, *Mike Lo* AR-3874 (SAR); Lawas, Long Semadoh, Long Tunid, Lebaluh Waterfall, 04°12'08.7"N 115°36'02.7"E, 26 May 2014, *Mike Lo* AR-4758 (SAR). MALAYSIAN BORNEO: **Sabah: Pantai Barat.** Ranau, Sungai Vulcanut, 05°51'59.8"N 116°48'23.3"E, 21 Dec 2012, *Mike Lo* AR-4092 (SAN, SAR); Kota Kinabalu, Inanam, Kionsom Waterfall, 05°57'24.0"N 116°12'25.3"E, 18 Apr 2014, *Wong Sin Yeng & P.C. Boyce* AR-4685 (SAN, SAR) & *Wong Sin Yeng & P.C. Boyce* AR-4689 (SAN, SAR); Kota Belud, Kinabalu N.P., Silau-Silau Trail, 06°00'26.6"N 116°32'37.9"E, 10 May 2014 *Wong Sin Yeng & P.C. Boyce* AR-4719 (SAN, SAR); Kota Belud, Kinabalu N.P., Poring Hot Springs, trail to Air Terjun Langanan, 06°03'13.8"N 116°41'52.6"E, 11 May 2014, *Wong Sin Yeng & P.C. Boyce* AR-4725 (SAN, SAR) & *Wong Sin Yeng & P.C. Boyce* AR-4727 (SAN, SAR); Ranau, Karanaan, Gana-gana, Sungai Totom, 05°54'15.0"N 116°38'23.0"E, 10 Sep 2015, *Rosediana Enora Welserd* AR-5240 (SAN, SAR). **Interior Division.** Keningau, Tenom - Tambunan road, Kitau, 05°33'00"N 116°16'30"E, 9 May 2012,

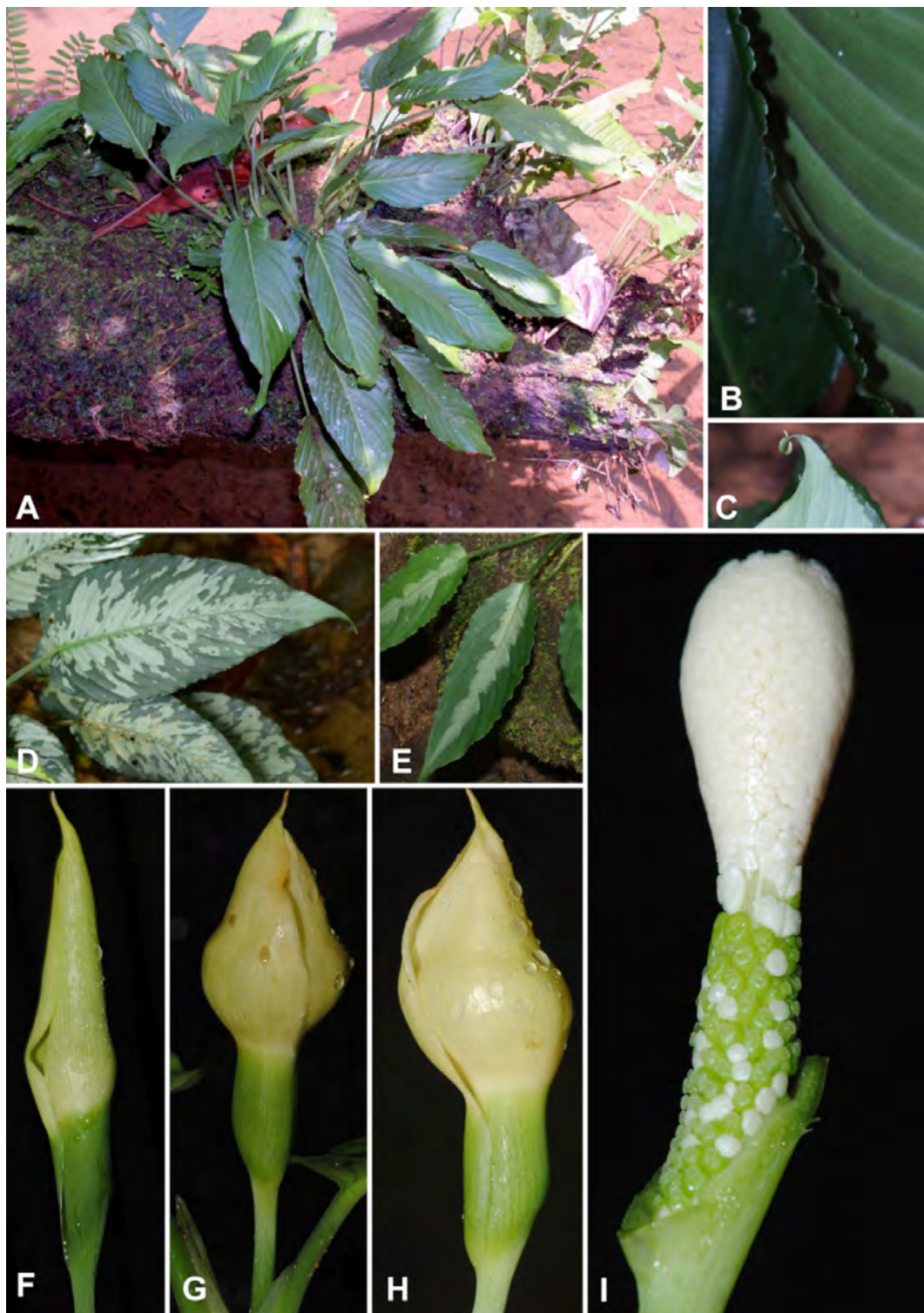


Figure 1. *Schismatoglottis ahmadii* A. Hay

A. Plant in habitat, Mulu N.P. **B.** Leaf blade margin showing crispulate edge. **C.** Leaf blade showing circinnate tip. **D & E.** Two types of variegation. **F.** Inflorescence at onset of pistillate anthesis. **G & H.** Inflorescence at late of pistillate anthesis. **I.** Spadix at late pistillate anthesis, spathe artificially removed. **A–C** from *AR-1979*; **D & E** from *AR-4725*; **F** from *AR-3908*; **G – I** from *AR-3854*. Images © P.C. Boyce.

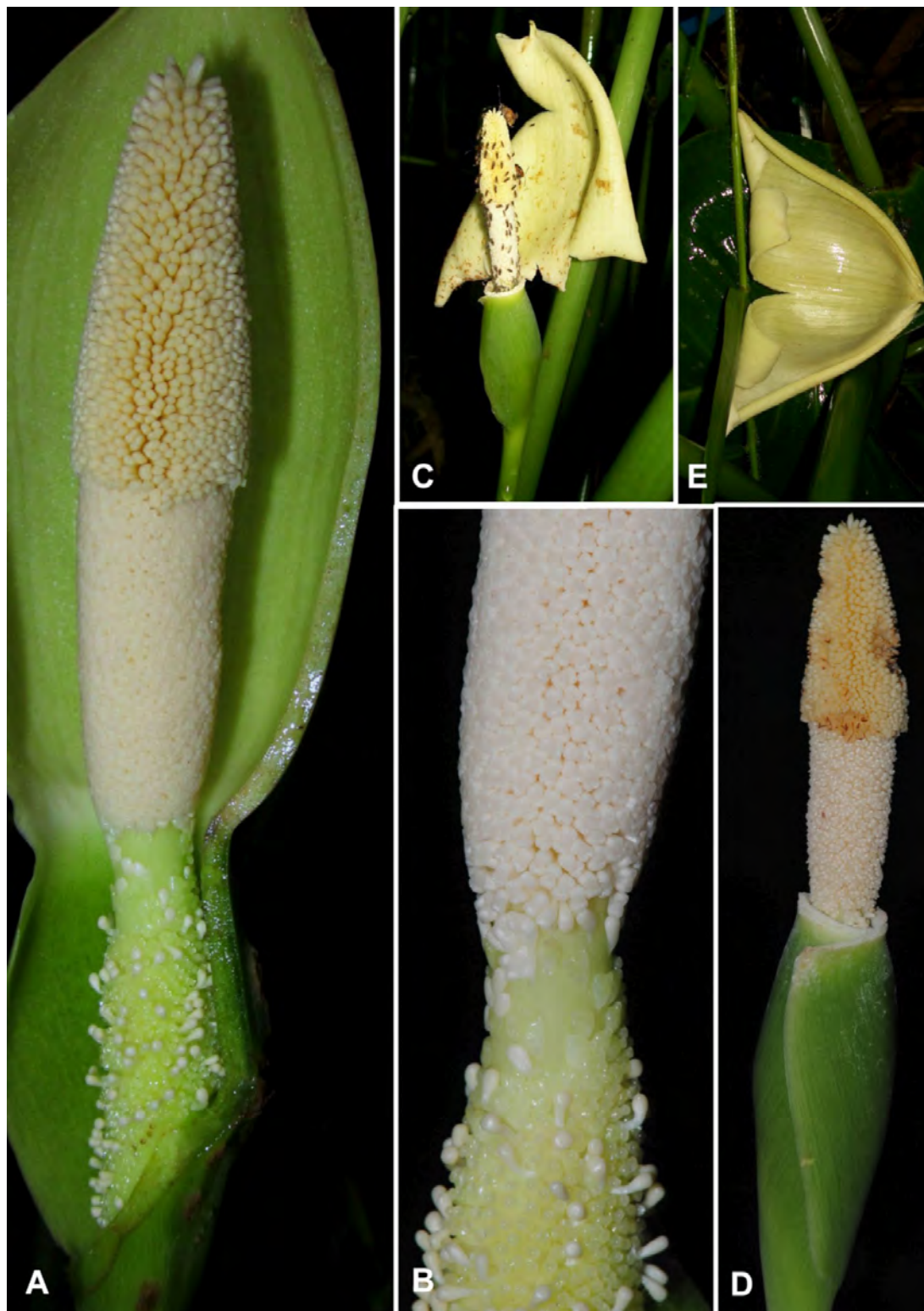


Figure 2. *Schismatoglottis ardenii* A. Hay

A. Flowering shoot. **B.** Inflorescence with nearside part of spathe removed. **C.** Pistils and inter pistillar staminodes. **D.** Staminodes in sterile interstice. **E.** Stamens; **F.** Staminodes of appendix. Image © Aroideana. Used with permission.

Mike Lo AR-3908 (SAN, SAR); Sapulut, Nabawan-Kalabakan road, [Sapulut-Maliau Basin road], 04°42.301'N 116°29.741'E, 17 Nov 2015, *Mike Lo AR-5265* (SAN, SAR). **Dalaman.** Tenom, Sipitang - Tenom road, 04°58'26.4"N 115°43'58.4"E, 15 Feb 2014, *Mike Lo AR-4355* (SAN, SAR). **Tawau.** Lahad Datu, Ulu Segama-Malua F.R., Air Terjun Bilong, *Mike Lo AR-3991* (SAN, SAR). **INDONESIAN BORNEO: Kalimantan Tengah.** Murung Raya, Puruk Cahu, 4 Apr 2012, *K. Nakamoto AR-3854* (BO, SAR); **Kalimantan Utara.** Malinau, 80km S.W. of Malinau, Tempat Wisata 3km N of Loreh village, 3 May 2012, *K. Nakamoto AR-3911* (BO, SAR); Malinau, Metarang Hulu, Longberang, 03°48'25.17"N 116°11'24.72"E, 25 Aug 2012, *K. Nakamoto AR-4015* (BO, SAR); **Kalimantan Timur.** Tanjung Selor, 3 Feb 2012, *K. Nakamoto AR-3751* (BO, SAR).

Schismatoglottis ardenii A. Hay, Aroideana 25: 67(–69), **Figure 1.** 2002 (2003). Type: Cult. Redlynch, Cairns, Queensland ex Malaysian Borneo, Sarawak, Kapit, (orig. coll. *A. Dearden s.n.*), 12 May 2001, *A. Hay s.n.* (holotype NSW). **Figure 2.**

Description

Rather slender clumping mesophytic herb to ca 50 cm tall. *Stem* hypogeal, clump-forming, modules hapaxanthic, ca 1.5 cm diam. *Leaves* 1–3 per crown; **petiole** ca 40 cm long, sheathing in the lower ca 1/4; **petiolar sheath** wings tapering, fully attached to petiole; **blade** narrowly hasto-

sagittate, glossy dark-mid green adaxially, paler abaxially, ca 30 cm long, ca 8 cm wide, tip acuminate for ca 4 cm, base deeply divided into two narrowly triangular, distally slightly out-turned posterior lobes to 6 cm long; **midrib** abaxially prominent, slightly impressed adaxially; **primary lateral veins** ca 8 on each side (more concentrated in the proximal 1/3 of blade), regularly alternating with interprimaries and diverging at ca 70°; **tertiary venation** obscure. **Inflorescence** solitary; **peduncle** short, entirely concealed (at anthesis) by subtending cataphyll. **Spathe** ca 6 cm long, abruptly constricted ca 2.5 cm from base; **lower spathe** squat ovoid-cylindric, pale green; **spathe limb** ovoid, slightly gaping, white, caducous and crumbling. **Spadix** sessile, 4.4 cm long, hourglass-shaped; **pistillate flower zone** not adnate to spathe, ca 1.3 cm long, subcylindric, slightly tapering distally; **pistils** crowded, very pale green, more or less ovoid, 1–1.5 mm diam.; **stigma** sessile, small, punctate; **interpistillar staminodes** numerous, narrowly cylindric, barely clavate, about equalling height of ovaries, white, ca 0.5 mm diam.; **sterile interstice** somewhat attenuate, top aligned with spathe constriction, ca 6 mm long, 4 mm diam. in upper part, composed of appressed elongate interpistillar staminodes of few of which with single fertile thecae, and a few partially fertile stamens; **staminate flower zone** narrowly obconic, ca 9 mm long, basally isodiametric with top of staminate flower zone, distally ca 7 mm diam.; **stamens** dumbbell-shaped from above with connective faintly raised between thecae, ca 1 mm across; **appendix** conoid, white, ca

1.3 cm long, basally slightly and abruptly wider than top of staminate zone, ca 9 mm diam., apically tapering to a ragged point; **appendix staminodes** columnar, irregularly polygonal with rounded angles, centrally impressed at apex, ca 0.6 mm diam., distal ones elongate and somewhat bent. **Fruit** unknown.

Ecology — “Steep banks on stream sides in forest.”

Distribution — Known only from the un-localized (but see below) Type locality.

Notes — *Schismatoglottis ardenii* is recorded only from Kapit, without precise locality, but most likely from lowland forest in the vicinity of Kapit town, probably at Taman Rekreasi Seabai, which comprises wet lowland and gallery forest predominantly on shales.

Schismatoglottis baangongensis S.Y. Wong, Y.C. Hoe & P.C. Boyce, **sp. nov.**

Type: Malaysian Borneo, Sarawak, Kuching Division, Padawan, Siburan, Kampung Sikog, trail to Baan Gong waterfall, 01°020'16.1"N, 110°20'09.6"E, 26 Jul 2009, P.C. Boyce & S.Y. Wong AR-2588 (holotype SAR!; isotypes SAR! – alcohol preserved). **Figure 3 & 4 & 13B.**

Diagnosis

Schismatoglottis baangongensis is most similar to *S. muluensis* differing by the conical (vs

almost cylindrical) spadix appendix, larger, longer pale yellow appendix staminodes (vs appendix staminodes small (c. 0.5 mm diam.), white, with the tips not diverging), the appendix having a coarsely papillate appearance (vs nearly smooth), the weakly obconic (vs strongly obconic) staminate flower zone, bright green spadix axis (vs white) and pistils (vs cream), and strongly clavate (vs tips barely expanded) interpistillar staminodes. Leaf blades of *S. baangongensis* are medium green, (vs deep green blades).

Description

Moderately robust clumping to colonial mesophytic herb, 30–90 cm tall. **Stems** hypogeal, modules hapaxanthic, 0.5–1.5 cm diam. **Leaves** 3–5 per crown; **petiole**, 42–48 cm long, weakly channelled ca 1/5 of length, smooth medium green, distally with prominent broken longitudinal darker green striations; **petiolar sheath** 11–14 cm long × 5–10 mm wide, up to 3/10 of petiole length, persistent, longitudinal striated membranous, fully attached or (in very robust specimens) with a very short ligule, equal at both sides, slightly in-rolled or sometimes straight, tapering; **blades** ovato-sagittate to ovato-cordate, occasionally oblong-lanceolate cordate base, 20–39 cm long × 13–23 cm wide, softly coriaceous, adaxially glossy green, abaxially paler, posterior lobes subtriangular, 7–11 cm, sinus 8–11 cm wide, apex acuminate to acute for ca 2 cm, ultimately mucronate for ca 1 cm; **midrib** adaxially flush with blade, raised abaxially, ca 5 mm wide at the

insertion; **primary lateral veins** ca 14 per side, diverging at 30°–80° from midrib, adaxially raised towards the midrib, marginally impressed, entirely raised abaxially; **interprimary veins** adaxially raised, alternating irregularly with primaries; **secondary veins** 0–2 arising from each primary vein with 3–4 secondary veins raised from primary veins near to petiole insertion; **tertiary veins** inconspicuous; broken **vein-like pellucid glands** slightly visible abaxially. **Inflorescence** up to 4, erect, strongly esteric smelling during pistillate anthesis, odour absent during staminate anthesis; **peduncle** 10–15 cm long × 4–9 mm wide, terete, green, erect at anthesis; **spathe** 11–12.5 cm long; **lower spathe** narrowly ovoid, ca 4 cm long × ca 2.3 cm wide, green, longitudinally ridged, separated from spathe limb by a constriction coinciding with sterile interstice; **spathe limb** turbinate, ovate when flattened, ca 6.5 cm long × ca 3.3 cm wide, mucronate for ca 2 mm, pale yellowish green at pistillate anthesis, ageing to dull pale yellow during anthesis, caducous in a single piece at onset of staminate anthesis; **spadix** 9–10.5 cm long, shorter than spathe, sessile; **pistillate flower zone** slender obconic, 4–5 cm long × ca 1 cm wide, ca 2/5 of spadix length, bright green; **pistils** densely arranged, sub-cylindric to sub-globose, 0.8–1.2 mm diam.; **style** barely differentiated; **stigma** globose, truncate, smaller than ovary, ca 0.3 mm diam.; **interpistillar staminodes** numerous, strongly clavate, stipe slender, 0.5–0.8 mm in diam., twice height of pistils, waxy white; **sterile interstice** cylindric, 0.5–1 cm long ×

5–6.5 mm wide, narrower than pistillate and staminate zone, partially naked, proximally and distally with flattened trapezoid staminodes; **staminate flower zone** weakly sub-conic, proximally narrower, 2.2–2.7 cm long × 9–12 mm wide, ca 3/10 length of spadix, yellowish white; **staminate flowers** densely arranged butterfly-shaped from above, ca 1 mm long × ca 0.5 mm wide, each comprising 2 truncate stamens, thecae sunken, separated by a narrow, raised connective; **appendix** conical, 2.2–2.5 cm long × ca 1 cm wide, ca 3/10 length of spadix, base wider (ca 1 mm) than apex of staminate zone, creamy yellow; **staminodes** columnar, ca 2.5 mm long × ca 1.2 mm wide, somewhat laxly arranged with diverging tips, giving appendix a coarsely papillate appearance, creamy yellow. **Infructescence** urceolate 4–6 cm long × 2–2.2 cm wide, on a declinate peduncle; **lower spathe** persistent, splitting and reflexing at fruit maturity; **fruits** 2–4 mm long × 1–2.5 mm wide, green to yellow; **seeds** ovoid ellipsoid, ca 0.4 mm diam., 13–22 per fruit, encased with greenish yellow gel.

Ecology — Terrestrial in perhumid lowland tropical forest adjacent to (but never occurring epilithically on karst limestone, often growing along trails next to small streams, 70–75 m asl.

Distribution — *Schismatoglottis baangongensis* is known from the type locality and its vicinity.

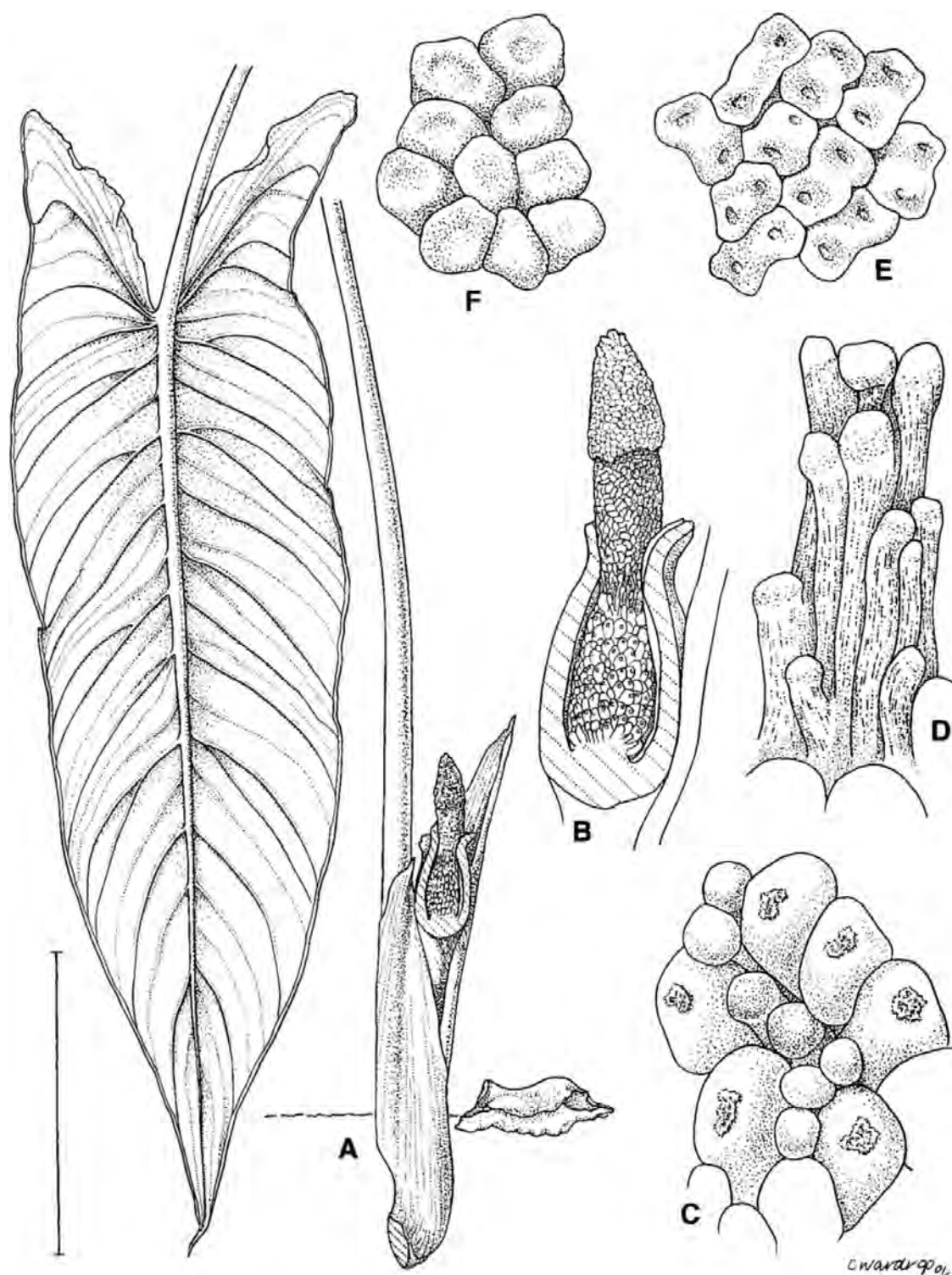


Figure 3. *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce. **A.** Plants in habitat. **B.** Plant in habitat. **C.** Detail of synflorescence, with one inflorescence post-anthesis (left), and one at pistillate anthesis (right). **D.** Inflorescence at pistillate anthesis. **A–E** from AR-2588. Images © Hoe Yin Chen.



Figure 4. *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce. **A.** Inflorescence at pistillate anthesis, nearside spathe artificially removed. **B.** Detail of spadix, uppermost portion of pistillate flower zone, sterile interstice, and lowermost portion of staminate flower zone; **C.** Inflorescence at onset of staminate anthesis with spathe limb beginning to shed. **D.** Caducous spathe limb. **E.** Inflorescence post anthesis with spathe limb shed. **A–E** from AR-2588. Images © Hoe Yin Chen.

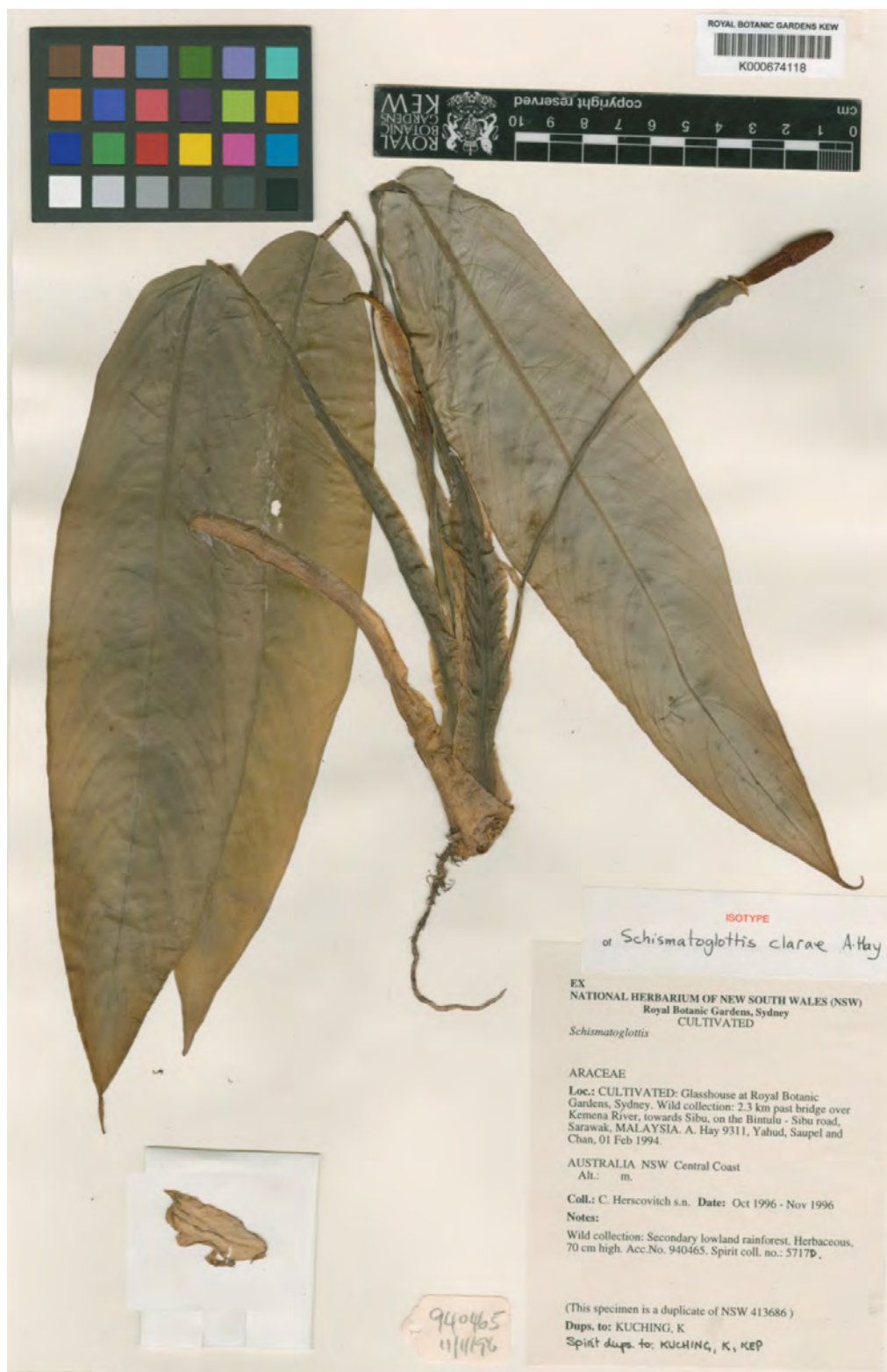


Figure 5. *Schismatoglottis clarae* A. Hay

A. Hay et al. 9311. Isotype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.

Etymology — Derived from the name of the type locality plus the Latin suffix, *-ensis*, to indicate origin.

Notes — There is persuasive evidence that true *S. calyptrata* is absent at least from Sarawak. On this basis in Sarawak *Schismatoglottis baangongensis* is most similar to *S. muluensis* differing by pistillate flower zone adnate for 2/3 its length to the spathe, the conical spadix appendix, larger, longer pale yellow appendix staminodes, the appendix having a coarsely papillate appearance, the weakly obconic staminate flower zone, bright green spadix axis and pistils, and strongly clavate interpistillar staminodes. Leaf blades of *S. baangongensis* are medium green, in marked contrast to the deep green blades of *S. muluensis*.

Other material examined: MALAYSIAN BORNEO: **Sarawak: Kuching.** Padawan, Siburan, Kampung Sikog, trail to Baan Gong water fall, 01° 20' 16.1"; 110° 20' 09.6", 26 July 2009, *P.C. Boyce & S.Y. Wong* Ar2587 (SAR).

Schismatoglottis clarae A. Hay, *Telopea* 9(1): 118(–119). 2000. Type: Cult. Royal Botanic Gardens Sydney Acc. No. 940465 ex Malaysian Borneo, Sarawak, Bintulu ("7th Divn"), 2.3 km past bridge over Kemena River, towards Sibuan on Bintulu-Sibuan Road (orig. coll. *A. Hay et al.* 9311), Oct/Nov 1997, *C. Hirschowitz* s.n. (holotype NSW + NSW spirit 5717D, isotypes K!, KEP!, SAR!). **Figure 5.**

Description

Robust mesophytic clump forming herb to ca 75 cm tall. **Stem** hypogeal, modules hapaxanthic, ca 2 cm diam. **Leaves** ca 3 per crown; **petiole** to 60 cm long, sheathing in the lower 1/3 – 1/2., wings of sheath tapering, fully attached; **blade** oblong-lanceolate to narrowly obovate, 26–37 cm long × 7–13 cm wide, dark green adaxially, paler below, base acute to rounded, not at all cordate, tip acute and acuminate for ca 2 cm; **midrib** not prominent; **primary lateral veins** ca 11 on each side, alternating with lesser interprimaries, diverging at 45–60° (wider angle towards middle of blade), soon rather abruptly deflected towards tip before joining margin; **secondary veins** rather obscure, arising from midrib; **tertiary veins** forming a tessellate reticulum visible on the adaxial side (dry material), abaxially obscure. **Inflorescences** to 5 together; **peduncle** to 13 cm long, erect, declinate after anthesis, cataphylls hidden in subtending leaf sheath. **Spathe** ca 8 cm long; **lower spathe** ovoid, 3 cm long, green, differentiated from the limb by a distinct constriction; **spathe limb** ovate, whitish, caducous, ca 5 cm long, acuminate for 1 cm. **Spadix** ca 7 cm long, sessile; **pistillate flower zone** 2.2 cm long, adnate to the spathe for 1 cm, subcylindric to slightly conic in upper 1/3, 8 mm diam.; **pistils** crowded, subglobose, 1 mm diam.; **stigma** sessile, button-like, papillate, ca 0.5 mm diam.; **interpistillar staminodes** scattered among the pistils, more or less irregularly polygonal, slightly convex-topped, ca 0.5 mm diam.; **sterile interstice** 8 mm long, stout, slightly conic, 5 mm

diam., with staminodes squashed by the spathe constriction; **staminodes** crowded, irregularly polygonal, ca 0.8 mm diam.; **staminate flower zone** slightly and rather abruptly thicker than sterile zone, ca. 7 mm diam. at base, slightly obconic, ca. 1.6 cm long; **stamens** very crowded, more or less dumbbell-shaped with connective mounded between the thecae, ca 1 mm across; pores more or less elliptic; **appendix** bullet-shaped, ca. 2.4 cm long, base slightly but abruptly wider than top of male zone, ca 1 cm diam., the tip acute; **appendix staminodes** flat-topped, irregularly polygonal, frequently in small connate groups, ca 0.75 mm diam. **Fruiting spathe** narrowly urceolate, to ca 4 cm long. **Fruits** not seen.

Ecology — Terrestrial on slopes in disturbed or old secondary perhumid lowland forest on clay loam, 50 – 150 m asl.

Distribution — *Schismatoglottis clarae* is so far known from the vicinity of Bintulu where it is locally common, and Sarikei where it is known from a single population.

Notes — *Schismatoglottis clarae* is distinguished from other hapaxanthic species allied to *S. calyptrata* by its robust elongate leaf blade with the base not at all cordate, the low interpistillar staminodes, the stout sterile interstice and the bullet-shaped appendix (Hay & Yuzammi 2000).

Other material examined: MALAYSIAN BORNEO: **Sarawak: Sarikei.** Ulu Sarikei,

01°55'05.4"N 111°29'35.8"E, 7 Dec 2005, P.C. Boyce *et al.* AR-1589 (SAR) & P.C. Boyce *et al.* AR-1590 (SAR). **Bintulu.** Bintulu, Air Terjun Baloi, 03°08'34.5"N 113°04'17.2"E, 15 Jan 2007, P.C. Boyce & Wong Sin Yeng AR-2071 (SAR).

Schismatoglottis muluensis M. Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 235(–237), **Figure 6**, A–F. 1966. Type: Malaysian Borneo, Sarawak, Marudi (“Mardi” *sic*), western ridge of Gunung Mulu, 17 Mar 1964, M. Hotta 14623 (holotype KYO!). **Figure 6 & 7 & 13C.**

Description

Medium to moderately robust epilithic clumping herb 30–80 cm tall. **Stems** hypogeal, modules hapaxanthic, ca 2 cm diam. **Leaves** 3–5 per crown; **petiole** D-shaped, smooth, 34–47 cm long, green, weakly channelled for ca ½ its length, longitudinal striations prominent but not noticeably darker; **petiolar sheath** 8–14 cm long × 5–10 mm wide, sheathing for 1/4–1/3 of petiole length, persistent, membranous, fully attached with a very short ligule in very robust plants, equal, slightly in-rolled or sometimes straight, tapering, scattered with greenish dots; **leaf blade** ovato-sagittate to ovato-cordate, 25–27 cm long × 13–25.5 cm wide, leathery, adaxially semi-glossy dark green, abaxially paler, posterior lobes subtriangular to rounded, 4.5–8 cm, sinus 3.5–6 cm wide, apex acute to acuminate for 1–2 cm, ultimately with a ca 4 mm tubular mucro; **midrib** adaxially flush with blade, raised

abaxially, 3.5–6 mm at insertion; **primary lateral veins** ca 16 per side, diverging at 30°–80° from the midrib, raised adaxially towards the midrib, marginally impressed, entirely raised abaxially; **interprimary veins** raised adaxially, alternating irregularly with primaries; **secondary veins** 3–4 arising from each primary vein; **tertiary veins** inconspicuous; **vein-like pellucid glands** clearly visible abaxially. **Inflorescences** 1–3, erect, smelling strongly of esteric acid during pistillate anthesis, floral odour absent during staminate anthesis; **peduncle** 10–19 cm long $\times$ ca 6 mm wide, long, terete, green, erect at anthesis; **spathe** ca 10 cm long; **lower spathe** ovoid-ellipsoid, ca 4 cm long $\times$ ca 1.7 cm wide, dull green, separated from spathe limb by a conspicuous constriction coinciding with lower part of staminate zone; **spathe limb** turbinate (triangular-ovate pressed flat), ca 6.5 cm long $\times$ ca 2.5 cm wide, mucronate for ca 5 mm, pale greenish yellow to pure white at pistillate anthesis, caducous in a single piece at onset of staminate anthesis; **spadix** ca 9 cm long, shorter than spathe, sessile; **pistillate flower zone** cylindric, ca 3 cm long $\times$ ca 7 mm wide, ca 2/5 length of spadix, creamy yellow; **pistils** densely arranged, sub-globose, ca 1 mm long $\times$ 0.4 mm wide; **style** barely differentiated; **stigma** sub-globose, wider than ovary, ca 0.5 mm diam., wet with stigmatic secretion at the onset of pistillate anthesis; **interpistillar staminodes** weakly clavate, stipe slender, ca 0.5 mm in diam., up to twice height of pistils, waxy white; **interstice** cylindric, ca 6 mm long $\times$ 5–7 mm wide, partially naked, narrower than

fertile zones, white, distally with 2–5 whorls of flattened spheroid staminodes, these intergrading into lower part of staminate zone, proximally pistillodes compressed, intergrading into the upper pistillate zone; **staminate flower zone** weakly conic, narrower proximally, ca 1.8 cm long $\times$ ca 5.5 mm wide, ca 2/7 length of spadix, white; **staminate flowers** densely arranged, ca 1 mm long $\times$ ca 0.5 mm wide, each comprising 2 truncate stamens, deeply holed, separated by a narrow, raised connective; **appendix** stoutly cylindric, ca 2 cm long $\times$ ca 5.5 cm wide, ca 2/7 length of spadix, base slightly (0.2 mm) wider than top of staminate zone, white; **appendix staminodes** densely arranged, sub-globose to sub-columnar, ca 1 mm long $\times$ 0.5 mm wide, white. **Infructescences** 1–4, ca 5 cm long $\times$ ca 2 cm wide, pendulous; **lower spathe** entirely persistent, splitting-reflexing when ripe; **fruits** ca 2 mm long $\times$ ca 1.5 mm wide, green to very pale yellow-green; **seeds** ovoid ellipsoid, ca 0.4 mm diam., longitudinally ridged, 7–40 per fruit, encased in with transparent viscous gel.

Ecology — Epilithic on karst limestone under perhumid lowland tropical forest, 40 – 75 m asl.

Distribution — *Schismatoglottis muluensis* is only known from the Karst limestone formations at Mulu N.P., where it is notably abundant along the trail to Deer Cave.

Notes — In Sarawak *S. muluensis* is most reminiscent of *S. baangongensis*, differing by

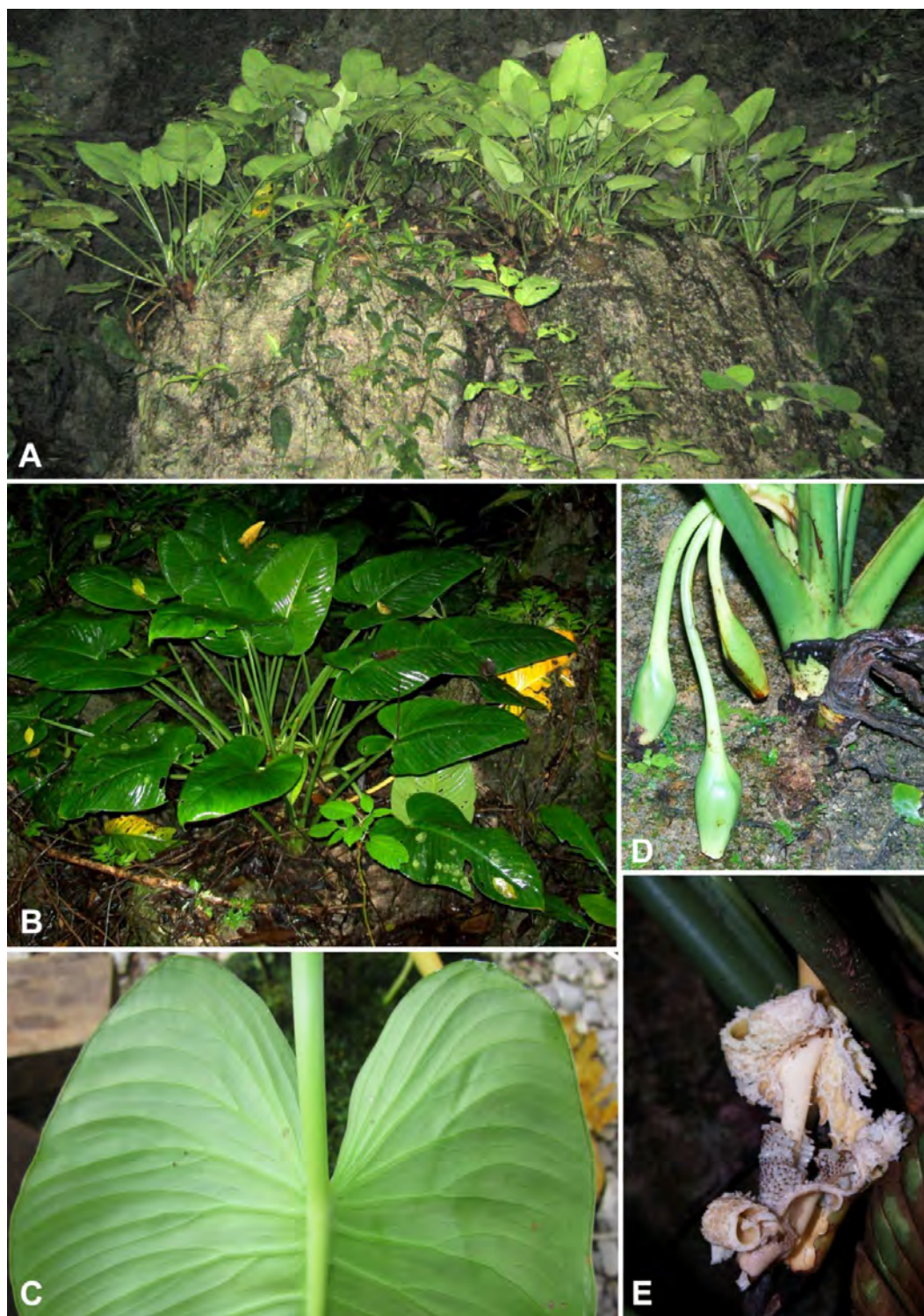


Figure 6. *Schismatoglottis muluensis* M. Hotta. **A & B** Plants in habitat occurring lithophytically on limestone. **C.** Abaxial side of leaf blade showing secondary veins arising from primary laterals. **D.** Developing infructescences. **E.** Ripe infructescence splitting to reveal fruits; naked portion of axis has fruits already been dispersed. **A–E** from *AR-1949*. Images © P.C. Boyce.



Figure 7. *Schismatoglottis muluensis* M. Hotta. **A.** Inflorescence at mid pistillate anthesis. **B.** Spadix at late pistillate anthesis, spathe artificially removed. Note that many of the interpistillar staminodes have been eaten. **C.** Inflorescence at onset of staminate anthesis with spathe limb beginning to shed. **A–C** from *AR-1949*. Images © P.C. Boyce.



Figure 8. *Schismatoglottis viridissima* A. Hay

A. Plant in habitat, Gunung Gading N.P. **B.** Inflorescence at pistillate anthesis. **C.** Inflorescence at onset of staminate anthesis, spathe limb beginning to fall. **D.** Inflorescence at late staminate anthesis, spathe limb almost shed. **E.** Spadix at late pistillate anthesis, spathe artificially removed. **F.** Inflorescence post anthesis with spathe limb shed. **E.** Spadix at late pistillate anthesis, spathe artificially removed. **A–C** from AR-5258. Images © P.C. Boyce.

the stoutly cylindrical spadix appendix, much smaller, shorter white appendix staminodes, almost smooth appendix, markedly obconic staminate flower zone, white spadix axis and creamy yellow pistils, and weakly clavate interpistillar staminodes. Leaf blades of *S. muluensis* are deep green.

Other material examined: MALAYSIAN BORNEO: **Sarawak: Miri.** Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 04°02'N, 114°49'E, 8 Aug 2006, *P. C. Boyce et al.* AR-1941 (SAR) & 27 Sep 2007, *P. C. Boyce et al.* AR-2204 (SAR); Marudi, Long Lama, Mulu N.P., trail to Clearwater Cave, 04°04' N, 114°50' E, 8 Aug 2006, *P. C. Boyce et al.* AR-1964 (SAR).

Schismatoglottis viridissima A. Hay, *Telopea* 9: 154. 2000. Type: Cult. RBG Sydney Acc. No. 940550 ex Malaysian Borneo, Sarawak, Kuching, Lundu, Gunung Gading (orig. coll. *A. Hay et al.* 9397) *C. Herscovitch s.n.* (holotype SAR!; isotypes K!, KEP!, L!, NSW, US). **Figure 8.**

Description

Small mesophytic clump forming herb to 25 cm tall. **Stem** hypogeal, modules hapaxanthic, ca 0.5 cm diam. **Leaves** ca 5 together in each crown; **petiole** to 20 cm long, sheathing in the lower third; petiolar sheath wings fully attached, tapering but apically truncate; **blade** narrowly ovate, brilliant green with a rubbery thinly sub-succulent texture, c. 16 cm long × 7 cm wide, base cordate with rounded posterior

lobes to 1.5 cm long, tip acute; **midrib** rather prominent; **primary lateral veins** ca 7 on each side, irregularly alternating with lesser interprimaries and diverging at 60–80°; **secondary venation** mostly arising from the midrib, some from bases of primary veins; **tertiary venation** forming an indistinct tessellate reticulum on both surfaces (visible in dry material). **Inflorescences** 2–3 together; **peduncle** fleshy, ca 4 cm long, mostly hidden by sheaths of subtending leaves. **Spathe** ca 9 cm long; **lower spathe** narrowly ovoid, ca 4 cm long, differentiated from limb by an abrupt constriction; **limb** ca 5 cm long, very broadly ovate, inflated over staminate zone and appendix and then acute, finally acuminate for ca 1 cm, greenish, caducous. **Spadix** 5–6 cm long, sessile, more or less hourglass-shaped; **pistillate flower zone** about half the length of spadix, ca 3 cm long, adnate to spathe in lower 2/3, ca 7 mm diam. in middle, then somewhat conic and attenuate to 5 mm diam.; **pistils** somewhat lax, more so in distal part of pistillate zone, bottle-shaped, bright green, ca 1 mm diam. in lower part of zone, ca 2 mm diam. higher up; **interpistillar staminodes** scattered among pistils, more or less mushroom-shaped, equalling ovaries in height, ca 0.5 mm diam.; **sterile interstice** ill-defined, upper 4 mm of pistillate zone thickly attenuate and occupied by mixed staminodes, stamens and ?abortive is “?” correct? pistils; **staminate flower zone** ca 1.4 cm long, subcylindric, ca 5 mm diam. in lower 5 mm (held within lower spathe chamber), remainder abruptly obconic, to ca 9 mm diam. and exerted

from lower spathe chamber; **stamens** crowded, truncate, hourglass-shaped, with connective thin and not at all elevated above thecae, ca 1 mm across; **appendix** shortly bullet-shaped, base slightly but abruptly wider than top of staminate flower zone, ca 1 cm wide at base, ca 1.3 cm long; **appendix staminodes** flat-topped, centrally impressed, irregularly polygonal, 0.5–0.7 mm diam., dull medium yellow. **Fruit** unknown.

Ecology — Terrestrial in medium to light shade under perhumid lowland to upper hill forest on granites or sandstones; 10 – 940 m asl.

Distribution — *Schismatoglottis viridissima* occurs throughout NW Sarawak on acidic geologies – the Type locality and Bukit Muan are granites; elsewhere (e.g., Puncak Borneo, etc.) populations occur on sandstones.

Notes — The dwarf habit and brilliant green rubbery leaves are immediately diagnostic. Morphologically rather similar plants occur on Karst limestone in NW Sarawak, and elsewhere on a variety of acidic sedimentaries throughout much of Sarawak, as far east as Limbang and south to the Gaat river (C Kapit). More work is required to determine if these populations are extensions of a single widespread species or represent a series of locally endemic segregates.

Other material examined: MALAYSIAN BORNEO: **Sarawak: Kuching.** Padawan, Puncak Borneo, trail to Hornbill Resort golf course maintenance kampong, 01°07'35.1"N 110°13'28.8"E, 30 Sep 2003, *P.C. Boyce & Jeland ak Kisai AR-95* (SAR); Lundu, Gunung Gading N.P., 01°42'N 109°50'E, 3 Mar 2004, *P.C. Boyce & Jeland ak Kisai AR-235* (SAR); Bau, Kampung Jugan, Sungai Boyuh, 22 May 2004, *Jeland ak Kisai & Jepom ak Tisai AR-417* (SAR); Sematan, Teluk Selabang, Sungai Semunsan Buta, 9 Oct 2004, *P.C. Boyce & Jepom ak Tisai AR-723* (SAR); Bau, Segong, Gunung Opar, 01°27'07.3"N 110°04'00.5"E, 9 Nov 2005, *P.C. Boyce et al. AR-1504* (SAR); Siburan, Kampung Giam, Air Terjun Giam, 01°19'20.7"N 110°16'21.4"E, 7 Feb 2006, *P.C. Boyce et al. AR-1689* (SAR); Lundu, Kampung Stungkur, 17 Apr 2006, *P.C. Boyce & Jepom ak Tisai AR-1769* (SAR); Lundu, Gunung Gading N.P., trail to waterfalls, Waterfall 3, 01°41'53.1"N 109°50'20.0"E, 14 Nov 2006, *P.C. Boyce & Wong Sin Yeng AR-2047* (SAR); Lundu, Gunung Gading N.P., trail to waterfalls, Waterfall 1, 01°41'28.3"N 109°50'43.6"E, 14 Nov 2006, *P.C. Boyce & Wong Sin Yeng AR-2048* (SAR); Matang, Kubah N.P., Waterfall Trail, 01°35'40.2"N 110°10'45.9"E, 28 Jul 2007, *P.C. Boyce et al. AR- 2126* (SAR); Sematan, Kampung Temaga Dayak, Sungai Temaga, 01°47'00.2"N 109°43'34.8"E, 23 Mar 2014, *Wong Sin Yeng & P.C. Boyce AR-4644* (SAR); Sematan, Kampung Sebako, Air Terjun Sebako, 01°42'09.0"N 109°42'28.2"E, 5 Jul 2014, *Ooi Im Hin, et al. AR-4849* (SAR); Lundu, Gunung Perigi, 01°44'24.9"N 109°49'03.9"E, 12 Jul 2014, *Ooi Im Hin et al*

AR-4901 (SAR); Sematan, Kampung Temaga Dayak, Sungai Temaga, trail to Gunung Pueh, 01°50'03.5"N 109°40'35.4"E, 7 Aug 2014, *Jepom ak Tisai et al.* AR-4859 (SAR); Padawan, Jalan Link, Kampung Begu, 01°12'15.70"N 110°19'51.30"E, 8 Nov 2014, *Wong Sin Yeng & P.C. Boyce* AR-4968 (SAR); Lundu, Gunung Gading N.P., trail above *Rafflesia* Site C, 01°41'29.8"N 109°50'22.7"E, 13 Aug 2009, *P.C. Boyce & Wong Sin Yeng* AR-5072 (SAR); Bau, Kampung Peninjau Lama, Bung Muan [Gunung Serembu], Brooke Trail, 01°26'00.9"N 110°13'22.6"E, 8 Nov 2015, *Wong Sin Yeng & P.C. Boyce* AR-5258 (SAR).

SCHISMATOGLOTTIS CALYPTRATA IN AMBON

Schismatoglottis calyptrata (Roxb.) Zoll. & Moritzi in Moritzi, Syst. Verz. 83 (1846). Type: *Arisarum esculentum* Rumph., Herb. Amboin. 5, t. 111, **Figure 1** (1747). (lecto; selected by Hay, 1996). Epitype: Indonesia, Maluku, Ambon, *A. Zippelius s.n.*, (L; designated by Hay & Yuzammi, 2000). **Figure 9–12, & 13A**

Homotypic Synonyms. *Calla calyptrata* Roxb., Fl. Ind. 3 (1832) 514 (1832). *Homalomena calyptrata* (Roxb.) Kunth, Enum. Pl. 3 (1841) 57 (1841). [*Colocasia? humilis* Hassk., Flora 25 (2), Beibl. 1: 10 (Jul 1842); Tijdschr. Ned. Ind. 4(2): 237 (1842), nom. superfl. pro *Schismatoglottis calyptrata* (based on *Arisarum esculentum* Rumph., Herb. Amboin. 5, t. 111, **Figure 1** (1747)).

[*Colocasia? humilis* var. *major* Hassk., Tijdschr. Nat. Gesch. & Physiol. 9: 160 (Aug/Sep 1842); Hassk., Cat. Hort. Bot. Bog. (1844) 56, nom. superfl. pro var. typ.]. *Zantedeschia calyptrata* (Roxb.) C. Koch, Ind. Sem. Hort. Berol. App. 9 (1854). [*Schismatoglottis calyptrata* var. *concolor* Hallier f., Bull. Herb. Boiss. 620 (1898); Ridl., Materials Fl. Mal. Pen. 3: 31 (1907); Engl., Pflanzenr. 55 (IV.23Da): 115 (1912); Ridl., Fl. Mal. Pen. 5: 111 (1925), nom. superfl. pro var. typ.].

Description

Moderate to robust mesophytic stoloniferous herb forming colonies, or clump-forming, 35–60 cm tall. **Stem** hypogeal, modules hapaxanthic, 1–2 cm diam. **Leaves** ca 6 per crown; **petiole** smooth, medium green with slightly darker broken striations, 15–50 cm long; **petiolar sheath** ca 1/3 petiole length, wings of sheath fully attached, persistent, tapering or, especially in diminutive forms, shortly and bluntly ligular at apex; **blade** usually dull to slightly semi-glossy mid-green, sometimes variegated with 1–2 bands or irregularly spotted grey-green to yellowish green, c. 7–35 cm long, widest at the base or ca 1/3 along its length, ca 4–18 cm wide, mostly cordate to sagittate; **midrib** somewhat abaxially prominent; **primary lateral veins** 6–15 per side, irregularly alternating with lesser interprimaries, diverging at 45–70°, nearly always raised adaxially towards the midrib, marginally impressed, entirely raised abaxially, mostly not branched but occasionally with 1 or 2 branches especially in lower part of blade; **secondary venation**

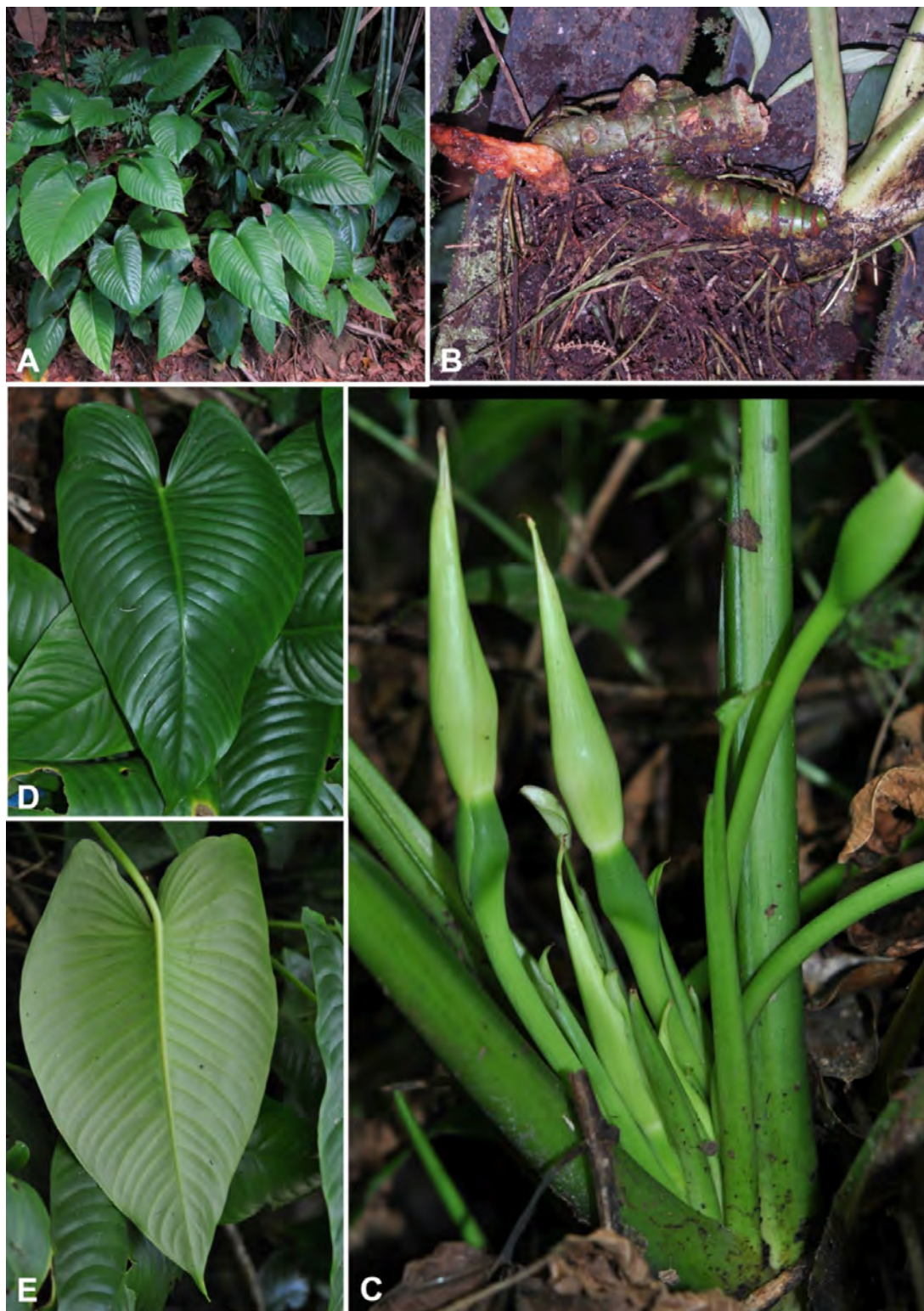


Figure 9. *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritz

A. Plants in habitat, Ambon. **B.** Excavated stems showing hapaxanthic modules. **C.** Detail of flowering plant with two inflorescences close to anthesis and a developing infructescence. **D.** Leaf blade adaxial surface. **E.** Leaf blade abaxial surface. **A–E** from *AR-4268*. Images © Hoe Yin Chen.



Figure 10. *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi

A. Inflorescence at onset of pistillate anthesis. **B.** Inflorescence at end of pistillate anthesis, spathe limb almost shed. **C.** Spadix at pistillate anthesis, spathe artificially removed. **D.** Fallen spathe limb. **E.** Inflorescence post-anthesis. Note that spathe limb is lost, leaving a dark scar, and that the post-anthesis staminate flowers (in light brown) are now well-differentiated from the spadix appendix (cream). **A–E** from *AR-4268*. Images © Hoe Yin Chen.

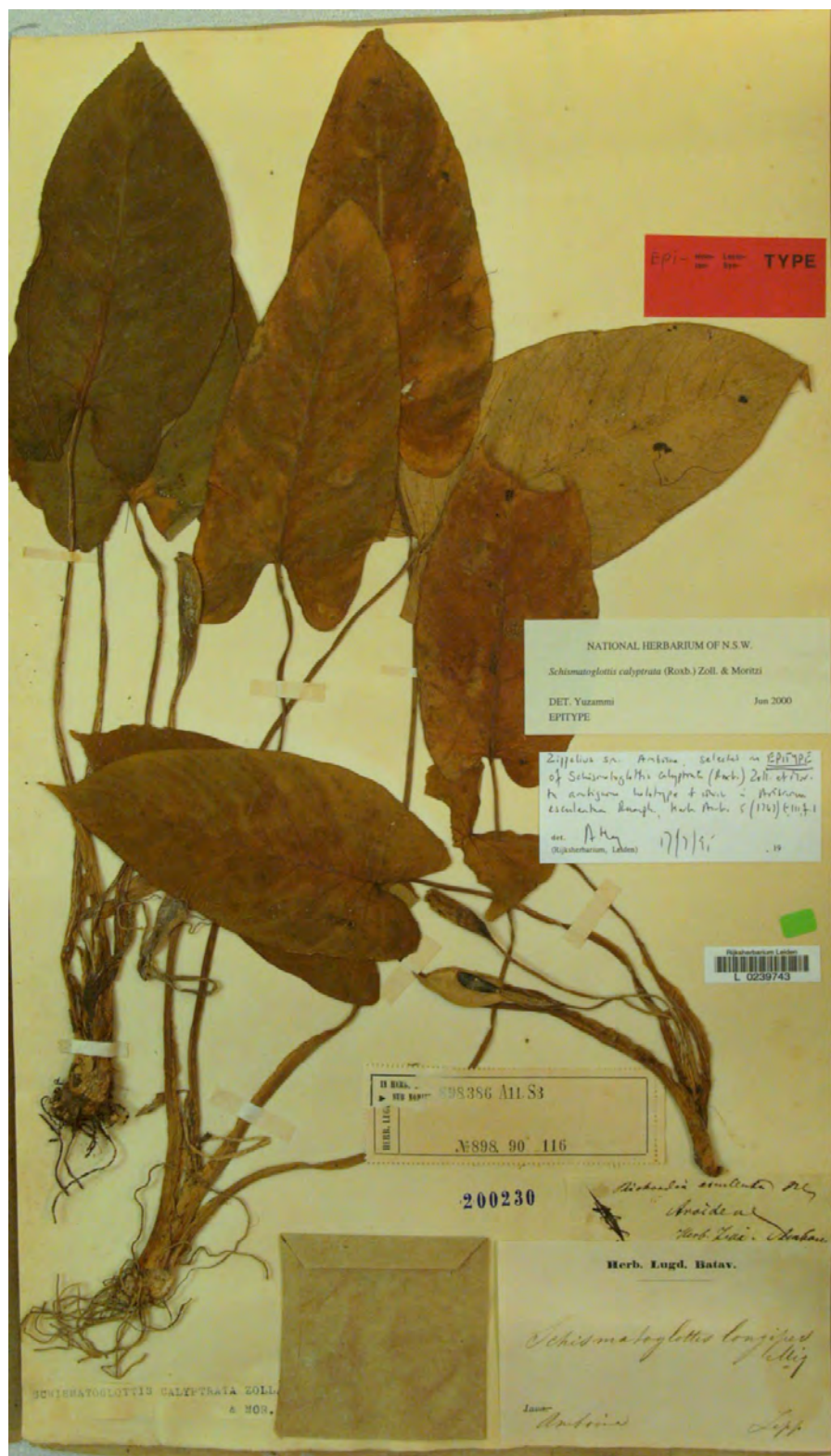


Figure 11. *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritz

A. Zippelius s.n. Epitype (L), Image © Naturalis Biodiversity Center. Used with permission.



Figure 12. *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi

Arisarum esculentum Rumph., Herbarium Amboinense 5, t. 111, **Figure 1** (1747). Lectotype of *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi.



Figure 13. Spadix of *Schismatoglottis* Calyptrata Complex Clade species compared.

A. *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi. **B.** *Schismatoglottis baangongensis* S.Y. Wong, Y.C. Hoe & P.C. Boyce. **C.** *Schismatoglottis muluensis* M. Hotta. **A.** from AR-4268; **B.** from AR-2588; **C.** from AR-1949. Image A © Hoe Yin Chen; images B & C © P.C.Boyce.

arising mostly from the midrib, sometimes from the bases of primary veins; **tertiary venation** inconspicuous. **Inflorescences** 1–8 together, with a strong esteric odour at pistillate anthesis; **peduncle** (exposed part) 8–14 cm, erect at anthesis, then deflected in fruit. **Spathe** 8–12 cm long; **lower spathe** narrowly ovoid, ca half the length of whole spathe, green; **limb** differentiated from lower spathe by an abrupt constriction corresponding to the base of the staminate zone of the spadix, at pistillate anthesis much inflated, narrowing and turbinate, the apex conspicuously mucronate, completely surrounding the spadix and gaping ventrally or with the margins loosely overlapping, creamy to pale greenish-yellow, caducous immediately after pistillate anthesis. **Spadix** ca 3/4 length of spathe, narrowly hourglass-shaped; **pistillate flower zone** about half length of whole spadix, partially adnate to spathe, ca 5–8 mm diam. below, distally tapering to c. 3–4 mm diam.; **pistils** pale green, close-packed, c. 1 mm tall, c. 0.5 mm diam., flask-shaped and close-packed below, distally becoming more widely spaced and subglobose, finally rather widely scattered and squashed by constricting spathe; **stigmas** button-like, papillate, raised on a short style; **interpistillar staminodes** white, mostly conspicuously taller than pistils, few in number, scattered, stalked, clavate; interstice between staminate and pistillate zones absent save sometimes for a relative concentration of interpistillar staminodes amongst distal pistils; **staminate flower zone** narrowly obconic, approximately half length of pistillate zone, distally ca 0.5–1 cm diam., ivory; **anthers**

dumbbell-shaped from above, ca 0.5×1 mm, with thecae apically impressed, connective shorter than to very slightly elevated above thecae; **appendix** elongated bullet-shaped, basally nearly always somewhat wider than apex of staminate zone, creamy yellow; **appendix staminodes** appendix columnar, irregularly and very weakly polygonal, flat- to slightly round-topped, ca 0.5 mm diam. *Fruiting spathe* declinate, urceolate.

Ecology — Lowland perhumid forest, and forest margins in both wet and well-drained sites.

Distribution — In its broadest circumscription (Hay & Yuzammi, 2000) *S. calyptrata* occurs from tropical southwestern China to Indo-China east to Vanuatu and south to Jawa. Our present interpretation precludes the presence of *S. calyptrata* at least for Sarawak and casts doubt its occurrence on Borneo.

Notes — The description provided excludes characteristics from material originating from Sarawak. As noted by Hay (Hay & Yuzammi 2000), ecological data (substrate, habitat, etc.) are lacking in most collections, “but where such data are available, it has been possible to

segregate morphologically very closely allied, eco-geographically distinct species. Refinement of the circumscription of *S. calyptrata* and the recognition of segregate species in other parts of its range

(particularly Sulawesi) seems a likely outcome of further field study. Attention to dispersal mechanisms in this widespread species with no obvious long-distance dispersal syndrome would likely inform understanding of the biogeography of the genus.”

References

Hay, A. 1996. The genus *Schismatoglottis* Zoll. & Moritzi (Araceae–Schismatoglottideae) in Peninsular Malaysia and Singapore. *Sandakania* 7: 1–30.

Hay, A. & Yuzammi. 2000. Schismatoglottideae (Araceae) in Malesia I – *Schismatoglottis*. *Telopea* 9(1): 1–177.

Hoe Y. C. & S. Y. Wong. in press. Floral biology of *Schismatoglottis baangongensis* (Araceae) in West Sarawak, Malaysian Borneo. *Pl. Syst. Evol.*
PAGINATION NOT YET SET

Low S. L. 2016: *Phylogeny and aspects of reproductive biology of Aridarum (Schismatoglottideae: Araceae).* – Unpublished Ph.D. Thesis. Universiti Malaysia Sarawak, Malaysia.

Scherberich, D. & P. C. Boyce. 2013. Studies on Schismatoglottideae (Araceae) of Borneo XXVI – *Schismatoglottis scintillans*, a new species with horticultural potential from Sabah, Malaysian Borneo. *Willdenowia* 43: 87–90.

Tate, R. B. 2001. The geology of Borneo island CDROM. – Kuala Lumpur: Persatuan Geologi Malaysia / Geological Society of Malaysia.

Acknowledgements

This is part of an on-going research funded by the Ministry of Education of Malaysia through Vote No. ERGS/01(02)/808/2011(03), FRGS/STWN10(01)985/2013(26) and NRGS/1089/2013-(03). The collaboration and support of the Sarawak Forestry Department are gratefully acknowledged. The most recent fieldwork has been conducted under Research Permit No. NCCD.907.4.4(Jld.12)-51 and Park Permit No. 121/2015.

***Rhaphidophora bogneri* (Araceae: Monsteroideae: Monstereae) a new species from West Africa, and notes on the *Rhaphidophora africana* Complex**

Peter C. Boyce*

Honorary Research Scientist

Ludwig-Maximilians-Universität München

Department Biologie I

Systematische Botanik und Mykologie

Menzinger Straße 67, 80638 München, Germany

boyce@biologie.uni-muenchen.de

*corresponding author

Anna Haigh

The Herbarium

Royal Botanic Gardens

Kew, Richmond

Surrey, TW9 3AE, U.K.

ABSTRACT

Rhaphidophora bogneri P. C. Boyce & Haigh is described as a new species from Gabon, equatorial West Africa, defined by inflorescences pendent during anthesis and fruiting. *Rhaphidophora* is additionally reviewed for Africa and three described species are accepted, of which *R. africana* N. E. Br. is considered undoubtedly polyphyletic, likely encompassing upwards of four species of which at least three are considered to be taxonomic novelties. Unfortunately, available preserved collections coupled with political

circumstances prevailing throughout much of the species' geographical range currently make a proper taxonomic treatment impossible. *Rhaphidophora ovoidea* A. Chev., described from fragmentary material from basalts, is treated as inadequately known. *Rhaphidophora bogneri* is illustrated from cultivated living plants, all described species are also illustrated from their nomenclatural types. The three accepted African *Rhaphidophora* species are delineated with a key.

KEY WORDS

Gabon, Bioko, Cameroon, Côte d'Ivoire, Montes de Crystal (Sierra de Crystal), Bakossi Mountains, basalt

INTRODUCTION

Rhaphidophora Hassk. is principally a tropical Asian genus of about 100 species of mostly hemiepiphytic lianes ranging from NE India through Indo-Malaya, Malesia and Papuasia to the tropical western Pacific, and extending as far south as NE Australia, but also with limited representation in tropical Africa, where species' distribution corresponds with the incidence of equatorial humid evergreen forests (Baharuddin & Boyce 2010; Boyce 1999a,b, 2000a,b, 2001a,b, 2005, 2006a,b; Boyce & Bogner 2000; Boyce & Nguyen 2012; Boyce

et al 2012; Hay 1993; Li et al. 2010; Ntépe-Nyamè 1988; Sofiman & Boyce 2010).

With qualification that this account is emphatically provisional, based, with the exception of *Rhaphidophora bogneri* P. C. Boyce & Haigh, **sp. nov.**, entirely on inadequate historical herbarium material supported by minimal fieldwork, we conclude that *Rhaphidophora* in tropical Africa comprises one undoubtedly polyphyletic taxon for which the name *R. africana* N. E. Br. is overall applicable, two further highly distinctive species (*R. bogneri* and *R. pusilla* N. E. Br.), and one inadequately known species (*R. ovoidea* A. Chev.) known from fragmentary material, and which may or may not be conspecific *R. africana* sens. str.

KEY TO AFRICAN RHAPHIDOPHORA SPECIES

- 1a. Spathe c. 2 cm long, white; spadix c. 1.8 cm long; stems of flowering shoots very slender, c. 3 mm in diameter, flexuous ***Rhaphidophora pusilla***
- 1b. Spathe always exceeding 5 cm long, occasionally up to 18 cm long; spadix 5–16 cm long; stems of flowering shoots moderately robust, at least 5 mm in diameter, not flexuous 2
- 2a. Inflorescence erect at anthesis; infructescence mostly erect; spathe mostly white; active shoot tips often copious persistent fibre derived from degraded cataphylls and petiolar sheath; leaf blades occasionally conspicuously fenestrate ***Rhaphidophora africana* sens. lat.**

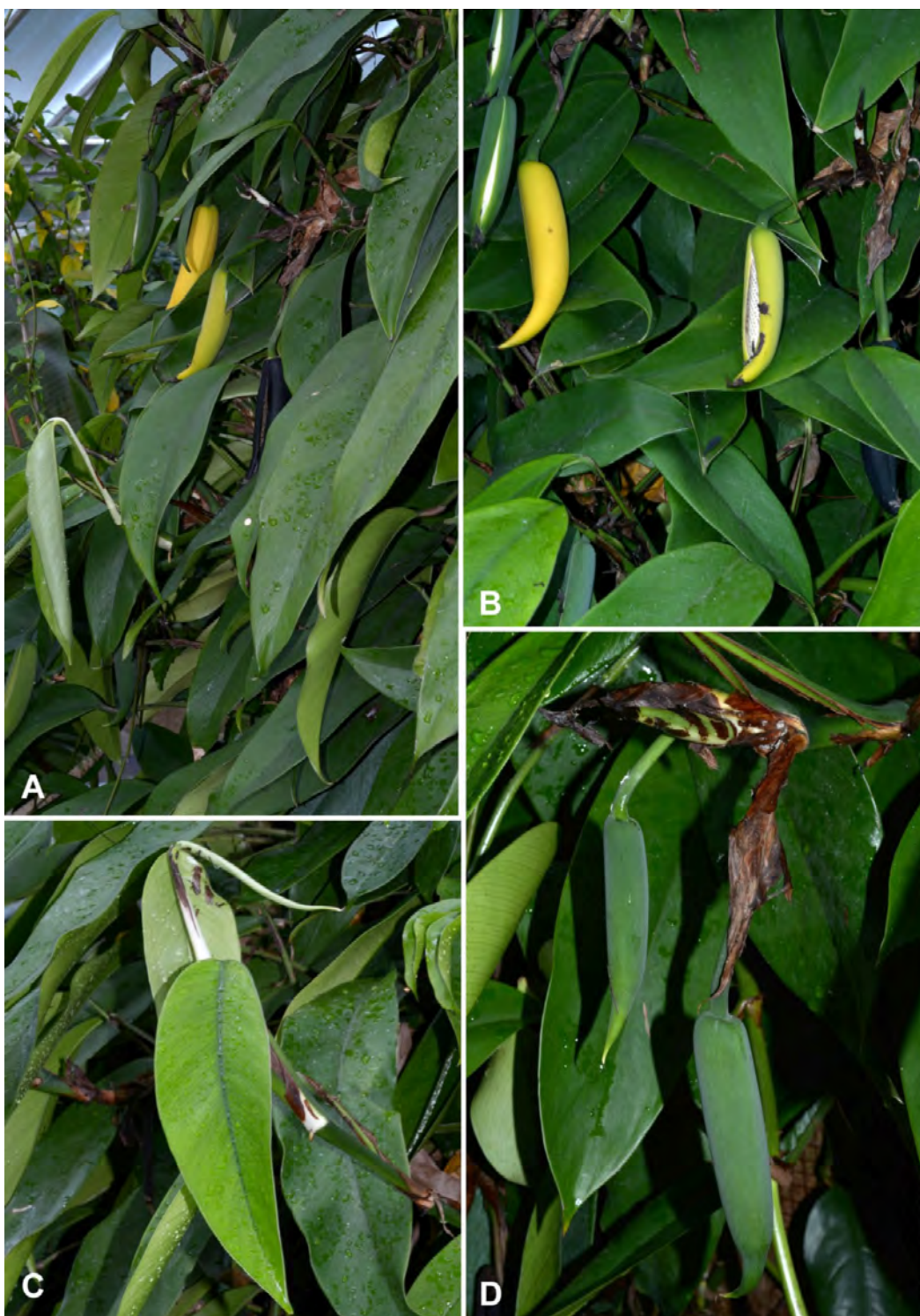


Figure 1. *Raphidophora bogneri* P. C. Boyce & Haigh. Type clone plant in cultivation, R.B.G., Kew. **A.** Overall view of flowering plant. **B.** Detail of flowering shoots; the two green inflorescences (top left) are pre-anthesis; middle inflorescence at pistillate anthesis; right hand inflorescence at late staminate anthesis. **C.** Sterile shoot. **D.** Developing inflorescences. All from *J. Bogner 708*. Images © D. Scherberich, used with permission.

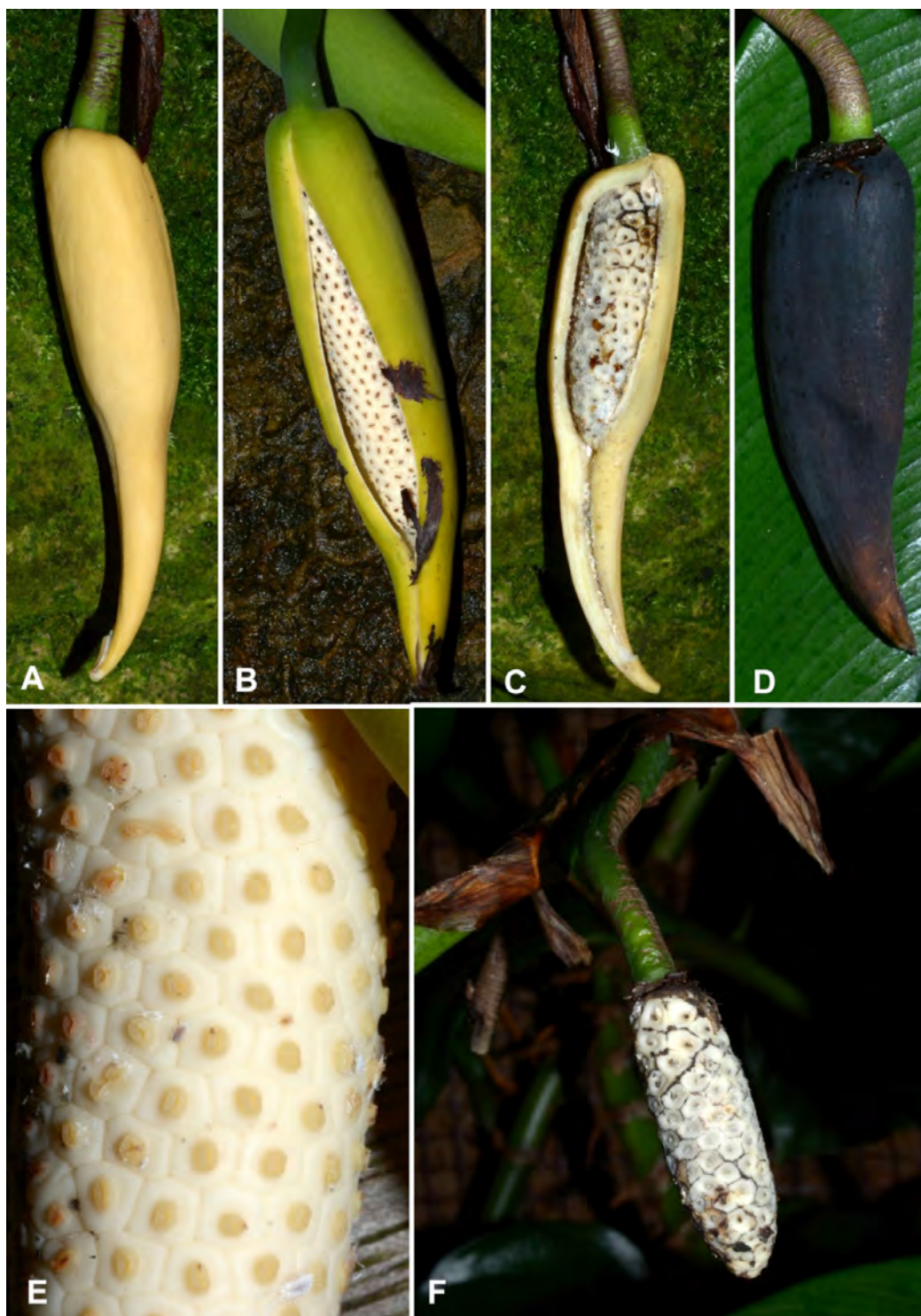


Figure 2. *Raphidophora bogneri* P. C. Boyce & Haigh. Type clone plant in cultivation, R.B.G., Kew. **A.** Inflorescence at pistillate anthesis. **B.** Inflorescence at staminate anthesis. **C.** Post-anthesis inflorescence, nearside spathe artificially removed. **D.** Older post-anthesis inflorescence with spathe darkened and about to be shed (note cracks at insertion on peduncle). All from *J. Bogner* 708. Images © D. Scherberich, used with permission.



Figure 3. *Rhaphidophora bogneri* P. C. Boyce & Haigh. *J. Bogner 708*. Isotype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.

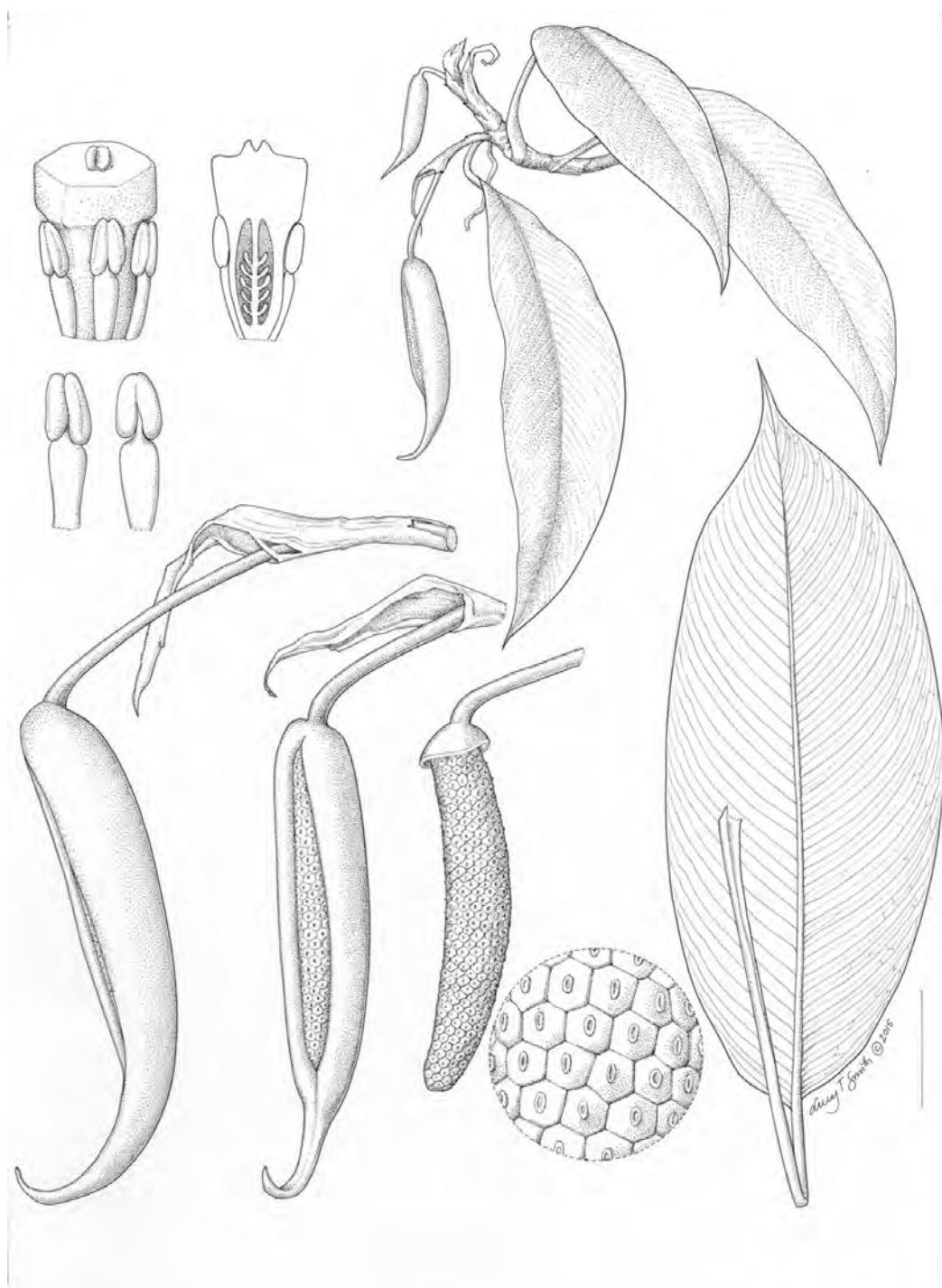


Figure 4. *Rhaphidophora bogneri* P. C. Boyce & Haigh. **A.** Flowering shoot. **B.** Leaf blade, abaxial surface. **C & D.** Inflorescence at pistillate anthesis. **E.** Spadix, spathe partially removed. **F.** Detail of styles and stigmas. **G.** Whole flower, pistillate anthesis. **H.** fFlower, longitudinally sectioned. **I.** Stamens ventral and dorsal view. Scale bar: A = 4cm; B = 2 cm; C–F = 7 mm; G & H = 3.3 mm; I = 2.5 All from *J. Bogner 708*. Plate prepared by Lucy Smith © Trustees of the Royal Botanic Gardens, Kew. Used with permission.

Rhaphidophora bogneri P. C. Boyce & Haigh, **sp. nov.** Type: Gabon, Sibang, 9 Nov 1973, *J. Bogner* 708 (holo MI; iso B!, K! & K (spirit – 37463.000!); US!). **Figure 1–4.**

Diagnosis

Rhaphidophora bogneri is distinguished from *R. africana* sens lat. by pendent inflorescences (vs inflorescences erect), pendent infructescences (vs infructescences mostly erect), and by active shoot tips lacking persistent fibre derived from degraded cataphylls and petiolar sheaths. *Rhaphidophora bogneri* is separated from *R. pusilla* by the longer spathe (5 cm vs 2 cm long), and by flowering shoots with much more robust stems.

Moderately robust, semi-leptocaul homeophyllous liane to c. 8 m high; **seedling stage** a non-skototropic shingling shoot; **pre-adult plants** forming rather extensive terrestrial colonies; **adult shoot architecture** comprised of elongated, clinging, physiognomically unbranched, leafy, non-flowering stems and long, moderately elaborated, free, densely leafy, flowering stems; **stems** smooth, medium semi-glossy green, climbing stems terete in cross-section, free stems spreading, sub-terete in cross-section, with sparse sparse prophyll, cataphyll and petiolar sheath remains at the tips of active shoots, internodes to (4–)5–9(–10) cm long 0.5–0.6 cm in diam., separated by oblique to almost straight leaf scars, older stems sub-woody; **flagellate foraging stems** present, internodes 10–15 cm long, with a clasping

cataphyll on each node, cataphyll 2.5–3 cm long, first whitish green, soon becoming brown and dry; **clasping roots** 4–5 arising from the nodes, rarely a few roots on the internodes of clinging stems, epidermis rough, brown; **feeding roots** occasionally formed by one of the few roots at the node becoming elongate and growing downwards to ground, c. 4 mm in diam., brown, somewhat rough outside, dividing at tip when reaching soil; **leaves** spiro-distichous on clinging and free shoots; **cataphylls and prophylls** membranous, 4–5 cm long, at first whitish green, soon drying light brown, clasping the internodes; **petiole** channelled adaxially (7–)9–17(–20) × 0.4–0.5 cm in diam., narrowing somewhat to apex, smooth, medium green, apical geniculum well defined, 0.5–1.5 cm long, c. 5 mm in diam., somewhat thicker than petiole, initially green, soon becoming brown, rough with slight horizontal ridges; basal geniculum prominent, ca 2.5 cm long, 0.6–0.8 cm diam., with the dorsal side canaliculate; **petiolar sheath** prominent, more or less reaching apical geniculum, soon drying and degrading into straw-coloured to brown netted fibres, eventually falling to leave a scar from the petiole base; **blade** entire, narrowly elliptic to elliptic-oblong, often slightly falcate and unequal (one side of the blade narrower from the midrib than the other), (16–) 26 (–40) long × 6.5–9.5 cm wide, coriaceous, adaxially matte medium to dark green, abaxially light green, base cuneate, apex cuspidate to acuminate, venation parallel-pinnate; **midrib** strongly prominent abaxially, sunken adaxially; **primary lateral venation**

ascending upwards 12–15 per side, slightly raised abaxially and adaxially; **interprimaries** parallel to primaries and less prominent, slightly raised abaxially and adaxially; **secondary and tertiary venation** $\pm$ obscure in fresh material, visible as a very faint reticulum in dried specimens; **inflorescence** solitary or up to three in sequence, pendent from tips of lateral free branches, subtended by a cataphyll up to 7 cm long more-or-less clasping the peduncle; **peduncle** compressed-cylindric, $5\text{--}6 \times 0.4$ cm, pale green; **spathe** broadly canoe-shaped, 5–7 (–10) long, stoutly acuminate, base rounded, stiff-fleshy, dark green when young, exterior buttercup-yellow at anthesis, often with almost black marks seemingly resulting from bruising, spathe interior somewhat paler to cream-coloured, spathe soon darkening and falling post-anthesis; **spadix** cylindrical, $\pm$ sessile, inserted level on peduncle, (3.5–) 4–5 (–6) cm long $\times$ 0.9–1 cm in diam., tip blunt, pale cream; **flowers** bisexual, naked (lacking perigone), 2.5–2.8 mm long; **stylar region** rhombo-hexagonal, c. 1.7 mm in diam., truncate, angled in view from above; **stigma** elliptic, raised with a central depression, c. 0.4 mm in diameter, cream; **anthers** barely exerted at staminate anthesis; **thecae** oblong, c. 1.5 mm long; **filament** flat, distally somewhat widened; **pollen grains** ellipsoid, $18\text{--}20 \times 15\text{--}16$ μm , extended sulcate, exine verrucate; **infructescence** 7–11 cm long, dirty white; **seeds** numerous, on 2–3 intrusive parietal placentas, individually ellipsoid, c. 2 mm long, testa smooth, brittle, pale cream. **Chromosome number** $2n = 60$.

Ecology — Lowland rainforest on leached red soils at c. 20m asl.

Distribution — Gabon, known with certainty only from the Type locality – but see notes under *R. africana*.

Eponymy — Named for Dr Josef Bogner (Munich Botanic Garden) in recognition for the immeasurable contribution he has made to our current knowledge and understanding of the aroids.

Notes — *Rhaphidophora bogneri* is immediately distinguishable from all other African *Rhaphidophora* species by the pendent inflorescences and infructescences. Elsewhere in *Rhaphidophora* pendent inflorescences are known only for *R. hookeri* Schott (NE India through N Thailand and Indochina to SW China), a species quite unrelated to *R. bogneri*.

Rhaphidophora africana N. E. Br., Bull. Misc. Inform. Kew 1897: 286. 1897; Brown in Th. Dyer, Fl. Trop. Afr. 8(1 & 2): 200. 1902; Hepper, Fl. West. Trop. Afr. 3(1): 114. 1968; Knecht, Aracées Côte d'Ivoire 1983; Mayo, Fl. Trop. East Afr., Araceae: 7. 1985; Ntépé-Nyamè, Fl. Cameroun 31: 75. 1988; Cabezas, Barquero & Velayos, Fl. Guinea Equat. 12: 98. 2015.

Afrorhaphidophora africana (N. E. Br.) Engl., Nat. Pflanzenfam., Nachtr. 3: 31. 1906; Engler & Krause in Das Pflanzenr., 37 (IV.23B): 54. 1908. Type: See under notes. **Figure 5–10.**







Figure 7. *Raphidophora africana* N. E. Br. G. Mann 103. Syntype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.



Figure 8. *Raphidophora africana* N. E. Br. H. A. Cummins 47. Syntype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.



Figure 9. *Raphidophora africana* N. E. Br. G. F. Scott-Elliot 4940. Syntype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.

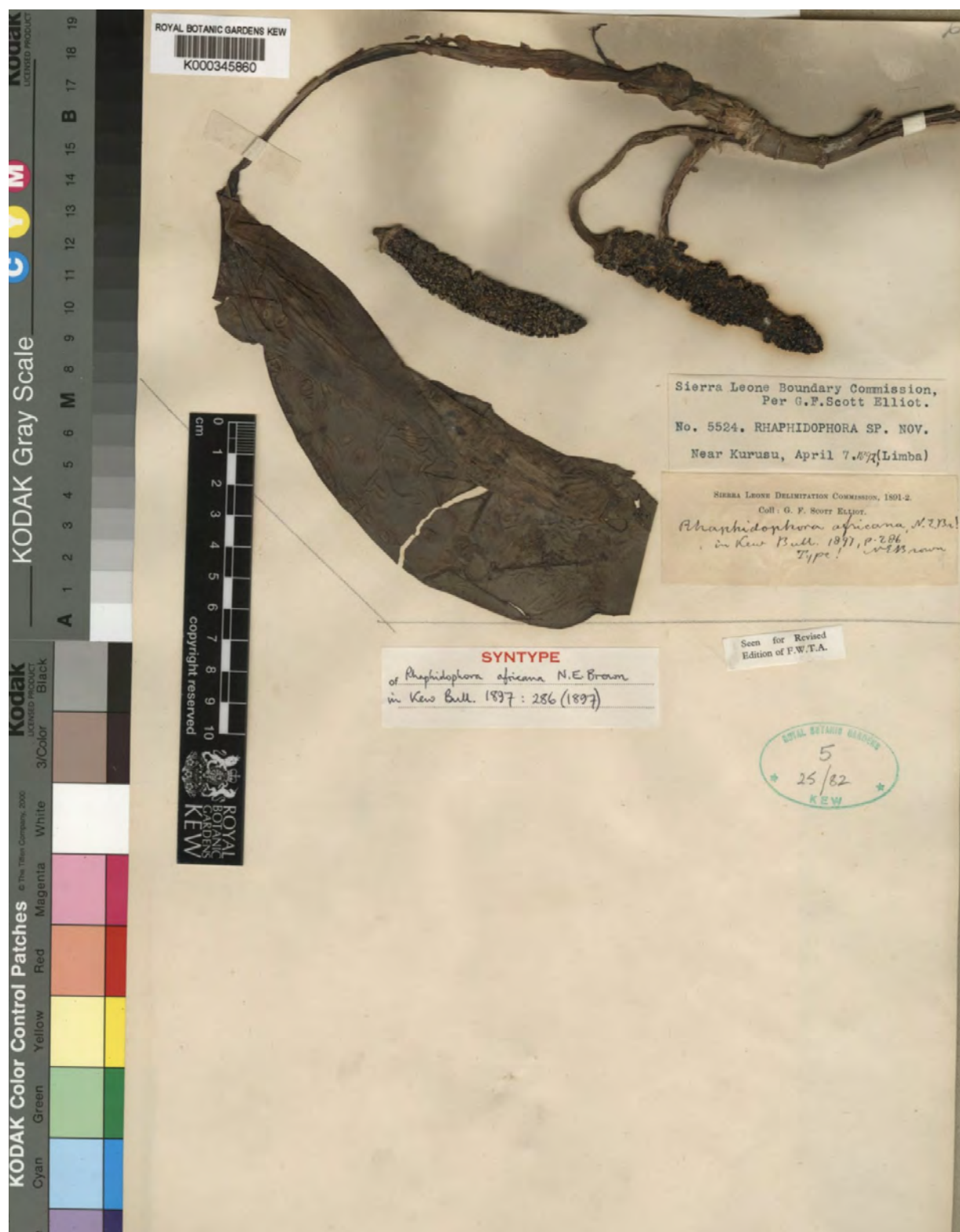


Figure 10. *Rhaphidophora africana* N. E. Br. G. F. Scott-Elliot 5524. Syntype (K). Image © Trustees of the Royal Botanic Gardens, Kew. Used with permission.