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Studies on Schismatoglottideae (Araceae) of Borneo XXXVIII: three novel *Schismatoglottis* species, and notes on the *Schismatoglottis* Asperata Complex

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Schismatoglottis crypta P.C. Boyce & S.Y. Wong, *Schismatoglottis shaleicola* P.C. Boyce & S.Y. Wong, and *Schismatoglottis tegorae* P.C. Boyce & S.Y. Wong are described as taxonomically novel species assigned to a newly circumscribed Asperata Complex. *Schismatoglottis crypta* and *S. tegorae* are facultative rheophytes most similar to *Schismatoglottis jelandii* P.C. Boyce & S.Y. Wong; *S. shaleicola* is a mesophytic species reminiscent of *Schismatoglottis sejuncta* A. Hay. A key to the species of the *Schismatoglottis* Asperata Complex is provided, and most species are figured from living plants.

Keywords: Araceae; Schismatoglottideae; *Schismatoglottis*; Malaysian Borneo; Sarawak; rheophytes

Introduction

Hay and Yuzammi (2000) defined the informal Asperata Group for species of *Schismatoglottis* with pleionanthic shoot modules, a petiole sheathing for at least a third of its length, and a spathe limb irregularly crumbling and breaking away at or after staminate anthesis. It was noted that the Group was possibly heterogeneous. Subsequently, informal species complexes have been defined within their framework of the Asperata Group (Wong 2010; Wong and Boyce 2011; Wong et al. 2012) although to date none of these informal species complexes take account of the typical species of the Asperata Group, i.e. *Schismatoglottis asperata* Engl. and its immediately most similar species, in chronological order: *Schismatoglottis scortechinii* Hook.f., *Schismatoglottis gillianae* P.C. Boyce, *Schismatoglottis sejuncta* A. Hay, and *Schismatoglottis jelandii* P.C. Boyce & S.Y. Wong.

We here propose a new informal taxon, the Asperata Complex, defined within Hay and Yuzammi's Asperata Group by possessing asperate to coarsely granulate petioles, a petiolar sheath with the wing extended into a persistent free ligule, erect inflorescences, and erect infructescences with the persistent lower spathe with an unconstructed terminal orifice and thickened walls remaining white beyond fruit maturity.

As defined here, the Asperata Complex comprises four mesophytic species (*S. asperata*, *S. scortechinii*, *S. sejuncta*, and *Schismatoglottis shaleicola* P.C. Boyce & S.Y. Wong, sp. nov.), and four rheophytes (*Schismatoglottis crypta* P.C. Boyce & S.Y. Wong, sp. nov., *S. gillianae*, *S. jelandii*, and *Schismatoglottis tegorae* P.C. Boyce & S.Y. Wong, sp. nov.

Schismatoglottis asperata Engl., Bull. Soc.Tosc. Ortic. 4: 11. 1879

Becc., Malesia 1: 285 (1883); Hay and Yuzammi, Telopea 9(1): 54 (2000).
Type: Malaysia, Sarawak, Matang, April 1866, *O. Beccari P.B. 1498* (lecto FI-B!; selected by Hay and Yuzammi 2000, p. 54). Figures 6 and 10A.

(=) *Schismatoglottis asperata* var. *albomaculata* Engl., Bull. Soc. Tosc. Ortic. 4: 11 (1879) & in Becc., Malesia 1: 285 (1883).
Type: Malaysia, Sarawak, Matang, April 1866, *O. Beccari P.B. 1497* (holo FI-B!).

(=) *Schismatoglottis crispata* Hook. f., Curtis's Bot. Mag. 107, descr. ad t. 6576 (1881).
Type: Curtis's Bot. Mag. 107, t. 6576 (1881).

Notes

As now understood *S. asperata* is restricted to the sandstones of the Matang Massif and Gunung Berendang, and to the adjacent Adis river valley.

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

Diagnosis

In overall appearance, *S. crypta* is reminiscent of *S. jelandii* but readily differentiated by the tapering-pointed spadix appendix that at most is only as wide as

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the staminate flower zone, and comprised of comparatively large staminodes – about six staminodes per spiral (versus spadix appendix clavate, blunt, mostly (except the distalmost part) exceeding the width of the staminate flower zone, and comprised of very small staminodes – *c*. 20 staminodes per spiral), also by the pistillate flower zone the same width as the interstice (versus narrower), by the larger pistillate flowers with a centrally depressed (versus umbonate) stigma, and by having interstice staminodes that are terminally excavated, and larger rusty red (versus pale salmon pink) staminate flowers.

Typus: Malaysia, Sarawak, Sarikei, Maradong, Rumah Dakun ak Jenang, Sungai Matob 01°52′06.1″ N 111°55′30.7″ E, 8 December 2005 *P.C. Boyce et al. AR-1614* (holo SAR!; iso SBC). Figures 1 and 9A.

Description

Facultative rheophytic herb to *c*. 30 cm tall, solitary or forming small clumps. Stem condensed, in older plants epigeal to *c*. 3 cm, erect, to *c*. 1 cm diameter, modules pleionanthic; internodes obscured by overlapping leaf bases, not conspicuous. Leaves several together (*c*. 10 per plant); petiole D-shaped in cross-section, 6–11 cm long,about one-third length of blade, sheathing in lower quarter, asperulate, dark green, occasionally reddish tinged at the base; petiolar sheath adnate to petiole for about half its length, then ligular for *c*. 2.5 cm, sheath rather narrow, margins in-rolled; blade narrowly obovate, thinly sub-succulent, 18–26 cm long by 3–5 cm wide, glossy deep green adaxially, either plain or variegated with two longitudinal zones of marbled/feathered paler brighter yellow-green blotches, pale green abaxially, base slightly obliquely rounded truncate, tip attenuate and apiculate for *c*. 3 mm; midrib somewhat impressed adaxially, raised abaxially; primary lateral veins *c*. 9 on each side diverging at *c*. 30° from midrib, slightly impressed adaxially, weakly raised abaxially; interprimaries much finer and somewhat dense; secondary veins barely visible. Inflorescence mostly paired, subtended by one narrow prophyll and one broad cataphyll, smelling of acetic acid at anthesis, strongest during pistillate anthesis; peduncle short, not or only barely exserted from leaf bases during anthesis. Spathe 7–11 cm long; lower spathe *c*. 2.5 cm long, ovoid, exterior pale olive-green flushed pale pink to reddish brown-pink, hardly differentiated from limb by a barely perceptible constriction corresponding with upper part of staminate flower zone; limb 4.5–8.5 cm long, narrowly ovate-lanceolate, acuminate distally, exterior greenish white flushed pale pink to reddish brown-pink, interior very pale to medium pink, ageing darker; limb gaping at onset of pistillate anthesis then opening almost flat with margins recurving during staminate anthesis, crumbling-deliquescent at late staminate anthesis. Spadix sessile, obliquely inserted on the spathe/peduncle, somewhat shorter than spathe, to 9.5 cm long; pistillate flower zone *c*. 2 cm long, *c*. 1 cm wide, obliquely very shortly adnate (to spathe), *c*. 5 mm diameter at base, cylindrical; pistils crowded, oblong-barrel-shaped, *c*. 1.2 mm tall, 1 mm diameter, pale yellow; stigma sessile, discoid, centrally depressed, papillate, fractionally wider than ovary, pale pink; interpistillar staminodes scattered, claviform, rather few among pistils, about twice height of pistils, *c*. 0.5 mm diameter, stipe semi-translucent, head opaque white; sterile interstice *c*. 8 mm long, slightly wider with top of pistillate and equalling base of staminate zone, with *c*. 2 whorls of staminodes; interstice staminodes irregularly polygonal, *c*. 1 mm long and 0.5 mm diameter, crystalline-white; staminate flower zone *c*. 2 cm long, very slightly conical; stamens deep pink ageing to rusty red, crowded, truncate with thick connective slightly elevated above thecae, irregularly bi- or tri-androus, rather irregular in shape, although roughly rectangular from above; pollen extruded in short pale orange strands; appendix white to medium pink, about one and a half times longer than rest of spadix, gradually tapering to a rather narrow sharp tip, 5–6 cm long, *c*. 1 cm wide at widest point; appendix staminodes more or less flat-topped, irregularly polygonal, 0.75–1 mm diameter, densely crowded. Fruiting spathe obliquely urceolate with rim margins recurved somewhat, exterior very pale olive-green, flushed pink. Fruit and seed not observed.

Distribution

Schismatoglottis crypta occurs in central Sarawak and north central Sarawak. Populations are scattered although plants are usually locally abundant.

Ecology

Schismatoglottis crypta occurs in lowland humid gallery forest on exposed shales, at altitudes of between 50 and 70 m.

Etymology

From Greek, *kryptos* (hidden, concealed) in allusion to our long-held belief that this and *S. jelandii* represented the same species, their shared overall similarity effectively concealing the more widespread *S. crypta*.

Notes

In overall appearance *S. crypta* is highly reminiscent of *S. jelandii*, differing by the narrow tapering-pointed spadix appendix comprised of comparatively large staminodes and by pistillate flower zone being the same width as the interstice and most notably by the larger rusty red staminate flowers. Both species occur as populations with plain green and variegated-banded leaf bladed individuals intermixed.

Rheophytism (*sensu* Van Steenis 1981, 1987; but see also Ridley 1893) is found independently in several

Figure 1. *Schismatoglottis crypta* P.C. Boyce & S.Y. Wong. **(A, B)** Plants in Type habitat. Note that leaf blades can be plain or with contrasting mid-banding. **(C)** Inflorescence at onset of staminate anthesis. **(D)** Spadix (spathe artificially removed) at staminate anthesis. **(E)** Spadix (spathe artificially removed) at pistillate anthesis. **(F)** Early stage of developing infructescence. **(A, B)** from *P.C. Boyce et al. AR-3078*; **(C–F)** from *P.C. Boyce et al. AR-1614*. Photo credits © Peter C. Boyce.

lineages of *Schismatoglottis* Zoll. and Moritzi, with rheophytic species most abundant in the Multiflora Group (*sensu* Hay & Yuzammi 2000), but also occurring sporadically in the Tecturata Group (e.g. *Schismatoglottis jipomii* P.C. Boyce & S.Y. Wong), the Calyptrata Group (e.g. *S. ahmadii* A. Hay), and the Asperata Complex (*S. jelandii*), and Hottae Complex (*Schismatoglottis thelephora* S.Y. Wong, P.C. Boyce & S.L. Low) of the Asperata Group (Boyce & Wong 2006; Wong et al. 2010, 2012; Wong 2013).

Other collections seen

Malaysia. Sarawak. Kapit, Pelagus, Pelagus Rapids, Woodpecker Trail, 02°11′59″ N, 113°04′01″ E, 1 December 2004, *Jeland ak Kisai AR-781* (SAR, SBC). Sarikei, Maradong, Rumah Dakun ak Jenang, Sungai Matob, 01°52′06.1″ N, 111°55′30.7″ E, 8 December 2005 *P.C. Boyce et al. AR-1611* (SAR, SBC). Bintulu, Tatau, GT Plantations trail behind Camp C Sungai Pandan Kecil, 02°42′40.1″ N, 113°20′37.9″ E, 5 September 2010, *P.C. Boyce, Wong Sin Yeng and Low Shook Ling AR-3078*

(SAR, SBC); Tatau, GT Plantations, Sungai Likau 02°44′37.6″ N, 113°26′10.5″ E, 6 September 2010, *P.C. Boyce, Wong Sin Yeng and Low Shook Ling AR-3091* (SAR, SBC).

Schismatoglottis gillianae P.C. Boyce, Kew Bull. 49: 793, fig. 1. 1994

Mayo et al., The Genera of Araceae 183, pl. 49(i), A, B (1997); Hay and Yuzammi, Telopea 9(1): 88 (2000).

Type: Brunei Darussalam, Tutong, Sg. Tutong, between Benutan and Balabau, 27 March 1990, *M.C.E. Coode et al. 6313* (holo K!; iso BRUN! L!). Figures 4 and 9B, C.

Notes

Boyce (1994) and Hay and Yuzammi (2000) were misled by the ligular portion of the petiolar sheaths of *S. gillianae* into assuming it to be related to *S. multiflora* Ridl. This is not so.

Since publication, extensive fieldwork has highlighted that the inflorescences of *S. gillianae* were described from rather immature material. New data enable a more accurate description of the inflorescences of *S. gillianae* as follows:

Description

Inflorescence paired or occasionally in threes, but developing one at a time with first inflorescence usually in early fruit by the time the last inflorescence is at anthesis; peduncle very short, 2–3.5 cm long, concealed by leaf and cataphyll bases, elongating to *c*. 5 cm in fruit. Spathe (3–)8–15 cm long, white, flushed pink, or rich pink; lower spathe narrowly ovoid, 1.5–3.5 cm long; limb lanceolate, caducous, 6.5–11.5 cm long. Spadix sessile, somewhat shorter than the spathe, more or less subcylindrical throughout; pistillate flower zone 1–2.5 cm long, very slightly adnate to spathe dorsally; interpistillar staminodes scattered, exceeding pistils, heads expanded to *c*. 1 mm diameter, waxy white; pistils squat, *c*. 1.5 mm tall and wide, creamy white or salmon pink; stigma sessile, discoid, slightly wider than ovary, *c*. 1.2 mm diameter, papillate, producing a large globose stigmatic droplet at anthesis, white or salmon pink; sterile interstice 3.5–5 mm long, wider than top of pistillate flower zone, very slightly narrowly obconic, composed of somewhat lax oblong to somewhat polygonal staminodes, white, cream or salmon pink; staminate flower zone 1–2.5 cm long, slightly obconic-cylindrical; stamens polygonal-columnar, truncate, densely arranged, 1–1.5 mm diameter, pale cream to deep pink (pink flowers associated with pink spathes); appendix 6–8 cm long, tapering, distally somewhat flattened, composed of very densely arranged trapezoid to polygonal, centrally impressed staminodes, white to cream, or flushed pink.

Schismatoglottis jelandii P.C. Boyce & S.Y. Wong, Gard. Bull. Singapore 58: 7, Pl. 1. 2006

Type: Malaysia. Sarawak, Bintulu Division, Bintulu, Bukit Satiam, 02°59′33.0″ N, 112°56′01.4″ E, 12 August 2004, *P.C. Boyce and Jeland ak Kisai AR-636* (holo SAR!). Figures 5 and 9D.

Schismatoglottis scortechinii Hook. f., Fl. Brit. Ind. 6: 537. 1893

Ridl., Materials Fl. Mal. Pen. 3: 32 (1907), Fl. Mal. Pen. 5: 113 (1925); Engl. and K. Krause, Pflanzenr. 55 (IV.23 Da): 100 (1912); Hay and Yuzammi, Telopea 9 (1): 81 (2000).
Type: Malaysia, Perak, *Fr B. Scortechini 148* (holo K!; iso CAL!).

(=) *Schismatoglottis kingii* Engl. in Engl. and K. Krause, Pflanzenr. 55 (IV.23 Da): 97, fig. 62, J (1912). Figures 7, and 10B, C.
Type: Malaysia, Johor, *King s.n.* (holo CAL!).

(=) *Schismatoglottis marginata* Ridl., J. Bot. 40: 36 (1902) and Materials Fl. Mal. Pen. 3: 34 (1907); Engl. and K. Krause, Pflanzenr. 55 (IV.23 Da) (1912) 89; *nom. illeg., non Schismatoglottis marginata* Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) [= *Piptospatha marginata* (Engl.) N.E. Br., Bot. Mag. 51 descr. ad. t. 7410 (1895) (Borneo)]
Type: Malaysia, Pahang, Tahan woods, *H.N.Ridley s.n.* (holo SING!).

Schismatoglottis sejuncta A. Hay, Telopea 9(1): 83. 2000

Type: Brunei Darussalam, Temburong Prov., Labu, Bukit Peradayan, 25 January 1964, *M. Hotta 13585* (holo KYO!). Figure 8.

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

Diagnosis

Schismatoglottis shaleicola differs from all other described species of the Asperata Complex by the rich pink pistils and staminate flowers, the deliquescing interpistillar staminodes, and by the pendulous sub-lyrate leaf blades with cordidulous bases.

Typus: Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Wong Ensalai, 01°11′51.0″ N, 112°03′39.9″ E, 26 May 2008, *P.C. Boyce, Wong Sin Yeng and Jepom ak Tisai AR-2409* (holo SAR!; iso SBC). Figures 2 and 10D.

Description

Mesophytic herb. Stem not visible (seedlings), 4–20 cm long (adult plants), modules pleionanthic, internodes to 3 cm long, 0.6–1.5 cm diameter, rooting along their dorsal length. Leaves several together (*c*. 8 per plant); petiole D-shaped in cross-section, 6–25 cm long, in larger individuals almost equalling the length of the blade, in smaller plants petiole about one-quarter length of blade, sheathing in lower quarter, asperulate with the adaxial angles conspicuously crispulate-alate, wings degrading in older petioles to leave a ragged scar; petiolar sheath adnate to petiole for about three-quarters its length, then ligular for *c*. 1.5 cm, sheath broad and initially almost membranous, in older petioles the sheath wings thickening and the ligular portion partly deciduous; blade sublyrate, sub-succulent, 18–41 cm long by 4–15 cm wide, glossy medium semi-glossy green adaxially, pale green abaxially, base cordidulous, tip rounded and apiculate for

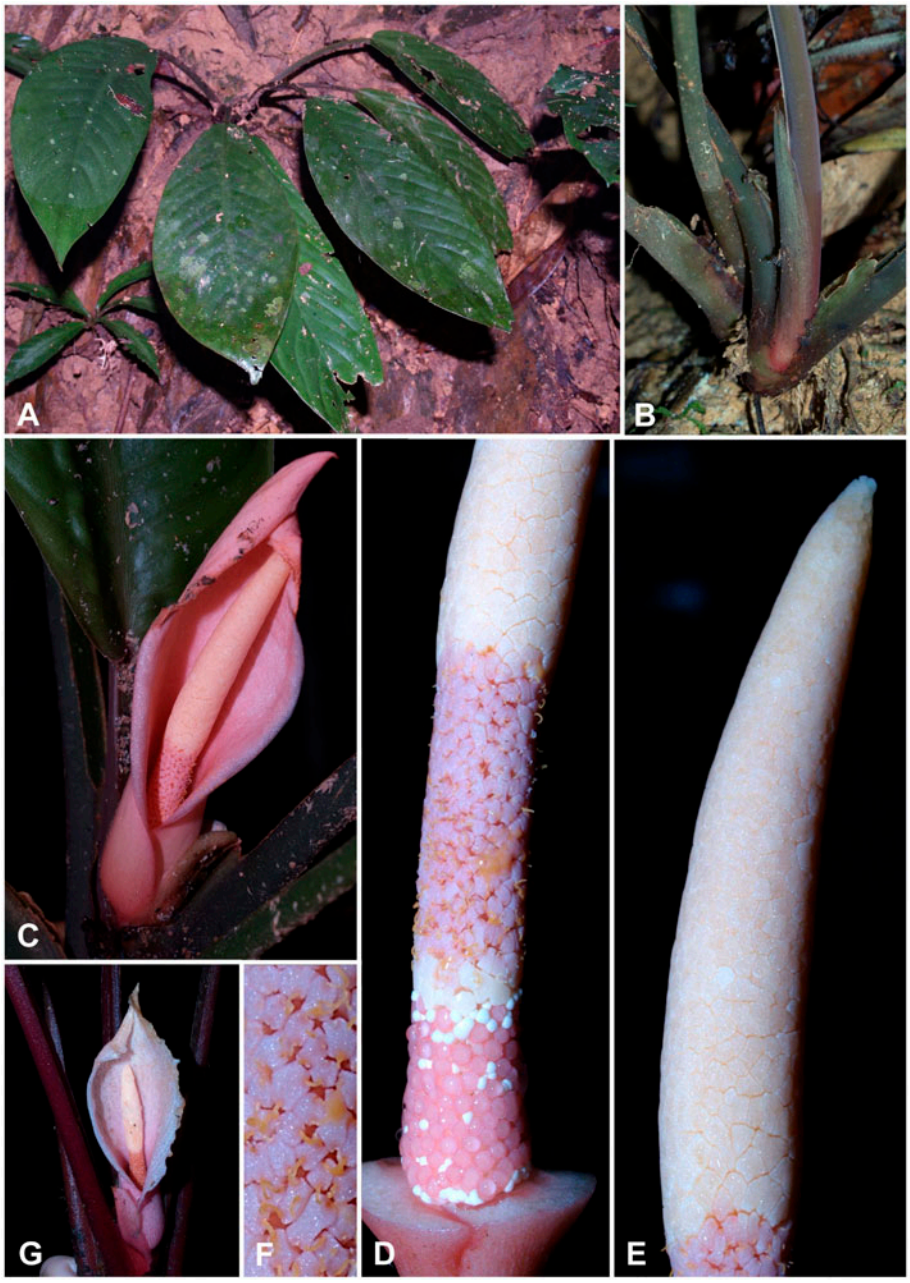

Figure 2. *Schismatoglottis shaleicola* P.C. Boyce & S.Y. Wong. **(A)** Plants in habitat. Note pendent leaf blades. **(B)** Detail of petiole bases. Note asperous texture and persistent ligular portion of petiolar sheath (bottom right). **(C)** Inflorescence at onset of staminate anthesis. **(D)** Fertile part of spadix (spathe artificially removed) and staminate anthesis. **(E)** Spadix appendix and distalmost part of staminate flower zone at staminate anthesis. **(F)** Detail of staminate flowers at staminate anthesis. Note contrasting colour of pollen strings. **(G)** Inflorescence near to end of staminate anthesis with spathe limb fading and beginning to degrade. **(A–F)** from *P.C. Boyce et al. AR-1983*; **(G)** from *P.C. Boyce et al. AR-2409*. Photo credits © Peter C. Boyce.

c. 3 mm; midrib somewhat impressed adaxially, raised abaxially; primary lateral veins *c*. 12 on each side diverging at *c*. 45° from midrib extending to the blade margins and forming a marginal vein, slightly impressed adaxially, weakly raised and darker than surrounding tissue abaxially; interprimaries about half as wide as primaries, not reaching the midrib, dark and semi-translucent; secondary veins forming an obscure slightly darker tessellate reticulum; tertiary veins invisible. Inflorescence solitary, subtended by one narrow prophyll and one or more broad cataphylls, smelling weakly of acetic acid at anthesis, strongest during pistillate anthesis; peduncle short, not or only barely exserted from leaf bases during anthesis. Spathe 8–14 cm long; lower spathe *c*. 2.5 cm long, funnel-form, exterior deep pink, hardly differentiated from limb by a barely perceptible constriction corresponding with upper part of staminate flower zone; limb 6.5–11.5 cm long, ovate-lanceolate, in-rolled and acuminate distally, both surfaces rich pink; limb gaping at onset of pistillate anthesis then opening almost flat with margins recurving during staminate anthesis, crumbling-deliquescent at late staminate anthesis. Spadix sessile, somewhat shorter than spathe, to 10.5 cm long; pistillate flower zone *c*. 2.2 cm long, *c*. 1 cm wide, narrowly obconic; pistils crowded, squat-fusiform, *c*. 1.2 mm tall, 1 mm diameter, dark pink; stigma sessile, discoid, centrally depressed, papillate, fractionally wider than ovary, medium to dark pink, producing a conspicuous droplet at anthesis; interpistillar staminodes mostly at the top and base of the pistillate zone and there becoming incomplete rows, otherwise very few and scattered, claviform, about equalling height of pistils, *c*. 0.9 mm diameter, head opaque white; sterile interstice *c*. 8 mm long, equalling the width of both fertile zones, with about two whorls of staminodes; interstice staminodes irregularly polygonal, *c*. 1 mm long and 0.5 mm diameter, dirty white; staminate flower zone 2–3 cm long, *c*. 1 cm wide, cylindrical; stamens deep pink, truncate with thick connective slightly elevated above thecae and with a shallow groove running between the thecae, mostly bi-androus, rather irregular in shape, although mostly more or less rectangular from above; pollen extruded in short deep orange strands; appendix dirty white, about one and a half times longer than rest of spadix, weakly fusiform, gradually tapering to a rather sharp tip, 7–8 cm long, *c*. 1 cm wide at widest point; appendix staminodes more or less flat-topped, irregularly polygonal, 0.75–1 mm diameter, densely crowded. Fruiting spathe obliquely urceolate, exterior flushed pink. Fruit and seed not observed.

Distribution

The known populations of *S. shaleicola* occur discretely in southwest central and in northeast Sarawak. It highly likely that the true distribution is throughout central Sarawak but that populations have been overlooked because the habitat favoured by *S. shaleicola* is often difficult to access.

Ecology

Schismatoglottis shaleicola occurs in lowland humid to very humid gallery forest on exposed, often vertical, shales, at altitudes of between 30 and 135 m.

Etymology

From the Neo-Latin noun *cola* – a dweller, and shale – hence dwelling on shale – all known populations of *Schismatoglottis shaleicola* occur exclusively on shale.

Notes

Schismatoglottis shaleicola is highly distinctive by the combination of pendulous leaves and the remarkable bright pink spathes. Leaf blades vary considerably in size, the largest exceeding 40 cm long (and then the tips almost invariably tattered owing to damage from spate flow of the stream), on petioles up to 25 cm long.

Other collections seen

Malaysia. Sarawak. Sri Aman: Lubok Antu, Sungai San to Wong Sanikal, from simpang tiga on logging track, 01°00′07.6″N, 111°47′10.3″E, 10 June 2014, *Ooi Im Hin and Sunang ak Empin AR-4785* (SAR); Lubok Antu Sungai Kelaweh to Sungai Morek, 01°02′04.6″N, 111°46′12.5″E, 11 June 2014, *Ooi Im Hin and Sunang ak Empin AR-4797* (SAR); Lubok Antu, Batang Ai, Batu Lintang, 01°11′19.6″N, 111°56′02.6″E, 27 July 2014, *S. Y. Wong and P.C. Boyce AR-4872* (SAR); Lubok Antu, Batang Ai Sungai, Sepipit, 01°11′54.9″N, 111°57′29.4″E, 27 July 2014, *S.Y. Wong & P.C. Boyce AR-4897* (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 August 2006, *P.C. Boyce et al. AR-1983* (SAR).

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

Diagnosis

Schismatoglottis tegorae approaches *S. jelandii* and *S. crypta* in general appearance, although differing from both by the leaf blades adaxially matte (versus glossy). The spadix of *S. tegorae* is most closely similar to that of *S. crypta*, differing by the spadix appendix basally slightly wider than the staminate flower zone and comprised of white (not salmon pink) staminodes, the proportionately shorter staminate flower zone – accounting for one-fifth (versus one-third) of the entire spadix, and by the cylindrical-columnar (versus pentagonal) interstice staminodes.

Typus: Malaysia, Sarawak, Kuching, Bau, Jambusan, Bongo Range, trail to Tegora Mine, 01°19′41.5″ N, 110°09′19.0″ E, 8 September 2007, *P.C. Boyce, Wong Sin Yeng and A. Kocyan AR-2188* (holo SAR!; iso SBC!). Figures 3 and 9E.

Description

Facultative rheophytic herb to *c*. 15 cm tall, solitary or forming small clumps. Stem condensed, erect, to *c*. 1.5 cm diameter, modules pleionanthic; internodes obscured by overlapping leaf bases, not conspicuous. Leaves several together (*c*. 11 per plant); petiole oblate D-shaped in cross-section, 2–3 cm long, about one-sixth the length of the blade, sheathing in the lower quarter, deep purple-brown, very slightly asperulate; petiolar sheath adnate to petiole for the greater part, then free-auriculate at the top for *c*. 1 cm, margins slightly in-rolled; blade narrowly obovate, thinly succulent, 15–21(–26) cm long by 2–4(–5) cm wide, matte olive-green adaxially, pale green abaxially, base minutely cordidulous, tip acuminate and apiculate for *c*. 2 mm; midrib adaxially somewhat impressed, abaxially prominently raised and deep reddish purple; primary lateral veins *c*.9 on each side, reddish purple, alternating with slightly to considerably lesser interprimaries, diverging at *c*. 30°;

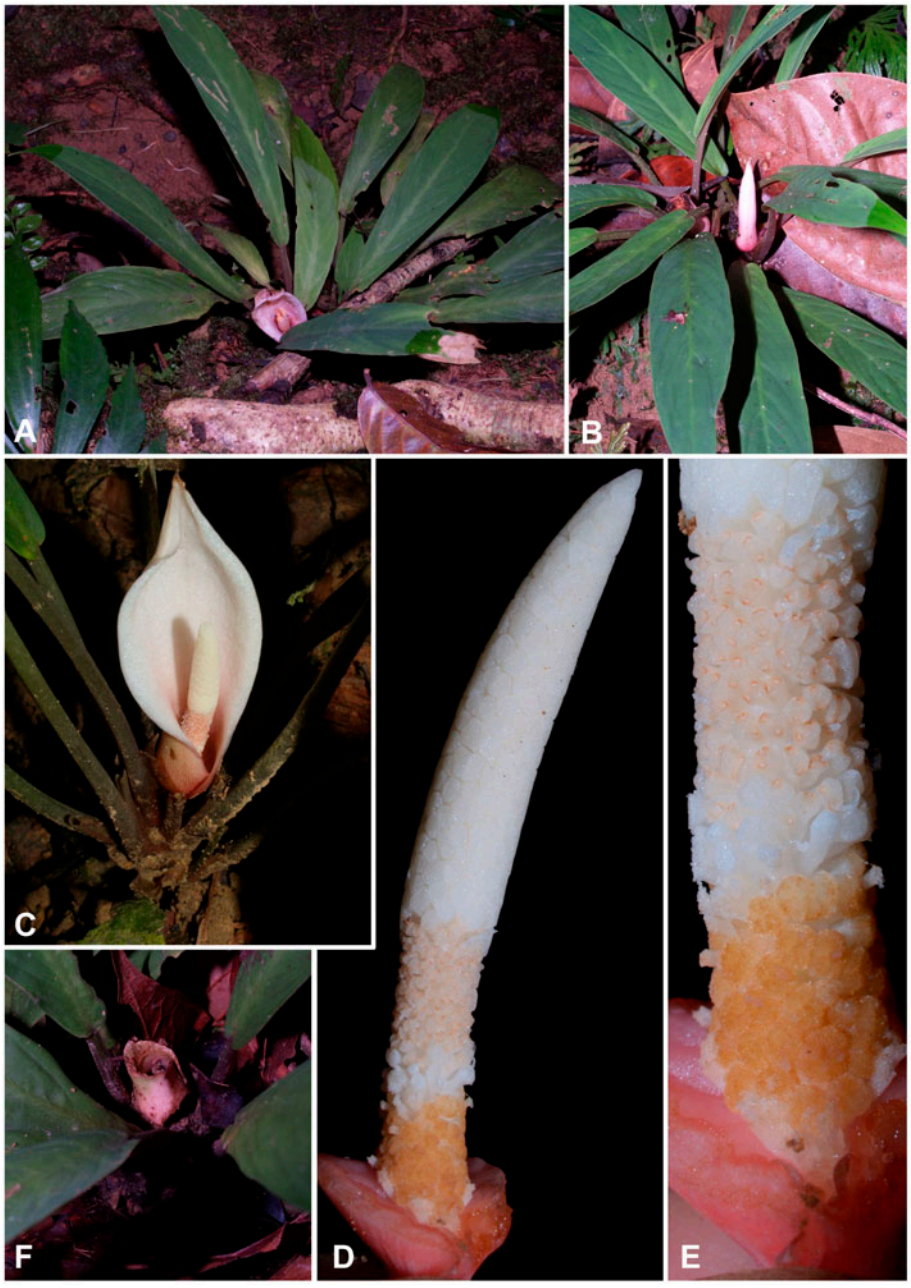

Figure 3. *Schismatoglottis tegorae* P.C. Boyce & S.Y. Wong. **(A, B)** Plants in Type habitat. Note matte leaf blades. **(C)** Inflorescence at onset of staminate anthesis. **(D)** Spadix at staminate anthesis, spathe artificially removed. **(E)** Detail of fertile flower zones at staminate anthesis. **(F)** Early stage of developing infructescence. All from *P.C. Boyce et al. AR-2188*. Photo credits © Peter C. Boyce.

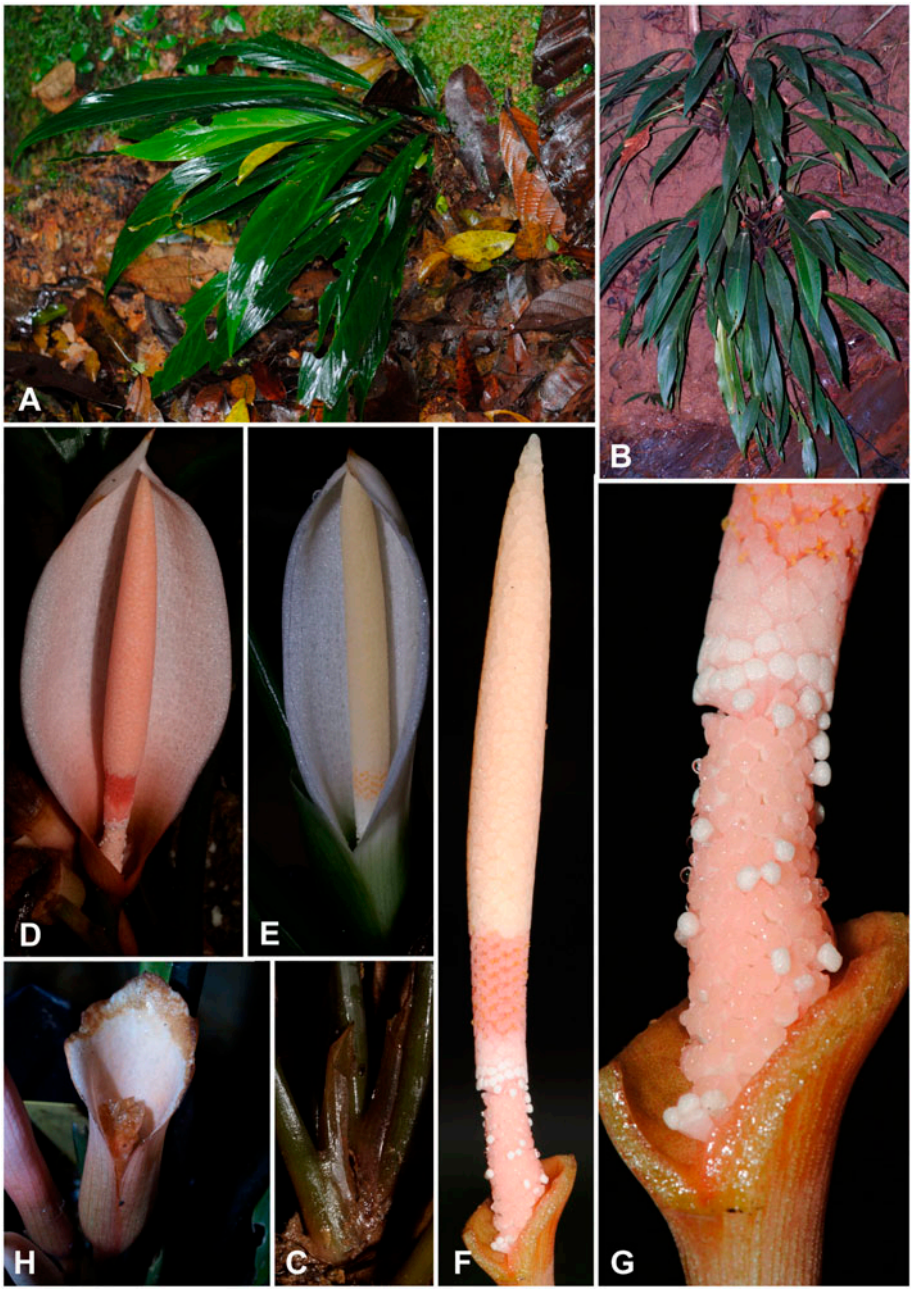

Figure 4. *Schismatoglottis gillianae* P.C. Boyce. **(A, B)** Plants in habitat. **(C)** Detail of petiolar sheath ligule. **(D, E)** Two colour forms of inflorescence. **(F)** Spadix (spathe artificially removed) at pistillate anthesis. **(G)** Detail of fertile flower zones at staminate anthesis. **(H)** Early stage of developing infructescence. **(A)** from *P.C. Boyce & Wong Sin Yeng AR-3248*; **(B, D, E, H)** from *P.C. Boyce et al. AR-2251*; **(C)** from *P.C. Boyce et al. AR-2268*; **(F, G)** from *P.C. Boyce et al. AR-2279*. Photo credits © Peter C. Boyce.

secondary venation weakly tessellate (abaxially); tertiary venation not visible. Inflorescence mostly solitary, occasionally two together, subtended by one narrow prophyll and one broad cataphyll; peduncle short, hardly or not exserted from leaf bases. Spathe *c*. 7.5 cm long, tapering; lower spathe *c*. 1.5 cm long, ovoid, pale pink, hardly differentiated from limb by a barely perceptible constriction corresponding with the upper part of staminate flower zone; limb *c*. 5 cm long, narrowly ovate-lanceolate, dirty white flushed pink externally and towards the base, gaping at onset of pistillate anthesis then spreading almost flat with the margins recurved, crumbling-deliquescent at late staminate anthesis. Spadix sessile, somewhat shorter than spathe, to 6.5 cm long; pistillate flower zone *c*. 1 cm long, 0.4 cm diameter at base, weakly conoid; pistils crowded, oblong-barrel-shaped, *c*. 1 mm tall, 0.75 mm diameter, creamy white; stigma sessile, discoid, weakly umbonate, papillate, fractionally wider than ovary and ± contiguous with neighbouring stigmas, dull orange; interpistillar staminodes very few, claviform, scattered among the pistils, slightly taller than the pistils, *c*. 0.5 mm diameter, pale orange-white; sterile interstice

Figure 5. *Schismatoglottis jelandii* P.C. Boyce & S.Y. Wong. **(A)** Plants in Type habitat. **(B)** Inflorescence at pistillate anthesis. **(C)** Inflorescence at onset of staminate anthesis. **(D)** Spadix (spathe artificially removed) at pistillate anthesis. **(E)** Post anthesis inflorescences, with spathe limb shed. All from *P.C. Boyce and Jeland ak Kisai AR-636*. Photo credits © Peter C. Boyce.

c. 3 mm long, with *c*. 2 whorls of irregularly polygonal-clavate staminodes, *c*. 0.5 mm diameter white; staminate flower zone 1–1.5 mm long, cylindrical, fractionally narrower than appendix base; stamens somewhat lax, very pale orange with the rim of the thecae pores darker, truncate with thick connective slightly concave between thecae, more or less rectangular from above; pollen extruded in short pale orange strands; appendix white, about one and a half times length of the rest of spadix, weakly fusiform, widest about half way up, then gradually tapering to a rather narrow blunt tip, 2.5–3.5 cm long, 4–6 mm diameter; appendix staminodes more or less flat-topped, irregularly polygonal, 0.75–1 mm diameter Fruiting spathe urceolate, pale dirty pink.

Distribution

Schismatoglottis tegorae is so far known only from the Type locality, where it is locally abundant.

Ecology

Schismatoglottis tegorae grows on almost bare riverside cinnabar-rich rocks under rather open perhumid lowland forest at about 70 m above sea level.

Figure 6. *Schismatoglottis asperata* Engl. **(A–C)** Plants in habitat showing variation in leaf blade markings in a single population. **(D)** Detail of petiole ornamentation. **(E)** Inflorescence at pistillate anthesis. **(F)** Spadix (spathe artificially removed) at pistillate anthesis. **(G)** Inflorescence at staminate anthesis. **(A–C)** Unvouchered field images; **(D–G)** from *P.C. Boyce and Jepom ak Tisai AR-1744*; **(C)** from *P.C. Boyce et al. AR-2268*; **(F, G)** from *P.C. Boyce et al. AR-2279*. Photo credits © Peter C. Boyce.

Etymology

The specific epithet is from the Type locality, Bukit (hill) Tegora, treating hill as feminine.

Notes

Bukit Tegora, the Type and only known locality of *S. tegorae*, is in the northwest part of the horseshoe-shaped Bungo Range to the southwest of Kuching, and was formerly a cinnabar mine. Cinnabar, mercury sulphide, the ore from which mercury is obtained commercially, was discovered at Tegora in 1867 by Ludvig Verner Helms, the first manager of the Borneo Company. Mining was begun immediately with the first exports made the following year. After a boom period in the 1870s, by the 1890s output was negligible and ceased entirely in 1898, although it was briefly restarted during the Japanese occupation between 1942 and 1945.

Schismatoglottis tegorae has proven difficult to maintain in cultivation in Kuching, despite the more

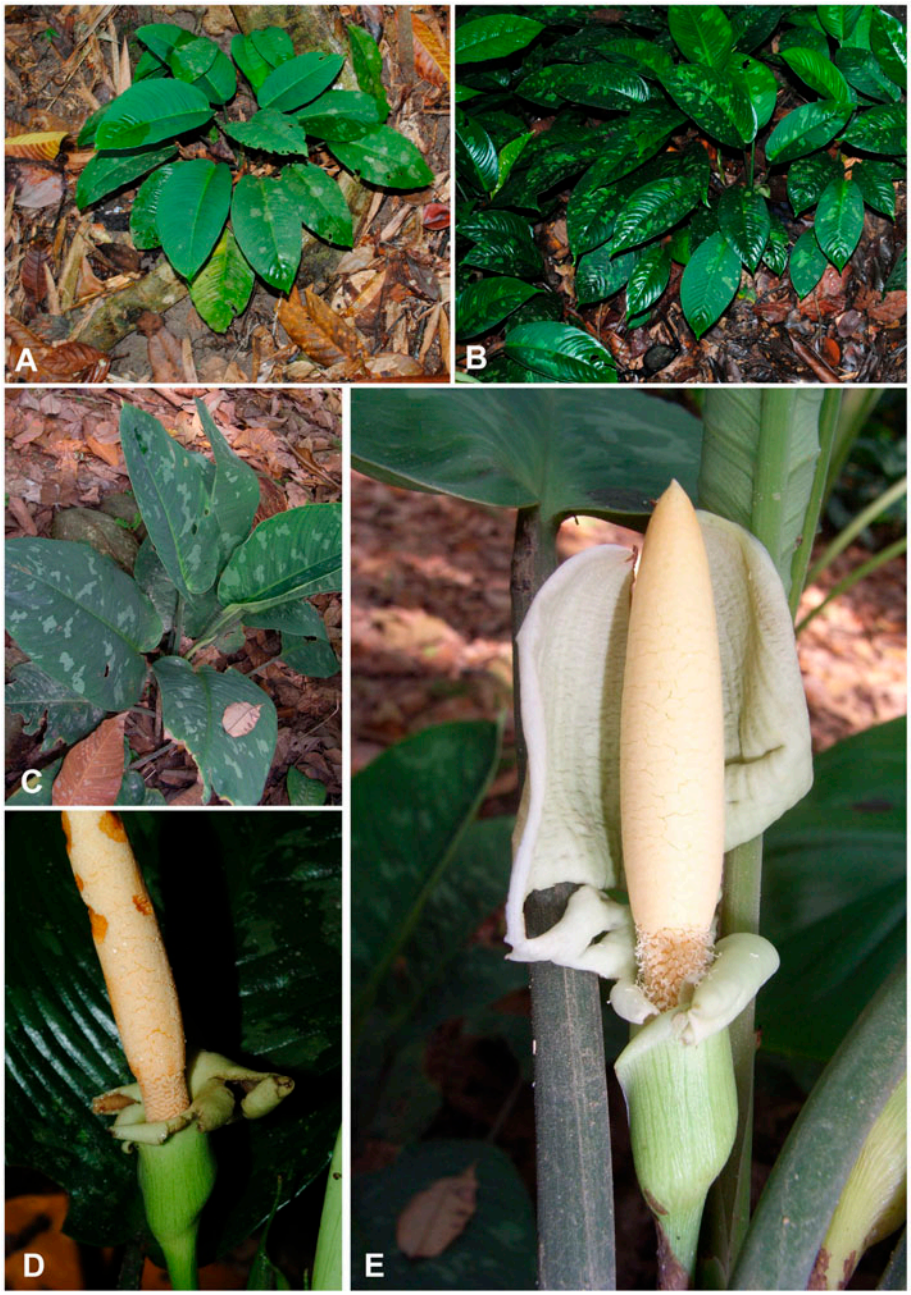

Figure 7. *Schismatoglottis scortechinii* Hook.f. **(A–C)** Plants in habitat showing variation in leaf blade markings in a single population. **(D)** Detail of petiole ornamentation. **(E)** Inflorescence at pistillate anthesis. **(F)** Spadix (spathe artificially removed) at pistillate anthesis. **(G)** Inflorescence at staminate anthesis. **(A–C)** Unvouchered field images; **(D–G)** from *P.C. Boyce and Jepom ak Tisai AR-1744*; **(C)** from *P.C. Boyce et al. AR-2268*; **(F, G)** from *P.C. Boyce & Wong Sin Yeng. AR-3957*. Photo credits © Peter C. Boyce.

widespread species with which it co-occurs (e.g. *Schismatoglottis jepomii* P.C. Boyce & S.Y. Wong, *Schismatoglottis tecturata* (Schott) Engl., and *Schismatoglottis wallichii Hook.f.*) posing no such problems. It is suspected that the limited distribution of *S. tegorae* is linked to an affinity with metal-rich rocks and that these are in turn a requirement for its well-being. Similar examples in the aroids are ultramafic (ultrabasic) obligated species that have proven difficult or impossible to cultivate (e.g. *Schismatoglottis decipiens* A. Hay and *Schismatoglottis silamensis* A. Hay).

Key to species of the *Schismatoglottis* Asperata Complex

1a. Stenophyllous facultative rheophytes.....2
1b. Mesophytes with broad leaf blades; if occurring on river banks then not growing in the spate-flow zone...5
2a. Leaf blades adaxially glossy; spadix appendix tapering cylindrical or clavate, equalling or conspicuously exceeding width of fertile portion of spadix ……..3
2b. Leaf blades adaxially matte; spadix only very slightly exceeding width of fertile portion of spadix; plants of metal-rich rocks. southwest Sarawak..... ***S. tegorae***

Figure 8. *Schismatoglottis sejuncta* A. Hay. Holotype specimen, *M. Hotta 13585*. Photo credit © H. Nagamasu, used with permission.

3a. Spadix appendix clavate, conspicuously wider than fertile portion of spadix, comprised of very small staminodes – *c*. 20 staminodes per spiral; stigma umbonate; staminate flowers pale salmon pink. Bintulu (Bukit Satiam).....***S. jelandii***

3b. Spadix appendix tapering-cylindrical, equalling fertile portion of spadix; stigma with a central depression 4

4a. Leaf blades spreading to pendulous; spadix slender-cylindrical; pistillate flower zone two to three times longer than staminate flower zone; staminate flowers pale to medium pink; plants of sandstone waterfalls. Southwest Brunei and central northern Sarawak.....***S. gillianae***

4b. Leaf blades erect; spadix rather stoutly tapering cylindrical; pistillate flower zone half length of staminate flower zone; staminate flowers rusty red; plants of shales. Central and northern central Sarawak.....***S. crypta***

5a. Staminate and pistillate flower zones separated by a slender naked interstice. Brunei.....***S. sejuncta***

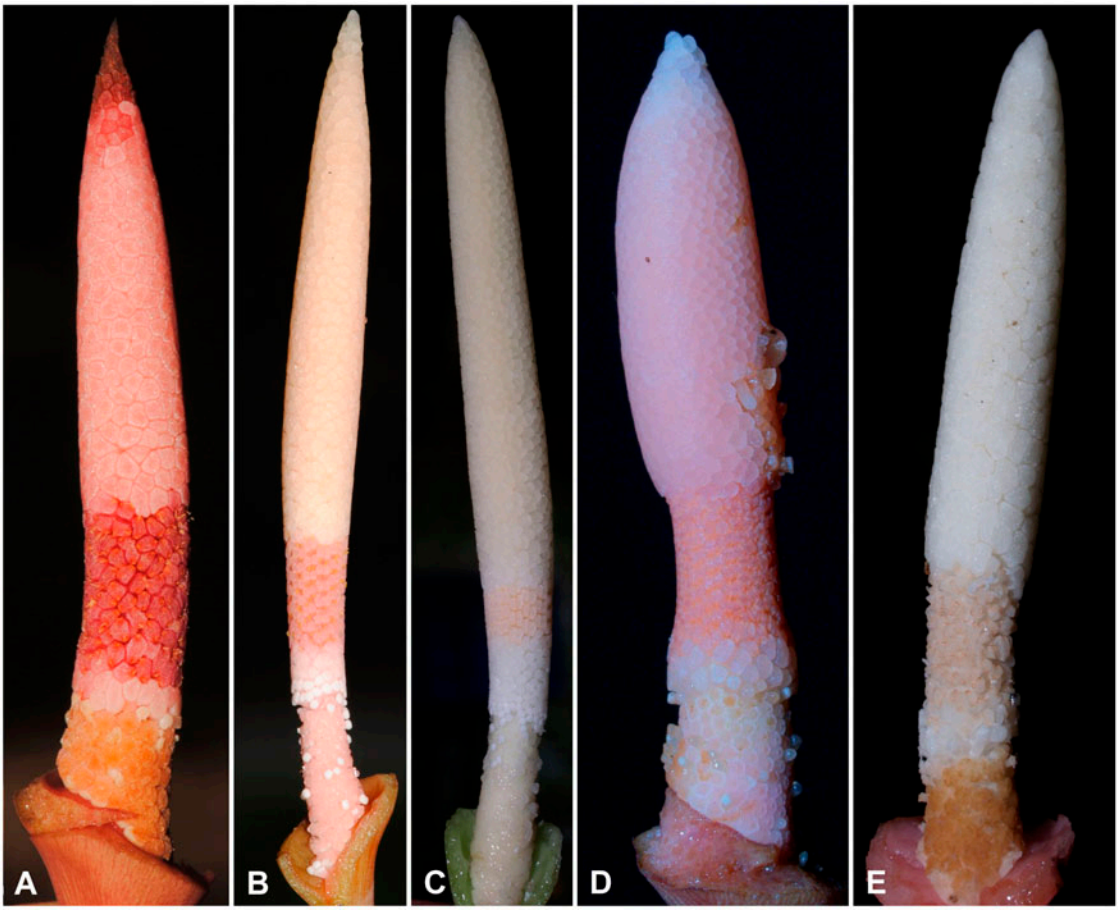

Figure 9. Spadices of rheophytic Asperata Complex compared. **(A)** *Schismatoglottis crypta* P.C. Boyce & S.Y. Wong. **(B, C)** *Schismatoglottis gillianae* P.C. Boyce. **(D)** *Schismatoglottis jelandii* P.C. Boyce & S.Y. Wong. **(E)** *Schismatoglottis tegorae* P.C. Boyce & S.Y. Wong. **(A)** from *P.C. Boyce et al. AR-1614*; **(B, C)** from *P.C. Boyce et al. AR-2251*; **(D)** from *P.C. Boyce & Jeland ak Kisai AR-636*; **(E)** from *P.C. Boyce et al. AR-2188*. Photo credits © Peter C. Boyce.

5b. Staminate and pistillate flower zones separated by a stout, staminode-covered interstice..... **6**
6a. Leaf blades pendulous, blade base cordidulous; spathe limb deep pink; spadix appendix slender cylindrical, about twice as long as remainder of spadix; staminate flower zone *c.* 3 times longer than wide, about twice as long as pistillate flower zone, and equalling spadix appendix in width; staminate and pistillate flowers rich pink. Shales, southwest and northeast central Sarawak .....***S. shaleicola***
6b. Leaf blades erect or spreading, blade base broadly cordiform to almost truncate; spathe limb white or pale greyish green; spadix appendix fusiform to clavate-cylindrical, equalling to at most 1.5 times length of remainder of spadix; staminate flower zone about twice as long as wide and about equal in length to pistillate flower zone, narrower than spadix appendix; staminate flowers pale pink to pale orange; pistillate flowers cream..... **7**
7a. Interpistillar staminodes present; petiole coarsely asperous, ornamentation often with a crystalline appearance; peduncle stout, hardly exserted from subtending petiolar sheath; plants of sandstone. Matang and vicinity (Kuching, Sarawak)..... ***S. asperata***
7b. Interpistillar staminodes absent; petiole slightly asperous; peduncle slender, conspicuously exserted from subtending petiolar sheath; plants of granite. Widespread in West Malaysia..... ***S. scortechinii***

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Figure 10. Spadices of mesophytic Asperata Complex compared. **(A)** *Schismatoglottis asperata* Engl. **(B, C)** *Schismatoglottis scortechinii* Hook.f. **(D)** *Schismatoglottis shaleicola* P.C. Boyce & S.Y. Wong. **(A)** from *P.C. Boyce et al. AR-2279*; **(B, C)** from *P.C. Boyce & Wong Sin Yeng. AR-3957*; **(D)** from *P.C. Boyce et al. AR-1983*. Photo credits © Peter C. Boyce.

References

Boyce PC. 1994. New species of Araceae from Brunei. Kew Bull. 49:793–801.

Boyce PC, Wong SY. 2006. Studies on schismatoglottideae (Araceae) of Borneo I: A trio of new *Schismatoglottis* from Sarawak. Borneo Gard Bull Singapore. 58:7–18.

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

Ridley HN. 1893. On the flora of the eastern coast of the Malay Peninsula. Trans Linn Soc London, 2nd series. Botany. 3:267–408.

Van Steenis CGGJ. 1981. Rheophytes of the world: an account of the flood-resistant flowering plants and ferns and the theory of autonomous evolution. Alpena aan den Rijn and Rockville: Sijthoff & Noordhoff.

Van Steenis CGGJ. 1987. Rheophytes of the world. Suppl Allertonia. 4:267–330.

Wong SY. 2010. Studies on Schismatoglottideae (Araceae) of Borneo XIII: a revision of the *Schismatoglottis nervosa* complex. Gard Bull Singapore. 62:177–209.

Wong SY. 2013. Rheophytism in bornean schismatoglottideae (Araceae). Syst Bot. 38:32–45.

Wong SY, Boyce PC. 2011. Studies on schismatoglottideae (Araceae) of Borneo XVI: a new species and a further new informal taxon (Multinervia Complex) of *Schismatoglottis* from Sarawak. Acta Phytotax Geobot. 60:131–137.

Wong SY, Boyce PC, Low SL. 2012. Studies on schismatoglottideae (Araceae) of Borneo XVII: the *Schismatoglottis hottae* complex, a new informal taxon, and three new species from Sarawak, Malaysian Borneo. Gard Bull Singapore. 64:257–269.

Wong SY, Boyce PC, Othman AS, Leaw CP. 2010. Molecular phylogeny of tribe schismatoglottideae based on two plastid markers and recognition of a new tribe, philonotieae, from the neotropics. Taxon. 59:117–124.