

---

# Studies on Monstereae (Araceae) of Borneo III — Two new *Rhaphidophora* species with perforated leaf blades

Wong Sin Yeng<sup>1,2\*</sup>, Peter C. Boyce<sup>3</sup>

<sup>1</sup>Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.

<sup>2</sup>Harvard University Herbaria, Cambridge, MA, USA.

<sup>3</sup>Centro Studi Erbario Tropicale (Herbarium FT), Dept of Biology, Univ. of Florence, Firenze, Italy.

\*Corresponding author. E-mail: [sywang@unimas.my](mailto:sywang@unimas.my)

---

## ABSTRACT

Two new species of *Rhaphidophora* with perforated leaf blades are described from Borneo and illustrated from living plants. An identification key to the five morphologically similar Bornean species is provided.

**Keywords:** *Rhaphidophora*, Mulu, Karst limestone, Sarawak, Sabah, Borneo.

## INTRODUCTION

*Rhaphidophora* Hassk. was last revised for Borneo by Boyce (2001), recognizing 13 species. Subsequently, *Rhaphidophora typha* P.C.Boyce has been described from NC Sarawak (Boyce, 2005) and *R. crassifolia* Hook.f. has been newly recorded for Borneo (Boyce, 2006). Additionally, two species, *R. tenuis* Engl. and *R. fluminea* Ridl. have been reinstated from synonymy respectively of *R. korthalsii* Schott and *R. beccarii* (Engl.) Engl. (Boyce, 2006; Wong & Jyloerica, 2021) taking to 17 the number of species on Borneo.

Fieldwork since 2001 has made it apparent that there are numerous Bornean *Rhaphidophora* species yet to be named, although available material is inadequate to permit description largely because plants are mostly encountered sterile in the field. It was with considerable surprise during fieldwork in 2018 on a trail that we have investigated on numerous occasions in Mulu National Park that we encountered flowering within two kilometres of one another two previously unnoticed, highly distinctive, and very obviously undescribed species of *Rhaphidophora*.

## KEY TO THE BORNEAN SPECIES OF *RHAPHIDOPHORA* WITH PERFORAT-

## ED, ENTIRE-MARGINED LEAF BLADES

- 1a. Leaf blades abaxially indumentose, matte ..... 2
- 1b. Leaf blades abaxially glabrous, glossy ..... 3
- 2a. Leaf blade abaxially entirely yellow-puberulent (especially noticeable on younger leaves); blade perforations large and evenly distributed along both sides of the midrib; active shoot tips with copious black mucilage; blooms on clinging shoots ..... *R. foraminifera*
- 2b. Leaf blades abaxially with the midrib grey-pubescent, the remainder glabrous, matte; blades with a row of ragged pin-holes running along both sides of the midrib; blooms carried on short free sympodial branches ..... *R. microperforata*
- 3a. Leaf blades with irregular perforations on both sides of the midrib; blooms solitary blooms on rather elongated lateral branches. Sarawak: Mulu in peatswamp forest over inundated Karst ..... *R. muluensis*
- 3b. Leaf blades with irregular perforations only on one side of the midrib; blooms three or more together on very congested lateral branches. Widespread in Borneo and extending to Peninsular Malaysia, not Karst-associated ..... *R. megasperma*

## THE NEW SPECIES

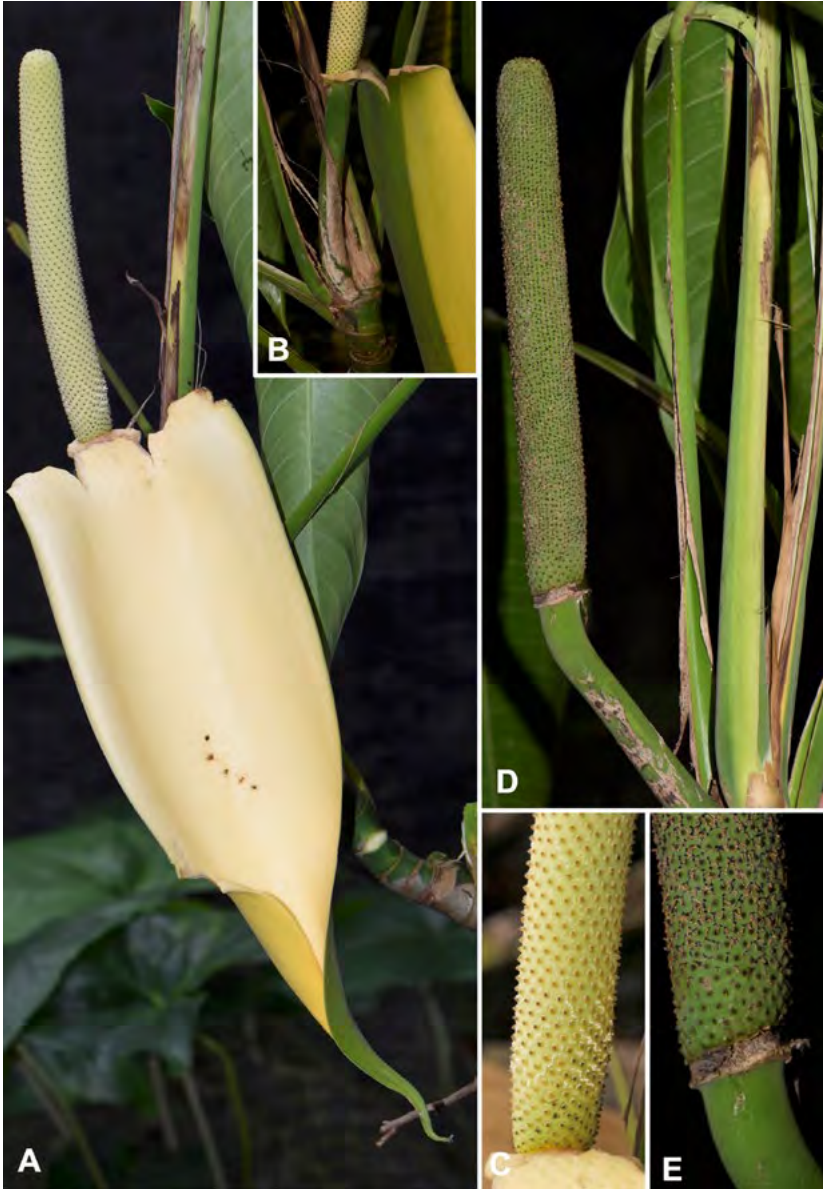
*Rhaphidophora microperforata* S.Y.Wong & P.C.Boyce, **sp. nov.** — Type: MALAYSIAN BORNEO. Sarawak, Miri, Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 4°02'23.8"N 114°48'54.6"E, 60 m asl., 9 December 2018, *Wong S.Y. & P.C. Boyce AR-2914* (holotype, SAR! + spirit!; isotype SING! + spirit!). **Figures 1 & 2.**

*Diagnosis:* *Rhaphidophora microperforata* is distinguished from all other described species by the presence of a row on each side  $\frac{1}{2}$ –1 cm from the midrib, of numerous pellucid dots, later jagged pin-holes.

Moderate to large, robust but semi-leptocaul, probably homeophyllous nomadic vines to 15 m; seedling stage not observed; pre-adult plants forming extensive terrestrial colonies giving rise to stout climbing stems; adult shoot architecture comprised of elongated, clinging, monopodial, leafy, non-flowering stems and short, free, sympodial, densely leafy flowering stems; stems smooth, terete in cross section, medium green with soon-falling sparse prophyll, cataphyll and petiolar sheath remains, internodes to 13 × 1.5 cm on adherent shoots, shorter on free shoots, separated by conspicuous oblique leaf scars, older stems tending to be woody; flagellate foraging stems absent; clasping roots sparsely arising from the nodes of clinging stems, stout, pubescent; feeding roots abundant, either attaching to suitable surfaces or hanging in



**Figure 1.** *Rhaphidophora microperforata*. (A) Plant in habitat. (B) Leaves viewed from below, pin-holes clearly visible. (C) Leaf blades in full sun. (D) Detail of leaf blade abaxial surface showing pubescent mid-rib and pin-holes. E & F. Feeding roots. Note the texture of the root (E) and the active root-tip (F). A & B from AR-2914; C from AR-3234; D–F from AR-2951.



**Figure 2.** *Rhabdophora microperforata*. (A) Bloom at staminate anthesis. (B) Detail of lower part of bloom. Note the splitting of the spathe at its insertion on the spadix/peduncle and the demarcated coloration of the spathe. (C) Lower part of spadix at staminate anthesis. Note the anthers are not exserted and that the lowermost six whorls of flowers lack stamens. (D) Shoot tip with post-anthesis spadix. (E) Lower part of spadix post-anthesis. The sterile nature of the lowermost six whorls of florets is clear. All from AR-2951.

the manner of bell-ropes, active tips with abundant clear mucilage, tissues leading to the active tip with a spongy-slimy texture, remainder of root smoothly corky, older segments producing slim adventitious rootlets. *Leaves* spiro-distichous on adherent and free shoots; cataphylls and prophylls membranous, quickly drying and degrading into sparse fibres, and these soon falling; petiolar sheath membranous, extending to the distal geniculum, initially pale yellow, soon marcescent a then degrading into slender papery strips; petioles 25–37 cm long (climbing shoots), 17–28 cm long (flowering shoots), canaliculate to the tip, the angles sharp, distally minutely sinuate-alate, with adhering fragments and strips of marcescent-degrading petiolar sheath, in older petioles angles becoming minutely erose and later corky-scarred; climbing shoots with proximal geniculum stout, ca  $4 \times 1.3$  cm, with the angles corky-scarred; flowering shoots with proximal geniculum rather ill-defined, those of senescent leaves usually becoming yellow before the remainder of the petiole, ca  $2.5 \times 0.7$  cm; distal geniculum well-defined on all leaves, dorsally broadly channelled, with the edges sharp, those of flowering shoots usually strongly deflexed with the leaf blade pendulous; leaf blades up to  $40 \times 16$  cm (climbing shoots),  $30 \times 13$  cm (flowering shoots), thinly coriaceous, medium semi glossy green adaxially, matte medium green to faintly glaucous abaxially, becoming glossy yellowish in full sun, oblong-elliptic with two rows, one on each side of the midrib, of numerous pellucid dots, later becoming jagged pin-holes  $\frac{1}{2}$ –1 cm from the midrib, often slightly falcate, blade base unequal one side acute the other obtuse to weakly truncate, apex acute with a brief (1.5 mm) mucro; midrib rounded-raised abaxially, slightly sunken adaxially, puberulent, especially in leaves in full sun; primary lateral veins conspicuous, about 21 on each side, regularly alternating with less conspicuous interprimaries, arising at ca  $60^\circ$ , abaxially rounded-raised with the distal portion paler than the surrounding blade tissue, higher order venation difficult to discern (flowering shoots) or (climbing shoots) forming a slightly sinuous/weakly branching series of veins running more-or-less parallel to the primary laterals. *Bloom* solitary, terminal on free lateral shoot, subtended by a fully developed but somewhat undersized foliage leaf, smelling of overripe fruit; peduncle strongly compressed-cylindric,  $4\text{--}9 \times 0.4\text{--}0.6$  cm.; spathe ca 28 cm long, stoutly rostrate, rostrum to ca 10 cm, gaping at pistillate anthesis, opening and reflexing to reveal the spadix with the margins later strongly in-rolling post staminate anthesis, the exterior glaucous pale green in bud, externally dull rich yellow at anthesis with a strongly demarcated green area from where the outer margin was convolute over the inner in bud, interior dirty cream, much of the rostrum save the distal 4 cm darkening, spathe partially separating from the spadix/peduncle insertion late in anthesis, with the lowermost part of the spathe darkening; spadix cylindrical, sessile, slightly obliquely inserted onto peduncle, longer side 15 cm, shorter 14.5 cm, ca 1.4 cm in diam., creamy white; stylar region mostly hexagonal,  $1.5\text{--}2 \times 2.1\text{--}2.5$  mm, truncate; stigma punctiform on a conical stigmatophore (*sensu* Cedeño-Fonseca et al. 2022), lowermost ca 6 spirals of florets functionally sterile; anthers exerted at anthesis; infructescence not observed.

**Distribution and ecology** — Restricted to NE Borneo where apparently widespread and overlooked. The three known collections occur at minimum of 235 km distance from one to the next and circumscribe an area approaching 32,000 km<sup>2</sup>. Ecology is diverse. At Mulu plants occur on well-drained domes in peat swamp forest over inundated Miocene Karst at about 60 m asl. The Tawau Hills population is in damper areas of *Shorea argentifolia* and *Tristaniaopsis*-dominated lowland kerangas over Pleistocene volcanics, between 200 and 320 m asl. The

collection from along the road from Kota Kinabalu to Tambunan occurs in permanently wet seepages of up-lifted Oligocene deepwater sediments in almost full sun, at about 1,500 m asl, with the plants forming extensive terrestrial colonies with the occasional stem climbing onto exposed wet rocks.

**Etymology** — The species epithet alludes to the tiny holes running beside both sides of the midrib.

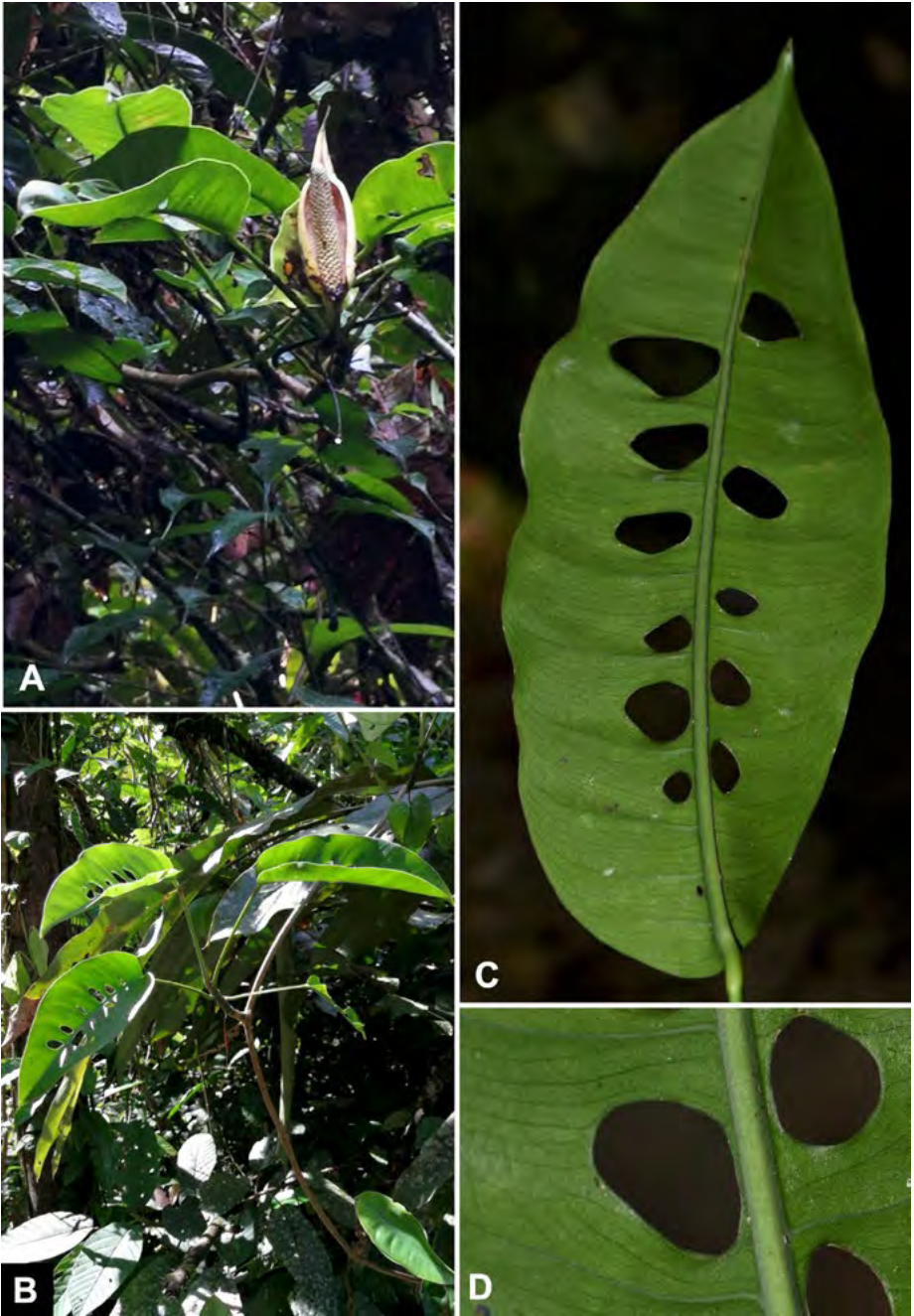
**Comments** — *Rhaphidophora microperforata* is immediately identifiable by the row of pin-holes running along both sides and parallel to the midrib. Examination of numerous leaves never resulted in finding these holes enlarging in the manner of those of *Rhaphidophora foraminifera*. From a distance *Rhaphidophora microperforata* could easily be confounded with some of the larger *Scindapsus* species such as *S. glaucescens* Alderw. or *S. latifolius* M. Hotta (the former is abundant and co-occurring at Mulu), or with the similarly scattered or rare but widespread *Epipremnum* [*Anthelia*] *falcifolium* Engl. Similar pin-holes occur in *Epipremnum pinnatum* which differs, among other characteristics, by the adult leaf blades pinnatifid to pinnatisect.

**Additional specimens seen** — MALAYSIAN BORNEO. **Sabah.** Tawau, Lahad Datu, Tawau Hills N.P., trail to Sulphur Spring Pool, 4°24'37.0"N 117°53'38.8"E, 320 m asl., 30 Dec 2018, *Wong S.Y. & P.C. Boyce AR-2951* (SAN, SAR). West Coast, Tuaran, Kota Kinabalu to Tambunan road, 5°50'38.7"N 116°19'37.8"E, 1508 m asl., 11 Oct 2019, *Wong S.Y., A. Hay & P.C. Boyce AR-3234* (SAN, SAR).

***Rhaphidophora muluensis*** S.Y.Wong & P.C.Boyce, **sp. nov.** — Type: MALAYSIAN BORNEO. Sarawak, Miri, Marudi, Long Lama, Mulu N.P., Kenyalang Trail, Bukit Kenyalang, 4°01'23.5"N 114°48'50.6"E, 88 m asl., 9 Dec 2018, *Wong S.Y. & P.C. Boyce AR-2917* ((holotype, SAR! + spirit!; isotype SING! + spirit!). **Figures 3 & 4.**

**Diagnosis.** *Rhaphidophora muluensis* is immediately distinguished by the single row of large somewhat irregular perforations on both sides of the midrib. The glabrous, glossy dark green leaf blades are most like those of *Rhaphidophora megasperma*, from which *R. muluensis* differs by solitary blooms (vs blooms three or more together) on rather elongated (vs very congested) lateral branches, and by its Karst obligation.

Moderately robust, semi-leptocaul, probably homeophyllous nomadic vine to 5 m; seedling stage not observed; pre-adult plants forming extensive terrestrial colonies; adult shoot architecture comprised of elongated, clinging or scandent, monopodial, leafy, non-flowering stems and short, loosely-branched, free, sympodial, sparsely leafy flowering stems; stems smooth, terete in cross section, glossy dark green with sparse prophyll, cataphyll and petiolar sheath remains, older sections smoothly corky pale brown, internodes to 10 × 1 cm on adherent shoots, shorter on free shoots, separated by conspicuous oblique leaf scars, older stems tending to be woody; flagellate foraging stems absent; clasping roots sparsely arising from the nodes of clinging stems, stout, pubescent; feeding roots few, attaching to suitable surfaces,



**Figure 3.** *Rhaphidophora muluensis*. (A) Flowering plant in habitat. (B) Climbing shoot with perforated leaf blades. (C). Leaf blade, abaxial view. (D). Detail of leaf blade perforations. Note the way that the veins are curved. All from AR-2917.



**Figure 4.** *Rhabdophora muluensis*. (A) Bloom in bud. (B). Bloom at late staminate anthesis. (C). Developing infructescence. All from AR-2917.



the active tip mucilaginous, remainder of root corky. *Leaves* spiro-distichous on adherent and free shoots; cataphylls and prophylls membranous, quickly drying and degrading into sparse fibres, and these soon falling; petiolar sheath membranous, extending to the distal geniculum, soon falling; petioles 13–21.5 cm long (climbing shoots), 10–15 cm long (flowering shoots), shallowly canaliculate to the tip, the angles blunt, with adhering fragments and strips of marcescent-degrading petiolar sheath, in older petioles angles corky-scarred, genicula well-defined on all leaves; proximal geniculum ca  $2.5 \times 1$  cm; distal geniculum ca  $2 \times 0.7$  cm; leaf blades up to  $28 \times 10$  cm (climbing shoots),  $15 \times 8$  cm (flowering shoots), thinly coriaceous, glabrous, dark glossy green adaxially, slightly paler abaxially, oblong-lanceolate or oblong-elliptic, often slightly falcate, single row of large somewhat irregular perforations on both sides of the midrib, base unequal with one side acute the other rounded to weakly truncate, apex acute with a brief (1.5 mm mucro); perforations round to rhombic, large, extending ca  $1/3$ – $1/2$  of lamina width on each side of the midrib; midrib rounded-raised abaxially, slightly sunken adaxially; primary lateral veins conspicuous, about 8 on each side, regularly alternating with less conspicuous interprimaries, arising at ca  $60^\circ$ , curving around the larger perforations; higher order venation forming a sinuous/weakly branching series of veins running more-or-less parallel to the primary laterals. *Bloom* solitary, subtended by a fully developed but undersized foliage leaf, smelling of stale beer; peduncle cylindric,  $5$ – $6 \times 1$  cm; spathe ca 13 cm long, stoutly rostrate with the rostrum to ca 3 cm long, wide-gaping at pistillate anthesis, opening and falling at late staminate anthesis, exterior very pale green in bud, medium yellow at anthesis, interior paler yellow, partially splitting from the spadix/peduncle insertion late in anthesis; spadix stoutly cylindrical, sessile, obliquely inserted onto peduncle, longer side 10 cm, shorter 9 cm, ca 1.6 cm in diam., creamy white; stylar region rounded-hexagonal,  $1.5$ – $2 \times$  ca 2.5 mm, stigma linear to almost punctiform on a conical stigmatophore (*sensu* Cedeño-Fonseca et al. 2022), lowermost ca 4 spirals of florets functionally sterile; anthers hardly exerted at anthesis; ripe infructescence not observed; developing infructescence with stylar plates rather swollen and rounded, white with black stigmatic remains.

**Distribution and ecology** — Known from a single population at Mulu, where the plants occur along the margins of open peat swamp forest over inundated Miocene Karst at about 90 m asl.

**Etymology** — From the type locality plus the Latin suffix, *-ensis*, to indicate ‘originating from’.

**Comments** — *Rhaphidophora muluensis* cannot be easily confused with any other Bornean species owing to the glabrous glossy dark green perforated leaf blades and straggling vining habit.

**Acknowledgements**

Fieldwork was most recently under Sarawak Forestry Department Permission to Conduct Research on Biological Resources — Permit No. (67) JHS/NCCD/600-7/2/107/Jld.2 and Park Permit No WL33/2019. The collaboration and support of the Sarawak Forestry Department and the Sarawak Biodiversity Centre are gratefully acknowledged. The second author extends his thanks to Tan Sri Datuk Amar Leonard Linggi Anak Jugah and Malesiana Tropicals Sdn Bhd for continued support and encouragement.

**REFERENCES**

- Boyce, P.C. (2001). The genus *Rhaphidophora* Hassk. (Araceae-Monsteroideae-Monstereae) in Borneo. *Gardens' Bulletin Singapore* 53(1): 19–74.
- Boyce, P.C. (2005). A new species of *Rhaphidophora* Hassk. (Araceae: Monstereae) from Borneo. *Gardens' Bulletin Singapore* 57: 211–216.
- Boyce, P.C. (2006). *Rhaphidophora tenuis* (Araceae: Monstereae) resurrected. *Gardens' Bulletin Singapore* 58(1): 1–5.
- Boyce, P.C. (2006). *Rhaphidophora crassifolia* (Araceae: Monstereae): a new record for Sarawak and notes on the *Rhaphidophora* 'Hongkongensis' group in Borneo. *Gardens' Bulletin Singapore* 58(1): 19–24.
- Cedeño-Fonseca, M., A. Hay & M.A. Blanco. (2022). A taxonomic revision of *Monstera* Adans. (Araceae: Monsteroideae) in Costa Rica. *Aroideana* 45(1): 4–198
- Wong S.Y. & Jyloerica J. (2021). Checklist of aroids (Alismatales, Araceae) from Sabah (Malaysian Borneo). *Check List* 17(3): 931–974.