Checklist of aroids (Alismatales, Araceae) from Sabah (Malaysian Borneo)

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Abstract

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Introduction
Scientific study of the flora of Sabah began with the earliest ascents of Mount Kinabalu by foreigners, beginning with Hugh Low in 1851 (Low 1852), the expedition of Low and Spenser St. John in 1858 (St John 1862, 1863), and the commercial collecting trips by Frederick Burbidge in 1877 and 1878 when Burbidge was joined by Peter Veitch for the first and for the second by a Mr Smith seconded to him by Andrew Boosie, the general manager of the Labuan coal mines (Burbidge 1880; Moulton 1915). The botanical discoveries of these early explorations, mainly *Rhododendron* L. and *Nepenthes* L., were written up by Joseph Hooker (1852, 1860). However, curiously except for Burbidge, none these ascents produced any aroid discoveries despite the abundance of family on the lower altitudes of the mountain range. Indeed, only three aroids, *Gamogyne burbidgei* N.E.Br., *Piptospatha insignis* N.E.Br., and what Burbidge assumed to be a second *Piptospatha* N.E.Br., are enumerated, with
none described from Sabah; *Gamogyne* N.E.Br. was described from Bukit Sagan in Sarawak (Brown 1882), while *Piptospatha insignis* (Brown 1879; Hooker 1881) was for 135 years from an unknown location until its rediscovery in Sarawak (Boyce and Wong 2013a). However, there exists in the Kew herbarium a sheet of notes in Burbidge’s hand, also cited by Brown (1882: 196), in which Burbidge explained that he discovered a second species (of *Piptospatha*) about 100 miles farther north than the *Gamogyne*, fringing the Dahombang and Kina Taki streams, near “Kina Balu”, but he lost both the living plants and herbarium specimens. This species was almost certainly *Ooia kinabalensis* (Bogner) S.Y.Wong & P.C.Boyce, which was eventually described in 1984, initially as a species of *Hottarum* Bogner & Nicolson, by Josef Bogner (1984).

The next botanical-focussed ascent of the mountain was in 1892 when George Haviland, at the time Curator of the Sarawak Museum in Kuching, accompanied by his cousin, spent two months on the mountain. Their collections formed the basis for Otto Stapf’s *On the Flora of Mount Kinabalu, in North Borneo* (Stapf 1894). Stapf’s paper lists only one aroid, *Gamogyne burbridgei*, based on a Burbidge collection from Paka Paka, a village on the road between Tuaran and Kota Belud. It seems extraordinary that Haviland, an acute field-observer, failed to collect any aroids during the two months he spent on the mountain, as his Sarawak collections contain numerous excellent specimens of Araceae.

From February 1910 Lilian Gibbs, accompanied by D.R. Maxwell, Assistant District Officer, of Kepel Province, spent three months botanizing Kinabalu from which Gibb’s remarkable 1914 publication, *A Contribution to the Flora and Plant Formations of Mount Kinabalu and the Highlands of British North Borneo* (Gibbs 1914) was the output. Just four species of Araceae were written up for Gibbs by Henry Ridley. One of these (*Arisaema simplicifolium* Ridley) was described as a new species and of the other three *Rhaphidophora peepul* (Roxb.) Schott was misidentified and later described by Furtado (1935) as *Rhaphidophora kinabalensis* Furtado [now *Scindapsus kinabalensis* (Furtado) Kartini & P.C.Boyce (Kartini et al. 2015b)], while *Schismatoglottis caulescens* Ridley, also misidentified, remains a mystery, as the material is inadequate to identify. The fourth, *Epipremnopsis huegelii* Engl. (*huegeliana* in Gibbs 1914), is a synonym of *Amyndrium medium* (Zoll. & Moritz) Nicolson. Thus, 63 years of botanical exploration in Sabah had logged only six aroid species in as many genera.

While exploration and collecting activity on the west coast made gradual progress, an agreement between the Philippine Bureau of Science and the Forestry Service of British North Borneo enabled the Bureau of Science collector Maximo Ramos to undertake 3½ months’ work in the lowlands in the vicinity of Sandakan in 1920 (Merrill 1922). A similar agreement already in existence with Sarawak (Merrill 1915) had greatly enabled the compilation of Elmer Merrill’s *A bibliographic enumeration of Bornean Plants* (Merrill 1921; upon which Masamune (1942) drew heavily), and, predictably, Merrill (1922a, 1922b) was soon active on the material Ramos collected, describing from among them two new aroids: *Pothos mirabilis* Merr. and *Schismatoglottis ferruginea* Merr.

Botanical exploration in Kinabalu continued in 1915 with the first visit to Kinabalu by the indomitable wife and husband team of Joseph and Mary Clemens. Although the Clemenses did collect some aroids, nothing was published until Furtado, based at Singapore, accompanied them to Kinabalu in 1932, and from which Furtado’s 1935 and 1939 *Araceae Malesicae I* and *II* were produced. Together these papers including the description of five new species for Sabah: *Homalomena gillii* Furtado, *H. kinabalensis* Furtado, *Pothos kinabalensis* Furtado, *Rhaphidophora kinabalensis* (now transferred to *Scindapsus* Schott; Kartini et al. 2015b), and *Schismatoglottis retinervia* Furtado. A sixth species, *Pothos borneensis* Furtado, was based on a Sarawak type and listed a Kinabalu collection as a paratype, but there remains doubt as to the identity of this rather poor specimen, although its placement in *Pothos* L. seems correct. By the onset of the Second World War the recorded Araceae flora of Sabah stood at 12 species in seven genera: *Amyndrium medium*, *Arisaema simplicifolium*, *Gamogyne burbridgei*, *Homalomena gillii*, *Homalomena kinabalensis*, *Pothos kinabalensis*, *Pothos mirabilis*, *Pothos ‘borneensis’* [identity remains unknown], *Rhaphidophora peepul* [now identified *Scindapsus kinabalensis*], *Schismatoglottis ‘caulescens’* [identity remains unknown], *Schismatoglottis ferruginea*, and *Schismatoglottis retinervia*. In addition, collections made by the Clemenses and by Furtado during his time with the Clemenses include specimens of what are now described species: *Nabalu corneri* (A.Hay) S.Y.Wong & P.C.Boyce, *Ooia kinabalensis*, and *Schismatoglottis ahmadii* A.Hay.

The war and the following upheavals led to a decline in botanical exploration until the 1960s when the Royal Geographical Society mounted their North Borneo Expedition in 1961 (Corner 1962). One result was good collections of the gargantuan *Schismatoglottis corneri* A.Hay (now *Nabalu corneri*; Hay and Yuzammi 2000; Low et al. 2018). Also, in the 1960s Kyoto University mounted a Borneo expedition that while mainly focusing on Sarawak (notably the Ulu Kakus and Mulu areas) and Brunei, also spent a few days in the Sandakan area (Hotta 1965). Of particular note for Araceae is that the Kyoto group included Mitsuru Hotta, who would be catalytic in revitalizing Araceae work in tropical Asia and would return to Kinabalu in 1968 and 1969 (Boyce 2015).

The start of current research activities in Sabah can be traced back to the late 1980s beginning with the description the spectacular *Amorphophallus lamii* Mayo & Widjaja (Mayo et al. 1982). A few years later, Alistair Hay began a remarkable and continuing

In the 1990s, Peter Boyce turned attention to various Bornean aroid genera including Epipremnum Schott (Boyce 1998), Rhaphidophora Hassk. (Boyce 2001), and Pothos (Boyce and Hay 2001), and participated together with Baharuddin Suleiman and Jain Linton in an expedition to the Crocker Range where at its northern extremity stands Mount Kinabalu (Boyce et al. 2002); their expedition resulted in a checklist expanding on that in Beaman and Beaman (1998). Also in the 1990s, Wilbert Hetterscheid began to publish on Amorphophallus Blume ex Decne., adding four species: Amorphophallus hottae Bogner & Hett., A. rugosus Hett. & A.L.Lamb, A. tinekeae Hett. & A.Vogel, and A. venustus Hett., A. Hay & J.Mood (Bogner and Hetterscheid 1992; Hetterscheid 1994; Hetterscheid and van der Ham 2001).

In the 2000s, Boyce was again joined by Baharuddin Suleiman in describing Homalomena galbana Baharuddin & P.C. Boyce from the remarkable Maliau Gorge (Baharuddin and Boyce 2010). A series of papers followed with Wong Sin Yeng and Kartini Saibeh describing new species of Homalomena Schott, Schismatoglottis Zoll. & Moritz, and Piptospatha primarily from central and east Sabah (Boyce and Wong 2013; Boyce et al. 2019; Kartini et al. 2015a, 2017, 2019, 2020; Wong et al. 2018, 2019), and Boyce with David Scherberich described an astonishing new ornamental Schismatoglottis (S. scintillans Scherberich & P.C. Boyce (Scherberich and Boyce 2013). Most recently a Sabahan, Jyloeria Joling has begun work on the aroids of Sabah for her M.Sc. research (Wong et al 2020a, 2020b), which includes the critical checklist presented here.

As molecular work clarifies relationships among aroid species and enables more critical analyses of generic boundaries, it becomes clear that some significant alterations are required to the taxonomy of aroids, notably in the Schismatoglottideae, a tribe that is particularly diverse and speciose on Borneo. One outcome pertinent to Sabah has been the recognition that Piptospatha (sensu Bogner and Hay 2000) is monotypic, and thus not recorded from Sabah, with the species previously assigned to Piptospatha actually belonging to Rhynchopyle Engl. (Low et al. 2018) and Ooia S.Y.Wong & P.C.Boyce (Wong and Boyce 2016), and that one species previously assigned to Aridarum as A. sabahense S.Y.Wong, S.L.Low & P.C.Boyce (Wong et al. 2014) in fact is a monotypic genus, now described as Taiwia S.Y.Wong, S.L.Low & P.C.Boyce (Low et al. 2018); additionally, the gigantic Schismatoglottis corneri, which is such a prominent feature of the west coast flora, is itself best accommodated in its own genus, Nabalu S.Y.Wong & P.C.Boyce. Thus, this paper provides an up-to-date checklist of Araceae in Sabah.

Study Area

The study was carried out in Sabah, which has an area of 73,371 km², in the northern part of Borneo. Sabah accounts for approximately 10% of Borneo’s total land area (Marsh and Greer 1992; Fig. 1). The altitude ranges from sea level up to 4095 m at the highest point on Mount Kinabalu. The average annual temperature ranges between 32 °C in the lowlands and 21 °C in the highlands. The mean annual rainfall is between 2500 mm and 3500 mm, with the highest rainfall occurring on Mount Kinabalu and in the Crocker Range (Juiling et al. 2020). Fifty-one distinct soil associations have been described based on differences in soil texture, nutrient availability, and drainage, and 19 distinct floristics associations are recognised within the State of Sabah (Sabah Forestry Department 2004). The lowland and upland areas with well-drained and moderately fertile to fertile soils are dominated by mixed dipterocarp forests. Kerangas (heath) forests are found on areas with podzolic soils in the lowland, upland, and montane regions. Freshwater swamp and peat swamp forests occur in the lowland on soils with an impeded drainage. Ultramafic forests are found on serpentine soils (Juiling et al. 2020). Lower montane forests occur on the moderate fertile soils at altitudes above 1000 m. This transition to upper montane forest occurs at an elevation of approximately 2500 m. It is replaced by subalpine vegetation at altitudes above 3500 m on the upper reaches of Mount Kinabalu (Sabah Forestry Department 2004). However, aroids are only found at below 1900 m elevation on Borneo (Boyce et al. 2010).

Methods

The checklist is based on observations of specimens from BORH, SAN, SAR, and SNP. Online herbarium
images from A, E, K, L, and P were also accessed. All specimens have been seen apart from duplicates deposited at AA, AAU, AAH, BO, BRUN, C, KEP, KRB, KYO, M, MO, NSW, PNH, SING, US, and UPM (Index Herbariorum 2020). Specimens without geographic coordinates were georeferenced using Google Earth and the Sabah Gazetter (Tangah and Wong 1995). An extensive literature search was carried out for species without specimens seen (indicated in species list below). For identifications, the following taxonomic treatments were consulted: Gibbs (1914), Furtado (1935, 1939), Nicolson (1969), Jacobsen (1985), Hay (1992, 1996, 1998), Bogner and Hetterscheid (1992), Boyce and Poulsen (1993), Boyce (1994, 1998, 1999, 2000, 2001, 2009), Hetterscheid (1994), Hetterscheid and Ittenbach (1996), Nguyen and Boyce (1999), Bogner and Hay (2000), Hay and Yuzammi (2000), Boyce and Hay (2001), Hetterscheid and van der Ham (2001), Gusman and Gusman (2006), Ahmad Sofiman and Boyce (2010), Baharudin and Boyce (2010), Boyce et al. (2010), Li and Landolt (2010), Boyce and Wong (2013), Wong et al. (2013, 2014, 2018, 2020a, 2020b), Kartini et al. (2015a, 2015b), Low et al. (2018), and Okada et al. (2020). All identified taxa were compared with the types. In the case that type material was absent, the database of digitized plants (JSTOR Global Plants) was consulted (Gallagher 2010). The descriptive terminology follows Mayo et al. (1997). The determination of terrestrial, epiphytic, and nomadic vine life forms was made using the classifications proposed by Croat (1988) and Zotz (2013). The distribution and ecological sections follow literature cited and notes on the specimens.

Results

Twenty-nine aroid genera are recorded for Sabah: Aglaonema Schott, Alocasia, Amorphophallus, Amydrium Schott, Anadendrum Schott, Arisaema Mart., Bucephalandra Schott, Colobogynium Schott, Colocasia Schott, Cryptocoryne Fisch. ex Wydler, Cyrtosperma Griff., Epipremnum, Gamogyne, Homalomena, Lasia Lour., Lemna L., Nabalu, Ooia, Phymatarum M.Hotta, PISTIA L., Pothis, Rhaphidophora, Purfsegloveia S.Y.Wong, S.L.Low & P.C.Boyce, Rhynchopyle, Schismatoglottis, Scindapsus, Spirodelia Schleid., Tawaia, Typhonium Schott, and Wolffia Horkel ex Schleid. The total number of described species and number of species yet to be described are 114 and 125, respectively (Table 1). Appendix Table A1 provides the list of aroid species in Sabah including the non-examined species in this study.
Table 1. List of genera, number of species described/endemic species, and novel species yet to be described per genus.

<table>
<thead>
<tr>
<th>Genus</th>
<th>No. of species described/no. of endemic species</th>
<th>No. of estimated new species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aglaonema Schott</td>
<td>2/0</td>
<td></td>
</tr>
<tr>
<td>Alocasia (Schott) G.Don</td>
<td>13/5</td>
<td></td>
</tr>
<tr>
<td>Amorphophallus Blume ex Decne.</td>
<td>5/4</td>
<td></td>
</tr>
<tr>
<td>Amynidrium Schott</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Anadendrum Schott</td>
<td>0/1--4</td>
<td>10</td>
</tr>
<tr>
<td>Arisema Mart.</td>
<td>3/1</td>
<td></td>
</tr>
<tr>
<td>Bucephalandra Schott</td>
<td>2/2</td>
<td>2</td>
</tr>
<tr>
<td>Celosioygnum Schott</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Colocasia Schott</td>
<td>2/1</td>
<td></td>
</tr>
<tr>
<td>Cryptocoryne Fisch. ex Wydler</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Cyrtosperma Griff.</td>
<td>2/0</td>
<td></td>
</tr>
<tr>
<td>Epipremnum Schott</td>
<td>2/0</td>
<td></td>
</tr>
<tr>
<td>Gamogynae N.E.Br.</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Hematolomena Schott</td>
<td>11/0</td>
<td>50</td>
</tr>
<tr>
<td>Laisia Lour.</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Lemna L.</td>
<td>3/0</td>
<td></td>
</tr>
<tr>
<td>Nubula S.Y.Wong &amp; P.C.Boyce</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Osaia S.Y.Wong &amp; P.C.Boyce</td>
<td>1/0</td>
<td>3</td>
</tr>
<tr>
<td>Phymatunum M.Hotta</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Platia L.</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Pothos L.</td>
<td>14/4</td>
<td>3</td>
</tr>
<tr>
<td>Rhaphidophora Hassk.</td>
<td>7/1</td>
<td>2</td>
</tr>
<tr>
<td>Purseglovea S.Y.Wong, S.L.Low &amp; P.C.Boyce</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>Rynochophyl Engl.</td>
<td>1/1</td>
<td>2</td>
</tr>
<tr>
<td>Schimatogensis Zoll. &amp; Montzi</td>
<td>24/20</td>
<td>50</td>
</tr>
<tr>
<td>Scindapsus Schott</td>
<td>8/1</td>
<td>3</td>
</tr>
<tr>
<td>Spirodelal Schied.</td>
<td>2/0</td>
<td></td>
</tr>
<tr>
<td>Taiwania S.Y.Wong, S.L.Low &amp; P.C.Boyce</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>Typhonium Schott</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Wolflia Hartel ex Schied.</td>
<td>1/0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114/50</td>
<td>125</td>
</tr>
</tbody>
</table>

Generic key to the Araceae of Sabah
(modified from Boyce et al. 2010; Low et al. 2018)

1a. Plants comprising small to minute, few-rooted or rootless, free-floating, thallus-like, leafless bodies ................................................................. 2

1b. Plants not as above. If free-floating, then leaves forming a conspicuous rosette with copious roots hanging beneath ................................................................. 4

2a. Roots 1–21 per plant body; plant body with 1–21 veins; the daughter plant bodies and inflorescences originating from 2 lateral pouches at the base of the plant body .................................................. 3

2b. Roots absent; plant body without veins; the daughter plant bodies originating from a single terminal pouch or cavity at the base of the plant body; inflorescence originating in a cavity on the plant body upper surface ........................................... Wolflia

3a. Roots (0–) 2–21 per plant body; plant bodies with (3–) 5–21 veins, surrounded at its base by a small scale (prophyll) covering the point of attachment of the roots .............................................. Spirodela

3b. Roots 1 per plant body; plant bodies with 1–3 veins, without a scale at the base ...................... Lemna

4a. Flowers bisexual each with a perigone of conspicuous tepals ........................................... 5

4b. Flowers bisexual without a perigone of conspicuous tepals, or unisexual ................................ 7

5a. Armoured helophytes .............................................. 6

5b. Climbing hemiepiphytes ...................................... Pothos

6a. Stems suffruticose, erect to decumbent, usually with prickly conspicuous internodes; leaves hastate to pinnatifid; spathe caducous, rarely marcescent; placation apical; fruit spinous ...

6b. Stem a condensed rhizome, rarely with distinct internodes, and these then unarmed; leaves entire, sagittate to hastate; spathe persistent to marcescent; placation not apical; fruit smooth ................................................................................. Cyrtosperma

7a. Flowers bisexual, perigone if present membranous and inconspicuous; mainly climbing hemiepiphytes, rarely raphophytic ............................................... 8

7b. Flowers unisexual .......................................................... 12

8a. Spathe in bud stout, short- to long-slud-pedunculate, not conspicuously long-beaked, if beak present then less than ½ length of entire spathes, opening with inside yellow, orange, greenish or white, only moderately waxy. Flowers naked. Infructescence a monsterocarp or, if with discrete berries, then these not truncate, and ripening white. Trichosclereids present (but sparse in Amydrium)................................................................. 9

8b. Spathe in bud slender, long-slud-pedunculate, conspicuously long-beaked (beak to ½ length of entire spathes), opening with inside greenish white or white and conspicuously glossy-waxy. Flowers with a membranous perigon of fused tepals. Infructescence with discrete, truncate berries ripening red or orange. Trichosclereids absent .................................................. Anadendrum

9a. Adult leaf leaf blade pinnate and conspicuously perforated. Higher order venation completely reticulate. Infructescence with discrete berries ripening white. Trichosclereids sparse ...

9b. Trichosclereids abundant (with many hair-like structures when leaf blade is broken). Higher order venation striate or reticulate ............................................. 10

10a. Ovules 2–6 or more, placation parietal. Fruits with more than 1 seed ..................................... 11

10b. Ovules solitary, placation basal. Fruits with a solitary seed .................................................. Scindapsus

11a. Ovules 8 or more, superposed on 2 (rarely 3) parietal placentas. Seeds many, ellipsoid, straight, 1.3–3.2 mm long, 0.6–1 mm wide; testa brittle, smooth ........................................... Rhaphidophora

11b. Ovules 2–4 (–6) at base of a single intrusive placenta. Seeds few, curved, 3–7 mm long, 1.5–4 mm wide; testa bony and ornamented .......... Epipremnum...
12a. Free-floating plants with leaves forming a conspicuous rosette, with copious roots hanging beneath ................................. Pistia
12b. Not so .................................................. 13
13a. Leaf blades ........................................... 14
13b. Leaf blades simple, ranging from linear-lanceolate to hastate ................................................................. 15
14a. Leaf blades decomposed. Inflorescences appearing before leaf emergence, with flowers of both sexes ........................................... Amorphophallus
14b. Leaf blades trifoliolate to pentalophiolate. Inflorescences produced with leaves, single-sexed ................................. Arisaema
15a. Aquatic plants. Inflorescences composed of dehiscent carpels ......................... Cryptocoryne
15b. Plants not aquatic. Inflorescences composed of berries ................................................................. 16
16a. Plants suffruticose. Fruits conspicuous red or pink berries not surrounded by a persistent spathe ................................................................. 17
16b. Plants not suffruticose. Fruits various, if red or orange red berries then surrounded by a persistent spathe ................................................................. Aglaonema
17a. Entire spathe closing after anthesis and then persisting until fruit maturity, basally circumcissect to release fruits ................................. Homalomena
17b. Upper spathe mostly shedding during or soon after anthesis, and lower spathe persisting until fruit maturity and then splitting basipetally to release fruits; if upper spathe persisting then attached portion of petiolar sheath very short and the remainder free-ligular or absent and the protective role taken on by prophy/cataphyll ............ 18
18a. Stamineate flowers forming synandria ................................ 19
18b. Stamineate flowers not forming synandria ................................ 20
19a. Inflorescences erect, fruits medium-sized, ripening orange-red, odourless ......................... Alocasia
19b. Inflorescences pendent, fruits small, ripening yellowish brown, smelling variously of overripe fruit or vomit ..................................................... Colocasia
20a. Tuberosous-stemmed geophytes. Sterile flowers between the stamineate and pistillate flower zones filamentous and tanged. Spadix with a long, naked appendix ................................................. Typhonium
20b. Mesophytes, rheophytes, lithophytes and chasmophytes with stems never tuberous. Sterile flowers between the stamineate and pistillate flower zones if present never filamentous and tanged. Spadix appendix, if present, never naked .................. 21
21a. Wings of petiolar sheath fully or almost fully attached to the petiole; seeds never with a micropylar appendage ............................................ Schismatoglossis
21b. Wings of petiolar sheath always extended into a free ligular portion; seeds sometimes with micropylar appendage ............................................ 22
22a. Thecae with needle- or horn-like extensions from tips of which pollen is extruded as a droplet ................................................................. 23
22b. Thecae without needle- or horn-like extensions; thecae surface flat or with a deep pit; pollen extruded in powdery masses or as strings ........................ 26
23a. Spathe limb separated from lower spathe by an abrupt constriction; stamineate flowers and staminodes conspicuously tuberculate; interstice staminodes static, closely resembling stamineate flowers; fruiting spathe urceolate, actively splitting to reveal fruits .................................................... Phymatarum
23b. Spathe not or only very faintly constricted; stamineate flowers and staminodes smooth or only weakly tuberculate; interstice staminodes motile, flattened, dissimilar to stamineate flowers; fruiting spathe a tubular, salverform or funneliform splash-cup ........................................................................ 24
24a. Inflorescence nodding; inflorescence erect by post-anthesis flexing of peduncle, or pendulous .................................................................. Tawaia
24b. Inflorescence and inflorescence erect .................. 25
25a. Interstice staminodes (if present) static, deciduous post-anthesis; stamen connective expanded on the distal side into a conspicuous rim ....................................................... Purseglovea
25b. Interstice staminodes shield-like, erect during pistillate anthesis, reflexing during stamineate anthesis, persisting post-anthesis, becoming photosynthetic, and functioning to seal orifice of splash-cup and protect developing fruits; stamen connective not expanded into a conspicuous rim ....................................................... Bucephalandra
26a. Massive arborescent pachychaual to ca. 4 m tall; peduncle very stout, to ca. 45 cm long, 3 cm thick, apically down-turned so inflorescences abruptly pendulous; spathe to 36 cm long; spadix ca. 29 cm long; stamineate and pistillate flower zones contiguous ........................................ Nabalu
26b. Not this combination ........................................ 27
27a. Shoot modules monophyllous; petiolar sheath reduced to a very short collar; persistent lower spathe splitting at peduncle/spathe insertion, spathe walls curling acroscopically to release fruits .................................................................. Colobogynium
27b. Shoot modules polyphyllous; petiolar sheath extensive; persistent lower spathe splitting at the top or middle, spathe walls curling basiscopically or medi-oscopically to release fruits, or forming a splash-cup or a non-splitting tubular structure with a restricted orifice ........................................ 28
28a. Pistillate flowers connate, berries forming a syncarpium .................................................. Gamogynae
28b. Pistillate flowers free, berries free .......................... 29
29a. Entire spadix axis persistent until after fruit dispersal; spent flowers individually shedding to leave conspicuous scars .................................. *Ooia*

29b. Pistillate portion of spadix persistent after anthesis, rest of axis shed .......................... *Rhynochopyle*

**Aglaonema nitidum** (Jack) Kunth

**Material examined.** MALAYSIA – Pedalaman • Beaufort, Kuala Penyu, Kepayan, Kampung Memalad; 05°27′40″N, 115°28′33″E; 50 m elev.; 1 December 1999; Diwol S. SAN 89424 (SAN) • Keningau, Kitai, Sungai Tumpason; 05°29′33″N, 116°16′25″E; 7 September 1982; Amin SAN 95339 (SAN) • Keningau, Sungai Apin-api; 05°29′28″N, 116°15′46″E; 19 February 1998; Diwol S. SAN 135342 (SAN) • Keningau, Ulu Senagang; 05°21′05″N, 116°01′26″E; 558 m elev.; 19 May 2010; Markus SAN 151903 (SAN) • Pensiangan, Pensiangan Utara, Kampung Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 25 October 1996; S. P. Lim 1537 (SAN) • Pensiangan, Sapulut, Bantu Punggul; 05°08′26″N, 118°08′03″E; 28 January 1993; Fidilis Krispinus SAN 135784 (SAN) • Sipitang, Ranau, Pantai Barat; 04°59′43″N, 115°41′04″E; 229 m elev.; 17 March 2011; J. T. Pereira SAN 135510 (SAN) • Tenom, Bukit Tenom; 05°07′20″N, 115°56′39″E; 23 January 1964; W. Meijer SAN 41164 (SAN) • Tenom, Ulu Kalang Forest Reserve; 05°49′43″N, 115°55′42″E; 683 m elev.; 6 March 2018; Alviana D. SAN 158869 (SAN) • Tenom, Ulu To, Kampung Kaaang, 3 Miles from Kampung Kaaang; 05°09′14″N, 115°56′39″E; 14 June 1979; Leopold M. SAN 90849 (SAN) • Pantai Barat • Penampang, Moyog along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53113 (SAR, MO) • Ranau, Sungai Nabutan; 05°52′21″N, 116°19′13″E; 23 March 1982; Aban G. SAN 94574 (SAN) • Kudat • Pitas, Hutan Simpan Paitan; 06°23′35″N, 117°25′11″E; 15 May 1987; George & Amin SAN 121275 (SAN) • Sandakan • Beluran, Sungai Gutu; 06°14′01″N, 117°19′04″E; 2 October 1961; W. Meijer SAN 27611 (SAN) • Kinabatangan, Sukau, Pangi Forest Reserve, Temagong Besar Hil; 05°31′38″N, 116°18′54″E; 18 September 1999; S. P. Lim 1242 (SAN).

**Identification.** This species is characterized by the leaf blade without conspicuous venation and not variegated; petiolar sheaths are long with scarious sheath margins. The spathe of the inflorescence is persistent until late fruiting (Nicolson 1969).

**Distribution and ecology.** Widespread in Sabah. Lowland to upper hill evergreen gallery forest, peat-swamp forest.

**Aglaonema simplex** Blume

**Material examined.** MALAYSIA – Pedalaman • Beaufort, mile 62% rail-line; [05°19′07″N, 115°47′50″E]; 22 March 1962; George Mikil, SAN 34539 (SAN) • Pensiangan, Batu Urd and shaded limestone rocks; 04°46′04″N, 116°38′05″E; 9.144 m (30 ft.) elev.; 20 May 1997; Kiew RK 4446 (SAN) • Pensiangan, Pensiangan Utara Sub District, Kampung Pun Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 24 October 1996; Lim S. P. et al., LSP 1522 (SAN) • Sipitang, Mile 22, Masapol Forest Reserve; 05°10′29″N, 117°09′13″E; 60.96 m (200 ft.) elev.; 20 March 1966; Francis Sadan SAN 50333 (SAN) • Sipitang, Ulu Meligan Forest Reserve, South-East Meligan Forest Reserve, 04°34′26″N, 115°37′22″E; 1570 m elev.; 9 April 2002; Lim S. P., Postar M. & Petrus B., SAN 154530 (SAN) • Tambunan, Rafflesia Forest Reserve, trail behind the arboretum garden, lower montane forest; 05°46′42″N, 116°20′28″E; 1249 m elev.; 13 May 2011; Suzana et al., SAN 153703 (SAN) • Pantai Barat • Ranau, Mount Kinabalu, Dallas; [06°05′30″N, 116°32′45″E]; 1524m elev.; 25 October 1931; Clemens & Clemens 26820 (L) • same locality; 1524 m elev.; 3 March 1932; Clemens & Clemens 29133 (L) • Ranau, Sungai Pandiruan west of Kg. Pinawantai, [06°09′44″N, 116°45′06″E]; 548.64 m elev.; 10 May 1973; G. Shea & Aban, SAN 76893 (SAN) • Ranau, Penibukan (Bhadaadoi), Sungai Tahubang, Forest; [06°00′15″N, 116°33′00″E]; 1000 m elev.; 11 March 1970; Nooteboom & Aban HP 1544 (SAN) • Kudat • Banggi Island, Sabor; [07°13′59″N, 117°13′04″E]; 121.92 m (400 ft.) elev.; 27 August 1964; Ampuria SAN 42149 (SAN); about 1 ½ miles south-east of Kampung Bawing on Bengkoka Peninsula, [06°35′03″N, 117°01′06″E; 60.96 m (200 ft.) elev.; 12 September 1972]; G. Shea & Minjulu SAN 76095 (SAN) • Sandakan • Beluran, Bidu-bidu Forest Reserve, Bangau-bangau River, along the Bangau-bangau River; 05°49′17.2″N, 117°22′19″E; 27 March 2009; Suzana et al., SAN 150035 (SAN) • Beluran, Botitian Forest Reserve, primary forest, 06°00′51″N, 117°19′39″E; 44 m elev.; 21 February 2014; Nur Adillah et al., SAN 156339 (SAN) • same locality; 55 m elev.; 21 February 2014; Nur Adillah, Aloysius & Tawadong SAN 156328 (SAN) • Beluran, Bukit Lumisir, primary forest; 05°40′38″N, 117°11′48″E; 2 February 1982; Abd. Rahim et al., SAN 92968 (SAN) • Beluran, Karamuak, Mount Tawai Forest Reserve, primary forest, hill side; 05°33′38″N, 117°08′58″E; 137.16 m (450 ft.) elev.; 27 July 1978; Diwol S. & Alexius M. SAN 88687 (SAN) • Beluran, Sapi Forest Reserve, Sungai Munyed, logged over area; 05°44′05″N, 117°24′09″E; 14 March 1975; Leopold M. SAN 81469 (SAN) • Beluran, Sugut, 4 miles South of Gunong Mabauk; 06°29′17″N, 117°07′47″E; 16 October 1975; P. F. Cockburn SAN 82520 (SAN) • Kinabatangan, Penangah Forest Reserve, step of hill; 05°01′15″N, 116°10′45″E; 27 April 1987; Joseph & Donggop SAN 119085 (SAN); Sepilok Forest Reserve, Mangrove Trail, lowland dipterocarp forest; 05°49′36″N, 117°57′04″E; 60 m elev.; 6 September 2006; Diwol S. et al., SAN 110746 (K, L, KEP, SAN) • Kinabatangan, Sungai Imbak Forest Reserve, mixed dipterocarp forest across the Sungai Imbak, NE of base camp; 05°06′17″N, 117°02′18″E; 9 June 2000; J. T. Pereira, R. Nilus, Sidkan A., Postar M. et al., JTP 788 (SAN) • Kinabatangan,
Tabin Wildlife Reserve, 200m south of Kuala Burong, limestone hill; 05°50′N, 116°15′E; 40 m elev.; 26 October 2000; A. D. Poulsen, Ruth Kiew, Hj. Suleiman, Johan & Yesri, ADP 1707 (AAU, BORH, K, KEPI, SAN) • Sandakan, Gomantong; [05°31′52″N, 118°04′17″E]; 152.4 m (500 ft.) elev.; 14 February 1960; W. Meijer SAN 20758 (SAN) • Sandakan, Kabili Forest Reserve, Bird Trail, ca. 500 m behind the Orange Utan Rehabilitation Centre Office; 04°35′03″N, 116°54′20″E; 15 April 2014; Suzana et al., SAN 156145 (SAN) • Sandakan, Kubun Cina; 05°51′04″N, 118°03′47″E; 21 May 1990; W. Meijer SAN 111233 (SAN) • Sandakan, Labuk Road, Labuk Road Mile 45, in primary forest; [05°41′57″N, 117°36′12″E]; 16 October 1965; A. Kanis SAN 53906 (SAN) • same locality; 1 January 1965; J. Singh SAN 48413 (SAN) • Sandakan, Segalind Lokan, Labuk Road, Mile 45, Labuk Road; [06°N, 117°E]; 30.48 m (100 ft) elev.; 24 June 1974; W. Meijer SAN 44011 (SAN) • Sandakan, Sepilok Forest Reserve, 14 miles west of Sandakan; [06°04′00″N, 116°27′00″E]; 21 November 1986; P. C. Welzen 924 (L) • Tawau, Kuala Lumpur, Sungai Kunatong; [05°10′29″N, 117°09′13″E; 76.2 m (250 ft.) elev.; 13 October 1973; Madani SAN 76335 (SAN) • Tongod, Lamag, road trace from Kg Kurat to Karamuak, Sungai Kunatong; [05°N, 115°45′E]; 91.44 m (300 ft.) elev.; 10 September 1973; Madani SAN 76335 (SAN) • Tongod, Lamag, road trace from Kg Kurat to Karamuak; 05°N, 115°45′E; 26 June 1975; Dongoop & Gambio SAN 81753 (SAN) • Tongod, Pinangah, Imbak, Imbak river camp 1; 05°10′29″N, 117°09′13″E; 200 m elev.; 3 July 2000; de Wilde, Tajuddin & Postar SAN 143976 (K, NSW, SAN) • Tongod, Pinangah, Ulu Sungai Melikop, Mile 5 Lobou Road; 04°45′N, 116°30′E; 31 May 1985; Diwol & Langkop SAN 109297 (SAN) • Tongod, Sungai Imbak Forest Reserve, Sungai Imbak Scientific expedition, Virgin Jungle Reserve; 05°08′57″N, 117°13′05″E; 132 elev.; 7 April 2014; Suzana et al., SAN 156487 (SAN) • Tongod, Telupid, Labuk-Sugut, 75 m by Telupid airstrip, forest on sand; [05°36′18″N, 117°05′00″E]; 75 m elev.; 19 January 1976; P. F. Stevens et al., PFS 550 (SAN) • Tongod, Telupid, Pinangah Forest Reserve, 4°58′41″N, 116°52′11″E; 13 February 1985; Diwol & Mansus SAN 68007 (SAN) • Tongod, Telupid, Tungkulp, Tawai Forest Reserve, lowland mixed dipterocarp forest; 04°58′41″N, 116°52′11″E; 103.632 m (304 ft.) elev.; 21 October 2004; John B. S. SAN 119245 (SAN) • Tongod, Telupid, VJR Ulu Sungai Sapapayau, at riverbank of Merah River, Lideh Sobal; 5°30′00.0″N, 118°30′00.0″E, 15 October 1985, Lideh S. SAN 109521 (SAN) – Tawau • Lahad Datu, Madai-Batourong Forest Reserve, Madai Hill; 04°41′18″N, 118°15′15″E; 1 January 1996; S. P. Lim, R. Kiew & Mail LSP 690 (SAN) • Lahad Datu, Sapagaya VJR, Ultramafic, near rocky stream; 04°58′11″N, 118°05′10″E; 253 m elev.; 16 February 2012; Suzana et al., SAN 151431 (SAN) • Lahad Datu, Silam; [04°57′30″N, 118°10′02″E]; 9.144 m (30 ft.) elev.; 27 September 1963; Agam B. Abdullah SAN 37167 (SAN) • Lahad Datu, Tabin Wildlife Reserve, Lipad Mulvucano Virgin Jungle Reserve; 05°14′30″N, 118°50′16″E; 3-7 November 1998; Fin Borchsenius FB 587 (BORH, SAN) • Lahad Datu, Tabin Wildlife Reserve, near Wildlife Department’s Headquarter, in selective mixed dipterocarp forest; 05°51′28″N, 116°58′37″E; 150 m elev.; 24 February 2000; Kjeldsen, Poulsen & Magintan H. K. Kjeldsen 38 (SAN) • Lahad Datu, Ulu-Segama Malau Forest Reserve, KM 79 Compartment 96, beside Bukit BRL; 05°03′10″N, 117°44′54″E; 320 m elev.; 14 February 2012; Suzana et al., SAN 154617 (SAN) • Lahad Datu, Ulu-Segama Malau Forest Reserve, Merisuli VJR, around the cave area, limestone; 05°08′26″N, 118°08′03″E; 186 m elev.; 17 February 2012; Suzana et al., SAN 151840 (SAN, SAR, SAN) • Semporna, Mile 1/4 Agri. Station, primary forest; 05°18′28″N, 117°04′23″E; 10 June 1962, J. Singh SAN 26319 (K, L, SAN) • Tawau, Bukit Gemuk Forest Reserve, rocky forest; 04°18′00″N, 117°52′00″E; 20 October 1985; Madani & Sigin SAN 111556 (SAN) • same locality; 28 June 2006; Julia S. et al., SAN 147143 (SAR, KEPI) • Semporna, Segarong Forest Reserve, limestone hill; [04°34′05″N, 118°25′24″E]; 60 m elev.; 26 August 1938; Keith, H. G. Keith 9419 (L) • Tawau, Kalabakan, Gunung Rara, Trail to Cave Batu Timbang, mixed dipterocarp forest; 04°58′31″N, 117°08′55″E; 237 m elev.; 12 March 2015; Suzana et al., SAN 157129 (KEP, SAN) • Tawau, Lembah Danum, Borneo Rainforest Lodge, gully near Lembah Danum; 05°01′10″N, 117°44′48″E; 1 March
1992; E. J. F. Campbell Gasis EG 316 (SAN) • Tawau, Mount Mullersdorf Forest Reserve, around the Teck Guan Quarry, limestone; 04°24’03″N, 115°00’53″E; 91 m elev.; date unknown; Nadiah et al., SAN 149140 (K, KEP, SAN) • Tawau, Tawau Hills Park, along the trail to Gelas Hill Trail; 04°23’N, 117°53’E; 272 m elev.; 29 June 2006; Suzana, S. with Joel D., & Cornelia L. SAN 147276 (KEP, SAN, SAR).

**Identification.** This species is distinguished by the leaf blade with strongly impressed (Nicolson 1969). The spathe is caducous, a day post anthesis (Chai and Wong 2019).

**Distribution and ecology.** Widespread in Sabah. Primary or secondary forests in ravines or damp places. It rarely occurs over 1500 m elev. but has been reported at “7000 feet” (over 2000 m elev.) on Mt. Kinabalu (Nicolson 1969).

*Alocasia cuprea* (C.Koch & Bouché) C.Koch

*Figure 2A*

**Material examined.** MALAYSIA – Pendalaman • Sipit-tang, Long Hoare & Pengiran Mio, hill across river to E. of village, 04°26’04″N, 115°44’50″E; 13 September 2000; A. D. 295 (SNP) • Tenom, Rafflesia site, TBC, Mosolog river, trail to Rafflesia site; 05°17’04″N, 116°01’38″E; 640 m elev.; 18 February 2003, Yabainus J., Kinahim S., & Joseph KNP 17802 (SNP) • Tenom, Ulu Senagang, TBC, Ulu Senagang, Trail to Rafflesia Site; 05°20’32″N, 116°01’53″E; 680 m elev.; 18 February 2003; Yabainus J., Kinahim S., & Joseph, SP 17818 (SNP) – Pantai Barat • Ranau, Pumpung Bundu Tuhan, Kampung Himbaan, Telupak; 05°57’26″N, 116°32’45″E; 8 January 1994; Doi-nis S., 689 (SNP) • Ranau, Kinabalu Park, Expidisi Mt. Tombuyukon, Wuluh Camp; 06°05’30″N, 116°32’45″E; 400-500 m elev.; 9 October 2009, Yabainus J. KNP 17339 (SNP) • Ranau, Mount Kinabalu, Marai Parai, 06°05’30″N, 116°32’45″E; 610 m elev.; 1985; Argent G. C. G. Argent, s.n. (K) • same locality, cultivated in glasshouse at Royal Botanic Gardens; Sydney; 610 n elev; September 1996-February 1998; C. Herscovitch s.n. (K, KEP L, SAN) – Sandakan • Kinabatangan, Maliau Basin, Gunung Rara Forest Reserve, 2.5 KM above Maliau Falls; 04°30’00″N, 116°45’00″E; 14 April 1996; A.Hay et al., A.Hay 12092 (SAN) – Tawau • Tawau, Ephil-stone Province; [04°18’00″N, 117°54’00″E]; October 1922 to March 1923; Elmer A. D. E. Elmer 20471 (L) • Tawau, Tawau Hills Park, lowland garden; 04°24’04″N, 117°53’24″E; 250 m elv.; 18 January 2007; Yabainus J., KNP 13338 (SNP).

**Identification.** Leaves of *A. cuprea* are subtended by two marcescent reddish brown cataphylls. The leaf blades are distinctive with bullate between the main veins, adaxially glossy bronze-green but abaxially deep purple. *Alocasia cuprea* has long been considered as one of the most spectacular and bizarre foliage plants in the genus and is a parent of several interspecific horticultural hybrids (Hay 1998).

**Distribution and ecology.** Endemic to Sabah. On slopes in rain forest, over a wide variety of substrates including ultramafics and sandstone, ca. 40–1500 m elev.

*Alocasia longiloba* Miq.

**Material examined.** MALAYSIA – Pantai Barat • Ranau, Mount Kinabalu; 06°05’30″N, 116°32’45″E; 3 June 1981; Buxton 352 (M) – Sandakan • Sandakan, Sepilok Forest Reserve, cultivated at Royal Botanic Gardens, Sydney. Acc. No. 960519, 05°19’N, 118°45’E; 23 April 1996; A. Hay 12153 (K, KEP, L, SAN) • Sandakan, Sepilok Kabili Forest Reserve, Kerangas forest; 04°26’56″N, 117°10’26″E; 156 m elev.; 12 October 2018; Khoo & Mari-tin SAN 159607 (SAN) – Tawau • Lahad Datu, Sungai Kapur; 05°20’04″N, 118°56’09″E; 72 m elev.; 20 March 2012; Sugau J. B. & Markus G. SAN 154915 (SAN).

**Identification.** Hay (1998) treats *A. longiloba* as an ophlospecies (species which exhibits a complex pattern of variation among its members but is not separable into distinct subspecific groups of several peak variants). The complex is distinguished by a triangular leaf blade (two to three times as long as broad). The leaf blade may be plain mid-green throughout to adaxially dark green and abaxially rich purple, often adaxially with the major veination white to pale grey-green.

**Distribution and ecology.** In perhumid tropical forest and regrowth storey, on boulders in forest and on exposed cliffs and ravines at low to medium elevation.

*Alocasia macrorrhizos* (L.) G.Don

**Material examined.** MALAYSIA – Pedalaman • Tenom, Sungai Rayoh Forest Reserve, 5°11’40″N, 115°52’50″E; 53 m elev.; 8 March 2018; Alviana et al. SAN 158800 (SAN) – Sandakan • Sandakan, Kg. Pukat, Leila Road; [05°49’52″N, 118°05’10″E]; 6 January 1950; Kadir Abdul A 2698 (SAN).

**Identification.** *Alocasia macrorrhizos* is a cultigen (Hay 1998) and is not known from wild. It has evidently been distributed widely in tropical Asia in prehistoric times as a subsistence crop and is now pantropical by introduction as an ornamental (Hay 1998). The species is a massive pachycaul with the stem is either decumbent or erect. The leaf blades are ovato-sagittate, bluntly triangular in general outline, held more or less erect with the posterior lobes ca. ⅓–⅔ the length of the anterior lobe. Inflorescences are paired among the leaf bases.

**Distribution and ecology.** Widespread in Sabah. Roadsides, waste places, gardens, mostly in wet sites at low to medium elevation. It is highly doubtfully native except perhaps in the far east of Sabah, elsewhere it is certainly a long-established ruderal escape.

*Alocasia melo* A.Hay, P.C.Boyce & K.M.Wong

*Figure 2B*

**Material examined.** MALAYSIA – Sandakan • Beluran, Porog, westside of Bidu-Bidu Hills near Kubar Labuk; [05°49’48″N, 117°14’29″E]; 152.4 m (500 ft.) elev.; 1
June 1964; W. Meijer SAN 41241 (SAN) • Tongod, Gunung Tingkar; 05°18′00″N, 117°07′45″E; 6 April 1996, A. Hay, Lim & Ahmad A. Hay 12001 (NSW, SAN) • Tongod, Pinangah Forest Reserve; Dewol Sundaling et al., 04°44′50″N, 116°36′53″E; 200 m elev.; 8 December 2004; SAN 113650 (SAN).

**Identification.** Highly ornamental. The finely and strongly rugose adaxial leaf surface of *A. melo* seems unique in the genus (Hay 1998).

**Distribution and ecology.** Endemic to Sabah. Rainforest on ultramafic rock, in rock crevices and on thin soil along steep banks of fast-flowing streams, at elevations of 120–400 m elev.

**Alocasia pangeran A.Hay**

Figure 2C

**Material examined.** MALAYSIA – Sandakan • Lahad Datu, Madai Caves, Cult. RBG Sydney, Acc. No. 960509; 400 m elev.; Hay et al. 12175 (isotype SAN).

**Identification.** *Alocasia pangeran* is distinguished from *A. princeps* W.Bull by its calcicolous lithophytic habit, smaller stature, more slender inflorescence, relatively longer lower spathe and lax interstice. *Alocasia pangeran* coexists with the terrestrial *A. wongii* A.Hay and the lithophytic *A. puteri* A.Hay at Madai Caves (Hay 1998).

**Distribution and ecology.** Endemic to Sabah, known only from Madai Caves. In soil and humus pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest at ca. 400 m elev.

**Alocasia princeps W.Bull**

**Material examined.** MALAYSIA – Pedalaman • Sipitang, Upper Sungai Miu near Mount Muruk Miu, Lower Montane Oak–Chestnut Forest; 04°21′57″N, 116°50′01″E; 1300 m elev.; 13 April 2000; S. P. Lim, Postar & Markus SAN 143225 (SAN) • Pantai Barat • Penampang, Moyog, W slopes of Crocker Range; 05°50′N, 116°15′E; 1000 m elev.; 26 September 1981; T. B. Croat 53102 (MO, SAR) • Sandakan • Madai Caves; 04°43′45″N, 118°08′E; 400 m elev.; 25 April 1996, A. Hay 12178 (K, L).

**Identification.** *Alocasia princeps* W.Bull by its calcicolous lithophytic habit, smaller stature, more slender inflorescence, relatively longer lower spathe and lax interstice. *Alocasia princeps* coexists with the terrestrial *A. wongii* A.Hay and the lithophytic *A. puteri* A.Hay at Madai Caves (Hay 1998).

**Distribution and ecology.** Endemic to Sabah, known only from Madai Caves. In soil and humus pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest at ca. 400 m elev.

**Alocasia puteri A.Hay**

**Material examined.** MALAYSIA – Pedalaman • Kuuk, Madai Caves; 04°43′45″N, 118°08′E; 400 m elev.; 25 April 1996, A. Hay 12178 (K, L).

**Identification.** *Alocasia puteri* occurs together with and in the same habitat as *A. pangeran* and can be differentiated by the bright green leaf colour (unusual for this species group), the broader posterior lobes, more upright petiole, a tendency for the leaves to be peltate in subadult plants, and by lacking a sterile interstice of the appendix (Hay 1998).

**Distribution and ecology.** Endemic to Borneo: Sabah and East Kalimantan. Confined to limestone; growing in soil pockets on limestone outcrops and boulders under mixed lowland dipterocarp forest, at ca. 600 m elev.

**Alocasia reginula A.Hay**

**Material examined.** MALAYSIA – Tawau • Lahad Datu, Tabin Wildlife Reserve KM 16 on road Headquarters area; 05°11′28″N, 118°37′06″E; 1219 m elev.; 11 March 1933; Clemens & Clemens 32095 (L) • Ranau, Mount Kinabalu, Plants of B.N. Penibukan; [06°7′, 116°35′E]; 1219 m elev.; 11 March 1933; Clemens & Clemens 32095 (L) • Ranau, About 3 miles NW of Kampung Pinawantai; [06°11′27″N, 116°44′54″E]; 1371.6 m (4500 ft.) elev.; 1 May 1973; G. Shea & Aban SAN 76586 (SAN) • Kudat • Pulau Balambang, limestone hill slope; 04°34′37″N, 118°15′05″E; 6.096 m elev.; 9 April 1977; collector unknown SAN 86716 (SAN) • Sandakan • Beluran, Nangoh, on hill top; 05°59′10″N, 117°16′33″E; 5 December 1983; Rahim Nawi SAN 101765 (SAN) • Kinabatangan, Tiber Forest Station, cultivated in Glasshouse at Royal Botanic Gardens, Sydney; 04°30′N, 116°45′E; 350 m elev.; 21 April 1996; wild collection, A. Hay 12140 (K, KEP, L, SAN, US) • Kinabatangan, Gua Batu Puteh, wild collection, a duplicate of NSW 425717, ACC 95035; 04°38′53″N, 116°36′54″E; date unknown, A. Hay 10015 (K, L, SAN).

**Identification.** *Alocasia princeps* is distinguished by the leaf blade leathery but not subsucculent that is dark green and shining at least when young (Hay 1998).

**Distribution and ecology.** Widespread in Sabah. In rainforest generally on well-drained slopes and ridgetops, on a variety of substrates including basalt and limestone, from more or less sea level to ca. 1200 m elev.

**Alocasia principiculus A.Hay**

**Figure 2D**

**Material examined.** MALAYSIA – Sandakan • Gomantong Cave; [05°31′52″N, 118°04′17″E]; 15.24 m (50 ft.) elev.; 27 September 1948; Austin Cuadra A. 1489 (isotype, SAN).

**Identification.** *Alocasia principiculus* differs from all the *A. princeps* complex in its small overall size, grey-green, thin, leathery leaves, relatively long peduncles, and the male zone is held entirely within the lower spathe chamber (Hay 1998).

**Distribution and ecology.** Endemic to Borneo: Sabah and East Kalimantan. Confined to limestone; growing in soil pockets on limestone outcrops and boulders under mixed lowland dipterocarp forest, at ca. 600 m elev.
very dark matt green and the abaxial is paler and flushed purple (Hay 1998).

**Distribution and ecology.** Endemic to Sabah, known only from Tabin Wildlife Reserve. Heavily shaded karst cliffs.

*Alocasia robusta* M.Hotta

*Figure 2F*

**Material examined.** MALAYSIA – Pedalaman • Keningau, TBC, Mile 21; 05°08′37″N, 116°17′20″E; 850 m elev.; 22 February 2003; Kinahim et al. SP 17856 (SNP) • Siptang, Chi Hin waterfall; 05°02′30″N, 115°50′39″E; 412 m elev.; 23 March 1999; R. Kiew & Ali I., Ruth Kiew 4647 (SAN) – Pantai Barat • Ranau, Mount Tombuyukon, Sub-station Monggis, summit trail to Mount Tombuyukon; 06°12′50″N, 116°39′20″E; 400 m elev.; 13 December 2009; Yabainus J. KNP 18147 (SNP) – Tawau • Lahad Datu, Tabin Wildlife Reserve; 05°12′N, 118°38′38″E; 150 m elev.; 4 July 2000; Kjeldsen K.H. Kjeldsen 186 (SAN) • Tawau, Tawau Hills Park; 04°59′30″N, 117°11′00″E; 22 April 1992; Berhaman et al. SAN 134531 (SAN).

**Identification.** *Alocasia robusta* is a gigantic arborescent herb with leaf blades strikingly glaucous on the undersides. This species resembles *A. macrorrhizos*, with a rather similar subtriangular ovato-sagittate leaf outline but can be distinguished by the posterior costae with tissue extending into the sinus and the glaucous abaxial side to the blade. The seedlings, even when quite large, have peltate leaves with the undersides glaucous and the whole glabrous (cf. *A. sarawakensis*). The inflorescences are very different from those of *A. macrorrhizos*, both in their clustered arrangement, and the thick marcescent/deliquescent cataphylls (bits of which often adhere to the open spathe), the ivory horizontally red-marked lower spathe and the thick greyish to purplish limb (Hay 1998).

**Distribution and ecology.** Widespread. Common in open swampy places; often seen in roadside ditches; encountered in swampy places in forest as a hairy juvenile; from sea level to ca. 1200 m elev.

*Alocasia scabriuscula* N.E.Br.

*Figure 2G*

**Material examined.** MALAYSIA – Pedalaman • Nabawan, Pensiangan Forest, Sungai Kerilin; 04°31′07″N, 116°19′39″E; 22 July 2016; Ubaldus & Baraham SAN 158024 (SAN) – Pantai Barat • Penampang, Moyog along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53114 (MO, SAR) • Ranau, Kundasang, Kinabalu above Sosopodon; 06°00′15″N, 116°33′00″E; 1524 m elev.; 2 February 1962; W. Meijer SAN 29021 (SAN) – Sandakan • Kinabatangan, Kalabakan Jungle Reserve, 04°27′01″N, 116°59′27″E; 300 m elev.; 7 April 1996; A. Hay 12006 (K, KEF, L, SAN) • Kinabatangan, Sukau, WWFM small plots; 05°31′37″N, 118°18′16″E; date unknown; G. Bassford & Reza A. GB 191 (SAR) • same locality; date unknown; G. Bassford & Reza A. GB 191 (SAR) • Kinabatangan, Maliau Falls, Gunung Rara Forest Reserve; 04°30′00″N, 116°45′00″E; 9 April 1996; A. Hay 12045 (K, KEF, L, SAN) • Sandakan, Sepilok Forest Reserve; 05°10′29″N, 117°09′13″E; 11 August 1994; G. Antok SAN 141501 (SAN) • Sandakan, Sepilok Sungai Seguntor corner; 05°49′56″N, 117°57′04″E; 20 July 1990; J. Kulip & W. Meijer SAN 130939 (SAN) – Tawau • Lahad Datu, Ulu Sungai Danum; 05°01′36″N, 117°46′15″E; 3 July 1976; B. C. Stone et al. SAN 85307 (SAN) • Lahad Datu, Danum Valley Field Centre, Orchid Trail to East trail; 04°40′00″N, 117°29′00″E; 150 m elev.; 4 August 1998; Magintan & Raya Magintan 573 (AAU, SAN) • Lahad Datu, Baturomg; 04°37′25″N, 118°45′29″E; 28 August 1999; R. Kiew RK 4794 (SING) • same locality, 28 August 1999, R. Kiew RK 4798 (SING).

**Identification.** *Alocasia scabriuscula* is a highly variable
species. Typical forms have ovatagiggitate and thick, dark to mid grey-green leaves with the inner sides of the posterior costae very narrowly oblanceolate. The leaf blade is from distinctly though rather thinly leathery, to blades almost 5 mm thick and virtually succulent (Hay 1998).

**Distribution and ecology.** Widespread in Sabah. Lowland forest to hill forest to ca. 1200 alt., often in disturbed areas, in swampy to well-drained sites, riverbanks, occasional on roadsides and in plantations.

**Alocasia wongii A. Hay**

Figure 2H

**Material examined.** MALAYSIA – Pedalaman • Keningau, Sepulut, growing on rocky place; 06°20′N, 116°40′E; 3 June 1985; Aban G. et al. SAN 107969 (SAN) • Keningau, Tambunan, Primary forest, flatland; 04°33′59″N, 116°58′01″E; 19 October 1983; Amin & Patrick SAN 69048 (SAN) • Sipitang, Ganim Forest Reserve, secondary forest; 05°00′25″N, 115°41′32″E; 380 m elev.; 17 March 2011; Pereira, J. T. & Jamirius, J. SAN 153520 (SAN) – Sandakan • Beluran, Sungai Kolayok, on ridge hill; 05°53′50″N, 117°39′48″E; 28 August 2018; Amin & Mohamad SAN 110146 (SAN) • Beluran, Ulu Tungug Forest reserve; 05°51′28″N, 116°58′37″E; 370 m elev.; 23 July 2005; Joanes et al. SAN 146876 (SAN) • Kinabatangan, Bukit Garam; 05°29′13″N, 117°51′19″E, 11 November 2019; Reza A. RA 30 (K, KEP, L, SAN) • Kinabatangan, Kota Kinabatangan; 05°26′02″N, 117°52′01″E; 3 April 1992; Dewol, Francis & Dauni SAN 132484 (SAN) • Sandakan, Gomantong Caves, 05°31′33″N, 118°04′24″E; 31 October 1968; S. Kokawa & Mitsuru Hotta, Kokawa & Hotta 576 (L) • Sandakan, Lamag, Sungai Pin; 05°23′28″N, 117°52′53″E; 25 November 1978; Dewol & Harun SAN 89905 (SAN) • Sandakan, Sepilok Forest Reserve, understory primary forest at Jalan Batu 15; 05°49′36″N, 117°57′04″E; 11 December 1973; Aban G. SAN 76687 (SAN) • Sandakan, Ulu Dusun Agriculture Research Station; 05°47′11″N, 117°46′06″E; 100 m elev.; 29 August 1989; Yap S. K. & Kairuddin SAN 106089 (SAN) • same locality, 10 August 1977; S. Lantoh SAN 87802 (SAN) • Tongod, Pinangah; 05°18′40″N, 117°06′10″E; 4 February 1983; Dewol & Mansus SAN 67396 (SAN) • Tongod, ridge of Bukit Mengalas-Kalas, disturbed Dipterocarp forest; 05°30′25″N, 116°52′15″E; 68 m elev.; 12 March 1981; Dewol S. SAN 93149 (SAN) • Tongod, Ulu Sungai Pinangah, uncutdland; 05°23′27″N, 117°52′52″E; 22 October 1984; Amin & Ismail SAN 107302 (SAN) – TAWAU • Kunak, Madai-Baturong Forest Reserve, Madai, Near Sungai Madai; 04°44′30″N, 118°07′55″E; 25 December 1993; Majawat & Kumin SAN 138329 (SAN) • Lahad Datu, Selangan Forest Reserve; 04°34′20″N, 118°30′05″E; 9.144 m (30 ft.) elev.; 13 August 1948; H. G. Keith A 1519 (SAN) • Lahad Datu, Silam, hillside; 04°59′00″N, 118°13′10″E; 23 October 2007; Pius et al. SAN 149373 (SAN) • Lahad Datu, Tabin Wildlife Reserve, near Wildlife Department’s Headquarter; 05°18′N, 118°44′E; 150 m elev.; 22 February 2000; K. H. Kjeldsen K. H. Kjeldsen 23 (SAN) • same locality; 150 m elev.; 1 March 2000; K. H. Kjeldsen K. H. Kjeldsen 58 (AAU, SAN) • Lahad Datu, Tabin Wildlife Reserve, trail to Lipad Mud Volcano; 05°14′30″N, 118°50′16″E; 28 May 1998; F. Borchsenius FB 506 (BORH, SAN) • Sepomora, Bohey Dulang Island, Taman Marin Tun S. Desakan; 04°35′50″N, 118°47′11″E; 185 m elev.; 2 August 2009; Kinahim et al. SP 16501 (SNP) • Sepomora, Selangan Forest Reserve, in forest; 04°34′20″N, 118°30′05″E; 6.096 m (20 ft.) elev.; 17 July 1938; H. G. Keith 9286 (SAN) • Tawau, Taman Bukit Tawau, trail to Hot Spring; 04°25′41″N, 117°53′23″E; 200 m elev.; 26 January 2000; Fauzi Laimin SP 14785 (SNP) • Tawau, TBC, route to Dipterocarpaeceae Plot 1 A; 459 m elev.; 7 June 2005; Dolos et al. SP 10176 (SNP) • Tawau, TBC, Trail Tamman Haiwan; 300 m elev.; 10 June 2003; Yabainus et al. SP 17771 (SNP) • Tawau, TBT, Ulu Sungai TBT, Trail Utama Barat; 300 m elev.; 19 May 2003, Yabainus et al. SP 17903 (SNP) • Tawau, Ulu Kalumpang Forest Reserve; 04°35′13″N, 117°57′42″E; 400 m elev.; 12 October 1996; Diwol Sundaling SAN 135224 (SAN).

**Identification.** A fairly well-defined and geographically coherent element distinguished from *A. princeps* s.s. by the generally slenderer stature, the petiole with markings distinctive in the complex but almost identical to those typically found in *A. longiloba* ‘denudata’. The spathes are suffused a rather dirty purpe-brown or violet-brown, with the limb somewhat darker than the lower spathe. The lower spathe in flower and the fruiting spathes are less rotund, and the limb shorter and slenderer than in *A. princeps*. The spadix is slenderer with the pistils and synandrodia rather loosely arranged and the male zone is less exerted (Hay 1998).

**Distribution and ecology.** Endemic to Sabah. Eastern, southwestern, and northeastern Sabah. Terrestrial in lowland mixed dipterocarp forest on well-drained and occasionally inundated sites at low elevation.

**Amorphophallus hottae Bogner & Hett.**

Figure 3A

**Material examined.** MALAYSIA – Pedalaman • Tenom, along Sungai Malatut, about 15 km north of Tenom; 300–450 m elev.; Dec. 22, 1968; Kokawa & Hotta 2527 (holo KYO, iso K).

**Identification.** *Amorphophallus hottae* is distinctive for its narrow spathe combined and its long, excerted, thin spadix (Bogner and Hetterscheid 1992).

**Distribution and ecology.** Widely distributed in Tenom, Ranau, and Crocker Range National Park, Sabah. Lime-stone forest; grows in pockets of limestone.

**Amorphophallus lambii Mayo & Widija**

Figure 3B

**Material examined.** MALAYSIA – Pedalaman • Tenom; 600 m elev.; 11 June 1980; A. Lamb s.n. (SAN) • locality unknown; 4 May 1984; A. Lamb s.n. (SAN).

**Identification.** *Amorphophallus lambii* has a rather
long flowering period in cultivation which may last over a week. It produces a distinct urine scent. The berries are eaten by Bulbuls (*Pycnonotus zeylanicus* Gmelin) as soon as they become ripe and turn red. Infructescences are therefore always found to contain only orange, slightly unripe berries and a naked upper infructescence axis (Hetterscheid and Ittenbach 1996).

**Distribution and ecology.** Endemic to Sabah. Found in Tenom, Ranau, and Crocker Range National Park. In shaded conditions in rubber plantations, cleared land, along riverbanks and in relic fragments of lowland rainforest, on rich alluvial soils, ca. 200 m elev.

*Amorphophallus rugosus* Hett. & A.L.Lamb

Figure 3C

**Material examined.** MALAYSIA – Pedalaman • Tambunan/Keninging District-boundary, Ulu Apin Apin, in colluvial soil, on slope of sandstone ridge, cool shaded habitat; ca. 700 m elev.; i-1993; Lamb & Surat ALFS 625 (holo L).

**Identification.** *Amorphophallus rugosus* is morphologically similar to *A. costatus* but can be differentiated by the much longer peduncle and larger proportions in general (Hetterscheid 1994).

**Distribution and ecology.** Endemic to Sabah. Known only from the type collection from Ulu Apin Apin, Tambunan-Keninging. *Amorphophallus rugosus* can be found growing in traditional orchards, rubber farms, secondary and mixed dipterocarp forest. In colluvial soil, on slope of sandstone ridge, cool shaded habitat, ca. 700 m elev.

*Amorphophallus tinekeae* Hett. & A.Vogel

Figure 3D

**Material examined.** MALAYSIA – Location unknown; cult. in Leiden Botanical Garden, original collection A. Vogel 950012; 5 April 1997; Hetterscheid H.A.M. 477 (holo L, spirit collection).

**Identification.** *Amorphophallus tinekeae* is a member of a group of exclusively Bornean species and most closely resembles *A. borneensis* Engl. & Gehrm., from which it differs by having a consistently short peduncle, strongly zygomorphic stigmas, and a rather narrow appendix (Hetterscheid and van der Ham 2001).

**Distribution and ecology.** Endemic to Sabah. Known from the type locality in Gomantong Caves on karst limestone.

*Amorphophallus venustus* Hett., A.Hay & Mood

Figure 3E, F

**Material examined.** MALAYSIA – Sandakan • Maliau Basin, Gunung Rara Forest Reserve, 2.5 km above main Maliau Falls, in mixed dipterocarp forest over sandstone; ca. 530 m elev.; Herscovich s.n. (holo NWS, spirit coll.).

**Identification.** *Amorphophallus venustus* is doubtless a close ally of *A. manta* Hett. & Ittenbach (Sumatra), *A. bufo* Ridl. (W. Malaysia), and *A. sparsiflorus* Hook.f. (W. Malaysia), with which it shares the unique linguiform spathe with its peculiar strongly dorsally curved margin above the base. *Amorphophallus venustus* differs mostly from all of these species by the silver variegation along the main veins of the leaflets, the presence of verrucae on the appendix, and the appendix itself being quite thin and creamish (vs. dark glossy purple and inflated in the other species). The peculiar colour and variegation of the leaflets of *A. venustus* is only shared with *A. pendulus* Bogner & Mayo (Sarawak), a species also closely allied to the species group mentioned above (Hetterscheid and van der Ham 2001).

**Distribution and ecology.** Endemic to Sabah. Sepilok, Maliau Basin, Gunung Rara mixed dipterocarp forest and sandstone. In secondary forest on sandstone, in deep shade, ca. 450 m elev.

*Amydrium medium* (Zoll. & Moritzi) Nicolson

**Material examined.** MALAYSIA – Pedalaman • Keninging, Hutan Simpan Trus Madi, lower montane forest; 05°30’21”N, 116°34’47”E; 689 m elev.; 28 October 2011; Pius G. SAN 154012 (SAN) • Keninging, Pisagon, along the riverside; 05°N, 116°15’E; 23 June 1989; Fidilis & Sumbing SAN 127663 (SAN) • Keninging, Pisagon, Growth along the riversides; 05°N, 116°15’E; 16 January 1990; Sumbing J. SAN 128253 (SAN) • Keninging, Ulu Sungai Blassanon KM 22 Jalan Keninging, along the riversides; 04°55’13”N, 116°29’31”E; 11 August 2019; Fidilis K. SAN 128195 (SAN) • Nabawan, Sungai Milian; 04°59’58”N, 116°29’56”E; November 1986; Sumbing J. SAN 118663 (SAN) • Nabawan, Syarikat Undan Sdn Bhd logging area, KM18 Jalan Nabawan/Pandawen; 04°55’13”N, 116°29’31”E; 14 March 1990; Sawan T. SAN 128095 (SAN) • Pensiangan, Kayu Forest Reserve, along the swamp; 25 January 1994; Sumbing J. SAN 136924 (SAN) • Sipitang, Long Pasia, Bukit Dusun; 04°27’34”N, 115°44’53”E; 1200 m elev.; 338.33 m (1110 ft.) elev.; 27 January 2003; Doloi et al. SP 18067 (SAN) • Sipitang, Lower Sungai Maga, Riverine Forest; 18 April 2000; S. P. Lim, Postar & Markus SAN 143299 (SAN) • Sipitang, Southern Eastern, Swamp Forest; 5°01’35”N, 115°35’19”E; 95 m elev.; 19 May 1990; W. Meijer SAN 130219 (SAN) • Tambunan, above Kg Sunsuron, hill slope on the trail to Rafflesia Plot; 05°44’38”N, 116°22’45”E; 18 November 1989; Joseph R. & Donggop T. SAN 128641 (SAN) • same locality; 17 November 1989; Joseph R. & Donggop T. SAN 128636 (SAN) • Tambunan, Trusmadi Tamba- han 2, Syarikat Tinju, hillside; 05°26’47”N, 116°48’15”E; 19 April 1990; Julius Kuli et al. SAN 130201 (SAN) • Tenom, Bunut; 05°06’39”N, 115°56’56”E; 300 m elev.; 21 November 1968; K. Ogata 11631 (L) • Tenom, Hutan Simpan Mendalom, lowland; 14 August 1993; Sumbing J. SAN 136117 (SAN) • Tenom, Lumaku Forest Reserve, Kampung Ulu Bunut, mixed dipterocarp forest; 05°03’94”N, 117°53’66”E; 800 m elev.; 24 March 2010; Suzana et al. SAN 151464 (SAN) • Tenom, Secondary forest, Agriculture Station; 05°10’54”N, 115°59’23”E; 15 October 1987; W. Meijer SAN 122497 (SAN) • Tenom, Ulu Kelang Forest Reserve, Montane Forest; 05°9’43”N,
115°55′42″E; 18 September 1991; L. Madan et al. SAN 133074 (SAN) – Pantai Barat • Kota Belud, above Kg Paka, cultivated area; 06°19′42″N, 116°22′33″E; 15 April 1989; Julius K., SAN 124867 (SAN) • Ranau, Bambangan; 05°58′30″N, 116°38′45″E; 7 April 1988; Amin G. SAN 121562 (SAN) • Ranau, Bukit Hampan Forest Reserve, Oak–Chestnut forest; 06′00″30′N, 116°39′31″E; 1364 m elev.; 11 May 2010; Pereira, J. T., Pius, G., et al. SAN 151722 (SAN) • Ranau, Bukit Kulung; 06′01″26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122422 (SAN) • Ranau, Bundu Tuhan, Kinattongan; 05°57′57″N, 116°32′46″E; 16 July 1993; Doinis Soibeh DS 293 (SAN, SNP) • Ranau, Kinabalu; 06′05″30′N, 116°32′45″E; 1100 m elev.; 12 March 1970; H. P. Nootboom 1583 (L) • same locality; 914.4 m (3000 ft) elev.; 18 September 1931; Clemens & Clemens 26733 (L) • same locality; 1219 m elev.; 1931; Clemens & Clemens 51420 (L) • Ranau, Lohan Ulu; 05′46′04″N, 116°49′08″E; 9 November 1987; Amin & Jarius SAN 124147 (SAN) • Ranau, Sungai Bundu Tuhan, primary forest; 05′58′15″N, 116°34′17″E; 3 September 1971; Aban G. SAN 74128 (SAN) • Ranau, Sungai Mangkadau; 05′56′54″N, 116°40′01″E; 457.2 m (1500 ft.) elev.; 29 May 1973; G. Shea & Aban SAN 77263 (SAN) – Ranau, Tenompok Forest Reserve, secondary forest; 05′57′40″N, 116°39′31″E; 9 November 1987; Amin G. SAN 76956 (SAN) – Ranau, Tenom, Kg. Kapa, cultivated area; 06′10′57″N, 116°45′35″E; 12 May 1973; G. Shea & Aban SAN 91015 (SAN) – Ranau, Tontolob, hillside; 05′44′05″N, 116°23′32″E; 1100 m elev.; 24 December 1990; W. Meijer & Abu Bakar, SAN 100207 (SAN) – Ranau, Bukit Hampuan Forest Reserve, around Teck Guan Quarry, limestone; 06′00′30″N, 116°39′31″E; 914.4 m (3000 ft) elev.; 18 September 1931; Clemens & Clemens 29144 (L) • Ranau, Bundu Tuhan, Mount Kinabalu; 06′05′30″N, 116°32′45″E; 1100 m elev.; 12 March 1985; Argent et al. SAN 107675 (SAN) • Taiwau, Luasong, SF logging area; 04′36′23″N, 117°24′03″E; 8 August 1977; Fidilis K. SAN 87303 (SAN) • Taiwau, Tawau, Tawau Forest Reserve; 04′49′00″N, 117°55′00″E; 1 April 1964; W. Meijer SAN 42993 (SAN).

**Identification.** An unmistakable aroid liane by virtue of the mature leaves with prominently reticulate venation, perforations and pinnation. Ripe fruits with domed stelar tissue resembling white berries (Nguyen and Boyce 1999).

**Distribution and ecology.** Widespread in Sabah. Low to middle elevation humid to wet primary lowland rain-forest to disturbed evergreen forest on a variety of substrates; 65–1500 m elev.

**Anadenrum Schott**

All the herbarium specimens belonging to *Anadenrum* are identified as undescribed species. The number of species is estimated to be approximately 10 based on 43 collections seen.

**Anadenrum sp. 1**

**Material examined.** MALAYSIA – Pedalanam • Tonom, Kg. Kapulu, side path, primary forest; 04′50′41″N, 116°01′58″E; S. Lantoh, SAN 73533 (SAN) – Pantai Barat • Ranau, Poring, secondary forest; 06′02′44″N, 116°42′02″E; 24 December 1990; W. Meijer & Abu Bakar, SAN 131913 (SAN) • Kudat • Ulu Sungai Kaidangan, along coupe boundary clear undergrowth; 06′31′33″N, 117°15′16″E; 16 October 1975; Saikhe & Aban, SAN 82373 (SAN) – Tango • Taiwau, Mt. Willersdorfs Forest Reserve, around Teck Guan Quarry, limestone; 04′27′29″N, 118°08′49″E; Nadiah I., Postar M., Jemson J., & Ubaldus M., SAN 149146 (K, KEP, SAN, SAR).
Material examined. MALAYSIA – Pedalaman • Keningau, Highland Plantation, mile 11; 05°12'21"N, 116°11'37"E; 8 June 1977; Talip A.H., SAN 85437 (SAN)
• Keningau, Ulu Senangan; 05°21'54"N, 116°01'25"E; 19 May 2010; Sugau J. B., SAN 151920 (K, SAN).

Anadendrum sp. 3

Material examined. MALAYSIA – Pantai Barat • Nabawan, Sungai Milian, hilltop; 04°59’56″N, 116°29’59″E; 6 November 1986; Asik Mantor, SAN 118559 (SAN).

Anadendrum sp. 4

Material examined. MALAYSIA – Pantai Barat • Nabawan, Sungai Milian, hilltop; 04°59’56″N, 116°29’59″E; 6 November 1986; Asik Mantor, SAN 118559 (SAN).

Material examined. MALAYSIA – Pantai Barat • Nabawan, Sungai Milian, hilltop; 04°59’56″N, 116°29’59″E; 6 November 1986; Asik Mantor, SAN 118559 (SAN).

Anadendrum sp. 5

Material examined. MALAYSIA – Pantai Barat • Sapulut, Batu Punggul, hillside; 04°37’48″N, 116°36’57″E; 28 January 1993; Kuntit Loloh, SAN 135788 (SAN) • Pensiangan, Pensiangan Utara sub-district, Kg. Batu, Bukit Pun Batu; 04°47’30″N, 116°11’33″E; 24 October 1996; Lim S.P. et al., LSP 1509 (SAN) • Pensiangan, Pensiangan Utara sub-district, Kg. Batu, Bukit Pun Batu; Lim S.P. et al., LSP 1556 (SAN) • Sapulut, Batu Punggul, hillside; 04°37’48″N, 116°36’57″E; 30 January 1993; Sumbing J., SAN 136100 (SAN) • Sapulut, Sungai Siliawan, upland mixed dipterocarp forest, near the forest edge, along the small stream; 04°43’05″N, 116°31’28″E; 13 June 2012; Suzana S., Nur Adil Anak M., Noor Azmizah A., Markus G., Ubaldus M., & Aloysius L., SAN 154837 (SAN).

Anadendrum sp. 6

Material examined. MALAYSIA – Sandakan • Telupid, Sungai Ruku-rukut, primary forest on flat land; 05°36’10″N, 117°09’53″E; 4 August 1981; Aban G., SAN 94003 (SAN) • Sandakan, Maliau Basin Conservation Area, Pakis Camp, Upper dipterocarp; 04°30’00″N, 116°45’00″E; 15 March 2001; Henry B. & Sidkan A., MB 784 (SAN) – Tawau • Tawau, Kunak, Madai-Baturong Forest Reserve, Sungai Siput Madai; 04°41’18″N, 118°15’55″E; 8 July 2000; Diwol S. & Ruth Kiew et al., SAN 133143 (K, SAN, SING) • Tawau, Kalabakan, Gunung Rara, ca. 50 m from base camp area; 04°59’28″N, 117°08’03″E; 13 March 2015; Suzana S., Nur Adillah M.Y., Baraham B. & David J., SAN 157097 (SAN) • location unknown; 18 March 1970; Nooteboom, H.P., H.P.Nooteboom 1623 (L) • location unknown; 15 November 1968; Ogata K., K.Ogata 11473 (L).

Anadendrum sp. 7

Material examined. MALAYSIA – Sandakan • Beluran, Bukit Mesasah near campsite, primary forest, ultrabasic soil; 05°58’12″N, 117°15’10″E; 17 May 1961; W. Meijer, SAN 25433 (SAN) • Beluran, Sugut Forest Reserve, along trail to Gua Sam Manan, lowland mixed dipterocarp kerangas forest; 06°18’67″N, 117°37’21″E; 26 September 2014; Ubaldus M., Tawadong T., & Barham, B. SAN 157487 (SAN) • Beluran, Telupid Road to microwave, ultrabasic soil, lowland dipterocarp forest; 05°36’30″N, 117°50’00″E; 30 June 2007; Pius G., Joel, D., Maidil A., & Aloysius L., SAN 149062 (K, SAN) • Beluran, Trusan Sugut Forest Reserve, near Gua Sam Manan, below the rock cliff; 06°25’16″N, 117°41’58″E; 15 November 2017; Sugau J.B., Markus G. & Adzwan S., SAN 158928 (SAN) • Telupid, Bukit Tangkunan, TV. Station Road, 05°38’33″N, 117°11’36″E; 30 January 1982; Abd. Rahim et al., SAN 92955 (SAN).

Anadendrum sp. 8

Material examined. MALAYSIA – Sandakan • Kinabatangan, Maliau Basin Conservation Area, Camel Trophy Camp, mountainous; 04°49’46″N, 116°53’49″E; 10 April 2000; Edward A. & Sidkan A., MB 109 (SAN) • Kinabatangan, mile 17 1/2 Karis-Karis camp, primary forest, on hillside; 05°16’55″N, 117°27’52″E; 11 May 1970; Patrick Lassan, SAN 70652 (SAN) • Sandakan, Danum Valley Conservation Area, Danum Valley Field Centre, path from Segama bridge to water pool, lowland dipterocarp rainforest; 05°01’00″N, 117°48’00″E; J. Gregson & Bernadas Bala Ola, JG 65 (K, SAN) • Sandakan, Sepilok Forest Reserve, mixed dipterocarp forest; 23 April 1996; A. Hay et al., A.Hay 12157 (SAN) • Telupid-Ranau Road, Mile 8 Telupid Ranau Road, on flat land, primary forest; 05°39’24″N, 117°04’15″E; 12 March 1974; Aban G. & Saikeh, SAN 79370 (SAN) • Sandakan, Sepilok Forest Reserve, mixed dipterocarp forest; 05°49’36″N, 117°57’04″E; 17 January 1989; Kessler, SAN 118162 (SAN) • Telupid, base of Bukit Tawai, logged over area; 05°31’51″N, 117°06’15″E; 8 April 1994; Leopold M., SAN 134275 (SAN) • location unknown; November 1986; Vermeulen J.J., Lam, A.L., J.J.Vermeulen 760 (L).

Anadendrum sp. 9

Material examined. MALAYSIA – Tawau • Lahad Datu, Lupang Watat (4°46’20″N, 119°42’53″E); 1956; G. Symonstein, RG 422 (SAN) • Lahad Datu, Sungai Siput Madai, 04°56’00″N, 117°29’45″E; 3 September 1976; B.C. Stone et al., SAN 85304 (SAN).

Anadendrum sp. 10

Material examined. MALAYSIA – Sandakan • Kinabatangan, Gomantong Caves, lowland rainforest on limestone boulder; 05°31’52″N, 118°04’17″E; 24 April 1996; A. Hay et al., A.Hay 12163 (SAN) • Kinabatangan, Gomantong; 05°31’52″N, 118°04’17″E; 21 June 1992; W. Meijer, SAN 136166 (SAN).

Bucephalandra danumensis S.Y.Wong, P.C.Boyce & Kartini

Figure 3G

Material examined. MALAYSIA – Tawau • Lahad Datu, Danum Valley near second waterfall; 04°57’30″N,
Identification. *Bucephalandra danumensis* is differentiated from all other *Bucephalandra* species with echinate/papillate spadix appendix staminodes by the combination of the appendix and stamine flower zone being of about equal length, by the ellipsoid thecae separated by a deep sinus on the ventral surface, needle-like thecae extensions that curve upwards and interstice stamnodes with conspicuously thickened, recurved margins. In appearance plants of *B. danumensis* most closely resemble those of *B. yengiae* P.C.Boye from Kalimantan Timur, and an imperfectly known undescribed species from Kalimantan Utara; *B. danumensis* differs from both by the equal proportions of the appendix and stamine flower zones (vs. appendix appreciably longer than stamine flower zone), and by the thick recurved margins of the interstice stamnodes (vs. staminode margins not or scarcely thickened, and not recurved). *Bucephalandra danumensis* differs from the only other *Bucephalandra* species from Sabah, *B. ultramafica* S.Y.Wong & P.C.Boye, by the echinate/papillate appendix stamnodes (vs. polygonal with very rounded angles, somewhat umbonate) and by not being obligated to ultramafic (ultrabasic) rocks (Wong et al. 2018).

Distribution and ecology. Endemic to Sabah. Known only from two localities, approximately 20 km distant, in the Danum Valley Conservation Area. Restricted to igneous stream beds and waterfalls outcropping through Cretaceous deepwater sediments in lowland perhumid forest between elevations of 120 and 310 m.

**Bucephalandra ultramafica** S.Y.Wong & P.C.Boye

Figure 3H

Material examined. MALAYSIA – Sandakan • Kinabatangan, Telupit, Gunung Tawai; 05°35′46″N, 117°04′37″E; 18 Dec 2012; M. Lo AR-4094 (holo SAN, iso SAR, SBC, SING).

Identification. *Bucephalandra ultramafica* is unique by the combination of deeply ridged petioles, narrow deep green glossy leaves, and a bullet-shaped appendix. The leaf blades are somewhat reminiscent of those of *B. goliath* S.Y.Wong & P.C.Boye, but *B. ultramafica* never develops the long pendent stems diagnostic of *B. goliath*, and the spadix appendix and appendix staminodes are of quite different form (Wong and Boyce 2014).

Distribution and ecology. Endemic to Sabah. Known only from the type locality at Gunung Tawai. Restricted to ultramafic (ultrabasic) Riverside rocks under lowland moist forest at ca. 130 m elev.

**Colocasia oresbia** A.Hay

Figure 4A

Material examined. MALAYSIA – Pedalaman • Sipitang, Sungai Melabid at lower Eastern slope of Ruan Watgerauo; 04°23′51″N, 115°40′57″E; 1300 m elev.; 17 April 2000; Pius G. et al. SAN 143466 (SAN) • Tambunan, Gunung Alab; 05°49′53″N, 116°20′24″E; 1600 m elev.; 12 December 1968; Kokawa & Hotta 1934 (L) • Tambunan, Alab, along the road from Agr. Exp. Station to south of Gunung Alab; 05°30′05″N, 116°21′04″E; 1500 m elev.; 11 December 1968; Kokawa & Hotta 1758 (L) – Pantai Barat • Ranau, Mount Kinabalu National Park, along road to summit; 06°4′N, 116°27′E; 2000-3000 m elev.; 27 September 1981; T. B. Croat 53134 (MO, SAR).

Identification. *Colocasia oresbia* is readily distinguished from wild-type *C.esculenta* by its non-waxy, wettable leaf blades, rather long stout stem thickly clothed in old leaf bases, lack of stolons, preference for non-saturated sites, much more robust infructescence, straight fruiting peduncle and its brown-tinged green (vs. yellow-orange) fruits (Hay 1996).

**Cryptocoryne ciliata** (Roxb.) Fisch. ex Wydler

Material examined. MALAYSIA – Tawau • Kalabakan, 04°40′N, 117°51′E; 28 July 2008; Ubaldus, Jemson & Postar SAN 149636 (SAN) • Lahad Datu, Sungai Gadun; 05°22′95″N, 118°49′03″E; 17 February 2009; Joel et al. SAN 149691 (KEP, SAN).

Identification. The ciliate margin of the spathe limb is diagnostic for this species (Jacobsen 1985).

**Epipremnum falcifolium** Engl.

Material examined. MALAYSIA – Pedalaman • Keningau, Sook, Sook Plain; 05°07′37″N, 116°16′28″E; 19 October 1987; W. Meijer & Kumin SAN 121389 (SAN) – Sandakan • Labuk & Sugut, along Sungai Meliau, foot of Mt. Tawai; 05°30′33″N, 117°03′51″E; 100 m elev.; 22 October 1968; Kokawa & Hotta 263 (L) – Tawau • Lahad Datu, Danum Valley; 04°56′35″N 117°36′25″E; 9 June 1990; Mariyoh & Lideh SAN 111746 (SAN).

Identification. *Epipremnum falcifolium* is found in Brunei, Malaysia (Sabah) and Indonesia (Kalimantan). *Epipremnum falcifolium* has similar infructescences with massively enlarged stylar tissue but they can usually be readily separated on leaf characters. Dried inflorescences and infructescences of *E. falcifolium* have the region around stigma expanded into two lateral cushions. *Epipremnum falcifolium* often produces fruits with a solitary seed by abortion (Boyece 1998).

**Distribution and ecology.** Widespread. Near rivers, mixed dipterocarp forest, swampy secondary forest, Setap shales, clay soil, yellow sandy loam; 5–250 m elev.
**Epipremnum pinnatum** (L.) Engl.

**Material examined.** MALAYSIA – Pedalaman • Nabawan, Sungai Maadun, Syt. Benewood, Sungai Maadun; 04°51’31.1″N, 116°34’48″E; 27 May 1987; Fidilis krispinus SAN 119394 (SAN) • Pensiangan, Batu Tiannah; 04°36’29″N, 116°35’11″E; 16 May 1997; R. Kiew 4404 (SAN) • Sipitang, Sungai Pasia; 04°25’11″N, 115°42’14″E; 1000 m elev.; 27 June 1997; A. Lamb MTED 404 (SAN) • Tenom, Lumaku Forest Reserve, 05°07’37″N, 115°56’29″E; 929 m elev.; 19 March 2010; Suzana, S., Ubal dus, M., Taw adong, T., Markus, G., John, B., SAN 150993 (SAN, K) – Sandakan • Tongod, Gunung Ting kar Forest Reserve, 05°18’28″N, 117°04’23′′E; 121 m elev.; 4 April 2013; Suzana S., SAN 150245 (SAN).

**Identification.** *Epipremnum pinnatum* can be distinguished from the superficially similar *Raphidophora korthalsii* by its primary lateral vein, stem, feeding root, pre-adult stage, the fertile stage (the style apex and the shape of the stigma) and its fruits (Boyce 1998).

**Distribution and ecology.** Widespread. Primary and secondary dense to open lowland to upper hill rain and monsoon forest, weeds of rubber plantation, growing occasionally on rocks and in coastal forest, on a variety of substrate including granite, andesite and limestone; 1–1600 m elev.

**Gamogyne burbidgei** N.E.Br.

**Material examined.** MALAYSIA – Pedalaman • Nabawan, Sungai Maadun, Syt. Benewood, Sungai Maadun; 04°51’31.1″N, 116°34’48″E; 27 May 1987; Fidilis krispinus SAN 119394 (SAN) • Pensiangan, Batu Tiannah; 04°36’29″N, 116°35’11″E; 16 May 1997; R. Kiew 4404 (SAN) • Sipitang, Sungai Pasia; 04°25’11″N, 115°42’14″E; 1000 m elev.; 27 June 1997; A. Lamb MTED 404 (SAN) • Tenom, Lumaku Forest Reserve, 05°07’37″N, 115°56’29″E; 929 m elev.; 19 March 2010; Suzana, S., Ubal dus, M., Taw adong, T., Markus, G., John, B., SAN 150993 (SAN, K) – Sandakan • Tongod, Gunung Ting kar Forest Reserve, 05°18’28″N, 117°04’23′′E; 121 m elev.; 4 April 2013; Suzana S., SAN 150245 (SAN).

**Identification.** *Gamogyne burbidgei* is defined by conate pistils, a pistillate flower zone with a conspicuous zone of pistillodes at base, a spadix fertile to the tip, thecae not set in deep pits, parietal placentation, the spathe at staminate anthesis and lacking rostral keels, and by the combination of its mesophytic habit and comparatively large spathe lacking a constriction between the lower spathe and limb. The only described species in Borneo with a similar spathe is *H. expedita*, but this is a colonial helophyte, has markedly different spadix morphology, and has yet to be recorded from Sabah. Among mesophytic species some larger expressions of *H. griffithii* (Schott) Hook.f. [Chamaeladon Supergroup] are vaguely similar in appearance to *H. galbana* but differ by the smaller spathes (less than 2 cm long), the interpistillar staminodes much shorter than the associated pistils, and smaller infuscences. The spathe becoming yellow at anthesis is highly distinctive and represents a novel morphology for *Homalomena*; furthermore, yellow is a rare spathe colour among terrestrial mesophytic aroids in general (Baharuddin and Boyce 2010).

**Distribution and ecology.** Endemic to Sabah. Known only from the type collection. Perhumid evergreen upper hill forest on mudstone, along small streams, ca. 700 m elev.

**Homalomena gempal** Kartini, P.C.Boyce. & S.Y.Wong

**Material examined.** MALAYSIA – Tawau • from plant cultivated at Institute for Tropical Biology and Conservation, Kota Kinabalu; 4 Jan 2015; Kartini BORH 2702 (original living collection: Malaysian Borneo, Sabah, Tawau, Tawau Hills N.P., Bukit Galas, Dec 2014, Kartini) (holo, BORH).

**Identification.** *Homalomena gempal* differs from Sarawak *H. atrox* P. C. Boyce et al. and *H. paucinervia* Rid by its squat pistils, its subglobose sessile interpistillar staminodes and its longitudinally finely ridged petioles, peduncle, and spathe limb exterior (Kartini et al. 2015a). Refer to *H. kiosomensis* for comparison (below).

**Distribution and ecology.** Endemic to Sabah. Known only from a restricted area at the type locality, Tawau Hills N.P., Bukit Galas. *Homalomena gempal* occurs as a strongly rooted rheophyte on exposed rhyolite under very wet lowland to lower hill forest at the base of waterfalls at an elevation of ca. 380 m elev.

**Homalomena gillii** Furtado

**Figure 4C**

**Material examined.** MALAYSIA – Pantai Barat • Penampang, Crocker Range Forest Reserve, Kg Kibun; 05°56’12″N, 116°14’08″E; 16 May 2011; Leong et al. PL 490 (SAN, SING).

**Identification.** Erect to creeping herb. Petiole length variable, shorter or longer than the leaf blade, 5–15 cm long, sheathing up to halfway. Leaf blade usually leathery, oblong, ovate to obovate-lanceolate, to elliptic, sometimes somewhat falcate, the base acute to obtuse, blades 9–20 cm long, 2.5–6 cm wide, primary lateral veins 6–9 per side, alternating with an equal number of slender interprimaries. Peduncle 4–8 cm long, slender, shorter than the petiole, rarely sub-equaling petiole.
Spathe ovate, the tip abruptly and strongly attenuate-cuspidate, lower spathe 1–1.5 cm long, 8–12 mm wide, spathe limb ca. 3 cm long, 3–5 mm wide. Spadix sub-equaling the spathe, subsessile pistillate zone 8–12 mm long, about three times long than wide, 3 cm long, the top 3–4 mm wide. Furtado (1939).

**Distribution and ecology.** Endemic to Sabah. Found growing on granite at low elevations.

**Homalomena kinabalensis** Furtado

**Material examined.** MALAYSIA – Kudatan • Pitas, Paitan, Hutan Simpan Paitan; 06°42′30″N, 117°9′30″E; 14 May 1987; George & Amin K., SAN 121273 (SAN) – Sandakan • Tongod, Imbak; 05°10′29″N, 117°09′13″E; 213.36 m elev.; 14 June 2000; SAN 142898 (SAN).

**Identification.** *Homalomena kinabalensis* is a high-altitude ultrabasic-associated species and is unusual in the genus by having the spathe and peduncle deep purple and is one of rather few ultrabasic-obligated aroids described to date (Kartini et al. 2015a).

**Distribution and ecology.** Endemic to Sabah. High-elevation, ultrabasic-obligated.

**Homalomena kionsomensis** Kartini, P.C. Boyce & S.Y.Wong

**Material examined.** MALAYSIA – Pantai Barat • Cultivated in Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, Sandakan, Sabah. Original collection: Malaysia, Sabah, West Coast Division, Kota Kinabalu, Inanam, Kionsom Waterfall; 05°58′26″N, 116°12′13″E; 23 June 2018; Kartini BORH 2706 (holo BORH).

**Identification.** *Homalomena kionsomensis* is most similar to *H. gempal* differing by the shortly stipitate spadix which extends at anthesis to exceed the spathe (vs. spadix sessile, not extending and remaining within the length of the spathe throughout anthesis), the weakly clavate (vs. sessile subglobose) interpellar staminodes, and smooth (vs. longitudinally finely ridged) petioles, peduncle, and spathe limb exterior (Kartini et al. 2019).

**Distribution and ecology.** Endemic to Sabah. Only known from the type locality where it is moderately abundant, Kionsom Waterfall, Inanam, Kota Kinabalu. Moist lowland forest on Oligocene deepwater sandstones, mostly occurring on the lower parts of shady consolidated alluvium soil banks at about 200 m elev.

**Homalomena marasmiella** Kartini, P.C. Boyce & S.Y.Wong

**Material examined.** MALAYSIA – Sandakan • Labuk & Sugut/Kinabatangan border, Telupid, Sungai Telupid; 05°35′49″N, 117°04′35″E; 128 m elev.; 25 Mar 2015; M. Lo AR5192 (holo SAN, iso SAR).

**Identification.** *Homalomena marasmiella* differs from Sarawak *H. Stella* P.C. Boyce & S.Y.Wong and *H. vagans* P.C. Boyce, the two species it most closely resembles, by the mushroom-shaped interpellar staminodes and cut tissues smelling of coriander leaves (vs. columnar interpellar staminodes and tissues with a smell reminiscent of turpentine). *Homalomena marasmiella* is further distinguished from *H. Stella* and *H. vagans* by being restricted to ultramafic rocks (*H. Stella* and *H. vagans* occur almost exclusively on shale). From *H. Stella*, *H. marasmiella* is differentiated by having the leaves scattered along a creeping and rooting rhizome-like stem (vs. a rosette of leaves on a compact, erect stem) and the presence of a naked interstice separating the pistillate and staminate flower zones. From *H. vagans*, *H. marasmiella* is differentiated additionally by chartaceous leaf blades. All observed plants of *H. marasmiella* have the leaf blades with fine broken streaks of pale grey variegation approximately coinciding with the primary lateral veins, whereas *H. Stella* and *H. vagans* have plain green leaves (Kartini et al. 2015a).

**Distribution and ecology.** Endemic to Sabah. *Homalomena marasmiella* is known only from the type locality, Sungai Telupid, Labuk & Sugut, Telupid. *Homalomena marasmiella* occurs on lightly shaded vertical earth banks over ultramafic rock under moderately humid lowland forest at an elevation of ca. 130 m.

**Homalomena portae-inferni** S.Y.Wong, J. Joling & P.C. Boyce


**Identification.** *Homalomena portae-inferni* is most similar to *H. kionsomensis*, differing by pistillate florets in two rows (vs. three to four rows), pistils without glands (vs. pistils with minute red glands), with the associated staminode oblong and pale green (vs. staminode almost globose on a very short hair-like stipe, and pale yellow), stigma ca. 1 mm in diam. (vs. 0.5 mm), and staminate florets pale green (vs. cream) (Wong et al. 2020a).

**Distribution and ecology.** Endemic to Sabah. Known only from the type locality at Tawau Hills Park, trail to Hot Springs. Forms large patches or occurs as smaller plants on moss-covered peat domes under *Tristaniopsis*-dominated lowland kerangas on Pleistocene volcanics, with elevation between 200 and 320 m elev.

**Homalomena rostrata** Griff.

**Material examined.** MALAYSIA – Pedalan • Keningau, Crocker Range Forest Reserve, Mile 16 highland plantation Crocker Forest Reserve; 05°51′15″N, 116°18′50″E; 1219.2 m elev.; 12 June 1977; A. H. Talip & Ejan SAN 87012 (SAN) • Sipitang, Mengalong Forest Research; 05°00′30″N, 115°29′11″E; 22 May 1990; W. Meijer SAN 130248 (AA, SAN) • same locality; 22
Material examined. MALAYSIA – Pedalaman • Beaufort, Klias Forest Reserve; forest between Klias Forest Reserve and Upper Sungai Apipi; 5 m elev.; 7 May 1998; 0°18′N, 115°40′E; S. P. Lim 1811 (SAN) • Tenom, Agr. Station; 0°10′54″N, 115°59′23″E; 2 November 1987; Mansus & Good SAN 122364 (SAN) – Sandakan • Tenom, KBD estate Komansi Labuk; 0°30′00″N, 117°00′00″E; 4 May 1965; W. Meijer & Kodoh SAN 49814 (SAN) • Kinabatangan, Pin, Pin Timber Camp, S of Bt. Pin Besar; 0°23′28″N, 117°52′52″E; 25 November 1968; Kokawa & Hotta 1521 (L) • Sandakan, Komansi River swampy river side, P tom Est at; 0°37′45″N, 117°08′00″E; 6.096 m (20 ft.) elev.; 14 May 1965; W. Meijer SAN 51629 (SAN) • Sandakan, Lalai Eat Corner near town Singapor a road; 0°50′06″N, 118°05′46″E; 10-40 m elev.; 16 October 1994; W. Meijer SAN 134360 (SAN). Identification. The lithophytic habit, creeping stem, and narrow leaf blades is distinctive for the species. The infructescence peduncle in *H. vagans* is unusual in the genus in its erect, not drooping habit (Boyce 1994).

**Distribution and ecology.** Steep banks near river in primary lowland mixed dipterocarp forest on Setap shale formation; 65 m.

**Lasia spinosa** (L.) Thwaites

Material examined. MALAYSIA – Pedalaman • Beaufort, Klias Forest Reserve, forest between Klias Forest Reserve and Upper Sungai Apipi; 5 m elev.; 7 May 1998; 0°18′N, 115°40′E; S. P. Lim 1811 (SAN) • Tenom, Agr. Station; 0°10′54″N, 115°59′23″E; 2 November 1987; Mansus & Good SAN 122364 (SAN) – Sandakan • Beluran, KBD estate Komansi Labuk; 0°30′00″N, 117°00′00″E; 4 May 1965; W. Meijer & Kodoh SAN 49814 (SAN) • Kinabatangan, Pin, Pin Timber Camp, S of Bt. Pin Besar; 0°23′28″N, 117°52′52″E; 25 November 1968; Kokawa & Hotta 1521 (L) • Sandakan, Komansi River swampy river side, Ptom Est at; 0°37′45″N, 117°08′00″E; 6.096 m (20 ft.) elev.; 14 May 1965; W. Meijer SAN 51629 (SAN) • Sandakan, Lalai Eat Corner near town Singapora road; 0°50′06″N, 118°05′46″E; 10-40 m elev.; 16 October 1994; W. Meijer SAN 134360 (SAN). Identification. Stems suffruticos, erect to decumbent with spiny internodes. Leaves usually dissected, or hastate. Spathe caducous or rarely marcescent. Placentation apical with fruit spiny (Hay 1992).

**Distribution and ecology.** Southwestern and northeastern Sabah. Found growing in swamps, riverbanks, ditches, moist places, occasionally in boggy places in forest undergrowth in tropical and subtropical forests. Sometimes cultivated along fishponds and rice fields.

**Nabalu corneri** (A.Hay) S.Y.Wong & P.C.Boyce

Figure 5A

Material examined. MATERIALS – Pedalaman. Tenom,
Trus Madi, Batu Lapan; 05°38′20″N, 116°27′05″E; 731 m elev.; 26 March 1999; Ruth Kiew 4670 (SAN) – Pantai Barat • Ranau, Kinabalu, Siliau Basin, Upper Kinabalu; [06°05′30″N, 116°32′45″E], 1829 m elev.; 1829 m elev.; 19 April 1932, Clemens & Clemens 29156 (L) • Ranau, Mount Kinabalu, Dallas; [06°5′30″N, 116°32′45″E], 1000 m elev.; 1931; Clemens & Clemens s.n. (L) • same locality; 1000 m elev.; April 1932; Clemens & Clemens 29157 (L) • Ranau, Mount Kinabalu, Eastern Shoulder; [06°05′N, 116°36′40″E]; 1066.8 m (3500 ft.) elev.; 18 June 1961; E. J. H. Corner & A. Stainton RSNB 642 (SAN) – Sandakan • Maliau Basin Conservation Area, Rafflesia Camp; 04°49′46″N, 116°53′49″E; 500 m elev.; 26 April 2000; Ming & Sidkan MB 297 (SAN).

Identification. Nabalu cornieri is defined by its massive arborescent pachycaul. The leaf sheath wings are persistent. The inflorescence is nodding with the spathe is hardly opening (Low et al. 2018).

Distribution and ecology. Highly localized. Disturbed forest or open sites by rivers among rocks, sometimes in great numbers together, 550–1000 m elev.

Ooia kinabaluensis (Bogner) S.Y.Wong & P.C.Boyce

Figure SB

Material examined. MALAYSIA – Pedalaman • Peniangan, Pensiangi Utara Sub-District, Kampung Pun Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 24 October 1996; S. P. Lim et al. LSP 1502 (SAN) • Sipitang, Long Pasia, Sungai Pulau; [04°24′11″N, 115°39′00″E]; 609.6 m (2000 ft.) elev.; 3 September 2002; Postar SAN 145751 (K, SAN) • Sipitang, Long Pasia; [04°24′11″N, 115°39′00″E]; 10 August 1988; Amin et al. SAN 123353 (SAN) • Sipitang, Lower Sungai Maga; [04°24′11″N, 115°39′00″E]; 1200 m elev.; 18 April 2000; S. P. Lim & Soinin SAN 143701 (SAN) – Tambunan, Mount Trus Madi; [05°37′N, 116°30′E]; 1000 m elev.; 19 March 1969; Nooteboom H. P. Nooteboom 1389 (SAN) • Tambunan, Trus Madi, Along Talabao River; [05°33′11″N, 116°31′01″E]; 23 May 1986; Joseph B. et al. SAN 113554 (SAN) • Tambunan, Trus Madi, Mount Trusmadi; [05°25′22″N, 118°14′19″E]; 1000 m elev.; 20 March 1969; Nooteboom H. P. Nooteboom 1417 (L) • Tenom, Katubu; [04°51′47″N, 115°58′03″E]; 533.4 m (1750 ft.) elev.; 29 April 1972; Cockburn SAN 70057 (SAN) – Pantai Barat • Kota Belud, Kinabalu Park, Kg Sayap, end of road to Wariu waterfall; 06°19′42″N, 116°22′33″E; 1000 m elev.; 17 January 1998; Jamili Nais SNP 4661 (KEP, SAN) • Kota Belud, Melangkap, Melangkap Kappa, On SW side of Mt. Kinabalu; [06°09′N, 116°31′E]; 600 m elev.; 15 February 1984; Beaman et al. J. H. Beaman, 8594 (L) • Ranau, Kinabalu National Park, along Sungai Dahobang S. side; [06°0′15″N, 116°33′E]; 914.4-1066.8 m (3000-35000 ft.) elev.; 19 September 1965; A. Kanis SAN 51466 (SAN) • Ranau, Kinabalu National Park, area near Park Headquarters, Moss Forest, in wet sandy soil near stream, also among boulders; [06°05′30″N, 116°32′45″E]; July 1986; Vermeulen & Chen J. J. Vermeulen 392 (L) • same locality; 1500 m elev.; 9 October 1968; Ogata K. Ogata 11083 (L) • Ranau, Kinabalu National Park, Eastern Shoulder; [06°05′N, 116°36′40″E]; 1981.2 m (6500 ft.) elev.; 7 July 1961; W. L. Chew, E. J. H. Corner, A. Stainton, RSNB 708 (SAN) • Ranau, Kinabalu National Park, Lungmanis Trail; 06°10′N, 116°34′E; 1000 m elev.; 25 June 2000; A. D. Poulsen ADP 1622 (SAN) • Ranau, Kinabalu National Park, Marai Parai; [06°05′30″N, 116°32′45″E]; 1700 m elev.; 23 March 1933; Clemens & Clemens 32290 (L) • Ranau, Kinabalu National Park, Penibukan, Dahobang river; [06°05′30″N, 116°32′45″E]; 1219.2-1524 (4000-5000 ft.) elev.; 3 March 1933; Clemens, J. & Clemens, M. S., Clemens & Clemens 31876 (A) • Ranau, Kinabalu National Park, Ulu Liwagu, Ulu Mesilou; [06°N, 116°35′E]; 1158.24 m (3800 ft.) elev.; 28 August 1961; W. L. Chew & E. J. H. RSNB 2501 (SAN) • Ranau, Kinabalu National Park, Upper Kinabalu, Upper Kinabalu, Siliau Basin; [06°05′30″N, 116°32′45″E]; 2300 m elev.; April 1931; Clemens & Clemens 29135 (L) • Ranau, Kinabalu, Penibukan (Bahandaoi), Sungai Tahanb; [06°00′15″N, 116°33′E]; 900 m elev.; 10 March 1970; Nooteboom & Aban, H. P. Nooteboom 1508 (SAN) • Ranau, Kinabalu, southern slope of Mt. Kinabalu, eastern route, on the riverbanks of the eastern attributary of the Sungai (River) Mesilau Cave and the larger landslide, at old trail between Mesilau Cave and Janet’s Halt; [06°05′30″N, 116°32′45″E]; 7 September 1963, Fuchs H. P. & Collenette S. H. Collenette 21634 (K, L) • Ranau, Kundasang near golf course, Montane Forest on valley; 06°01′51″N, 116°35′56″E; 14 March 1986; L. Madani SAN 111616 (SAN) • Ranau, Mesilau River, above upper edge of Mt. Kinabalu golf course site near East Mesilau River, Oak–Laurel Forest, Trusmadi Formation; 06°05′30″N, 116°32′45″E; 13 November 1983; Beaman et al. J. H. Beaman 7473 (L) • Ranau, Mesilou, Hillside; 05°59′08″N, 116°36′28″E; 1750 m elev.; 3 September 1988; Amin et al. SAN 123519 (SAN) • Ranau, Kundasang, Nature Reserve, Nepenthes Trail, Montane forest; 05°59′08″N, 116°36′28″E; 1940 m elev.; 6 July 2010; Pereira J. T. SAN 152369 (SAN) • Ranau, Poring National Park; 06°02′44″N, 116°42′02″E; 12 July 1998; Reza Azmi RA 12798 B (SAN) • Ranau, Tawaras, Toki on way to Pinousuk; [06°07′10″N, 116°47′56″E]; 185.806 m (2000 ft.) elev.; 3 November 1959; W. Meijer SAN 20294 (SAN) • Ranau, Tenompok, Mount Kinabalu, Kundasang; [05°58′58″N, 116°30′40″E]; 1330 m elev.; 8 April 1932; Clemens & Clemens 29136 (L) • Ranau, Ulu Tungud Forest Reserve, Gunung Mongkobo Expedition, Sungai Parangampang; [05°00′44″N, 116°59′41″E]; 417 m elev.; 29 July 2005; Saw SAN 145957 (SAN).

Identification. Ooia kinabaluensis is extremely variable in size vegetatively and is defined by fragrant inflorescences, a persistent spadix axis, deciduous flowers with the pistillate flowers inserted on a conspicuous swollen cushion, parietal placentation, a spathe completely persistent to persistent more than half its length, with the persistent portion ovoid-subcylindric to fusiform or funneliform, and never flaring, and production of copious
plantlets from the finer roots (with a conspicuous mucigel cap to the roots) (Bohner and Hay 2000).

**Distribution and ecology.** Kinabalu range. Facultatively rheophytic, lithophytic or terrestrial in shade, 750–2300 m elev.

**Phymaturum borneense M.Hotta**

**Material examined.** MALAYSIA – Pantai Barat • Beaufort, beside road mile 58; 05°20′32″N, 115°46′28″E; 15 December 1989; Amin SAN 114925 (SAN).

**Identification.** *Phymaturum borneense* is defined by a constricted spathé, with the lower persistent part actively splitting-opening at fruit maturity, unistaminate flowers with large densely papillate thecae, sharply downturned needle-like thecae extensions dehiscing by an apical pore, and pollen in droplets (Low et al. 2018).

**Distribution and ecology.** This is a first record for Sabah (Jyloerica et al. in review). Eastern Sabah. Rheophytic, occasionally terrestrial on very wet forest floor, in deep shade at low elevation.

**Pothos atropurpurascens M.Hotta**

**Figure 5C**

**Material examined.** MALAYSIA – Pantai Barat • Ranau, Mount Kinabalu, Penibukan; 06°05′30″N, 116°32′45″E; 16 January 1933; Clemens & Clemens 31126 (A) • Sandakan • Telupid-Ranau Road, Mile 8 Telupid Ranau Road; [05°39′24″N, 117°04′15″E]; 22 March 1974; Aban & Saikeh SAN 79445 (SAN) • Sandakan, Sepilik Forest Reserve; [05°49′36″N, 117°57′04″E]; 22 April 1960; W. Meijer SAN 21234 (SAN).

**Identification.** *Pothos atropurpurascens* belongs to subgenus *Allopothos*, the Barberianus group where the species are characterized by thickened, often sharply deflexed long peduncles and often cucullate, somewhat deflexed long peduncles and often cucullate, somewhat split-open at fruit maturity, unistaminate flowers with the flowers set directly on the spadix axis and not on a swollen pad. This species is variable in size and the development of its inflorescence is closely linked to the vigour of the plant or even of an individual branch (300% size difference).

**Pothos barberianus Schott**

**Material examined.** MALAYSIA – Pedalaman • Tambunan, Gunung Alab; [05°49′51″N, 116°20′23″E], 1300 m elev.; 22 February 1969, H. P. Nooteboom 999A (L) • Pantai Barat • Kota Belud, Mt Templer Forest Reserve, South of Sungai Talupid; [06°24′10″N, 116°36′39″E]; 548.64 m (1800 ft) elev.; 26 September 1972; G. Shea & F. Minjulu SAN 76257 (SAN) • Sandakan • Beluran, Labuk & Sugut, Doji, western side of Bt. Doji and pass way from Telupid to Ulu Karamuka, Bt. Doji, Telupid; [05°37′39″N, 117°04′15″E]; 100 m elev.; 24 October 1968; Kokawa & Hotta 413 (L) • Kinabatangan, Karamuka, Sungai Kerang; [05°N, 115°45′E]; 1 September 1970; Kumin Muroh SAN 70601 (SAN) • Sandakan, Bidu-Bidu Hills, Bidu-Bidu Hills above Kiabau; 05°50′49″N, 117°15′41″E; 457.2 m elev.; 3 June 1964; W. Meijer SAN 43823 (SAN) • Sandakan, Kebun Cina; 05°51′04″N, 118°03′47″E; 30 May 1990; W. Meijer SAN 124380 (SAN) • Sandakan, Mile 17 Labuk Road; [05°53′28″N, 117°55′09″E]; 26 March 1963; Mukmin Asir SAN 35621 (SAN) • Tawau • Lahad Datu, Madai Forest Reserve; [04°41′18″N, 118°01′55″E]; 6 August 1993; Martin Sands & K. M. Wong 6033 (SAN).

**Identification.** *Pothos barberianus* belongs to subgenus *Allopothos*, the Barberianus group. It can be detected easily from its inflorescence pendent by the sharply reflexed peduncle, spathe strongly reflexed and spadix only just exceeding the greatly enlarged peduncle (Boyce and Hay 2001).

**Distribution and ecology.** Northwestern, southwestern, and northeastern Sabah. In a wide range of habitats from primary and disturbed lowland forest on clays to ridge top kerangas, 10–1800 m elev.

**Pothos beccarianus Engl.**

**Material examined.** MALAYSIA – Pedalaman • Beaufort, Bukit Montoron; [05°20′56″N, 115°48′10″E]; 27 October 1975; Dewol & Karim SAN 80276 (SAN) • Keningau, Ulu Sungai Tinagal Forest Reserve; [05°35′N, 116°18′12″E]; 20 November 1985; Fidilis Krispinus SAN 113123 (SAN) • Keningau, Tulid Area, Ulu Sungai Sembauan, 05°19′15″N, 116°25′27″E; 20 September 1988 Fidilis Krispinus SAN 125636 (SAN) • Sandakan • Kinabatangan, Penangah Forest Reserve, 05°01′45″N, 116°43′14″E; 27 April 1987; Joseph B., Maidil & Gambio SAN 119084 (SAN).

**Identification.** *Pothos beccarianus* is endemic to Borneo (not yet recorded from Kalimantan) and belongs to the Goniiurus supergroup. *Pothos beccarianus* is recognized for its frequently long, pubescent inflorescences with the flowers set directly on the spadix axis and not on a swollen pad. This species is variable in size and the development of its inflorescence is closely linked to the vigour of the plant or even of an individual branch (300% size difference). *Pothos beccarianus* has two different types of inflorescences colour, yellow (common) and dark pink (rare) (Boyce and Hay 2001).

**Distribution and ecology.** Southwestern and northeastern Sabah. Primary to variously disturbed lowland to hill forest, on slopes and ridgetops, very occasionally in kerangas, 135–820 m elev.

**Pothos brevistylus Engl.**

**Material examined.** MALAYSIA – Pedalaman • Beaufort, Klias Forest Reserve; [05°17′47″N, 115°37′50″E]; 20 July 1993; Dewol & Karim SAN 77798 (SAN) • Sandakan • Kinabatangan, Bukit Garam, Sungai PSN, Block 13; 05°29′25″N, 117°49′38″E; 14 December 1990; Shim Phuyau Soon SAN 131673 (K, SAN) • Kinabatangan, Pin-Supu Forest Reserve, Batu Puteh, Tulug Hill; [05°25′14″N, 117°56′25″E]; 8 June 1996; S. P. Lim 626 (SAN) • same locality; 12 December 1990; W. Meijer & Dewol SAN 131635 (SAN) • Tawau • Lahad Datu, Segama River Forest Reserve; [04°57′42″N, 117°49′57″E]; 17 March 1985;
Leopold M. & Ismail SAN 108602 (SAN) • Tawau, Luasong Camp; 04°23′59″N, 117°53′21″E; 11 July 1985; Leopold M. SAN 107943 (SAN) • Tawau, Tawau Hills Park, Bombalai Hill; 22 October 1985; Leopold M. & Sigin SAN 111552 (SAN).

**Identification.** *Pothos brevistylus* belongs to the Oxyphyllus group and endemic to North Borneo (Brunei, Sabah, and Sarawak). *Pothos brevistylus* approaches *Pothos laurifolius* P.C.Boyce & A.Hay (Brunei) but can be separated from its leaves, sessile stigma, spathe and synflorescences (Boyce and Hay 2001).

**Distribution and ecology.** Southwestern, northeastern, and eastern Sabah. Lowland forest on shale, slopes, and ridges, rarely in peatswamp, 20-80 m elev.

*Pothos cylindricus* C.Presl

**Material examined.** MALAYSIA – Sandakan • Kina- batangan, Kampung Pangkaian, Tamoggang Timber Camp near Kampung Pangkaian; [05°25′22″N, 118°14′19″E]; 20 November 1968; Kokawa & Hotta & Mitsuhiro Hotta 1300 (L, P) • Tawau • Lahad Datu, Danum Valley, side of tractor path coupe 1989; 04°57′30″N, 117°41′47″E; 23 August 1990; Maikin & Lideh SAN 131103 (SAN) • same locality; 20 June 1989; C. E. Risdale 2113 (L) • Lahad Datu, Madai-Baturong Forest Reserve; 04°41′18″N, 117°01′55″E; 9 June 1996; Madai Hill, S. P. Lim 653 (SAN) • Tawau, Bukit Gemuk; 04°18′11″N, 117°52′E; 8 August 1993; K. M. Wong et al. SAN 144814 (SAN).

**Identification.** *Pothos cylindricus* belongs to subgenus *Pothos*, the Junguhnnii group and is very close to *Pothos longipes* Schott but differs from its sessile spadix and flowering only terminally on leafy branches. *Pothos cylindricus* is also very near to *P. papuanus* Becc. ex Engl. (also with a sessile spadix), but *P. papuanus* usually lateral on a sometimes sympodially branched short shoot in distal leaf and the spathe oblong-ovate to oblong-lanceolate (Boyce and Hay 2001).

**Distribution and ecology.** Northwestern and eastern Sabah. Primary and secondary lowland to upper hill forest, often in well-drained positions, 40–900 m elev.

*Pothos fractiflexus* J.Joling, Pereira & A.Damit

**Material examined.** MALAYSIA – Pedalaman • Sapulut, Nurod-Urod F.R.; 04°35′10″N, 116°54′27″E; 582 m elev.; 14 Jun 2012; Suzanna S. SAN 154991 (SAN) • Sandakan • Ulu Sg. Pinangah, 04°44′45″N, 116°37′00″E; 17 Oct 1984, Patrick Lassan SAN 107216 (K, L, SAN).

**Identification.** In general appearance very close to *P. degenerans*, but readily differentiated by pedicellate florets and shallow saucer-like receptacle (Wong et al. 2020b).

**Distribution and ecology.** Endemic to Sabah. Forested hillsides on Neogene or Quaternary sediments between 300 and 500 m elev.

*Pothos insignis* Engl.

**Material examined.** MALAYSIA – Pedalaman • Keningau, Lian Cave; 05°29′30″N, 116°10′30″E; 5 June 1965; W. Meijer & John Kuripin SAN 5712 (K, L, SAN) • Nabawan, Maitland Range Area, Sungai Pingas-Pingas; 05°14′20″N, 116°40′32″E; 14 May 1986; Asikantor San 119395 (SAN) • Pandawan, Sungai Pementarian; 04°58′12″N, 116°25′24″E; 13 February 2019; Sumbing Jimpin San 119949 (SAN) • Pantai Barat • Ranau, Bukit Ampuan, hillside; [06°01′18″N, 116°39′59″E]; 792 m elev.; 20 November 1973; L. Madani SAN 89395 (SAN) • Ranau, Kinabalu; [06°04′22″N, 116°33′29″E]; 1371.6 m (4500 ft.) elev.; 16 August 1963; G. Mikil SAN 38668 (SAN) • Ranau, Poring, Sungai Kipungit; 06°02′53″N, 116°42′06″E; 457.2 m (1500 ft.) elev.; 3 October 1987; W. Meijer SAN 122512 (SAN) • Sandakan • Kinabatangan, Tabin Wildlife Reserve, northern part near Tabin River; 05°19′N, 118°45′E; 19 October 2000; 180 m elev.; A. D. Poulson 1678 (AAU, BORH, K, KEP, L, SAN, SING) • Sandakan, Gomantong Forest Reserve, Dulong Lambu; 05°33′30″N, 118°06′30″E; 100 m elev.; 28 April 1996; S.P. Lim 584 (SAN) • Sandakan, Ulu Dusun, Mile 30; [05°47′06″N, 117°46′14″E]; 15.24 (50 ft.) elev.; 18 August 1977; S. Lantoh SAN 87859 (KEP, SAN, SAR).

**Identification.** *Pothos insignis* is apparently allied to *P. rumphi Schott and P. borneensis* Furt. in having long petioles with a petiolar sheath extending to the base of the geniculum, a relatively large, leathery spathe and robust tepals. *Pothos insignis* is distinguished from *P. rumphi* and *P. borneensis* by the manner in which the inflorescences are presented. In *P. insignis* new fertile stems arise from leafless, post fertile stems. The new fertile stems are clothed along their entire length by inflated cataphylls each consisting of a greatly enlarged petiolar sheath terminated by a much-reduced leaf blade. From the apex of each fertile stem emerge the inflorescences, one at a time, each new inflorescence emerging as the previous one begins to fruit. It is unclear how many inflorescences a fertile stem produces before it dies, but a study of the scarring of post fertile stems suggest that it may be as many as 12 (Boyce and Poulsen 1993).

**Distribution and ecology.** Northwestern, southwestern, and northeastern Sabah. Lianescent, hemi-epiphytic or lithophytic trunk or treetop climber at base of ridges or near rivers in primary to disturbed primary mixed dipterocarp forest on shales or limestone, at 10–1200 m elev.

*Pothos kinabaluensis* Furtado

**Material examined.** MALAYSIA – Pantai Barat • Kinabalu, Mts. At Tenompok, ca. 5000 ft elev. (leg. Furtado, comm. Clemens sub. N. 29,155) (holo SING).

**Identification.** The species is related to *P. lancifolius* Hook.f., but differentiated by the sessile spadix, and by the much larger leaf blades with three collective veins, the longer petiole, and the wider petiolar sheath (Furtado 1935). This foliage is very similar to that of *P. insignis*, but the latter has a unique flowering architecture (P.C. Boyce, pers. comm.).

**Distribution and ecology.** This species in endemic
to Sabah. Known from its type locality at Tenompok. Mixed dipterocarp forest on slopes, ridges and streambanks on clay, sandstone, and shale.

**Pothos leptostachyus Schott**  
Figure 5E  
**Material examined.** MALAYSIA – Pedalaman • Te-nom, Alutok; 04°39’27”N, 115°51’33”E; 17 March 1987; Fidilis Krispinus SAN 120163 (SAN) – Sandakan • Kin-abatangan, Gomantong Caves; 05°31’52”N, 118°04’17”E; 300 m elev.; 24 April 1996; A. Hay 12166 (SAN) – Kin-abatangan, Tabin Wildlife Reserve, northern part near Tabin River; 05°19’N, 118°45’E; 180 m elev.; 19 October 2000; A. D. Poulsen, Jens Kanstrup & Kho Ju Ming, A.D.Poulsen 1677 (SAN) • Sandakan, Gomantong Caves; 31 October 1968; Kokawa, S. & Hotta, M. S. Kokawa Lambu limestone massif, Gomantong limestone hill; 50 m elev.; 24 April 1996; S. P. Lim et al. LSP 576 (SAN).  
**Identification.** This species belongs to the Allopothos supergroup together with *P. kingii* Hook.f. *Pothos leptostachyus* and *P. kingii* have thinly chartaceous leaves. The stout (2–3 mm in diameter) erect peduncles and longer, lorate spathe readily distinguishes *P. leptostachyus* (Boyce 2009).  
**Distribution and ecology.** *Pothos leptostachyus* is a new record for Sabah. Damp to rather dry evergreen hill forest on limestone, 50–300 m elev.

**Pothos longivaginatus Alderw.**  
**Material examined.** MALAYSIA – Tawau • Tawau, Elphinstone Province, [04°18’N, 117°54’E]; October 1922; A. D. E. Elmer 21822 (L).  
**Identification.** *Pothos longivaginatus* is distinguished by the long petiolar sheath, almost reaching the gynecium. The leaf blade is thickly leathery, obliquely lanceolate, unequal on both sides. The peduncle is longer than the petiole with a sessile spadix (Alderwerelt 1920).  
**Distribution and ecology.** Northwestern and eastern Sabah. Mixed dipterocarp forest on slopes, ridges and streambanks on clay, sandstone, and shale, 23–1525 m elev.

**Pothos mirabilis Merr.**  
Figure 5F  
**Material examined.** MALAYSIA – Sandakan • Sandakan, Myburgh Prov.; [05°51’19”N, 117°53’4”E]; October 1921; A. D. E. Elmer 20364 (L) • Sandakan, Labuk Sgut, below Bukit Panandawan; 06°10’12”N, 117°32’02”E; 914.4 m (3000 ft.) elev.; 21 August 1961; Muin Chai SAN 26034 (SAN, K) • Lahad Datu, Ulu Lungmanis 1969 Coupe L, Kolapis Road; [05°31′45″N, 117°53′04″E]; October 1922; A. D. E. Elmer 21822 (L).  
**Identification.** *Pothos mirabilis* is endemic to Sabah and is unique from its flower, its enormously elongated and twisted pendent spathe. *Pothos mirabilis* is allied to *Pothos volans* P.C.Boyce & A.Hay and *Pothos wallichii* Hook.f. due to its inflorescences are mostly produced from the tips of leafy shoots and this together with the long slender peduncle (Boyce 2000).

**Distribution and ecology.** Endemic to Sabah. Lowland forest on yellow sandy loam, 20–300 m elev.

**Pothos motleyanus Schott**  
**Material examined.** MALAYSIA – Federal Territory of Labuan • P. Labuan; Motley 99 (holo K).  
**Identification.** *Pothos motleyanus* belongs to the Gon-iurus supergroup (Boyce & Hay 2001), with the spadix with scattered flowers. Inflorescences carried on much abbreviated stems clothed in minute cataphylls and arising from the mid-parts (rarely the tips) of sterile mature stems. In *P. curtisii* these lateral shoots arise from beneath the leaf axil (or node) and are elaborated by sympodial branching into leafless, sometimes highly complex, compact, or lax synflorescences bearing two to many inflorescences simultaneously, or sometimes single inflorescences in series. Synflorescences are usually borne along or at the end of leafy branches or, more rarely on older leafless parts of the stem.  
**Distribution and ecology.** Endemic to Sabah. The type is from Labuan and the species has not been refound anywhere in Sabah, Sarawak, and Brunei.

**Pothos ovatifolius Engl.**  
Figure 5G  
**Material examined.** MALAYSIA – Pantai Barat • Tambunan Distr., road to Kg Tondulu, Kg Tondulu valley; Boyce 1422 (K) • Tambunan Distr., Kg Kangeran road, Br. Lapan, 1.5 hours by car from Kg Kangeran; Boyce 1423 (K).  
**Identification.** This species belongs to the Allopothos supergroup (Boyce and Hay 2001) and can be distinguished by its leaf blade stiffly chartaceous to coriaceous, (3–)8.5–27 × (2.5–)7–27 cm, spreading, oblong ovate to very broadly ovate, oblique, sometimes profoundly so, base broadly rounded to narrowly cordate.  
**Distribution and ecology.** Found in small, scattered populations in wet river valleys in Sabah. This species is not common in northern Borneo. Primary to degraded secondary lowland to lower montane forest, 70–1400 m elev.

**Pothos scandens L.**  
Figure 5H  
**Material examined.** MALAYSIA – Pedalaman • Tambunan, Junction Sungai Tikalod; 06°01’12”N, 116°47’55”E; 23 April 1986; George Majawat, SAN 114312 (SAN) – Pantai Barat • Ranau, Mount Kinabalu, Dallas; 06°05’30”N, 116°32’45”E; 27 October 1931; Clemens & Clemens 26808 (P) • Ranau, Singgaron Baru, Marali side; 06°01’12”N, 116°47’55”E; 914.4 m (3000 ft.) elev.; 23 April 1986; Amin Gambating SAN 114312 (SAN) – Sandakan • Sandakan, Segali Lukan Forest Reserve, Lungmanis 1969 Coupe L, Kolapis Road; [05°31′45″N, 117°32′02″E]; 22 May 1970; C. Charington SAN 63644 (SAN) – Tawau • Lahad Datu, Silam; [05°51′19″N, 117°53′04″E]; 121.92 m (400 ft.) elev.; 21 August 1961; Muin Chai SAN 26034 (SAN, K) • Lahad Datu, Ulul Sandakan, Tawau, Lahad Datu • Motley 99 (holo K).  
**Identification.** This species belongs to the Allopothos supergroup (Boyce and Hay 2001) and can be distinguished by its leaf blade stiffly chartaceous to coriaceous, (3–)8.5–27 × (2.5–)7–27 cm, spreading, oblong ovate to very broadly ovate, oblique, sometimes profoundly so, base broadly rounded to narrowly cordate.  
**Distribution and ecology.** Found in small, scattered populations in wet river valleys in Sabah. This species is not common in northern Borneo. Primary to degraded secondary lowland to lower montane forest, 70–1400 m elev.
Sungai Segama; 04°57′24″N, 117°37′03″E; 3 March 1985; G. Argent et al. SAN 107698 (SAN) • Tawau, Bukit Gemuk, [04°18′N, 117°52′E]; 8 August 1993; K. M. Wong, Baraham & Kumin SAN 134814 (SAN).

**Identification.** *Pothos scandens* is highly variable, the plant bears small inflorescences on bent peduncles, it can be high-climbing plants bearing tiny inflorescences, some may have large inflorescences not exhibiting the bent peduncle until very late anthesis or during early infructescence development, the large inflorescences of *P. scandens* can be mistaken with *P. roxburghii* de Vriese (Boyce 2000).

**Distribution and ecology.** Northwestern, Southwestern, northeastern, and eastern Sabah. On trees and rocks in primary and secondary wet to dry lowland to hill evergreen tropical to subtropical forest, occasionally on sea cliffs, in hedges or scrub or in coconut plantations, on a variety of substrates including clay, limestone and granite. Sea-level to 1000 m elev.

*Pursegloveia imbakensis* H.Okada, Tsukaya & M.Suleiman

**Material examined.** MALAYSIA – Sandakan • Tonggod, Imbak Canyon Conservation Area, Kuli Water Fall; 8 Aug. 2015; Tsukaya, H., Okada, H., Hayashi, T. & Suleiman, M. TOH-113 (holo BORH).

**Identification.** Similar to *Pursegloveia minima* (H.Okada) S.Y.Wong & P.C.Boyce in having stamens with shallow cavity but differing in the horseshoe-shaped staminate flowers and shining dark green leaves 20–30 cm long vs. chain-shaped staminate flowers and shining green leaves 4–7 cm long in *P. minima* (Okada et al. 2020).

**Distribution and ecology.** Known only from the type locality at Kuli Waterfall, Imbak Canyon Conservation Area. Observed only on a large rock just below Kuli Waterfall (Okada et al. 2020).

*Rhaphidophora fluminea* Ridl.

**Material examined.** MALAYSIA – Pedalaman • Keningau, Camp C area Tiulan; 05°07′31″N, 116°23′02″E; 31 October 1983; Maikin Lantoh SAN 102053 (SAN) • Kenigau, Lanas, Shang Lian logging area; 05°25′39″N, 116°29′28″E; 21 October 1986; Fidilis Krispinus SAN 118444 (SAN) • Kenigau, Ulu Sungai Matud; 05°12′N, 116°06′E; 29 June 1987; Shawn Tangki SAN 119596 (SAN) • Kenigau, Ulu Sungai Pingas-Pingas, along the riversides; 05°14′20″N, 116°40′32″E; 8 March 1988; Sumbing Jimpin SAN 122024 (SAN) • Pensiangan, logged areas, Ponontomon; 05°01′21″N, 115°57′15″E; 23 September 1989; Sumbing Jimpin SAN 128024 (SAN) • Pensiangan, Pensiangan Kayu; 04°52′02″N, 116°16′53″E; 21 January 1994; Asik Mantor SAN 136885 (SAN) • Pantai Barat • Ranau, Kampung Paus, edge of riverbank; 05°41′12″N, 116°47′02″E; 23 February 1982; Amin G. SAN 94681 (SAN) – Sandakan • Beluran, Labuk & Sugut, Doji, western side of Bt. Doji and pass way from Telupid to Ulu Karamuak; 05°37′42″N, 117°06′48″E; 100 m elev.; 25 October 1968; Kokawa & Hotta 471 (L) • Beluran, Sungai Baba; 05°45′01″N, 117°08′40″E; 1 March 1980; Ahan G. SAN 90040 (SAN) • Kinabatangan, Imbak Canyon; 05°07′N, 116°58′E; 160 m elev.; 15 May 2004; H. Nagamasu 7278 (K, KEP, KYO, L) • Sandakan, Babakang River, VJR Mile 42; 05°06′42″N, 118°59′39″E; 16 December 1985; Lideh et al. SAN 118056 (SAN) • Sandakan, Labuk & Sugut, along Sungai Meliau, foot of Mt. Tawai, Telupid; [05°30′33″N, 117°35′4″E]; 20 October 1968; Kokawa & Hotta 110 (L) • Sandakan, Labuk Road Mile 45; [05°41′57″N, 117°36′12″E]; 26 July 1964; W. Meijer SAN 44014 (K, L, SAN) – Sandakan, Labuk Sugut, Ulu Tungud, Ensuan; 05°47′20″N, 117°05′78″E; 26 January 1987; Amin K. & Mansus SAN 117025 (SAN) • Sandakan, Lamag, Sungai Loken; [05°29′51″N, 117°20′03″E]; 5 June 1983; Amin K. et al. SAN 97483 (SAN) • Sandakan, Lamag, Ulu Sungai Loken, side of streams on rocks; [05°29′51″N, 117°20′03″E]; 8 November 1979; Aban G. & Petrus SAN 90675 (SAN) • Sandakan, Lungmanis, Virgin Jungle Reserve 45 A; 05°38′40″N, 117°43′25″E, 19 December 1985; Dewol S. et al. SAN 118075 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 17 January 1989; Kessler SAN 118160 (SAN) • Sandakan, Trail to Ulu Sungai Tariu, Kampung Wonod; [05°38′38″N, 117°05′24″E]; 14 March 1974; Aban G. & Saikeh, SAN 79387 (SAN) • Telupid, Penangah Forest Reserve; 4°58′41″N, 116°52′11″E; 20 July 1993; Fidilis K. SAN 135710 (SAN) • Telupid, VJR Ulu Sungai Sapapaya, at riverbank of Sungai Merah; 05°30′N, 118°30′E; 15 October 1985; Dewol S. et al. SAN 109519 (SAN) • Tawau • Kalabakan, Batu Timbang VJR, 06°27′14″N 116°48′07″E; 12 March 2015, Ubaldus, M. & Tawadong, T. SAN 157055 (KEP, SAN).

**Identification.** *Rhaphidophora fluminea* is differentiated from *R. beccarii* Engl. (both species are rheophytes) by having falcate, narrow, entire leaf blades and a bright yellow spathe and spadix vs. mature leaf blade pinnatifid to pinnatisect and a creamy yellow spathe and spadix. 

**Distribution and ecology.** *Rhaphidophora fluminea* is endemic to Sabah. Widespread. Occurs on exposed mud near river.

*Rhaphidophora korthalsii* Schott

**Material examined.** MALAYSIA – Pedalaman • Tenom, Malutut, north ridge of Mt. Malutut, ca. 15 km N of Tenom; [05°15′11″N, 115°55′28″E]; 450 m elev.; 21 December 1968; Kokawa & Hotta 2455 (L) • Tenom, Sungai kaang; 05°08′54″N, 115°58′27″E; 28 March 1987; Asik Mantor SAN 120296 (SAN) • Pantai Barat • Penampang, Tungol, Togudon KM48 Jalan Tambunan/ Penampang; 05°46′48″N, 116°20′43″E; 24 August 1989; Sumbing J. SAN 127801 (SAN) • Ranau, Bukit Kulung, 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122429 (SAN) • Ranau, Bundu Tuhan Forest Reserve; 05°58′58″N, 116°32′32″E; 1371.6 m (4500 ft.) elev.; 28 June 1994; J. T. Pereira 9 (K, KEP, SAN) • Ranau, Kinabalu
Rhaphidophora latevaginata M.Hotta

Material examined. MALAYSIA – Pantai Barat • Penampang, Moyog, along road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53118 (MO, SAR) • Ranau, Bukit Kulung; 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122414 (SAN) – Sandakan • Sanadakan, Phenological Trail Above Sawmill; 05°51′19″N, 117°53′04″E; 60.96-91.44 m (200 ft.-300 ft) elev.; 15 December 1990; Dewol & Meijer SAN 131653 (SAN).

Identification. The juvenile and pre-adult stages of R. latevaginata and R. korthalsii are superficially similar and to non-specialist difficult to differentiate. Rhaphidophora latevaginata has petiolar sheath that is long-persistent (vs. very rapidly marcescent), mostly adnate (vs. mostly free) with the wings strongly unequal (vs. weakly or not at all unequal), shortly free-auericulate (vs. long, narrowly triangular free-ligulate) and petiole of R. latevaginata proportionately longer (petiole: blade ca. 1.5 vs. ca. 1:2) (Ahmad Sofinan and Boyce 2010).

Distribution and ecology. Northwest and northeastern Sabah. Primary to secondary moist lowland to hill dipterocarp forest on clay and sandstone. 50–840 m elev.

Rhaphidophora lobbia Schott

Material examined. MALAYSIA – Pantai Barat • Ranau, Ulu Tungud Forest reserve, Gunung Monkobo expedition, Sungai Kiberibi; 05°50′57″N, 116°59′17″E; 324 m elev.; 23 July 2005; Saw L. G. et al. SAN 146651 (KEP, SAN, SAR) – Sandakan • Kinabatangan, Kampung Pangkaian, Tamegang Timber Camp near Kpg. Pangkaian; 05°25′22″N, 118°14′19″E; 22 November 1968; Kokawa & Hotta 1417 (L) – Kinabatangan, Pinup Suri Forest Reserve, Batu Puteh, Supu Hill; 05°25′14″N, 117°56′25″E; 13 June 1996; S. P. Lim 676 (SAN) • Sandakan, below waterfall Kubun Cina Forest Research centre; 05°50′46″N, 118°05′08″E; 20 December 1990; W. Meijer & Dewol S. SAN 131749 (SAN) • Sandakan, Labuk Road; 05°50′13″N, 118°06′53″E; 182.88 m (600 ft) elev.; 26 August 1963; W. Meijer SAN 38784 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 24 May 1982; Amin G. SAN 94588 (SAN) • Sandakan, Sapi Virgin Forest Reserve; 05°49′30″N, 117°25′30″E; 25 June 2007; Pius G. et al. SAN 148862 (SAN).

Identification. Rhaphidophora lobbia have combination of characters unknown in any other Malesian
Rhaphidophora, the slender, asperous stems, softly leathery leaves and minutely puberulent spathe exterior. In dry material the leaves discolorously strongly and the primary veins prominently darker than the abaxial leaf surface (Boyce 2001).

**Distribution and ecology.** Northwestern and northeastern Sabah. Primary to disturbed secondary lowland dipterocarp and peatswamp forest on wet to inundated soils, 250 m elev.

**Rhaphidophora minor** Hook.f.

**Material examined.** MALAYSIA – Sandakan • Beluran, Bongaya Forest Reserve; [05°45′00″N, 117°24′00″E]; 15.24 m (50 ft.) elev.; 22 July 1975; Kodoh & Aban G. SAN 82024 (SAN) • Beluran, Sungai Mengkayok near Sungai Kalagan; [06°00′46″N, 117°33′06″E]; 16 May 1965; W. Meijer SAN 51617 (SAN).

**Identification.** *Rhaphidophora minor* may look similar to *R. sylvestris* (Blume) Engl. when it is fresh, although the thinner, more prominently veined leaf and longer spathe beak of *R. minor* are diagnostic. Dried material of *R. minor* is notable for the uniformly pale straw-coloured leaves (Boyce 2001).

**Distribution and ecology.** Northeastern Sabah. Swampy habitats in full sun, often along the banks of large rivers. Sea level to 10 m elev.

**Rhaphidophora puberula** Engl.

**Material examined.** MALAYSIA – Sandakan • Beluran, Bongaya Forest Reserve; [05°45′00″N, 117°24′00″E]; 15.24 m (50 ft.) elev.; 22 July 1975; Kodoh & Aban G. SAN 82024 (SAN) • Beluran, Sungai Mengkayok near Sungai Kalagan; [06°00′46″N, 117°33′06″E]; 16 May 1965; W. Meijer SAN 51617 (SAN).

**Identification.** *Rhaphidophora minor* may look similar to *R. sylvestris* (Blume) Engl. when it is fresh, although the thinner, more prominently veined leaf and longer spathe beak of *R. minor* are diagnostic. Dried material of *R. minor* is notable for the uniformly pale straw-coloured leaves (Boyce 2001).

**Distribution and ecology.** Northeastern Sabah. Swampy habitats in full sun, often along the banks of large rivers. Sea level to 10 m elev.

**Rhaphidophora sylvestris** (Blume) Engl.

**Material examined.** MALAYSIA – Pantai Barat • Ranau TenomPok; 1524 m elev.; 14 April 1932; Clemens & Clemens 29227 (L, P) • Ranau, Bukit Hammond; 06°00′53″N, 116°41′50″E; 17 November 1987; Amin & Jarius SAN 121155 (SAN) • Ranau, Mount Kinabalu-Mesilau Valley; [05°59′11″N, 116°36′17″E]; 1524 m (5000 ft.) elev.; 29 September 1972; Cockburn SAN 70108 (SAN) • Ranau, Mount Kinabalu, Dallas; [06°53′0″N, 116°32′45″E]; 2 November 1931; Clemens & Clemens 26921 (L) • Ranau, Mount Kinabalu; 06°00′20″N, 116°44′29″E; 19 July 1994; W. Meijer SAN 141633 (SAN) – Sandakan • Kinabatangan, Kampung Pangkaian, Tamenggang Timber Camp; 05°25′22″N, 118°14′19″E; 22 November 1968; Kokawa & Hotta 1416 (L) • Kinabatangan, Lamag, Ulu Sungai Pin, growing on huge rock; 05°23′28″N, 117°52′48″E; 18 September 1979; Leopold M. & F. Saigol SAN 90180 (SAN) • Sandakan, Sungai Batang off Sungai Manila Road; 05°55′18″N, 117°58′27″E; 15 March 1965; W. Meijer & Kodoh SAN 49805 (SAN) • Tongod, Maliau Valley, Belian Camp; 4°50′56″N, 116°50′28″E; 250 m elev.; 16 July 2001; Postar, Ubaldus, de Wild et al. SAN 144149 (K, KEP, L, SAN) – Taiwan • Kalabakan, Luasong Camp, KM 41 Imbak Road; 04°37′00″N, 117°24′18″E; 22 February 1983; Fedilis K. SAN 95680 (SAN) • Lahad Datu, Segama, Borneo Marble Quarry; 04°58′42″N, 118°13′46″E; 27 August 1999; Diwol Sundaling et al. SAN 141862 (SAN, SING) • Lahad Datu, Sungai Tabin Wildlife Centre; 05°14′30″N, 118°50′16″E; 11 August 1991; L. Madani SAN 132607 (SAN) • Taiwan, Elpinstone province; [04°30′34″N, 117°33′13″E]; 26 March 1929; A. D. E. Elmer 21593 (L) • Taiwan, Sabah Foundation Logging Area, Umas-Umas; [04°27′09″N, 117°42′27″E]; 8 July 1977; Fedilis. K. SAN 87213 (SAN).

**Identification.** *Rhaphidophora puberula* resembles *R. foraminifera* (Engl.) Engl., especially in the perforate-leaf forms and can be differentiated from *R. foraminifera* from its inflorescence on free lateral shoots and in having the active shoot tips without the characteristic black mucilage of *R. foraminifera*. Generally, flowering plants of the perforate-leaved forms of *R. puberula* have smaller leaves that are noticeably less perforated than those of *R. foraminifera* (Boyce 2001).

**Distribution and ecology.** Northwestern, southwestern, and northeastern Sabah. On trees and rocks in primary and secondary lowland to lower upper montane transition forest, often on steep slopes, on granite and limestone. 90–1550 m elev.
from *R. conoecephala*, while the juvenile shoots without conspicuously twisted stems separate them from *R. crassifolia*. Leaf blade thickness is not a consistent character, even between duplicates of the same collection (Boyce 2001).

**Distribution and ecology.** Northwestern Sabah. Primary to disturbed secondary lowland to lower montane forest on a variety of substrates including sandy loam and limestone. 120–1800 m elev.

**Schismatoglottis ahmadii** A.Hay

**Figure 6A**

**Material examined.** MALAYSIA – Tawau • Tawau Hills Park, trail to Bukit Gelas; 04°23′59″N, 117°53′21″E; 25 November 1998; J. T. Pereira 551 (SAN) • Tawau, Tawau Hills Park, Bukit Gelas Waterfall; 04°23′00″N, 117°53′00″E; 30 June 2006; Julia S. SAN 147860 (SAN) • Tawau River Forest Reserve; [04°24′40″N, 117°53′28″E]; 33 m (100 ft.) elev.; 6 July 1959; W. Meijer SAN 19468 (L).

**Identification.** Flowering *Rhynchopyle loi* most closely resembles *R. pileata* (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce by the deep magenta-purple strongly rosate spathe limb. However, *R. loi* is readily differentiated by the spathe basally with a prominent ventral mentum, by the larger, centrally impressed interstice staminodes held in a zone wider than the remainder of the spadix, the stamens irregularly arranged (not carried in two rows), and the proportion-ately longer staminate flower zone. The leaves of *R. loi* are only ca. half as long as those of *R. pileata*, and much narrower; the entire plant is seldom exceeding 15 cm (Boyce and Wong 2013b).

**Distribution and ecology.** Endemic to Sabah. Growing on bare or moss-covered basalt waterfall rocks under perhumid lowland forest; between 200 and 300 m elevation. Typically inhabits the steep banks of muddy, mean rheophytic on rocks in streams and, less frequently, the floor of lowlying forest where it may be inundated in wet periods.

**Schismatoglottis clemensiorum** S.Y.Wong & P.C.Boyce

**Figure 6B**

**Material examined.** MALAYSIA – Pedalaman • Beaufort, Bukit Bendira; [05°22′02″N, 115°22′47″E]; 22 August 1975; Dewol Sundaling SAN 80169 (SAN) • Keningau, Kitau, Sungai Tumpason; 05°29′32″N, 116°16′26″E; 6 September 1985; L. Madani & Ismail SAN 95330 (SAN) • Tambunan, Rafflesia Forest Reserve, KM68 Tambunan Road; [05°46′37″N, 116°20′37″E]; 6 September 1985; L. Madani & Ismail SAN 111228 (SAN) • Tenom, Kallang Falls; [05°58′54″N, 115°58′27″E]; 300 m elev.; 4 January 1984; B. J. Wallace & L. J. Forlonge B. J. Wallace 84216 (SAN) • Tenom, Lumaku Forest Reserve, Kg Baru Jumpa; [05°05′04″N, 115°53′58″E]; 469 m elev.; 22 March 2010; Suzana S. SAN 151515 (SAN) • Pantai Barat • Penampang, Moyog, along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°53′08″N, 116°14′05″E; 460 m elev.; 26 September 1981; T. B. Croat 53110 (MO, SAR) • Penampang, Stesen Inobong, slope, trail to go down the river; 05°51′24″N, 116°08′17″E; 22 July 2010; Markus G. SAN 152106 (SAN) • Ranau, between Sungai Kupinggit and Sungai Langanan; 06°02′53″N, 116°42′06″E; 1 October 1987; W. Meijer SAN 119148 (SAN) • Ranau, Kinabalu River, Route to Motung-Lotung Waterfall; 06°04′45″N, 116°32′59″E; 19 September 2007; Dolois S. KNP 14832 (SAN) • Ranau, Mesilau; 05°59′08″N, 116°36′28″E; 1524 (5000 ft.) elev.; 11 April 1964; W. L. Chew & E. J. H. Corner KNP 4899 (SAN) • Ranau, Mount Kinabalu, Mount Kinabalu National Park, along road to summit; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; T. B. Croat 53137 (MO, SAR) • same locality; 2000–2300 m elev.; 27 September 1981; T. B. Croat 53138 (MO, SAR) • Ranau, Mount Kinabalu; Dallas; [06°05′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 7 August 1931; Clemens & Clemens 26024A (L) • same locality; 1700 m elev.; 27 March 1932; Clemens & Clemens 29185 (L) • same locality; 426.72 m (1400 ft.) elev.; 3 April 1932; Clemens & Clemens 29183 (L) • same locality; 1000 m elev.; 3 April 1932, Clemens & Clemens 29188 (L, P) • Ranau, OMRD area; 06°01′25″N, 116°39′40″E; 29 August 1987; Martin SAN 122298 (SAN) • Ranau, Poring, Langana Riverside; 06°02′44″N, 116°42′02″E; 8 October 1987; Amin et al. SAN 118660 (SAN) • Ranau, Sungai Bambangan; 05°58′30″N, 116°38′45″E; 18 November 1986; Amin & Jarius SAN 116539 (SAN) • Ranau, Sungai Kupingkit, Kinabalu National Park; 06°02′53″N, 116°42′06″E; 6 July 1992; W. Meijer SAN 134592 (SAN) • Ranau, Tenompok; [05°59′59″N, 116°30′3E]; 21 September 1988; Amin et al. SAN 123499 (SAN) • Ranau, Ulu Senagang; 05°21′06″N, 116°01′34″E; 566 m elev.; 18 May 2010; Markus G. SAN 151775 (SAN) – Kudat • Kota Marudu, Ulu Sungei-Sungei; 06°29′25″N, 116°38′38″E; 21 November 1981; Aban G. et al. SAN 148330 (SAN) – Sandakan • Sandakan, Gunung Rara Forest Reserve, Maliau Falls, 04°30′N, 116°45′E; 530 m elev.; 10 April 1996; Lim & Ahmad A. Hay 12060 (SAN).

**Identification.** *Schismatoglottis clemensiorum* differs from *S. calyptrata* (Roxb.) ZOLL. & MORITZI by its smaller inflorescence, larger more globose ovaries, more conspicuously flat-topped interpistillar staminodes, smaller appendix, its erect fruiting peduncle, tough primary veins, the leaves have less cordate base, numerous and closely spaced (Hay and Yuzammi 2000).

**Distribution and ecology.** Widespread. Facultatively rheophytic on rocks in streams and on forest floor. ca. 300–1500 m elev.
Schismatoglottis clivemarshii S.Y.Wong, P.C.Boyce & Kartini

Figure 6D

Material examined. MALAYSIA – Tawau • Lahad Datu, Danum Valley Conservation Area, Tembling Falls trail; 05°01′01″N, 117°44′40″E; 281 m elev., 6 July 2018, Wong Sin Yeng, P.C. Boyce & Kartini Saibeh BORH 2703 (holo, SAN).

Identification. Schismatoglottis clivemarshii is most similar to S. venusta A.Hay by hapaxanthic shoots, rather coriaceous, slightly succulent leaf blades that are often variegated, a pistillate flower zone adnate to the spathe for about half its length, a staminate flower zone entirely exerted from the lower spathe chamber, thecae with the rim of the pore broken by a slit on the outer side, and by an unbroken row of staminodes along adnation of spathe and spadix. Schismatoglottis clivemarshii differs from S. venusta by glabrous petioles D-shaped in cross-section and narrowly crisped-alate on the angles (vs. minutely puberulent petioles terete in cross-section and lacking wings), by the presence of a well-defined naked sterile interstice (vs. sterile interstice ill-defined, with the apex of the pistillate flower zone attenuate and partially naked, or sometimes with a few abortive ovaries and reduced inter-pistillar staminodes contiguous with the base of the staminate flower zone), by a shorter, stouter pistillate flower zone, with more laxly arranged, better-defined and larger staminate flowers, and by an appendix base wider than the top of the staminate flower zone (vs. isodiametric). The two species may also be separated ecologically, with S. clivemarshii restricted to Miocene Melange outcrop-pings whereas S. venusta occurs lithophytically or chas-mophytically on Karst limestone (Boyce et al. 2019).

Distribution and ecology. Endemic to Sabah. Known only from two separate localities, approximately 10 km distant, the Danum Valley Conservation Area. Restricted to Miocene Melange outcrop-pings through Cretaceous deepwater sediments in lightly shaded lowland perhumid forest between elevation 215 m and 310 m elev.

Schismatoglottis crinitissima A.Hay

Material examined. MALAYSIA – Pedalaman • Tam-bunan, Gunung Trus Madi, 5°33′12.8″N 116°31′0.1″E; 24 August 1988, Asik mantor SAN 125582 (SAN).

Identification. Schismatoglottis crinitissima is unique in the genus because of its multicellular hairs on petiole, blade margins, both adaxial and abaxial surfaces (Hay and Yuzammi 2000).

Distribution and ecology. Southwest Sabah. Terrestrial in disturbed lowland forest at ca. 200 m elev.

Schismatoglottis decipiens A.Hay

Material examined. MALAYSIA – Sandakan • Kin-abatangan, Tongod, Gunung Tingkar; 05°18′59″N, 117°09′00″E; 550 m elev.; 24 August 1992; K. M. Wong 2218 (L) • Sandakan, Bidu-bidu Hills; Porog; [05°50′49″N, 117°15′41″E]; 1 June 1964; W. Meijer SAN 41246 (SAN) • Sandakan, Ulu Tungud, Telupid, Kg. Bauto; 05°39′30″N, 117°12′27″E; 91.44 m (300 ft.); 24 July 1980; Dewol Sundaling SAN 92427 (SAN).

Identification. Schismatoglottis decipiens is closely allied to Schismatoglottis trivittata Hallier, Schismatoglottis motleyana Engl. and other allied species with hapaxanthic stems, fully attached leaf sheaths and caducous spathe limbs. Schismatoglottis decipiens has a unique combination of features in the staminate zone ex-gressed from the lower spathe chamber, the conspicuous partly naked interstice, the broad flat connective of the stamens, the appendix barely and not abruptly wider than the staminate zone, and the leaves with rather few primary lateral veins and a large number of secondary veins arising from them (a characteristic generally, though not entirely, otherwise associated with species with larger leaves) (Hay and Yuzammi 2000).

Distribution and ecology. Schismatoglottis decipiens is endemic to Sabah. Terrestrial on slopes and rocky sites in forest over ultramafic substrate at elevations of ca. 100–400 m.

Joseph B. et al. SAN 124005 (SAN) • Sipitang, Long Pa-sia, Bukit Dusur, Ulu Padas, Oak Forest; 04°27′34″N, 115°44′53″E; 1125 m elev.; 27 January 2003; Dolois S. & Gusli J. SP 17697 (SAN) • Sipitang, Expidisi Ulu Padas, Bukit Dusur; 04°27′34″N, 115°44′53″E; 10 August 2018; Dolois et al., SP 17578 (SAN) • Tambunan, Gunung Alab; 05°49′33″N, 116°20′28″E; 12 August 1987; Fedulis Kris-pinus SAN 121675 (SAN) • Tambunan, Gunung Trus Madi; 05°33′13″N, 116°31′00″E; 13 August 1988; Asik Mantor SAN 125483 (SAN); same locality; 13 August 1988; Asik Mantor SAN 125486 (SAN) – Pantai Barat • Penampang, Tongudon-Tungol, KM 48 Jalan Tambunan-Penampang; 05°46′48″N, 116°20′43″E; 1300 m elev.; 11 August 1989; Asik Mantor SAN 127707 (SAN) • same locality; 1400 m elev.; 15 August 1989; Sumbing Jimpin SAN 127744 (SAN) • Penampang, Tungol Forest Reserve KM 45, Jalan Kota Kinabalu; 05°46′48″N, 116°20′43″E; 26 July 1986; Asik Mantor SAN 115787 (SAN) • same locality; 6 September 1992, Asik Mantor SAN 131313 (SAN) • same locality; 19 July 1986; Fidilis & Sumb-ing SAN 114613 (SAN) • Ranau, Kinabalu above Sos- odoopon; [06°00′15″N, 116°33′00″E]; 1524 m (5000 ft.) elev.; 2 February 1962; W. Meijer SAN 29222 (SAN) • Ranau, Tenom-pok, Mount Kinabalu; [05°58′58″N, 116°30′40″E]; 1700 m elev.; 15 April 1932; Clemens & Clemens 29272 (L).

Identification. Schismatoglottis clivemorsiorum resem-bles S. acuminatissima Schott (Sumatera) in leaf and habit, but differs in the large stigma and small, condensed sterile interstice (Hay and Yuzammi 2000).

Distribution and ecology. Northwestern, southwestern, and northeastern Sabah. Terrestrial in forest of ridges, and on stream banks, occasionally on rocks but not rheophytic, 1200-1600 m elev.
**Schismatoglottis ferruginea** Merr.

**Material examined.** MALAYSIA – Pedalaman • Tambunun, Sunsuron, KM45 jalan Tambunun-Penampang; 05°46′48″N, 116°20′43″E; 1300 m elev.; 23 August 1989; Asik Mantor SAN 127890 (SAN) – Sandakan • Sandakan, Pinangang, Ulu Sungai Melikop; 05°05′46″N, 116°36′33″E; 152.4 m (500 ft.) elev.; 1 June 1985; Dewol et al. SAN 109270 (SAN) – Sandakan, Tongdak, Maligau Valley, Agathis Camp; 04°50′56″N, 116°50′28″E; 450-500 m elev.; 13 July 2001; Pereira J. T., Postar, de Wilde et al. SAN 144373 (SAN) – Sandakan; [05°51′19″N, 117°53′04″E]; 40 m elev.; September 1920; M. Ramos 1675 (L) • Tongdak, Imbak, Pinangah Forest Reserve; 05°10′29″N, 117°09′13″E; 213.6 m elev.; 14 June 2000; Pius et al. SAN 142899 (K, KEP, NSW, SAN) – Tawau • Tawau, Bukit Quion, Teck Guan Cocoa Plantation; 04°24′47″N, 118°01′12″E; 150 m elev.; 7 December 2003; P. C. Boyce, J. Linton & A. Surat AR 201.1 (SAR).

**Identification.** *Schismatoglottis ferruginea* is similar to *Schismatoglottis barbatata* Engl. (Sarawak) in the coarsely hairy petiole and the leaf shape tendency to be widest distal to midway along the midrib. Both species differ in the not tufted habit, larger size, the distinctly cordate leaf blade base, the hairy and relatively long peduncle, the slender hairy spathe constricted near the base and, presumably from the shape of the spathe, the more or narrowly tapering spadix (Hay and Yuzammi 2000).

**Distribution and ecology.** Endemic to Sabah. Lithophytic in sandstone crevices by riverbanks or in secondary forest near streams at low elevation. On boulders and terrestrial on rather dry slopes in mixed lowland forest at low elevations.

**Schismatoglottis imbakensis** Kartini, S.Y.Wong & P.C.Boyce

**Literature cited.** MALAYSIA – Sandakan • Telupid, Imbak Canyon Conservation Area, Sungai Kangkawat; 05°50′05″N, 117°03′20″E; ca. 260 m elev.; 1 Oct 2018; Kartini et al. 2705 (holo, BORH + spirit).

**Identification.** *Schismatoglottis imbakensis* is distinguished from *S. retinervia* Engl., the only other species of the Patentinervia clade occurring in Sabah, by the plant glabrous (vs. petioles and abaxial midribs puberulous), by the naked sterile interstice of the spadix equalling the pistillate floret zone (vs. naked sterile interstice hardly developed), by the deep green pistils with the stigma about half the width of the ovary (vs. pistils dirty pale green with the stigma almost equalling the ovary width), by the staminate florets somewhat laxly arranged and the stamens readily discernible (vs. staminate florets very densely packed and individual stamens scarcely distinguishable). *Schismatoglottis imbakensis* is distinguished from *S. pichinensis* P.C.Boyce and *S. puncakborneensis* P.C.Boyce, the other two Patentinervia clade species with a long naked sterile interstice, by large rhomboidal cream interpistillar staminodes (vs. interpistillar staminodes lorate or if rhomboidal then small and white), the large, laxly arranged stamens (vs. small and congested), and sharply pointed (vs. blunt) spadix appendix (Kartini et al. 2020).

**Distribution and ecology.** Endemic to Sabah. Known only from the type locality on the Sungai Kangkawat, Imbak Canyon Conservation Area. Primary lowland mixed dipterocarp forest on Cretaceous Harzburgite and Serpentinite outcrops, occurring on steep, muddy riverbanks above the flood zone, ca. 270 m elev.

**Schismatoglottis lingua** A.Hay

**Material examined.** MALAYSIA – Pedalaman • Nabawan, Sungai Madaun, Syt. Benawood, Sungai Madaun; 04°51′31″N, 116°34′48″E; 25 May 1987; Fidi lis krispinus SAN 119368 (SAN) – Sandakan • Sandakan, Tongdak, Maligau Valley, Agathis Camp; 04°44′10″N, 116°58′37″E; 17 April 1996; A. Hay 12098 (SAN) • same locality; 17 April 1999, A. Hay 12111 (SAN).

**Identification.** *Schismatoglottis lingua* have similar spadix to *S. calyptrata*, and can be differentiated from its larger size, heavier appendix, solitary long-pedunculate inflorescence, rims of the staminal thecae elevated well above the connective, erect petioles with bases joined by the wings of the sheath into something resembling a pseudostem, the elongated tongue-shaped leaves (Hay and Yuzammi 2000).

**Distribution and ecology.** *Schismatoglottis lingua* is endemic to Sabah. Stream banks in kerangas forest at 960 m elev.

**Schismatoglottis moodii** A.Hay

**Figure 6E**

**Material examined.** MALAYSIA – Pedalaman • Tambunun, Patau, Mahua Waterfall, trail to Gunung Alab; 05°48′01″N, 116°24′13″E; 1173 m elev.; 19 April 2014; Wong Sin Yeng & P. C. Boyce AR 4692 (SAR) – Pantai Barat • Penampang, Ulu Babagong Forest Reserve, Kampung Kibunut; 13 April 2004; Joseph B. et al. SAN 148754 (SAN).

**Identification.** This species resembles *S. trusmadiensis* A.Hay & Mood in the hasto-sagittate leaf blade. It differs in the much more robust stature, the female zone not adnate to the spathe, the shortly cylindric appendix, taller interpistillar staminodes and the narrower connective (Hay and Yuzammi 2000).

**Distribution and ecology.** Endemic to Sabah. North-western Sabah. Terrestrial in secondary forest along a stream at 230 m elev.

**Schismatoglottis motleyana** (Schott) Engl.

**Material examined.** MALAYSIA – Federal Territory of Labuan • Labuan, T. Motley s.n. (holo, K).

**Identification.** *Schismatoglottis motleyana* is a highly variable species. It is characterised, within the *S. calyptrata* group, by a slender subcylindric spadix without a sterile interstice (though occasionally there may be a concentration of interpistillar staminodes at the interface}
of the two fertile zones), a slender cylindric to very narrowly obconoid male zone held partly within the lower spathe chamber and a subcylindric to very narrowly conoid appendix. However, these are features shared with *S. trifasciata* Engl., another highly variable species, in this case with a very wide range of leaf shape, venation pattern and petiolar ornamentation. The two species can be distinguished by the length/width ratios of the spadix (measured from dried specimens; width taken at the base of the appendix), which are around 40:1 in *S. trifasciata* (range 30:1–50:1) and around 15:1 in *S. motleyana* (range 10:1–22:1 (~26:1)). Plants with the high extreme ratio in *S. motleyana*, which are unusual, approach the low extreme ratio in *S. trifasciata*, and so these two species can be difficult to separate at the extremes of their variation (Hay and Yuzammi 2000).

**Distribution and ecology.** Labuan endemic, but is never re-found. Terrestrial (rarely lithophytic) on secondary and mature rainforest floor and in disturbed sites (rubber plantations) over a variety of substrates; sea level to ca. 1400 m elev.

_Schismatoglottis porpax_ S.Y. Wong, Kartini & P.C. Boyce

**Material examined.** MALAYSIA – Pantai Barat • Kota Kinabalu, Inanam, Kionsom Waterfall; 05°58′26″N, 116°12′30″E; 270 m elev., Wong Sin Yeng & P.C. Boyce AR-4684 (holo, SAN, iso, SAR).

**Identification.** *Schismatoglottis porpax* is most similar to _S. hayi_ S.Y.Wong & P.C.Boyce, a species endemic to the forested Karst limestone of Niah Caves in northeastern Sarawak (Wong and Boyce 2011), notably in the leaf blade shape and pubescent petioles. It can, however, be distinguished from that species by leaf blades not producing adventitious plantlets, and by the longer, narrower pistillate flower zone, the much smaller sub-pistillar staminodes and by the elongated leaf blades of _S. porpax_ which are different to the ovate blades of _S. multinervia_ M.Hotta (Boyce and Wong 2015), a species restricted to the forested Karst formations in the Mulu National Park, while the spadix of the two species differs in several key characteristics (Wong et al. 2019).

**Distribution and ecology.** Endemic to Sabah. Known only from the type locality at Kionsom waterfall when it occurs in abundance along a 500 m stretch of the trail to the first waterfall. Moist lowland forest growing on Oligocene deep water sandstones, mostly occurring on the lower parts of shady and rocky banks kept permanently wet by seepage, elevations between 200 and 300 m.

_Schismatoglottis priapica_ S.Y.Wong, Kartini & P.C. Boyce

**Material examined.** MALAYSIA – Tawau • Lahad Datu, Danum Valley Conservation Area, trail to Tembaling Falls; 04°56′31″N, 117°48′31″E; 235 m elev., 8 July 2018; Wong Sin Yeng, P.C. Boyce & Kartini Saibeh BORH 2704 (holo SAN, iso SAR)

**Identification.** *Schismatoglottis priapica* may not have any species it is clearly related to and is distinct from its erect and self-supporting stem. *Schismatoglottis priapica* has unique aeroial stems with conspicuously elongated internodes occurs in the Multiflora clade (*Schismatoglottis erecta* M.Hotta and *Schismatoglottis schottii* Bogner & Nicolson), the Nervosa clade (most species), the Ca-lyptrata clade (*Schismatoglottis convolvula* P.C.Boyce, *Schismatoglottis niahensis* A.Hay), in the still unplaced *Schismatoglottis conoidea* Engl. and *Schismatoglottis evelyniae* P.C.Boyce & S.Y.Wong, and in an undescribed species from Mulu National Park (Boyce et al. 2019).

**Distribution and ecology.** Endemic to Sabah. Known only from one locality in the Danum Valley Conservation Area. Lowland mixed dipterocarp forest on deep alluvial sandy-loamy soils overlaying Cretaceous deep-water sediments.

_Schismatoglottis retinervia_ Furtado

**Material examined.** MALAYSIA – Pedalaman • Ken-ingau, Crocker Range area, Kimanis road, Mile 16; 05°51′15″N, 116°18′50″E; 23 August 1986; Fidelis Kris-pinus SAN 120565 (SAN) • Sipitang, Sungai Long Pas-ia; 04°24′24″N, 115°43′58″E; 3 September 2002; Postar & Geoffrey D. SAN 145767 (K, SAN) – Pantai Barat • Ranau, Mount Kinabalu, Tenompok; 06°05′30″N, 116°32′45″E; 1524 m elev.; 26 March 1932; Clemens & Clemens 29153 (L) • Ranau, Masilau, Pinosok Plateau, Kinabalu; 06°02′05″N, 116°36′56″E; 1371.6 m (4500 ft.) elev.; 27 July 1963; W. Meijer SAN 25472 (SAN).

**Identification.** The somewhat elongate sprawling habit, in which the plants may form clonal colonies, together with the membranous, elliptic leaves with spreading primary and conspicuously tessellate tertiary venation and the solitary inflorescence suggest affinity with species such as _S. patentinervia_ Engl. and _S. brevicuspus_ Hook.f. (Malay Peninsula) (Hay and Yuzammi 2000).

**Distribution and ecology.** Endemic to Sabah. Terrestrial in mid-montane forest near streams (but not rheophytic) at ca. 1200–1500 m elev.

_Schismatoglottis saafiei_ Kartini, P.C.Boyce. & S.Y.Wong

**Material examined.** MALAYSIA – Pedalaman • Ken-ingau, Ulu Senagang; 05°21′51″N, 116°01′26″E; 558 m elev.; Suzana S. SAN 151904 (SAN).

**Identification.** The somewhat elongate sprawling habit, in which the plants may form clonal colonies, together with the membranous, elliptic leaves with spreading primary and conspicuously tessellate tertiary venation and the solitary inflorescence suggest affinity with species such as _S. patentinervia_ Engl. and _S. brevicuspus_ Hook.f. (Malay Peninsula) (Hay and Yuzammi 2000).
Distribution and ecology. Endemic to Sabah. Known only from the type locality in Tawau Hills Park on the banks of Tiku River along the trail to Galas Hill. Grows in open areas and along track sides in lowland evergreen perhumid forest on basalts at elevation about 100 m and is so far known only from the type locality where it is locally abundant.

Schismatoglottis scintillans Scherberich & P.C. Boyce

Identification. Schismatoglottis scintillans most closely approaches S. decipiens A.Hay and S. trusmadiensis by the pistillate flower zone extensively (≥ ½) adnate to the spathe, but it is readily distinguished from both species by the combination of a much longer proportion of this adnation (5/6 of the entire pistillate zone vs. ½), and by scintillating leaf blades. Schismatoglottis scintillans is specifically distinguished from S. decipiens by the staminate flower zone half enclosed (not fully exerted) from the lower spathe, and by lacking a naked interstice between the staminate and pistillate zones. From S. trusmadiensis, S. scintillans is further distinguished by a bullet-shaped appendix being much wider than the top of the staminate flower zone (vs. appendix bluntly conoid, and indistinctly wider than the top of the staminate zone) and by the overall much more compact stature, and ovate-sagittate, variegated, velvety leaf blades (vs. hastate-sagittate, plain glossy green) (Scherberich and Boyce 2013).

Distribution and ecology. Endemic to Sabah. Known only from the type locality in Keningau, Apin Apin, elevation ca. 610 m (“2000 ft”). Grows terrestrially in very shaded riverine forests on wet alluvial soils, at ca. 600 m elev.

Schismatoglottis silamensis A.Hay

Material examined. MALAYSIA – Pedalaman • Keningau, Apin Apin, 16 km on village road, west, and 2 km walk along Apin Apin river to 610 m (“2000 ft”) elev.; 23 Jan 1993; J. Mood 563 (holo K, iso LYJB, SAN, SAR).

Identification. Schismatoglottis silamensis is allied to S. calyptrata, S. motleyana, S. trivittata and S. trifasciata—variable species which tend to approach each other at the extremes of their variation. In this widespread alliance, S. silamensis is distinguished by the short inter-pistillar staminodes occurring in very large numbers in the female zone, the rather well-defined sterile interstice composed of abortive pistils and anthers, and its conspicuous leaves which have rather unusual variegation in three shades of green. It represents a local endemic segregate on ultramafic substrate (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. On rocks on (dry) stream bank in rather dry mixed lower montane forest on ultramafic substrate at ca. 500 m elev.
Schismatoglottis trivittata Hallier

Material examined. MALAYSIA – Kudat • Bangleu island; [07°15′08″N, 117°09′23″E]; 6 April 1905; P. Castro 1343 (P).

Identification. The current concept of Schismatoglottis trivittata is of a variable, widespread and rather scattered species. In inflorescence it is only distinguishable from S. niaihensis A.Hay by the sterile interstice usually lacking a zone of sterile anthers and by the connective being less clearly elevated into a low peak between the thecae. However, the leaf is relatively shorter and broader, without the very broad midrib and primary veins characteristic of Schismatoglottis niaihensis A.Hay. More importantly, the stem is hypogean and hapaxanthic in S. trivittata where it is epigean and pleionanthic in S. niaihensis (Hay and Yuzammi 2000).

Distribution and ecology. Widespread but scattered in Sabah. Lowland rainforest floor and elevated soil patches in swampy forest, and low montane forest; sea level to 1000 m elev.

Schismatoglottis trusmadiensis A.Hay & J.Mood

Literature cited. MALAYSIA – Pedalaman • Tambunan; Kengaran Distr., Trus Madi, Cult. Haleiwa, Hawaii J. Mood s.n (orig. coll. Mood M791a) (holo NSW + NSW spirit).

Identification. This species is similar in leaf shape to the more robust S. moodii. It differs from that species in the female zone of the spadix relatively longer and half adnate to the spathe, the shorter interpistillar staminodes, the stamens with small pores separated by a rather thick connective, the obtusely conoid appendix not abruptly thicker than the male zone, and the smaller diameter appendical staminodes (Hay and Yuzammi 2000).

Distribution and ecology. Schismatoglottis trusmadiensis is endemic to Sabah. Known only from the type locality on Gunung Trus Madi. Terrestrial in secondary forest at 920 m elev.

Schismatoglottis unifolia A.Hay & P.C.Boyle

Material examined. MALAYSIA – Pedalaman • Keningau, Ulu Senagang sub-station; 05°21′60″N, 116°01′34″E; 566 m elev.; 18 May 2010, Markus G. SAN 151778 (SAN) • Tenom, Ulu Senagang; 05°21′01″N, 116°01′03″E; 470 m elev.; 21 October 1999; P. C. Boyle 1432 (K).

Identification. Schismatoglottis unifolia is known only from the type locality. The affinities of this species are rather unclear, as it has hapaxanthic shoots restricted to the Schismatoglottis calyptrata group, but it also has irregular absiccing and disintegrating (rather than caducous) spathe limb implying it to the Schismatoglottis asperata group. Schismatoglottis unifolia has unusual breeding system in the genus as the male zone held within the lower spathe chamber like in Schismatoglottis pudenda A.Hay and Schismatoglottis grabowskii Engl. (Hay and Yuzammi, 2000).

Distribution and ecology. Endemic to Sabah. Terrestrial in deep leaf litter over sandy loam in secondary gallery forest on a steep slope, at 470 m elev.

Schismatoglottis venusta A.Hay

Material examined. MALAYSIA – Sandakan • Kinabatangan, Gomantong hill, bottom of Libingpayu hole; 05°31′52″N, 118°04′17″E; 15.24 m (50 ft.) elev.; 21 July 1954; G. H. S. Wood A 4602A (SAN) • same locality; 15.24 m (50 ft.) elev.; 27 September 1948; Austin Cuadra A 1490 (SAN) • same locality; 21 June 1992; W. Meijer SAN 136165 (SAN) • same locality; 21 June 1992; W. Meijer SAN 136168 (SAN) • same locality; 300 m elev.; 24 April 1996; A. Hay 12167 (SAN) • Kinabatangan, Gomantong Forest Reserve, Dulong lambu limestone massif, Gomantong limestone hill, Simud Hitam Cave; 05°31′22″N, 118°03′50″E; 50 m elev.; 21 May 1996; S. P. Lim 605 (SAN) – Tawau • Lahad Datu, Madai Caves, cultivated at glasshouse at Royal Botanic Gardens Sydney; 04°43′45″N, 118°08′00″E; 400 m elev.; 25 April 1996, A. Hay 12179 (SAN).

Identification. This species is clearly allied to S. calyptrata, sharing the hapaxanthic modules, sagittate leaf blade, caducous spathe limb and hourglass-shaped spadix with partially adnate female zone. It differs in the very dark green somewhat coriaceous (almost subsucculent) leaves, lithophytic habit, larger pistils, shorter and wider interpistillar staminodes and the shortly cylindric appendix (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. North-eastern and eastern Sabah. Lithophytic on limestone (occasional on nearby forest floor) in mixed dipterocarp forest, ca. 50–400 m elev.

Schismatoglottis wongii A.Hay

Material examined. MALAYSIA – Pantai Barat • Penampang, Moyog, along road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53111 (SAR, MO) – Sandakan • Sandakan, Ulu Dusun, 05°47′05″N, 117°45′50″E; 1 March 1995; A. Hay 10026 (K) • Sandakan, Sepilok Forest Reserve, cultivated at glasshouse at Royal Botanic Garden Sydney; 05°49′36″N, 117°57′04″E; 23 April 1996; S. P. Lim 605 (SAN) – Tawau • Lahad Datu, Madai Caves, cultivated at glasshouse at Royal Botanic Garden Sydney; 04°43′45″N, 118°08′00″E; 400 m elev.; 25 April 1996, A. Hay 12179 (SAN).

Identification. This species is only known from the type locality in Sepilok Forest Reserve. Schismatoglottis wongii is similar in habit to Schismatoglottis longispatha W.Bull but differs in the cordate leaf base and dimerous anthers. Schismatoglottis wongii have horticultural potential as ormentals especially variegated forms of Schismatoglottis wongii (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Forming dense clonal carpets sometimes several metres across on the floor of mixed lowland dipterocarp forest at low elevation.
**Schismatoglottis zainuddinii** Kartini, P.C. Boyce & S.Y. Wong

**Material examined.** MALAYSIA – Tawau • Cultivated at Institute for Tropical Biology and Conservation, Kota Kinabalu; 22 Feb 2016; Kartini BORH 4405 (BORH) [original collection: Malaysian Borneo, Sabah, Tawau, Tawau Hills N.P., Tiku River; 04°22′ N, 117°54′E; 19 Feb 2016].

**Identification.** A species distinguished from all other species of the *S. Asperata* clade by leaf blades glossy, bright medium green above and matte, pale green below, densely minutely asperous, glossy, deep green petioles, and older plants with a much-elongated decumbent stem. Differentiated from *S. sejuncta* Hay (geographically the closest species) by having staminate and pistillate flower zones contiguous (not separated by a well-defined and conspicuous naked sterile interstice) (Kartini et al. 2017).

**Distribution and ecology.** Eastern Sabah. Tawau Hills Park on the banks of Tiku River along the trail to Galas Hill. Occurs on steep slopes and earth banks over basalt in wet lowland to hill forest elevation between 90 and 330 m.

**Scindapsus crassipes** Engl.

**Material examined.** MALAYSIA – Pedalaman • Sipitang, Long Pasia, Ulu Padas, Bukit Busur, 338.328 m (1110 ft.) elev.; 27 January 2003; Doloso S. SP 18081 (SAN) • Sandakan • Beluran, Hutan Simpan Timinimbang, (B) Compartment 52, Near 1st plot of ecology team; 05°59′33″N 117°06′08″E; 96 m elev.; 20 February 2014; Nur Adilah 156305 (SAN) • Kinabatangan, Maliau Basin, Gunung Rara Forest Reserve, 2.5KM above main Maliau Falls; 530 m elev.; 9 April 1996; A. Hay 12030 (SAN).

**Identification.** Trichosclereids abundant. Solitary, leaf-litter-trapping, bole perching.

**Distribution and ecology.** *Scindapsus crassipes* is endemic to Borneo. Southwestern and northeastern Sabah.

**Scindapsus curranii** Engl. & K. Krause

**Material examined.** MALAYSIA – Pedalaman • Pandawan, Sungai Pementarian; 04°58′12″N, 116°25′24″E; 13 February 1987; Sumbing Jimpin SAN 119952 (BORH, SAN) • Tenom, Sungai Kaang; Asik Mantor SAN 120266 (SAN, UKMS) • Pantai Barat • Ranau, Bukit Kuling; 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122424 (SAN) • Ranau, Mount Kinabalu, Kinabalu; 06°05′30″N, 116°32′45″E; Clemens & Clemens, s.n. (L) • same locality; 1371.6 m (4500 ft.) elev.; 5 September 1961; W. L. Chew, E. J. H. Corner & A. Stanton RNSB 2770 (SAN) • same locality; 1284.96 m (52000 ft.) elev.; 10 September 1961, W. L. Chew, E. J. H. Corner, A. & Stanton RNSB 2940 (SAN) • same locality; 1284.96 m (52000 ft.) elev.; 18 April 1964; W. L. Chew & E. J. H. Corner RNSB 4939 (SAN) • Ranau, Poring; 06°02′53″N, 116°42′06″E; 457.2 m (1500 ft.) elev.; 3 October 1987; W. Meijer et al. SAN 122513 (SAN) • Ranau, Tenompok; 05°58′58″N, 116°30′40″E; 1524 m elev.; 9 May 1932; Clemens & Clemens 29617 (P) – Sandakan • Beluran, Ulu Tungud Forest Reserve; 05°48′51″N, 117°07′16″E; 188.976 m (620 ft.) elev.; 17 August 2004, J. B. Sugau SAN 145513 (SAN) • Ranau, Mount Kinabalu; [06°05′30″N, 116°32′45″E]; 1645.92 m (5400 ft.) elev.; date unknown; Cockburn SAN 76802 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 17 December 1990, W. Meijer SAN 131689 (SAN) • Sandakan, Tongod, Lamag; 05°28′29″N, 117°49′24″E; 21 March 1980; L. Madani SAN 92041A (SAN) • Sandakan, Ulu Dusun; 05°47′06″N, 117°46′18″E; 15.24 m (50 ft.) elev.; 2 September 1977; S. Lantoh SAN 87917 (L, SAN) • Telupid; 05°39′35″N, 117°03′08″E; 19 March 1974; Aban & Saikeh SAN 79412 (SAN) – Tawau • Kalabakan; 04°24′30″N, 117°29′00″E; 16 October 1999; Fedilis & Sumbing SAN 91332 (SAN) • Tawau Hill Park; 04°23′00″N, 117°53′00″E; 29 June 2006; Julia et al. SAN 147009 (SAN, SAR).

**Identification.** Herb. Climbing along small tree stems in wet sand gravelly soil of very humid forested flats and along streams at 750 ft; stem or stems bendable, less than one-half of an inch thick, subterete, dark or dull green, from 10 to 15 feet high, ringed every 3 to 5 inches, taking rootlets at the joints, more or less crooked, occasionally branched along the main stem but profusely branched toward the top; the ultimate branches long, curved and drooping, becoming interlaced, at first descending, finally ascendingly curved toward their tips, as thick as a man’s small finger, of the same green color as the stems; woody fibers tough and yellowish, the whitish pith relatively large; leaf blades pendant from ascending involutely twisted green herbaceous stalks or petioles, flat and paler green on the nether side. Inflorescence erect, 3 inches long, one half to three quarters of an inch thick, fusiform, glaucous black, in the early state clothed with a smooth shining-green sheath or spathe which with maturity turns creamy yellow or creamy white on the inside; spadix or cob quite thick and rigid, terminated in a green, slender and curved point; florets sulphureus except the green margins between the individuals. Infructescence with fruiting spike erect, terete, very dark or a sort of metallic green or dull dark green.

**Distribution and ecology.** Northwestern, Southwestern, and northeastern Sabah. Mainly well-drained perhumid to everwet broadleaf forest at low to middle elevations.

**Scindapsus kinabaluensis** (Furtado) Kartini & P.C. Boyce

**Material examined.** MALAYSIA – Pedalaman • Keningau, Crocker Range Forest Reserve, Mile 16 Highland Plantation; [05°51′15″N, 116°18′50″E]; 1219.2 m (4000 ft.) elev.; 12 June 1977; A. H. Talip SAN 87006 (SAN) • Keningau, Hutan Simpan Trus Madi, Sinua; 05°30′21″N, 116°25′24″E; 19 February 1987; Sugau J. B. Fedilis & Sumbing SAN 91332 (SAN) – Tawau Hill Park; 04°23′00″N, 117°53′00″E; 29 June 2006; Julia et al. SAN 147009 (SAN, SAR).

**Identification.** Herb. Climbing along small tree stems in wet sand gravelly soil of very humid forested flats and along streams at 750 ft; stem or stems bendable, less than one-half of an inch thick, subterete, dark or dull green, from 10 to 15 feet high, ringed every 3 to 5 inches, taking rootlets at the joints, more or less crooked, occasionally branched along the main stem but profusely branched toward the top; the ultimate branches long, curved and drooping, becoming interlaced, at first descending, finally ascendingly curved toward their tips, as thick as a man’s small finger, of the same green color as the stems; woody fibers tough and yellowish, the whitish pith relatively large; leaf blades pendant from ascending involutely twisted green herbaceous stalks or petioles, flat and paler green on the nether side. Inflorescence erect, 3 inches long, one half to three quarters of an inch thick, fusiform, glaucous black, in the early state clothed with a smooth shining-green sheath or spathe which with maturity turns creamy yellow or creamy white on the inside; spadix or cob quite thick and rigid, terminated in a green, slender and curved point; florets sulphureus except the green margins between the individuals. Infructescence with fruiting spike erect, terete, very dark or a sort of metallic green or dull dark green.
Sembuan Tulid; 04°47’30″N, 116°11’33″E; 27 September 1988; Fedilis K. SAN 1501 (NWS, SAN) • Pensiangan, Pensiangan kayu; 06°05′30″N, 116°32′45″E; 17 January 1994; Asik Mantor SAN 28487 (SAN) • Sipitang, lower slope of Bukit Rimau, approximately north of Long Miau, lower montane heath forest; 04°27′58″N, 115°42′11″E; 1200 m elev.; 12 April 2000; Lim S. P., SAN 143207 (SAN) • Sipitang, Maligcon Forest Reserve; 04°34′26″N, 115°37′22″E; 1219.2–1524 m (5000 ft.) elev.; 13 July 1991; Leopold M. SAN 132712 (SAN) • Sipitang, Sungai Tamaki, ridge at upper Sungai Tamaki; 04°26′52″N, 115°47′49″E; 1600 m elev.; 14 April 2000; Lim S. P., SAN 143194 (K, NSW) • Sipitang, Ulu Meligan, Ridge East of Maligcon Forest Reserve, Lower Montane Forest; 04°41′28″N, 115°41′18″E; 1880 m elev.; 11 April 2002; Lim S. P., Postar M. & Petrus Butin SAN 144163 (SAN) • Tambunan, Alab, between Agriculture Exp. Station and Kampung Garib, Mount Alab; 05°49′43″N, 116°20′28″E; 1300 m elev.; 14 December 1968; Kokawa & Hotta 2222 (L) • Tambunan, Alab, Mount Alab; 05°50′N, 116°20′E; 2000 m elev.; 31 August 1986; E. F. Vogel 8673 (L) • Tambunan, Gunung Alab; 05°49′43″N, 116°20′28″E; 1300 m elev.; 914.4 m (3000 ft.) elev.; 17 August 1983; Clemens & Clemens 261 (P) • same locality; 17 August 1983; Fedilis Krispinus SAN 95887 (SAN).
Scindapsus longistipitatus Ridl.

**Material examined.** MALAYSIA – Pedalaman • Tambunan, Rafflesia Forest Reserve Rafflesia, trail behind Rafflesia Information Centre; 05°46′22″N, 116°20′28″E; 14 May 2011; P. Leong 453 (SAN, SING) – Tawau • Lahad Datu, Danum Valley Field Centre; 04°57′30″N, 117°41′47″E; 19 February 1992; A. Berhanan SAN 134403 (SAN) • Lahad Datu, Segama River Forest Reserve; 04°57′42″N, 117°49′57″E; 18 March 1985; Leopold M. & Ismail SAN 108616 (SAN) • Tawau, Tawau Hills Forest Reserve; 04°23′60″N, 117°53′21″E; 6 July 1974; Aban G. & Free SAN 79670 (SAN).

**Identification.** Lianes and stem 7 mm. in diameter. This species is superficially similar to *S. longistipitatus* Merr. but is differentiated with a shorter stipe (refer *S. longistipitatus* below).

**Distribution and ecology.** Southwestern and eastern Sabah. Mainly well-drained perhumid to everwet broadleaf forest at low to middle elevations. **Scindapsus longistipitatus** Merr.

**Material examined.** MALAYSIA – Pantai Barat • Ranau, Lohan Ulu; 05°46′03″N, 116°49′07″E; 9 November 1987; Amin & Francis SAN 121419 (SAN) • Ranau, Mount Kinabalu; [6°05′30″N, 116°32′45″E]; 1219.2–1524 m (4000–5000 ft.) elev.; 4 October 1933; Clemens & Clemens 40601 (L) • Tawau, Tawau Hills Forest Reserve, along Sun River; 05°52′26″N, 117°56′59″E; 14 December 1990; W. Meijer & Dewol SAN 131644 (SAN) • Sandakan, Ulu Dusun, fresh water, zone inside mangrove; 05°46′53″N, 117°46′09″E; 28 November 1987; W. Meijer SAN 122736 (SAN) – Tawau • Semporna, Bohey Dulang Island; 04°35′59″N, 118°47′04″E; 50 m elev.; 12 October 1998; J. B. Sugat et al. SIP-B 108 (SAN) • Tawau, Brantian, logged area Mill 12, Hap Seng Road; 04°30′58″N, 117°33′26″E; 14 March 1979; Fedilis K. & Sumbing J. SAN 89756 (SAN) • Tawau, Bukit Gemuk Forest Reserve; 04°18′00″N, 117°52′00″E; 17 March 1984; Sumbing J. SAN 103454 (SAN).

**Identification.** *Scindapsus longistipitatus* is strongly characterized among all the described forms of this genus by its long-stipitate spadices, these in fruit being 18–29 cm.

**Distribution and ecology.** Northern and northwestern Sabah. In primary forests, elevation about 20 m.

Scindapsus pictus Hassk.

**Material examined.** MALAYSIA – Pedalaman • Nabawan, Sungai Pingas-Pingas, mainland over ridge area, hillsides; [05°42′00″N, 116°40′32″E]; 11 July 1986; Fedilis K. & Sumbing J. SAN 115896 (SAN) • Sipitang, near montane Muruk Miau, Lower Montane Oak–Chestnut Forest; 04°21′57″N, 115°50′01″E; 1300 m elev.; 13 April 2000; Pius G. & Dauni S. SAN 143168 (SAN, AAU, NSW) – Pantai Barat • Ranau, Mount Kinabalu, along road to summit; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53140 (MO, SAR) • same locality; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53141 (MO, SAR) • same locality; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53142 (MO, SAR) • Ranau, Mount Kinabalu, Penibukan; [06°05′30″N, 116°32′45″E]; 1219.2–1524 m (4000–5000 ft.) elev.; 4 October 1933; Clemens & Clemens 40601 (L) • Tambunan, Gunung Alab, rain forest; [05°50′N, 116°20′E]; 1600 m elev.; 100 m elev.; 26 February 1969; H. P. Nooteboom, H. P. Nooteboom 1042 (SAN) – Sandakan • Beluran, Lungmens Forest Reserve, roadside; 05°74′N, 117°67′E; 17 December 2009; Pius G. SAN 150776 (SAN) • Sandakan, Kabili, Timbon; 05°47′47″N, 117°53′55″E; 22 November 1989; George M. SAN 125771 (SAN) • Sandakan, Sepilok Forest Reserve, Jalan Kabili cpt. 14; [05°49′36″N, 117°57′04″E], 24.384 m (80 ft.) elev.; 29 March 1965, Patrick P. Sam SAN 49932 (SAN) • Sandakan, Sepilok, Sepilok Forest Research Compt 3, along North South; 05°52′26″N, 117°56′59″E; 14 December 1990; W. Meijer & Dewol SAN 131644 (SAN) • Sandakan, Ulu Dusun, fresh water, zone inside mangrove; 05°46′53″N, 117°46′09″E; 28 November 1987; W. Meijer SAN 122736 (SAN) – Semporna, Bohey Dulang Island; 04°35′59″N, 118°47′04″E; 50 m elev.; 12 October 1998; J. B. Sugat et al. SIP-B 108 (SAN) • Tawau, Brantian, logged area Mill 12, Hap Seng Road; 04°30′58″N, 117°33′26″E; 14 March 1979; Fedilis K. & Sumbing J. SAN 89756 (SAN) • Tawau, Bukit Gemuk Forest Reserve; 04°18′00″N, 117°52′00″E; 17 March 1984; Sumbing J. SAN 103454 (SAN).

**Identification.** *Scindapsus pictus* is most similar to *S. treubii* Engl. Juvenile plants of *S. pictus* have leaves with a crystalline texture and a smooth, dull grey-green blade variously marked with jagged silver-grey blotches. Flowering plants of *S. pictus* have falcate leaves with little or no posterior lobe development (Bogner and Boyce 1994).

**Distribution and ecology.** Widespread in Sabah. In a variety of habitats in lowlands to mid-elevation. Usually encountered as a juvenile shingling climber, rarely encountered adult plants form extensive curtains of much-branched stems pendent from the tops of tall forest trees, with the inflorescences born on the tips of the stems. **Scindapsus treubii** Engl.

**Material examined.** MALAYSIA – Sandakan • Sandakan, Sepilok Forest Reserve, arboretum trail; 05°49′36″N, 117°57′04″E; 60.96-91.44 m (200–300 ft.) elev.; 15 December 1990; W. Meijer & Dewol SAN 131655 (AA, SAN) • Sandakan, Kabun Forest, below waterfall; 05°51′04″N, 118°03′47″E; 20 December 1990; W. Meijer & Dewol SAN 131747 (SAN) • same locality; 05°51′04″N, 118°03′47″E; 20 December 1990; W. Meijer & Dewol SAN 131748 (L, F, SAN).

**Identification.** Lianes. The leaf blade is narrowly elliptic to very narrowly falcate oblanceolate (juvenile and pre-adult), to oblique-elliptic (adult). The juvenile plants often with the leaf blades grey-banded.
Distribution and ecology. Northeastern Sabah. Usually in well drained subtropical and tropical perhumid to ever wet broadleaf subtropical and tropical forest at low to middle elevations.

Tawaia sabahensis (S.Y.Wong, S.L.Low & P.C.Boyce)

S.Y.Wong & P.C.Boyce

Material examined. MALAYSIA – Sandakan • Tonggod, Gunung Tingka; 05°18′00″N, 115°07′45″E; 167.64 m elev.; 24 August 1992; K. M. Wong & Joseph Radin WKM 2215 (SAN).

Identification. Tawaia sabahensis is the only species in Tawaia and is unique by the combination of globose thecae and spatulate interpetiolar staminodes. In overall aspect, by the nodding spathe on a long, slender peduncle, and by the spathe limb hardly opening at pistillate anthesis and deliquescing acroscopically, spathe recurved and abscises, remained with a 5 mm rim beyond the junction of upper spathe and the persistent lower spathe, upper spathe then marcescent and was partially attached on the persistent lower spathe, thence browning and marcescent during staminate anthesis (Low et al. 2018).

Distribution and ecology. Endemic to Sabah. Occurs as an obligate rheophyte on ultramafic (ultrabasic) river boulders and waterfalls under moist lowland forest, elevation between 135 and 300 m.

Typhonium roxburghii Schott

Material examined. MALAYSIA – Pedalaman • Tenom, Rayoh Hill; [05°12′24″N, 115°52′49″E]; 60.96 m elev.; 27 April 1964; J. Ampuria SAN 41466 (K) • Tenom, Agriculture Station, in demonstration garden; 05°10′54″N, 118°06′15″E; 500 m elev.; 16 October 1987; W. Meijer SAN 121365 (SAN) – Sandakan • Sandakan, near Duchess of Kent Hospital; 05°51′30″N, 118°06′15″E; 15.24 m elev.; 15 July 1983; Young SAN 96794 (SAN).

Identification. The leaf blades of T. roxburghii are commonly trilobed with the sterile flowers spreading and strongly decurved. The distribution of T. roxburghii as a native species is still uncertain in marginal areas but is confirmed to be native to Malaysia (Nicolson and Sivadasan 1981). In Sabah, this species is naturalized (Wong 2016).

Distribution and ecology. Southwestern and northeastern Sabah. Ruderal, sometimes on limestone, ca. 50 m elev.

Discussion

Sabah contains about 31% of the 370 described species of Araceae recorded in Borneo (Boyce and Croat 2011). Schismatoglottis has the most species (24 spp.), followed by Pothos (14 spp.), and Alocasia (13 spp.). Although Homalomena has only 11 described species, the estimated number of species in Sabah exceeds 100 (Boyce and Croat 2011). These results are similar to those obtained in previous work for Borneo, such as Boyce et al. (2010), Wong (2016), and Low et al. (2018), where Schismatoglottis and Homalomena are the most diverse genera. In Sarawak alone, Schismatoglottis comprises a total of 72 described species (including 51 endemics), representing the most diverse genus in Sarawak (Boyce and Croat 2011). In Sabah, 20 Schismatoglottis species are endemic to Sabah, representing 84% of Schismatoglottis in Sabah.

On the other hand, Pothos with 14 described species (including four endemics), represents the second largest genus of Araceae in Sabah. Sabah contains a significant level of endemism, as 44% of the aroid species present in Sabah are endemic. This is true also for other plant families, i.e., begonias (80% endemicity; Sang and Kiew 2014) and orchids (59%; Hassler and Rheinheimer 2020).

Apart from Tawaia, the only endemic aroid genus, Sabah also harbours a few more endemic genera in Orchidaceae (monotypic Jejewoodia Szlach. and Kipandiorchis PO’Byrne & Gokusing), Euphorbiaceae (Borneodenron Airy Shaw), Loranthaceae (Lampas Danser), and Rubiaceae (Phyllocrater Wernham) (Neo et al. 2020).

Our results demonstrate the need to carry out thorough inventories in poorly studied sites, such as exists in Kalimantan, and to stress the importance of floristic and taxonomic studies as the basic tool to advance our knowledge of biodiversity.

Acknowledgements

We thank the curators of SAN, BORH, and SNP for allowing access to their collections.

Authors’ Contributions

JJ and WSY contributed to the design and implementation of the research, made identifications, and reviewed herbarium material, and reviewed all versions of the manuscript.

References


Alderwerelt van Rosenburgh CRWK van (1920) New or noteworthy Gymnosperms and non-orchid monocotyledons. Natural History Publications (Borneo) Sendirian Berhad, Kota Kinabalu, Malaysia; Royal Botanic Gardens, Kew, UK, xii + 220 pp. + 25 pls.


Hetterscheid WLA, Ittenbach S (1996) Everything you always wanted to know about Amorphophallus, but were afraid to stick your nose into!!! Aroidaeana 19: 7–131.


Masamune G (1942) Boruneo no kenka shokubutsu. [Enumeratio phaerogamarum Bornearum]. Taishoku Imperial University, Taishoku, Formosa, 335 pp.


Wong and Joling | Aroids of Sabah, Malaysian Borneo 973
## Appendix

**Table A1. List of aroid taxa in Sabah.**

<table>
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<tr>
<th>Taxon</th>
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<td><em>Aglaonema nitidum</em> (Jack) Kunth</td>
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