The Aroids *of* Borneo

What are the aroids?

The Araceae - aroids or *keladi hutan* - is a family of herbaceous monocotyledons with 108 genera and about 3,750 species worldwide. Nowadays, the Lemnaceae (duckweeds) are included in the Araceae. The aroids are predominantly tropical in distribution with 90% of genera and about 95% of species restricted to the tropics. The greatest number of species originate in South America (including the two largest genera, *Anthurium* and *Philodendron* with over 1500 species between them) but the tropics of South East Asia are also very rich, with the large and horticulturally important genera, such as *Alocasia* (photo 1, 2) and *Amorphophallus* (photo 3).

Alocasia chaii, a recently discovered species endemic to central Sarawak.

Alocasia cuprea. Long considered endemic to Sabah, this horticulturally important species has recently been discovered in Sarawak.

Aroids are one the most abundant herb groups in the forests of Borneo but, paradoxically, are among the least well known and studied. As many as 60% of the aroid species of Borneo await formal classification and a universally recognized scientific name, while almost none have received scientific attention with regard their evolutionary relationships,

Amorphophallus eburneus. A species restricted to limestone habitats in Borneo.

their pollination and seed dispersal, their co-existence with other organisms and much else besides.

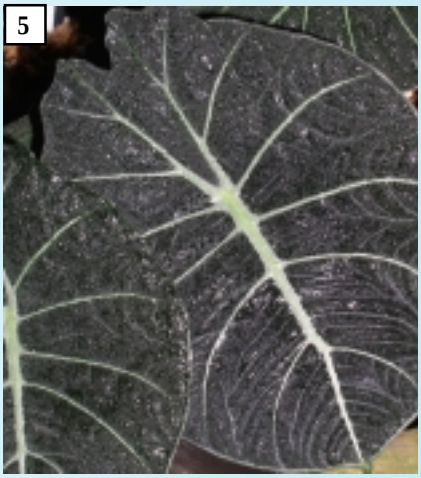
Aroids of Borneo – How many and where do they grow?

As currently understood the aroid flora of Borneo comprises 265 described species in 27 genera, making it the richest and most diverse region in tropical Asia and perhaps second only to that of north western South America (Colombia and Ecuador). Sarawak, particularly the northwest and central regions, is notable for the extreme wealth and diversity of aroid species. However, this number is most certainly well below the actual figure and does not take into account the great number of aroids that are known to exist but have yet to receive a formal name, let alone plants yet to be discovered.

The dominant terrestrial non-climbing aroids encountered in Borneo are *Alocasia*, *Schismatoglottis* and *Homalomena*. *Alocasia* (photo 4, 5) has 31 species described for Borneo of which 29 are endemic. There are a further ten yet to be described.

Alocasia robusta has the honour of having the largest undivided leaf of any land plant. This specimen photographed in Sabah stood over 6 m tall. This remarkable species was described as new to science in the mid 1970s.

Schismatoglottis includes 62 species of which 55 are considered endemic and at least another 20 await description (photo 6, 7, 8). *Homalomena*, for which there has been no revision for over a century, in Borneo appears to have as many as 60 percent that are novel



Alocasia reginula was known in cultivation for over 30 years before it was at last found in the wild in Borneo only a few years ago.

Schismatoglottis viridissima one of many species of *Schismatoglottis* described as new to science in the past few years. This one is restricted to western Sarawak.

Schismatoglottis ciliata is remarkable for the white bristles that cover the petioles and leaf backs. Borneo has several such hairy *Schismatoglottis* – all locally restricted.

(photo 9, 10). The total number of aroid species in Borneo (based on novelties described while revising genera plus the discovery rate of unidentifiable species for genera where a recent revision exists) suggests a total in excess of 400. Indications are that over 95% of all Bornean aroid species are endemic, that is, found nowhere else on Earth.

The aroids are overwhelmingly plants of humid, shaded forest. Species diversity is greatest in gallery forest on steep slopes of stream valleys at low to mid-elevation (up to 850 m a.s.l.). There is a strong correlation between the species and their geological preference (limestone, ultramafic, etc.) and also to altitudinal range. In the genus *Alocasia* there are good examples of species complexes where sister species are separated by favouring lowland or highland habitats (photo 12, 13), limestone or non-limestone habitats (photo 14, 15). Many species favour steep rocky habitats above streams on rock outcrops under mature forest (photo 16, 17).

A group of particular interest in Borneo are the rheophytes, species adapted to the flood zone of forest streams, and which tend to have wide spreading, strong roots and streamlined leaves. Among this group Borneo specialities include the rheophytic genera *Piptospatha grabowskii* (photo 18) and *Bucephalandra motleyana* (photo 19).

Aroids are highly diverse in life forms and leaf and inflorescence characteristics. Life forms range from submerged or free-floating aquatics to terrestrial (and sometimes tuberous) and to epiphytic or hemi-epiphytic plants or climbers. Leaves range from simple and entire to compound and highly divided, and may be basal or produced from an aerial stem.

What makes an aroid an aroid?

The Araceae is defined by bearing small flowers on a fleshy axis (spadix) subtended by a modified leaf (spathe). There is much variation on this theme. In some genera, the spathe is very conspicuous and brilliantly coloured (e.g., many *Amorphophallus*) while in others the spathe is small and leaf-like (e.g., most *Pothos*). The behaviour of the spathe varies from genus to genus. In some (e.g., *Cryptocoryne*), the spathe completely encloses the spadix, while in others the spathe reflexes to leave the spathe clearly visible (e.g., most *Pothos*). In some genera, the spathe is shed as soon as the inflorescence begins to flower, either falling completely (e.g., *Rhaphidophora*) or partially (e.g., *Schismatoglottis*). The spathe ranges in size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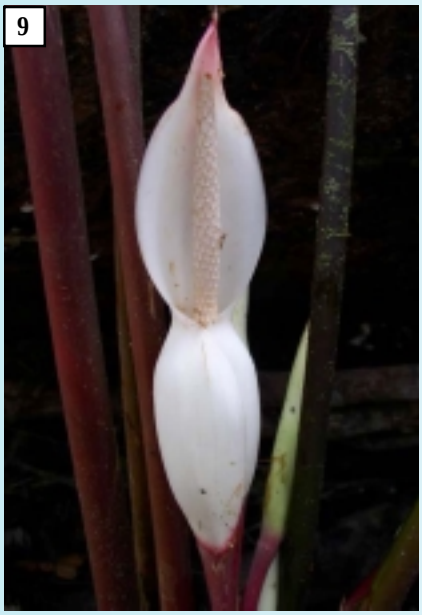
Schismatoglottis motleyana is a widespread and very variable carpet-forming species. The leaves range in colour from plain dark green though to the beautiful variegation depicted here.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An as-yet undescribed species of *Homalomena*. The large white inflorescences have a strongly aniseed fragrance.


10

Homalomena geniculata was once thought to be restricted to a small area of forest in north Sarawak but has subsequently been shown to be widespread but always scattered and never common.


11

Homalomena humilis is a widespread and common species with stems and leaves that range from clear green to the deep purple-red shown here.


12

Alocasia beccarii is one of several related species each with a particular habitat and altitude preference. *Alocasia beccarii* occurs in lowland mixed dipterocarp forest.


13

Alocasia peltata can be considered as the high-altitude sister species to *A. beccarii*. Both *A. peltata* and *A. beccarii* are endemic to Borneo.


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Alocasia ridleyi has recently been recognized as a species related to but distinct from *A. scabriuscula* and from which it differs, among other characters, by being restricted to limestone.

Another factor in sister species grouping can be geology. *Alocasia scabriuscula* is a common species in Borneo occurring on a range of soil types but never on limestone.

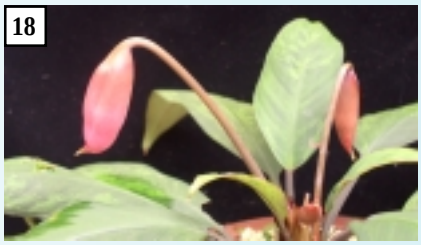
Schismatoglottis bauensis here dominating a limestone cliff in west Sarawak.

Alocasia reversa is a lithophytic *Alocasia* so far only found on limestone in west Sarawak. It is an important horticultural species.

and shape from 5mm long and simple in *Homalomena humilis* (photo 11) to the huge fluted 1m wide vase of *Amorphophallus hewittii*.

The sex of the individual flowers and their arrangement on the spadix are among the characters used to define taxonomic groups. Depending on the genus, the spadix may bear either unisexual or bisexual flowers. If bearing bisexual flowers, these are uniformly arranged over the spadix. Almost without exception bisexual flowers are subtended by reduced tepals termed a perigon. If unisexual, the flowers are usually arranged with the females at the base of the spadix and the males above with the zones occasionally separated by a zone of sterile flowers and the spadix occasionally terminated by a sterile appendix (photo 20).

All Araceae studied to date display insect pollination. Many aroids attract pollinators by odour. Inflorescence odours can smell of dung, carrion, rotting fruit, old socks, semen, bad breath, beer, spearmint, boiled sweets and cinnamon. Many, notably the revoltingly smelly *Amorphophallus*, have evolved to be pollinated by insects attracted to dung or carrion (sapro-entomophily). Many tropical aroids are pollinated by bees, wasps and beetles. Others like *Philodendron* are pollinated by large dynastid scarab beetles. Several genera have inflorescences that heat up considerably during flowering, often by as much 20°C above the ambient temperature and these often produce at the same time a strong, foul odour.



Piptospatha grabowskii is a very attractive rheophytic aroid endemic to Borneo. It often occurs as large colonies but requires clear, swift-moving streams in order to thrive.

Bucephalandra motleyana is one of two species of this Bornean endemic genus. It is an obligate rheophyte.

The complex spadix of *Typhonium trilobatum*, a weedy species in Borneo, has noodle-like structures that are sterile flowers and partially obscure the female flowers. The spadix appendix produces a penetrating smell of rotting meat.

A ripe infructesence of *Amorphophallus eburneus*. Each berry contains a single large seed.

Rhaphidophora lobbii produces yellowish white fruit-scented infructescences that probably attract arboreal or perhaps flying mammals.

Fruits are frequently red fleshy berries (photo 21) suggesting bird dispersal, although the greenish yellow, fruitily perfumed fruits of climbers, such as *Rhaphidophora*, are more probably eaten and dispersed by arboreal mammals or bats (photo 22).

Ornamental species

Many Bornean aroids are prized ornamentals, in particular species of *Alocasia*. Of especial note are forms and cultivars of the widespread and variable *A. longiloba* of which *A. longiloba* 'lowii' and the superb *A. l.* 'watsoniana' are among the most beautiful of all foliage aroids. In recent years a great deal of interest has been directed at the dwarf growing thick leaved *Alocasia* from limestone and ultramafic rocks. Three species, *A. reginula*, *A. melo* and *A. nebula* have particularly attracted attention and are now being produced in the Asian region from tissue culture while others, including several scientific novelties, are showing great horticultural potential. Aside from *Alocasia*, attention is also being given to two further terrestrial genera, *Homalomena* and *Schismatoglottis*. Both contain numerous species with attractive foliage and, in many cases, good-sized inflorescences and a new generation of ornamental pot and garden plants is under development.

Peter Boyce
Malesiana Tropicals
Kuching, Malaysia

Photos by: Peter Boyce