Why is 'Flora Malesiana' Araceae not currently a practicable undertaking - *Fenestratarum* as an example

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ABSTRACT

Flora Malesiana is a systematic account of the flora of Malesia, the plant-geographical unit spanning seven countries in Southeast Asia: Indonesia, Malaysia, Singapore, Brunei Darussalam, the Philippines, Timor Leste, and Papua New Guinea. The Araceae is one of the larger plant families of Malesia, currently comprising 42 described genera and, conservatively, about 1200 species. A substantial proportion of Malesian aroid species are either only recently named, or have yet to be formally described. Despite encouraging progress with regional monographic accounts in the1990s and early 2000s, notably for *Alocasia*, *Schismatoglottis*, *Pothos*, *Epipremnum*, and *Rhaphidophora*, the intervening years, marked by a significant increase in field-based research, have revealed an extraordinary wealth of novel diversity such that none of the terrestrial and rheophytic genera can be currently be considered adequately known. Highlighting increases in described species in the past 15 years, and drawing on the example of the recently described genus *Fenestratarum*, reasons why *Flora Malesiana* Araceae is not currently practicable are enumerated, and practicable alternatives proffered.

KEY WORDS

Borneo, Indonesia,

INTRODUCTION

Flora Malesiana (FM) is a systematic account of the flora of Malesia, the plant-geographical unit spanning seven countries in Southeast Asia: Indonesia, Malaysia, Singapore, Brunei Darussalam, the Philippines, Timor Leste, and Papua New Guinea (http://floramalesiana.org/). The Araceae is one of the larger plant families of Malesia, currently comprising 42 described genera (excluding three genera of former Lemnaceae) and an estimated 1200

species (excluding nine species of former Lemnaceae) with a substantial percentage of species either only recently named, or yet to be formally described (**Table 1**; Boyce & Croat 2011).

Table 1. Changes in species numbers of Araceae of *Flora Malesiana* region over the last 15 years

Taxon	2001	2015	% increase	2001 + known novelties	% increase since 2001
Aglaodorum Schott	1	1	0	1	0
Aglaonema Schott	17	17	0	17	0
Alocasia (Schott) G.Don	59	63	7	87	48
Amorphophallus Blume ex Decne.	57	63	11	78	37
Amydrium Schott	3	3	0	0	0
Anadendrum Schott	10	12	20	47	370
Apoballis Schott [≡ *Schismatoglottis* Rupestris Group in Hay & Yuzammi 2000].	[12]	12	0	20	67
Aridarum Ridl.	8	24	200	26	225
Arisaema Mart.	14	14	0	15	7
Bakoa P.C.Boyce & S.Y.Wong [≡ *Piptospatha* pr. pte in Bogner & Hay 2000].	[2]	4	100	4	100
Bucephalandra Schott	2	29	1350	50	2400
Colocasia Schott	3	3	0	3	0
Cryptocoryne Fisch. ex Wydler	37	41	11	44	19
Cyrtosperma Griff.	12	12	0	12	0
Epipremnum Schott	13	13	0	13	0
Fenestratarum P.C.Boyce & S.Y.Wong	0	1	0	2	100
Furtadoa M.Hotta	2	2	0	2	0
***Gen. nov.* 1**	0	0	0	1	100
***Gen. nov.* 2**	0	0	0	1	100
***Gen. nov.* 3**	0	0	0	1	100
Hapaline Schott	3	3	0	3	0
Hestia S.Y.Wong & P.C.Boyce [≡ *Schismatoglottis longifolia*, Hay & Yuzammi 2000].	[1]	1	0	5	400
Holochlamys Engl.	1	1	0	1	1
Homalomena Schott	88	131	49	350 *[1]	297
Hottarum Bogner & Nicolson [≡ *Piptospatha* pr. pte, Bogner & Hay 2000].	[1]	1	0	2	100
Lasia Lour., Fl. Cochinch.: 81 (1790).	2	2	0	2	0
Nephthytis Schott	1	1	0	1	0
Ooia S.Y.Wong & P.C.Boyce [≡ *Piptospatha* Grabowskii Group pr. pte, Bogner & Hay 2000].	[2]	3	50	10	400
Pedicellarum M.Hotta	1	1	1	1	0
Phymatarum M.Hotta	1	1	1	1	0
Pichinia S.Y.Wong & P.C.Boyce	0	1	100	1	0
Pistia L.	1	1	0	1	0
Piptospatha N.E.Br.	11	12	9 *[2]	15	36
Podolasia N.E.Br.	1	1	1	1	0
Pothoidium Schott	1	1	1	1	0
Pothos L.	41	41	0	43	5
Remusatia vivipara (Roxb.) Schott	1	1	0	1	0
Rhaphidophora Hassk.	81	83	2.5	88	9
Sauromatum Schott	2	2	0	2	0
Schismatoglottis Zoll. & Moritzi	89	118	33 *[3]	180 *[4]	102
Schottariella P.C.Boyce & S.Y.Wong	0	1	100	1	0
Schottarum P.C.Boyce & S.Y.Wong [≡ *Schismatoglottis* pr. pte, Hay & Yuzammi 2000].	[1]	2	100	3	200
Scindapsus Schott	32	32	0	33	3
Spathiphyllum Schott	3	3	0	3	0
Typhonium Schott	7	7	0	7	0
Totals	**634**	**765**	**21%**	**1180**	**86%**

*[1] this total is undoubtedly conservative, based as it is only on undescribed species that are well-resolved; the genuine total could easily be half as much again, i.e., ca 500 species.
*[2] taking into account species removed from *Piptospatha* sensu Hay & Bogner the % increase is 100%
*[3] taking into account species removed from *Schismatoglottis* sensu Hay & Bogner the % increase is 59.6%
*[4] this total is conservative, based as with *Homalomena* on undescribed species that are well-resolved; the total will likely stabilize around 300 species.

During the IV International Aroid Conference (Moscow, 24–30 August 1992) a group of then-active tropical Asian aroid researchers gathered to agree on the best approach to tackling the Araceae for *Flora Malesiana*. The outcome was a division of labour under the general editorship of Alistair Hay, with genera allotted according to individual expertise and interests (Hay 1994). The general agreement as a starting point was the compilation and publication of a checklist and bibliography for the Araceae for Malesia. This was published in 1995 (Hay et al., 1995). Thereafter the years leading up to 2001 saw the publication of monographic and regional accounts for *Alocasia* (Hay, 1998; 1999b), *Colocasia* (Hay, 1996b), *Epipremnum* (Boyce, 1998), *Hapaline* (Boyce, 1996), *Homalomena* (Hay, 1999a), the Potheae (Boyce & Hay, 2001), *Rhaphidophora* (Boyce, 1999; 2000a,b; 2001a,b; Boyce & Bognerm 2000), *Schismatoglottis* (Hay, 1996a), and the Schismatoglottideae (Bogner & Hay, 2000), together with the description of a new and remarkable Bornean species of *Nephthytis*, a genus until then known only from tropical West Africa (Hay et al., 1994). In combination with reliable earlier accounts for *Aglaonema* (Nicolson, 1969), *Alocasia* (Hay & Wise, 1991), *Cryptocoryne* (Jacobsen, 1985; Jacobsen & Bogner, 1986, 1987), the Lasioideae (Hay, 1988), and *Pothos* (Hay, 1995) this body of work looked to provide a very significant contribution towards completion of the Araceae for *Flora Malesiana* within 10 years, as originally envisaged at the Moscow gathering.

However, after 2001 owing to employment changes three of the "Moscow Team" ceased full-time research on the Araceae of Malesia, although the situation improved somewhat late in 2002 when the author relocated to Sarawak and was again able to begin work on aroids, at least for Borneo. Paradoxically it was the opportunity to be based long-term in the wet tropics that brought into sharp focus that despite the numerous publications to date much remained to be done, even for taxa such as the Schismatoglottideae which had received significant attention from established specialists. Two factors, establishment of a substantial living collection and the concomitant removal of dependency on herbarium collections – the problems associated with dependency on herbarium material for studying aroids has been previously discussed (Boyce & Wong, 2012; Wong & Boyce, 2014) – and access to a molecular lab., impacted substantially on what thought we knew to the point that it became clear that we remain a long way from being in a position to work up a complete account for the aroids of Malesia.

Using 2001 as being the last year in which any *comprehensive* regional monograph was published, the taxonomic changes to the

aroids of Malesia are shown **Table 1**. Column '2015' is the total described, accepted species per genus at the beginning of 2015 as compared with the same total shown in column '2001' – for the family this is an increase of 21% in 15 years. Column '2001+ known novelties' is the total *known* species (described and undescribed) for each genus, a family-wide increase of 86% for the period 2001–2015. As indicated in the footnotes, these are conservative figures.

It might seem from the above that great strides have been made in the past 15 years such that now it is the time to 'stop' and work up the aroids for FM – however, the novelties that Table 1 highlights are overwhelmingly (>90%) described from Borneo – very substantial tracts of the Flora Malesiana region, notably Sumatera and Sulawesi, as well as a significant part of Borneo, are still virtually unknown.

Borneo continues to produce extraordinary novelties, exemplified by a new genus *Fenestratarum*, the existence of which was unimagined, described at the very end of 2014 (Boyce & Wong, 2014). As surprising as the appearance *Fenestratarum* was, a greater surprise was in store when, literally as the proofs the ms were being checked a second species of *Fenestratarum*, likewise unforeseen, came to light over 600 km further east than the Type locality of the first. This second species is currently in press (Boyce & Wong, in press). Aside from providing a pleasurable frisson of excitement the discovery of *Fenestratarum* has usefully 'solved' a support problem at the base of an otherwise "good" clade, enabling taxonomic resolutions to be made about several problematic species currently assigned to inappropriate genera, and resolving the placement of yet another novelty as a new genus.

ARACEAE FOR *FLORA MALESIANA* – WHAT ARE THE OPTIONS?

The speed and especially the magnitude of taxonomic change occurring within the Araceae of the *Flora Malesiana* region effectively prohibits the prospect of producing a printed *Flora Malesiana* account for the aroids in the next decade, or longer. But it is enormously important that what is published is made freely available via an archived and readily up-dateable portal. To this end with the assistance of Albert Huntington we have been archiving all our publications on the International Aroid Society's website:

http://www.aroid.org/gallery/boyce/

http://www.aroid.org/gallery/wong/

We strongly urge all researchers to do likewise.

In addition, over the past few years we have established a significant image resource of living plants and Type specimens, together with scans of original descriptions (protologues) on our Flickr site:

https://www.flickr.com/photos/araceae_of_sunda/collections/

We encourage those with images to make them available through this or a similar reliable free-to-use public portal.

Currently there are several web-based resources for the aroids in genera. One of the best is:

Emonocot:
http://emonocot.org/taxon/urn:kew.org:wcs:family:3

Much of the early literature for Araceae in general and South East Asian in particular is not easy to access in libraries, although in recent years the situation has become easier with several web-based resources, in particular:

The Biodiversity Heritage Library:
http://www.biodiversitylibrary.org/

Botanicus Digital Library:
http://www.botanicus.org/

In addition to these institutionally-based resources we have compiled a free to download resource of all the critical early literature for Araceae in DropBox – please contact the author – phymatarum@gmail.com – for access permission.

CONCLUSIONS

Compiling the Araceae for *Flora Malesiana* is a noble enterprise but one with a considerable burden imposed by the combination of reduction in full-time researchers, increasing rate of habitat disturbance, ironically a marked increase in the discovery of taxonomic novelties, and a shifting understanding of higher taxa delimitation into which the units we call species are grouped and catalogued. Production of a 'traditional' printed account is neither practicable in terms of time available to the current researchers nor indeed desirable given the very fluid nature of the subject, notably the taxonomy. Provision of well-advertized on-line access to published accounts and reliably identified images is of paramount importance to keep everyone abreast of the research that is occurring until such time that a full account is deemed appropriate.

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