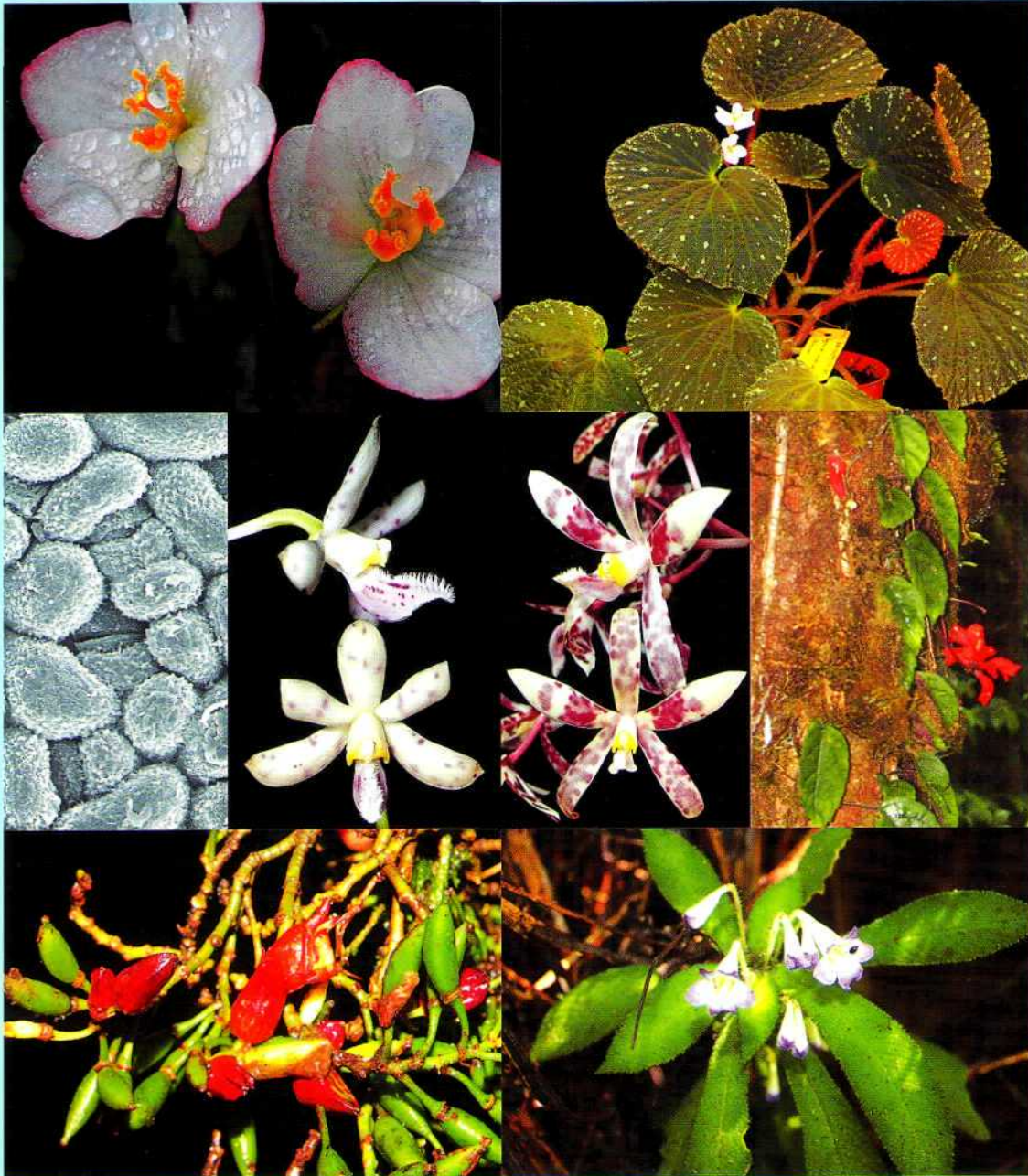




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Cover images: 1. *Begonia holosericeoides* (female flower and habit) (Begoniaceae; Ardi *et al.*); 2. Abaxial cuticles of *Alseodaphne rhododendropsis* (Lauraceae; Nishida & van der Werff); 3. *Dipodium puspitae*, *Dipodium purpureum* (Orchidaceae; O'Byrne); 4. *Agalmyla exannulata*, *Cyrtandra coccinea* var. *celebica*, *Codonoboea kjellbergii* (Gesneriaceae; Kartonegoro & Potter).

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DIVERSITY OF BEGONIA (BEGONIACEAE) IN BORNEO – HOW MANY SPECIES ARE THERE?

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ABSTRACT

JULIA, S. & KIEW, R. 2014. Diversity of *Begonia* (Begoniaceae) in Borneo – how many species are there?. *Reinwardtia* 14(1): 233 – 236. — A total of 126 species are currently named and described from Borneo (Brunei - 16 species, Kalimantan – 5 species, Sabah – 41 species and Sarawak – 72 species). However, based on our survey of the *Begonia* collection in the Sarawak Herbarium, the un-named taxa (about 110 species) significantly outnumber the 72-named species. The situation is probably the same for Sabah, so with many more new species than the 41 named ones at a conservative estimate the Sabah *Begonia* flora can be expected to exceed 100 species. For Kalimantan (5 named species), the total number of un-named species is likely to be even higher considering that Kalimantan occupies a larger land area, its begonia-rich mountains and limestone areas are hardly collected, and the *Begonia* flora has hardly been studied at all. We can therefore expect the *Begonia* flora of Borneo to exceed 600 species. In view of the high level of narrow endemism (80% of species are known from a single locality), expeditions to unexplored areas are necessary to document, in particular, areas that are experiencing irreversible land-use change. Alpha-taxonomy on a large scale is needed to tackle the backlog of literally hundreds of new undescribed species.

Keywords: *Begonia*, Borneo, diversity, endemism

ABSTRAK

JULIA, S. & KIEW, R. 2014. Keanekaragaman *Begonia* (Begoniaceae) di Borneo – Berapa jenis yang ada disana?. *Reinwardtia* 14(1): 233 – 236. — Sebanyak 126 jenis telah diberi nama dan dipertelakan dari Borneo (Brunei - 16 jenis, Kalimantan – 5 jenis, Sabah – 41 jenis dan Sarawak – 72 jenis). Akan tetapi, berdasarkan hasil survei koleksi *Begonia* di Herbarium Sarawak, taksa yang belum diberi nama (sekitar 110 jenis) ternyata jumlahnya melebihi dari 72 jenis yang telah diberi nama. Kondisi ini diperkirakan sama dengan Sabah, dengan lebih banyak jenis baru melebihi 41 jenis yang telah diberi nama, diperkirakan jumlah *Begonia* di Sabah lebih dari 100 jenis. Untuk Kalimantan (5 jenis yang telah diberi nama), jumlah jenis yang belum dipertelakan kemungkinan lebih besar karena Kalimantan mencakup area yang luas, pegunungan yang banyak *Begonia* dan daerah batu kapur sangat sulit dikoleksi, sehingga jenis *Begonia* hampir tidak dipelajari sama sekali. Diperkirakan jumlah jenis *Begonia* di Borneo melebihi 600 jenis. Mengingat tingginya tingkat endemisitas (80% jenis diketahui berasal dari lokasi tunggal), ekspedisi di daerah yang belum dijajah perlu dilakukan, khususnya pada daerah yang telah mengalami alih fungsi lahan. Alfa-taksonomi pada lingkup yang luas diperlukan untuk mengatasi ratusan jenis yang belum dipertelakan.

Kata kunci: *Begonia*, Borneo, endemisitas, keanekaragaman

INTRODUCTION

The first *Begonia* species described from Borneo was *Begonia microptera* by Hooker (1857) based on a specimen reportedly from Borneo, but without specific locality (Hughes, 2008). The SE Asian *Begonia* database (<http://elmer.rbge.org.uk/begonia>) listed a total of 95 named species for Borneo, which comprises Brunei, Kalimantan, Sabah and Sarawak (Hughes & Pullan, 2007). Since then, another 31 species have been described, mainly from limestone areas in Sarawak (Kiew & Julia, 2007; Kiew & Julia, 2009; Julia *et al.*, 2013).

In Brunei, the only well-studied region in Borneo, a total of 16 species were recognised (Sands, 1997). In contrast, only five species are recorded from Kalimantan and the Tambelan Islands. For Sabah, a total of 41 species have been described to date. Of these, 19 species were described from Mount Kinabalu (Beaman *et al.*, 2001) and 18 species from limestone hills (Kiew, 2003). Of the 72 species from Sarawak, 13 species were described by Ridley (1906) mostly from the Kuching District in the first and only account of begonias in Borneo. Irmscher (1953) described a further 10 species based on Beccari's collections collected from north and central parts of Sarawak.

Since then exploration of limestone hills has yielded a further 35 species (Pearce, 2003; Kiew & Geri, 2003; Kiew & Julia, 2007; Kiew & Julia, 2009; Julia *et al.*, 2013) and two from other areas (Tawan *et al.*, 2009).

To date, a total of 126 species are described from Borneo, almost half described in the 21st century. However, the rate of describing new species is rather slow (0.6 species per year between 1857 and 1900, and 4 species per year in the 21st century) and there are many more species collected that have yet to be described. For example, in Sarawak Herbarium, (SAR), more than half the taxa cannot be matched to a known species. While the type images, which are essential in facilitating revisionary work, are available online in the SE Asian begonia database, there is still the problem that the early types are poor quality specimens. Initiatives to re-collect specimens from the type localities of these specimens are needed, but in some cases this is quite impossible or very difficult because the locality data are either absent or very general and is without details of habitat. One exception is for Ridley's specimens from limestone in the Kuching District where specimens have been recollected from type sites (Kiew & Geri, 2003).

Endemism

All begonias species known in Borneo are endemic to the island. The level of local endemism is also particularly high with more than 90% of the total species endemic to either Brunei, Kalimantan, Sabah or Sarawak. Only six species in Borneo are known to cross these political boundaries (Table 1). Of these, only two species (*B. baramensis* and *B. fuscisetosa*) can be found in all four regions.

Most species are also narrowly endemic. For example, 80% of species are known only from a single collection or only from the type specimen, while others have only been collected from a single locality (Table 2). However, this likely

reflects the lack of collecting as the *Begonia* flora of Borneo is still very poorly known.

Diversity of Bornean Begonias

Begonias in Borneo belong to five sections but pre-dominantly to the sect. *Petermannia* (Table 3). Ridley (1906) wrote "*Borneo, at least Sarawak, appears to be tolerably rich in Begonias.... The most abundant are the tall woodland species of the Petermannia section with very insignificant flowers*". This statement remains true today. Of the named and un-named Sarawak *Petermannia* species at least 88 species are cane-like begonias compared with 24 species that are creeping and small-leaved begonias and 20 species that have short stems, non-oblique leaves and short petioles. Species belonging to sect. *Diploclinium* and *Reichenheimia* are some of the most attractive begonias, some with a neat rosette habit and peltate leaves (sect. *Reichenheimia*) or with yellow or peach-coloured flowers (some sect. *Diploclinium*). (*Begonia adenostegia* is probably wrongly assigned to sect. *Platycentrum* which is not thought to occur in Borneo). Begonias in sect. *Sphenanthera* are unusual for the genus in having fleshy berries without wings compared with the usual dry winged capsule.

How Many Begonia Species Are There in Borneo?

From Brunei with a land area of 5.765 km², a total of 16 species are known (Sands, 1997), giving an estimate of 1 species per 360 km². If this figure is extrapolated to estimate the number of begonias in Borneo as a whole (with a total land area of approximately 740.000 km²), it translates into more than 2000 species! But is Brunei typical as a whole for Borneo? One factor that suggests that the total number will be lower than 2000 species is habitat. Begonias are not evenly distributed as Beccari (1904) observed "*I was surprised, also, to find in quite limited area no less than five distinct forms of begonia, a genus which*

Table 1. Distribution of widespread Bornean species

Species	Distribution
<i>B. baramensis</i> Merr.	Brunei, Kalimantan, Sabah, Sarawak
<i>B. borneensis</i> A.DC.	Sabah, Sarawak
<i>B. chlorocarpa</i> Irmsch.	Sabah, Sarawak
<i>B. cyanescens</i> Sands	Kalimantan, Sarawak
<i>B. fuscisetosa</i> Sands	Brunei, Kalimantan, Sabah, Sarawak
<i>B. stenogyna</i> Sands	Brunei, Sarawak

Table 2. Examples of narrowly endemic species in Borneo

Species known from a single collection	<i>B. hidiri</i> Tawan, Ipor & Meekiong <i>B. keithii</i> Kiew <i>B. kiamfeei</i> Kiew & S. Julia <i>B. kurakura</i> Tawan, Ipor & Meekiong <i>B. layang-layang</i> Kiew <i>B. murudensis</i> Merr. <i>B. nagaensis</i> Kiew & S. Julia <i>B. promethea</i> Ridl. <i>B. punchak</i> Kiew & S. Julia <i>B. serapatensis</i> Kiew & S. Julia <i>B. sicutensis</i> Sands <i>B. tambelanensis</i> (Irmsch.) Kiew <i>B. urunensis</i> Kiew <i>B. vaccinioides</i> Sands
Species known from a single locality	<i>B. apiensis</i> Kiew & S. Julia <i>B. benaratensis</i> S. Julia <i>B. chlorosticta</i> Sands <i>B. eutricha</i> Sands <i>B. hullettii</i> Ridl. <i>B. juliasangii</i> Kiew <i>B. longiseta</i> Irmsch. <i>B. niahensis</i> K. G. Pearce <i>B. papyraptera</i> Ridl. <i>B. payung</i> S. Julia & Kiew <i>B. propinqua</i> Ridl. <i>B. sarangica</i> Kiew & S. Julia

is by no means rich in species in Borneo". Habitats that occupy a large proportion of land area in Borneo, such as peat swamp, heath forest and lowland forest, are relatively poor in begonia species. On the other hand, habitats such as limestone, mountains and rocky streams, are particularly rich in begonias. For example, at least 20 species are known from Gunung Kinabalu.

In theory, too, as more areas are explored we should expect to find that species are more widespread (Table 1) so that the number of new begonias would not continue to increase. In fact, experience shows that this is not the case. It is not unusual, based on our experience, for a 10-day expedition to a previously unbotanised area to yield ten *Begonia* species of which only one or two are named species. For example, from the begonias collected from the Bakun area, Sarawak, before the area was flooded for a hydroelectric dam, of the 15 species only one, *B. pyrroha* Ridl. can be named, the remaining 14 are new and awaiting description.

In addition, there is already a large number of *Begonia* specimens in local herbaria that are un-named and represent new species. For Sarawak, based on our survey of the *Begonia* collection in SAR, the un-named taxa represent about 110 species compared with only 72 named

species. The situation is probably the same for Sabah where there are many more new species in the SAN herbarium than the 41 named ones so that the Sabah begonia flora can be expected to exceed 100 species. For Kalimantan, where only five species are currently named, the total number of un-named species is likely to be higher than that of either Sabah or Sarawak considering that Kalimantan occupies a larger land area, its mountains and limestone areas are hardly collected and the *Begonia* flora has hardly been studied at all. We can therefore expect the begonia flora of Borneo to exceed 600 species. This overwhelming number shows that *Begonia* is one of the largest genera of plants in Borneo and the fact that there are more un-named taxa than named ones also shows that more work needs to be done.

What Next?

To continue to improve our knowledge of the Bornean begonias, the following next steps are suggested:

- i. To encourage more alpha-taxonomy to get names on species, particularly in view of the fact that there are already more new species without names in local herbaria than those with names;
- ii. To keep the SE Asian begonia database up-to-

Table 3: Diversity of begonias in Borneo

Section	No. of species	Examples
Diploclinium	9	<i>B. calcarea</i> , <i>B. elatostemma</i> , <i>B. gueritziana</i> , <i>B. havilandii</i> , <i>B. sabahensis</i> , <i>B. diwolii</i> , <i>B. subnummularifolia</i> , <i>B. kurakura</i> , <i>B. piring</i>
Petermannia	102	<i>B. baramensis</i> , <i>B. congesta</i> , <i>B. conipila</i> etc.
Platycentrum	1	<i>B. adenostegia</i>
Reichenheimia	7	<i>B. andersonii</i> , <i>B. burttii</i> , <i>B. juliasangii</i> , <i>B. payung</i> , <i>B. speluncaea</i> , <i>B. rhodochaeta</i> , <i>B. tambelanensis</i>
Sphenanthera	1	<i>B. chlorocarpa</i>

date to facilitate taxonomic work;

- iii. To keep active an informal network among taxonomists who work on begonias in SE Asia or elsewhere. Because taxonomic institutions in Malaysia are unlikely to develop molecular facilities to study a non-commercial group such as begonia, a symbiotic relation with institutions outside Malaysia or Borneo is desirable;
- iv. To focus field work to little known areas (*e.g.* mountainous areas) as well as to areas that are in imminent danger of irreversible land use changes, (*e.g.* by conversion of forest to oil palm plantations, construction of hydroelectric dams, quarrying for limestone).

CONCLUSION

The diversity and endemism of the *Begonia* species in Borneo is overwhelming with more than 600 species expected of which more than half are still undescribed. Closing this knowledge gap becomes increasingly important in view of the increasing rate of deforestation and habitat loss in Borneo.

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