DIPLYCOSIA BLUME – A LITTLE-KNOWN GENUS OF THE ERICACEAE FROM SOUTH-EAST ASIA CULTIVATED UNDER GLASS AT THE ROYAL BOTANIC GARDEN EDINBURGH

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ABSTRACT

The Royal Botanic Garden Edinburgh holds a number of small and understudied collections in the glasshouses at Edinburgh about which relatively little is known. This paper introduces one of these genera. A brief introduction and history is given of the genus *Diplycosia* Blume. An outline of the literature and a summary of their distribution, along with an overview and history of the collections held at Edinburgh, are also presented, as are cultivation notes. All plant names in this paper have been cross-referenced using the International Plant Names Index website (International Plant Names Index, 2010).

INTRODUCTION

The bulk of the research collections in the family Ericaceae under glass at the Royal Botanic Garden Edinburgh (RBGE) are rhododendrons in the subgenus Vireya, also known as the 'Tropical' or 'Malesian' rhododendrons and informally as 'the vireyas'. Many people do not realise that collections also exist of other genera in Ericaceae. These are often collected on the same expeditions where the vireyas are collected. The reason for this is that they tend to occupy the same ecological habitats, primarily the montane tropics of Malesia, a biogeographical area of South-East Asia composed of Indonesia, Malaysia, Brunei, Papua New Guinea and the Philippines (see box).

Within a small corner of the research glasshouse where the vireyas grow, there lurk some little-known genera of the Ericaceae, one of the major families being studied at RBGE. Of these other smaller collections, which include *Vaccinium*, *Dimorphanthera*, *Costera*, *Agapetes* and *Gaultheria*, one of the most interesting is *Diplycosia*.

On collecting trips *Diplycosia* species are often overlooked in favour

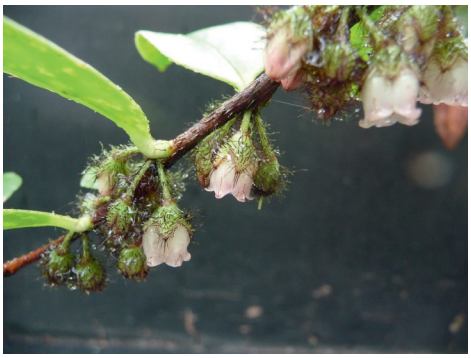

Fig. 1 *Diplycosia paulsmithii* flowers, in cultivation at RBGE. Photo: Tony Conlon.

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of the more 'blowsy' plants growing in close proximity, on account of, at first glance, their often being unremarkable, green scrambling shrubs with tiny flowers. However, on closer inspection, they can be quite astounding because the flowers and new growth are often remarkably hairy in some species. One of these is *D. paulsmithii* Argent (Fig. 1), a relatively newly described species collected by RBGE staff in Sabah, Malaysian Borneo in 1995.

HISTORY

Diplycosia was named in 1826 by Carl Ludwig von Blume (1796–1862), a German-born Dutch botanist who became director of the Rijksherbarium at Leiden in the Netherlands. He travelled and worked in South-East Asia, particularly on Java, where he was the Deputy Director of Agriculture at the botanic garden in Bogor (Buitenzorg) from 1823 to 1826. He is commemorated by the genus name *Blumea* DC and by the botanical journal *Blumea*, a journal of plant taxonomy and plant geography published by the National Herbarium of the Netherlands (Muir, 1994).

The origin of the name *Diplycosia* differs depending on which authority is consulted. It either comes from the Greek words *diploos* (double) and *kos* (covering), referring to the two connate bracteoles (small, leaf-like appendages that occur on the flower stalk) which form a second covering to the flower (Chittenden, 1981; Quattrocchi, 2000), or from the Greek *di* (twice) and *plekos* (matting or weaving), referring to the two perianth whorls (Ng, 1978).

LITERATURE

The literature on *Diplycosia* is relatively sparse. Following Blume's initial naming of the genus with three species (Blume, 1826), various authors published a number of new species throughout the late nineteenth and early twentieth centuries. The main players included O. Beccari, who named six new species in 1878, O. Stapf (ten new species in 1894), E.D. Merrill (thirteen new names between 1906 and 1941), A.D.E. Elmer (five new names between 1911 and 1915) and J.J. Smith (twenty-one new names between 1912 and 1937) (Missouri Botanical Garden, 2010).

These and other new species were all added in an *ad hoc* manner, and the limits of the genus subsequently became somewhat uncertain. Some semblance of clarity arrived with Professor H.O. Sleumer (1906–1993), also a German-born taxonomist working out of the Rijksherbarium at Leiden, who continued Blume's work, adding to it his work on Ericaceae for the account in *Flora Malesiana*, an ongoing project still active today. Sleumer published about 52 new names whilst also revising the genus for *Flora Malesiana* (Sleumer, 1967), in which about 100 species and subspecies were described.

There then followed a gap of 15 years before Dr G.C.G. Argent, working at RBGE, described a new species of *Diplycosia* and initially one new species of *Pernettyopsis* King & Gamble (Argent, 1982). This was followed by two more new species and a

provisional key to the genus in Borneo (Argent, 1989); further to this Argent described ten new taxa whilst also reducing the genus *Pernettyopsis* to synonymy with *Diplycosia* (Argent, 2002).

The previous year Powell and Kron (2001) had included *Diplycosia* in a phylogenetic analysis, which involved using molecular DNA sequences to infer evolutionary relationships. Building on this work Bush *et al.* (2009) concluded that *Diplycosia* was monophyletic and nested within part of the genus *Gaultheria*. From this it can be inferred that *Diplycosia* is a distinct natural grouping of similar species with their origins in *Gaultheria*.

However, debate is still ongoing, as in 2009 a new species was described from India in the eastern Himalayan phytogeographic zone (Debta & Chowdhery, 2009). The discovery of this species is in conflict with Sleumer and others, who agreed with the transferral of all the species previously described from the Eastern Himalaya and Upper Burma (Myanmar) to the genus *Gaultheria*.

DESCRIPTION AND IDENTIFICATION

Of the 100+ species currently described, most are epiphytic, sometimes terrestrial shrublets or shrubs, or occasionally small trees, often with thick roots and/or a swollen base. Their habit can often be sprawling, scrambling or upright, occasionally creeping or

Fig. 2 *Diplycosia heterophylla* fruits, in cultivation at RBGE. Photo: Tony Conlon.

climbing. They range in height from a few centimetres, such as *D. kostermansii* Sleumer, to 10m or more, such as *D. viridiflora* Sleumer and have a wide range of leaf sizes, from an average leaf size of 12 × 6mm in the small epiphytic shrublet *D. microphylla* Becc., up to the relatively large leaves of *D. penduliflora* Stapf with an average leaf size of 150 × 80mm. The flowers are small, actinomorphic, bell-shaped and sometimes hairy; they are generally white, green or cream in colour (or a combination of these), but they can also be pink, red, violet, brownish or flesh-coloured; whilst the fruits (technically a dry capsule surrounded by the enlarged fleshy calyx) are fleshy and accrescent (they become larger with age) and range in colour from white through greens, reds, pinks, blues, purples and black (Fig. 2).

Although they may be closely related to *Gaultheria*, from a morphological perspective they are clearly different (Argent, 2002). Technically, the anthers of *Diplycosia* have elongate apical tubules whereas *Gaultheria* does not. In fact the pair of bracteoles that form a persistent cup-like structure in *Diplycosia* usually means that the genus can be identified at a glance. Although *Gaultheria* can have paired bracteoles they rarely persist on old pedicels in the way that they do in *Diplycosia* (Argent, pers. comm.).

However, the diagnosis of species can be very difficult. Sleumer's key in *Flora Malesiana* (Sleumer, 1967) is often based on various indumenta types, that is, hairs,

Fig. 3 *Diplycosia apoensis* new growth in cultivation at RBGE. Photo: Tony Conlon.

Fig. 4 Drawing of *Diplycosia apoensis.* Accession number: 19972554A. Drawing: Gülnur Ekşi.

Fig. 5 *Diplycosia chrysothrix* on Mount Kinabalu showing the hairs that typically occur on young shoots. Photo: Tony Conlon.

bristles and glands and where they occur on the plant, particularly on the twigs and new growth (Figs 3, 4 & 5). The occurrence of a certain type or combination of types of indumentum is apparently constant enough to characterise a species or variety with a high degree of certainty (Sleumer, 1967). Argent's key to the Bornean species (Argent, 1989) is similarly based on Sleumer's but includes all species named since then as well as much updated information based on new observations made in the field. Argent suggests that fruits could be useful in identification but that they are often not collected or noted in the field (Argent, 1989; 2002). Of the 100 to 150 species that have been named, there are about 113 presently accepted species.

Despite their horticultural and scientific worth, no economic or other use is known. Some have a peculiar smell and are believed to contain wintergreen oil, similar to *Gaultheria*.

HABITAT AND DISTRIBUTION

The map in Fig. 6 shows the biogeographical area of Malesia. It lies between the Tropic of Cancer at 20°N and the Tropic of Capricorn at 15°S and from roughly 95°E to 160°E longitude. All *Diplycosia* species come from this region except *D. annamensis* Sleumer,

which is endemic to what is now known as Vietnam, and the doubtful record of *D. indica* from India (Debta & Chowdhery, 2009).

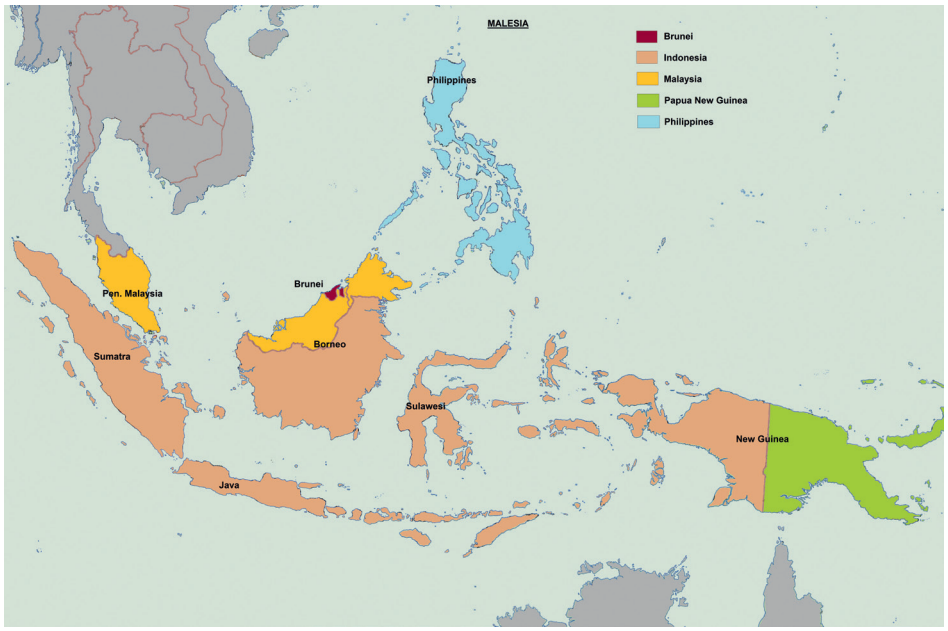

Fig. 6 Map of Malesia in South-East Asia, showing political regions and main islands. Map drawn by Tony Conlon.

This region is relatively new in geological terms and has a high rate of speciation and endemism of some 70–80 per cent (Davis *et al.*, 1995). It is therefore of great importance to botanists and scientists.

A high percentage of the species are endemic to the islands of Borneo, New Guinea and Sulawesi, with others coming from Sumatra, the Philippines, Java and the Moluccas. There is possibly a centre of distribution on the island of Borneo, as many of the species are known only from Mount Kinabalu and often have very restricted distributions; however, this may also be explained by the lack of general collections and a number of the species having ever been collected only once or very occasionally. It has recently been purported (Fritsch, 2009) that they may have originated in the northern hemisphere when temperatures were warmer, only moving southwards when the climate cooled and subsequently dying out in the north.

Most species are found in tropical montane rainforest or mossy forest and at quite high altitudes in summit scrub; a few even live above the timber line in open rocky places, close to the summits of some of the highest mountains in this region. For example, records exist for *Diplycosia kinabaluensis* Stapf near the summit of Mount Kinabalu at about 4,000m, which has been confirmed by the author on a recent trip to the summit. Temperatures range from 30 to 40°C close to sea level whilst there can be

Malesia

A short note must be made here to explain the names given to the countries, islands and political areas of this region, as the archipelago consists of some 20,000 islands (Davis *et al.*, 1995) which make up the larger biogeographical area of Malesia.

Indonesia is a political region made up of the islands of Sumatra (Sumatera), Java, Bali, Sulawesi (formerly known as the Celebes), the Moluccas (also known as the Maluku Islands or the Spice Islands, located between Sulawesi and New Guinea); Kalimantan (the south-eastern two-thirds of the island of Borneo) and West New Guinea (the western half of the island of New Guinea – also known as Papua, West Papua or Irian Jaya). Malaysia is also a political region, comprising Peninsular Malaysia and Sabah and Sarawak (the north-west third of the island of Borneo). Papua New Guinea is mainly the eastern half of the island of New Guinea plus some smaller islands. The Philippines is the name for a collection of over 7,000 islands, the 11 largest accounting for the majority of the land area, with the 2 largest islands Luzon and Mindanao accounting for about 70 per cent of the total land area. In the north of this region of Malesia, Brunei Darussalam is a small country situated between Sabah and Sarawak on the north-west coast of the island of Borneo.

This region has a wet equatorial climate and varied topography with mountains reaching over 5,000m on some of the islands. Mount Kinabalu in Sabah, Malaysian Borneo, for example, attains a height of 4,095m (the highest point on the island), whilst the highest mountain on the island of New Guinea, and indeed the whole of Malesia, is Puncak Jaya (Mount Carstensz, or Carstensz Pyramid), attaining 5,030m in Indonesian Papua. Mount Kerinci at 3,805m is the highest point of Sumatra, whilst the island of Java attains 3,676m with the active volcano of Mount Semeru. Sulawesi boasts the 3,455m of Rantekombola or Mount Rantemario, depending on which authority one consults. Mount Apo at 2,954m is the highest point in the Philippines.

occasional night-time frosts at higher altitudes. Humidity can often be stifling during the day with rainfall, often heavy, occurring on most days.

Although mostly epiphytic, the terrestrial species tend to grow in poor soils, often on ultramafic substrates, that is, with a high heavy-metal content which often leads to highly adapted and specialised communities of plants.

THE COLLECTIONS AT RBGE

RBGE has a long history of research on the family Ericaceae stretching back well over 100 years, with records showing species in the Ericaceae growing in the gardens at least as early as 1896. This research continues today and it is still a 'flagship' family for RBGE.

Living Collections at RBGE

The first plant collections of *Diplycosia* to come to RBGE were from seed collected in 1967 by B.L. Burtt & A.M. Martin in Sarawak in Malaysian Borneo. In 1968 P.J.B. Woods brought back living plants from the Genting Highlands in Peninsular Malaysia and Java in Indonesia. The majority of the current Living Collection was introduced between 1982 and 2001 by a number of botanists and horticulturists from RBGE who brought back collections from Malaysia, Philippines, Sulawesi and Sumatra, amongst others. The most recent collections were made in 2008 from Mount Alab in Sabah, Malaysian Borneo.

Introductions to RBGE have been brought back as plants, seed, seedlings or cuttings. Twenty-nine arrived as actual plants, twenty came in as seed, twelve as seedlings and nine as cuttings. How five of the records arrived is unknown, and one accession came in as a DNA sample.

Of the 76 accessions recorded in total, 35 are currently alive and growing at RBGE. Appendix 1 shows the origins of the current Living Collection. Older accessions tended to arrive as plants whereas nowadays more material tends to be collected as cuttings or seed, as people now tend to have a more 'ecological' approach to collecting plant material from the wild. Actual plants are virtually always left *in situ* and cuttings or seed taken from them, ensuring that the plants remain growing in the wild. The most recent collections (in 2008 by T. Conlon and G. Argent) were from cuttings taken on Mount Alab in Sabah, Malaysian Borneo and are happily growing in the research glasshouses, waiting for a species name to be assigned to them when they flower. Of these 36 living accessions, 12 are known to be different species, whilst 16 are still simply named *Diplycosia* sp. Indeed, taking into account all the accessions that have ever existed as plants, seed or cuttings at RBGE, this still accounts for only about 18 different taxa. However, when specimens from the herbarium at RBGE, denoted as (E), are analysed about 80 different taxa are represented.

Herbarium specimens

Of the approximately 3 million herbarium specimens held at RBGE, *Diplycosia* accounts for only about 400. There is an ongoing project to update the records on the database and to digitise all the type specimens (Fig. 7) held at RBGE, which is a huge undertaking. Of the *Diplycosia* specimens about 137 are currently on the database and can

be found in the herbarium catalogue on the RBGE website (RBGE, 2010). Of the 400 or so specimens that exist in the herbarium at RBGE, some were collected in the early 1930s by J. and M.S. Clemens. They were prolific collectors in South-East Asia, especially from Mount Kinabalu in what was then British North Borneo (Sabah), and they collected many type specimens of numerous *Diplycosia* species (Beaman *et al.*, 2001). Of the herbarium specimens at RBGE, some dating back to collections made as early as 1882 (*D. elliptica* Ridl. was collected in the Malay Peninsula by Dr King's collectors), the majority are from Borneo, with Indonesia and the Philippines being the other main areas represented. This reflects the fieldwork that RBGE has carried out over the years, as *Diplycosia* have only ever been collected on other field trips such as the RBGE-Philippine National Herbarium Expeditions in the late 1990s (from which *D. apoensis* Elmer came, which exists as both specimens in the herbarium and living plants in the glasshouses (Fig. 3)). No specific expeditions have been undertaken with *Diplycosia* as the main focus. See Appendix 2 for all taxa represented in the herbarium or as plant accessions at RBGE.

Fig. 7 Digitised image of the type specimen held of *Diplycosia viridiflora* collected in the early 1930s from the Kinabalu massif. Scan: N. Sharp.

CULTIVATION AND DISPLAY

Cultivation of these plants is based on the same techniques that are used for the rest of the vireya collection and a description follows. Mitchell (2002) gives further recommendations for cultivation.

Most of the glasshouse-grown Ericaceous plants at RBGE are now grown in plastic pots or half pots, also known as pans, as these give the grower more control over watering. It is quite difficult, for instance, to control the moisture content with the cooler temperatures experienced in the winter, and as a consequence plants in clay pots languish in compost that is too wet. Plants in plastic pots dry out more quickly, which is desirable in low winter temperatures.

Even though *Diplycosia* come from the tropics, the temperature at higher altitudes can be relatively low. For every 1,000m ascended the temperature can be assumed to fall by about 6°C. This ability to withstand fairly low temperatures partly accounts for why we can grow them here at RBGE in a relatively cool glasshouse, with a night minimum temperature of 10°C. It has to be remembered, however, that even though low temperatures may be tolerated over night, the daytime temperatures in the tropics can get much higher relatively soon after sunrise. This is not the easiest situation to replicate in the depths of an Edinburgh winter!

To take account of the poor acid soils and often epiphytic habit found in nature we have found that the most productive potting mix consists of a medium-sized potting bark (3–15mm) with horticultural charcoal (5–15mm) added at a ratio of about 70l bark to 3–4l charcoal. To take account of the lack of nutrients in this mix we also use a balanced weak feed (NPK 1:1:1) often applied at half strength about every two to four weeks over the summer months. Plants are potted on when required and are generally repotted annually in the spring when smaller. They can stay in the same pots for two to three years when larger and well established.

The watering regime varies depending on the weather but in general, a daily watering in the summer is given using a lance covering the whole plant (not just the compost) with an extra damping down of the surrounding areas to keep the humidity high on the hottest of days. This can be reduced to about once a week in the winter months with only occasional damping down. Shading is applied to the house for the summer months to prevent scorching of the new foliage.

Propagation is straightforward. Semi-ripe stem cuttings (with or without rooting hormone) are inserted to a mix of propagating bark (2–7mm) with a handful of medium vermiculite or medium-grade perlite, charcoal and chopped sphagnum moss depending on availability or preference. The cuttings are then placed in a closed case with bottom heat and watered or misted daily as required. Cuttings will generally root within one to three months but can take up to six months.

Propagation by seed is also successful when the seeds are sown in pots on the surface of small propagating bark (2–7mm) or growbark (0–6mm) which has been sterilised using boiling water. Galloway reports that seed germinates well when sown directly onto sphagnum moss; however, I have not yet tried this as the current method works well and often only a small amount of material is available for propagation, therefore tried and tested methods tend to prevail (Galloway, pers. comm.). Once sown, pots are then placed in a ¾ closed case, with supplementary lighting, suspended on a metal grille above a reservoir of heated water (21°C) to keep humidity high and with a fan at one end to encourage good air movement. Germination can take from a few days to a few weeks.

Although *Diplycosia* have been grown at RBGE for over 40 years (they do not appear to be grown in any great numbers in any other collections around the world), they have a reputation for being notoriously difficult to cultivate, often dying for no apparent reason, particularly the very hairy ones which have dense golden brown indumenta.

Species such as *D. chrysothrix* Stapf (Fig. 5) or *D. aurea* Sleumer could have high horticultural worth. Some species have been observed to partly die back in late winter, sending up new growth in early spring, which suggests a tendency to be perennial. With a programme of continued propagation these problems can be overcome, or at least managed effectively. Some of the RBGE living accessions date back to the early 1980s with at least one of the original accessions, *D. heterophylla* Blume (Fig. 2) still surviving from 1968.

The public displays in the Tropical Montane House (previously known as the Peat House) have been set out in a naturalistic manner (Fig. 8), where the plants are planted as one would see them in the wild. Some *Diplycosia* species can be seen in the Tropical Montane House growing as epiphytes on the barks of 'false' trees. This is a situation in which they seem to thrive and it provides an opportunity for the public to view these plants at RBGE.

Fig. 8 Tropical Montane Display House at RBGE. Photo: Tony Conlon.

CONCLUSIONS AND DISCUSSION

Although new collections have been made as recently as 2008, a number of species have only been collected once or very rarely. There is still much to be done if this group of plants is to be fully understood. Many *Diplycosia* are endemic to particular mountains and as such they can be useful indicators of hotspots of biodiversity. Similarly, as with

many plants, the possible benefits (medicinal or otherwise) may never be known unless further studies are done. This is now more urgent as the forests in the parts of the world where *Diplycosia* occur are still being cut down at an alarming rate to make way for palm oil plantations. More collections need to be made of both plants and herbarium specimens and from these more DNA samples need to be taken and analysed in order to fully understand this underrated group of plants. Furthermore, new collections may be able to shed more light on the 'new' species described from India in 2009.

It is almost certain that new species remain to be discovered in what is a remote, underexplored and undercollected region. Some areas are very difficult to get to, involving many days of trekking through what remains of the rainforest. Unpredictable weather and poor roads coupled with frequent landslides and earthquakes can make these areas at times inaccessible.

RBGE staff are making plans to return to Borneo in the near future in the hope of collecting more specimens and living material for the collections. These will help scientists with their work in discovering and naming new species. Who knows what delights remain to be discovered in the mountain forests of South-East Asia?

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APPENDIX 1: CURRENT LIVE ACCESSIONS AT RBGE WITH COLLECTORS AND COUNTRY OF ORIGIN

Collector code	Collectors	No. of live accessions	Country / island of origin
AMC	A. Conlon	1	Sabah – Borneo
ARG	G. Argent	7	Sabah & Sarawak – Borneo, Philippines, Sumatra, Java, Peninsular Malaysia
MSM	D. Mitchell & P. Smith	1	Irian Jaya – New Guinea
P97	G. Argent, M. Mendum, T. Pennington, P. Wilkie	9	Philippines
P98	G. Argent, Q. Cronk, M. Mendum, D. Middleton, P. Wilkie	1	Philippines
SCOTT	S. Scott	1	Sulawesi
SIN	I. Sinclair	1	Sabah – Borneo
SMTSU	P. Smith	5	Aceh – Sumatra
SULSG	P. Smith & L. Galloway	8	Sulawesi
WOO	P. Woods	1	Java

APPENDIX 2: ALL TAXA AND PLANTS EVER GROWN OR REPRESENTED IN THE HERBARIUM AT RBGE

(N/A = Not applicable)

Plant name	Accessions (to the Living Collection)	Herbarium specimens	Plant status	Country / island of origin
Diplycosia sp.	Y	Y	Alive	Malesia
D. abscondita	N	Y	N/A	Borneo
D. acuminata	Y	Y	Dead	Borneo
D. aff. *acuminata*	Y	N	Dead	Borneo
D. apoensis	Y	Y	Alive	Philippines
D. aurea	N	Y	N/A	Borneo
D. baclayanensis	N	Y	N/A	Philippines
D. barbigera	N	Y	N/A	Borneo
D. carrii	Y	Y	Alive	Borneo
D. caudatifolia	N	Y	N/A	Borneo
D. chrysothrix	Y	Y	Dead	Borneo
D. ciliolata	N	Y	N/A	Borneo
D. cinnamomifolia	N	Y	N/A	Borneo

Plant name	Accessions (to the Living Collection)	Herbarium specimens	Plant status	Country / island of origin
D. clementium	N	Y	N/A	Borneo
D. commutata	Y	Y	Alive	Borneo
D. crassirameae	N	Y	N/A	Sulawesi
D. cf. *crassirameae*	N	Y	N/A	Sulawesi
D. crenulata	N	Y	N/A	Borneo
D. elliptica	Y	Y	Dead	Borneo, Pen Malaysia
D. aff. *elliptica*	Y	N	Alive	Borneo
D. ensifolia	N	Y	N/A	Borneo
D. epiphytica	N	Y	N/A	Thailand, Malaysia
D. fimbriata	Y	Y	Dead	Borneo
D. glauciflora	N	Y	N/A	Sumatra
D. heterophylla	Y	Y	Alive	Java, Sumatra, Pen Malaysia, Borneo, Philippines
D. heterophylla var. *acutifolia*	N	Y	N/A	Borneo
D. heterophylla var. *latifolia*	N	Y	N/A	Borneo, Peninsular Malaysia
D. heterophylla var. *punctulata*	N	Y	N/A	Borneo
D. hirtiflora	N	Y	N/A	Borneo
D. kalmiifolia	N	Y	N/A	Borneo
D. kemulensis	N	Y	N/A	Borneo
D. kinabaluensis	Y	Y	Dead	Borneo
D. lohieri	N	Y	N/A	Philippines, New Guinea
D. lotungensis	Y	Y	Alive	Borneo
D. lucida	N	Y	N/A	Philippines
D. luzonica	N	Y	N/A	Philippines
D. luzonica var. *calelanensis*	Y	Y	Alive	Philippines
D. mantori	N	Y	N/A	Borneo
D. megabracteata	N	Y	N/A	Borneo
D. memecyloides	N	Y	N/A	Borneo
D. aff. *memecyloides*	N	Y	N/A	Borneo
D. microphylla	Y	Y	Alive	Thailand, Sumatra, Borneo

Plant name	Accessions (to the Living Collection)	Herbarium specimens	Plant status	Country / island of origin
D. microsalicifolia	N	Y	N/A	Borneo
D. mogeana	N	Y	N/A	Borneo
D. morobeensis var. *ovatifolia*	N	Y	N/A	New Guinea
D. myrtillus	Y	N	Dead	Borneo
D. orophila	N	Y	N/A	Borneo
D. othmani	N	Y	N/A	Borneo
D. paulsmithii	Y	Y	Alive	Borneo
D. penduliflora	N	Y	N/A	Borneo
D. pilosa	Y	Y	Alive	W. Java, Sumatra
D. pinifolia	N	Y	N/A	Borneo
D. pittosporifolia	N	Y	N/A	Borneo
D. pittosporifolia var. *fimbriata*	N	Y	N/A	Borneo
D. pittosporifolia var. *glabra*	N	Y	N/A	Borneo
D. pittosporifolia var. *pittosporifolia*	N	Y	N/A	Borneo
D. pittosporifolia var. *punctiloba*	N	Y	N/A	Borneo
D. pseudorufescens	N	Y	N/A	Borneo
D. pseudorufescens var. *elliptifolia*	N	Y	N/A	Borneo
D. punctulata	N	Y	N/A	Borneo
D. rosmarinifolia	N	Y	N/A	Borneo
D. rufa	N	Y	N/A	Borneo
D. rufescens	N	Y	N/A	New Guinea
D. rupicola	N	Y	N/A	New Guinea
D. sagittanthera	N	Y	N/A	Sulawesi
D. salicifolia	N	Y	N/A	Borneo
D. cf. *salicifolia*	N	Y	N/A	Borneo
D. salicifolia f. *gigantea*	N	Y	N/A	Borneo
D. sanguinolenta	N	Y	N/A	Borneo
D. saurauioides	N	Y	N/A	Borneo
D. scabrida	Y	Y	Dead	Borneo
D. setosa	N	Y	N/A	New Guinea
D. soror	N	Y	N/A	New Guinea

Plant name	Accessions (to the Living Collection)	Herbarium specimens	Plant status	Country / island of origin
D. soror var. *nuda*	N	Y	N/A	New Guinea
D. sphenophylla	N	Y	N/A	Borneo
D. sumatrensis	N	Y	N/A	Sumatra
D. tetramera	N	Y	N/A	Sumatra
D. trinervia	N	Y	N/A	Philippines
D. trinervia var. *urdanetensis*	N	Y	N/A	Philippines
D. urceolata	N	Y	N/A	Borneo
D. urceolata var. *nova*	N	Y	N/A	Borneo
D. viridiflora	N	Y	N/A	Borneo
D. viridiflora var. *megalantha*	N	Y	N/A	Borneo
D. viridiflora var. *nova*	N	Y	N/A	Borneo
D. sp. nov.	Y	Y	Alive	Borneo
D. indet.	N	Y	N/A	Borneo