Gardenwise

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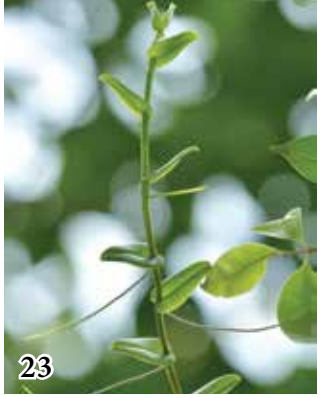

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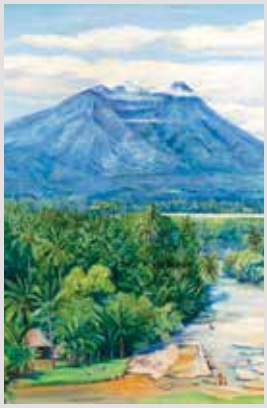
Regular Features



Cover
The Salak Volcano in Java, one of the paintings by Marianne North on display in the CDL Green Gallery from 4 August until 26 November. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

Editors
Ada Davis, Nigel P. Taylor

Production Managers
Ada Davis, Christina Soh

Design
Photoplates Pte Ltd

Singapore Botanic Gardens
1 Cluny Road, Singapore 259569
National Parks Board

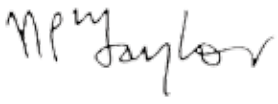
nparks_sbg_visitor_services@nparks.gov.sg
www.sbg.org.sg
www.nparks.gov.sg

Opposite page
The Keppel Discovery Wetlands at the Learning Forest. *(Photo credit: NParks)*

Group Direction

Dear Readers, as I write this we have just celebrated the second anniversary of the Botanic Gardens' inscription on to the UNESCO World Heritage list (4 July 2015) with a nine-day programme called Heritage Week (1–9 July), including special displays at the National Orchid Garden. Inscribed sites such as ours are required to have a Buffer Zone and it was in part of this area that we opened our new Learning Forest in the presence of Prime Minister Lee Hsien Loong on 31 March (see pages 8–12). To date the Learning Forest has had a marked impact on our visitor numbers, with May 2017, though a rather rainy month, seeing the third highest visitor count for any month in the last six years! Another major milestone recently achieved is the launch of our 10-year Flora of Singapore project (pages 25–28). In this issue we kick off with a piece about one of the world's smallest flowering plants, called *Wolffia*, which from its appearance is often mistaken for an alga, but actually belongs to a family including some very imposing plants like the Titan Arum (pages 2–3). Currently in Singapore there is a surge in interest for growing edible plants, and in recognition of this, in this instalment of *Gardenwise* we launch a new regular section called Edibles, featuring both vegetables and fruit (pages 32–35). Botany and the work of botanic gardens tends to be thought of as focused on green plants, but the unrelated fungi are also an important part of botanical research and the Gardens has a long tradition in this area. Here we learn about the beautiful and intricate 'silver eggs' of the Bird's Nest Fungus, an extraordinary saprophyte (pages 29–30). Borneo, in this case Sarawak, features once again in this issue with a focus on six unusual or remarkable species of plants encountered on an expedition by our staff and their local counterparts. Another Bornean connection was sealed with the recent signing of a Memorandum-of-Understanding with the Sabah Forestry Department (page 38). Sabah was in the news earlier this year with the discovery of the world's tallest broad-leaved tree in the Danum Valley, *Shorea faguetiana*, towering at 95 metres! Young specimens of this species have been planted in our Learning Forest, in the area known as the SPH Walk of Giants. Conservation of such special elements of biodiversity is what the work of a botanic garden is all about and, of course, the Gardens has been doing this with orchids for more than two decades – see the story of the reintroduction of *Thrixspermum amplexicaule* on pages 23–24.

Heritage includes things we no longer have, but that might be of interest to recall, hence our regular feature on the back cover, this time of a visitor kiosk that only the long-standing visitor to the Gardens will be able to remember. Historic photographs form an important record for us, so it was with pleasure that I received a small team of staff from our 52-year long partners at Miyazaki Parks Association and the Miyakoh Botanic Garden Aoshima, Japan (see Key Visitors to the Gardens, page 41). They came to visit in June, taking away cuttings of cultivars of our *Bougainvillea*, but giving us a CD of archival photographs of the Gardens and environs taken in October 1965, when the Republic of Singapore was only two months old. Heritage is also manifest in botanical art and as I write we are showcasing the work of two 19th-century intrepid artists who lived in or visited the Southeast Asian region, Berthe Hoola Van Nooten and, from 4 August, Marianne North, both in the CDL Green Gallery beside Botany Centre (see pages 13–22). Twelve of the Hoola Van Nooten plates will feature in our 2018 calendar, so please put that on your list of things to buy in time for Christmas 2017, or maybe earlier as these treasures tend to sell out quickly!

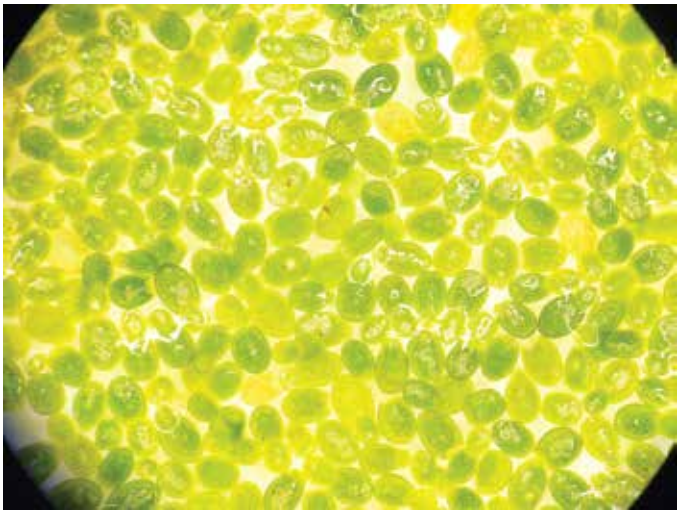


Nigel P. Taylor
Group Director
Singapore Botanic Gardens

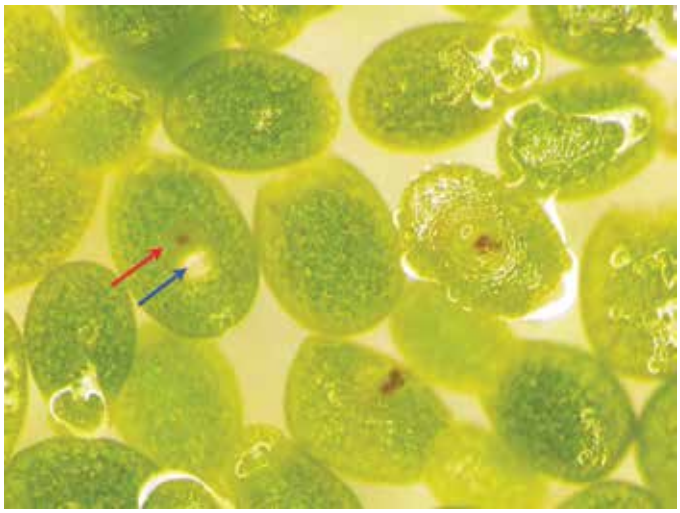
An infinitesimal flowering plant on our little red dot

Singapore is often referred to as the 'little red dot'. Indeed, we are a small country, but we can boast that we have at least one of the wonders of the plant world. Recently, an excited colleague brought in a water sample with tiny green dots which she had collected from a freshwater body in the Sungei Buloh Wetland Reserve. With a drop of the sample on a slide, the identity of those measly specks was instantly revealed under the microscope – *Wolffia globosa*, commonly known as the Asian Watermeal, a type of duckweed.

Wolffia globosa is a diminutive aquatic plant that floats on or just beneath the surface of waterbodies. Measuring a mere milimetre across, it is described as the world's smallest flowering plant. While it is distributed throughout the warmer regions of the world, it is often overlooked amongst aquatic plants due to its minuscule size. The bitty *Wolffia globosa*, known locally by the Thais as '*khai-nam*', is eaten by some people in Southeast Asia. In addition, it serves as an important food source for certain waterfowl, and is also potentially valuable for wastewater reclamation because it can remove contaminants such as heavy metals.



Wide-field view of *Wolffia globosa* under the microscope. *(Photo credit: Ho Boon Chuan)*

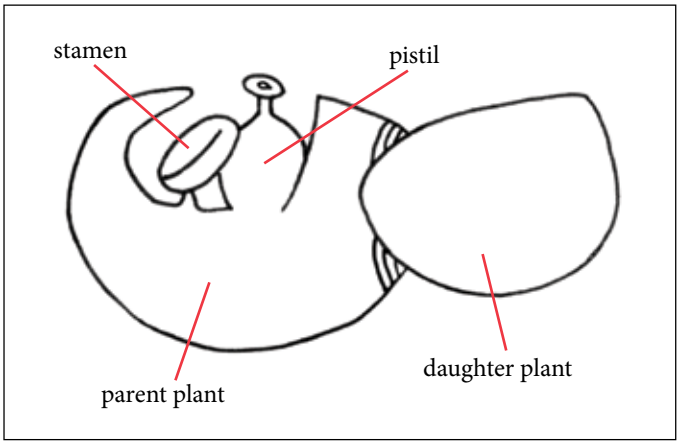


Flowers of *Wolffia globosa* with red and blue arrows indicating a pistil and a stamen respectively. *(Photo credit: Ho Boon Chuan)*

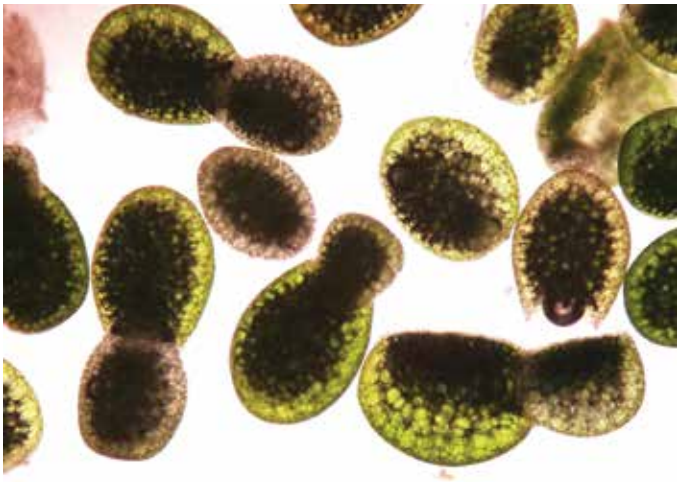
Wofflia globosa belongs to the family Araceae. Commonly known as aroids, members of this family are herbaceous monocotyledonous flowering plants that typically have flowers arranged in a spadix – an aggregate of tiny flowers borne on a fleshy axis enclosed within a leaf-like sheath. So lo and behold, this infinitesimal flowering plant is actually a cousin of the Titan Arum (*Amorphophallus titanum*), which produces the largest unbranched inflorescence in the plant world. What an irony of plant life! The Aroid family includes many common ornamental plants, such as the Money Plant (*Epipremnum aureum*), Dumb Cane (*Dieffenbachia amoena*), and Laceleaf (*Anthurium andraeanum*). A common ingredient in many Asian dishes, the Coco Yam or Taro (*Colocasia esculenta*) is also part of this large family.

Wolffia globosa is morphologically the simplest of all flowering plants known. Its tiny ovoid body is undifferentiated, lacking leaves, roots and stems. Members of the genus *Wolffia* are the ultimate in the neotenous reduction of their flowering parts, with sexually mature plants still retaining their juvenile form. The simplified flower is found within a small floral cavity in the centre of the upper side of the plant body, and consists of a pistil and single stamen. Although it is capable of sexual reproduction, *Wolffia globosa* prefers to reproduce asexually. It reproduces exponentially via vegetative budding from the mother plant, thus making it the fastest reproducing flowering plant in the world. The daughter plants

Giant inflorescence of the Titan Arum *(Amorphophallus titanum).* *(Photo credit: Ho Boon Chuan)*



Diagrammatic representation of *Wolffia globosa* in transverse cross-section. *(Drawn by Regina Yeo)*



Dark regions on the plant body of *Wolffia globosa* consist of air pockets that help it to float on water. Note that the air pockets are concentrated on the upper flattened surface of the plant body. *(Photo credit: Ho Boon Chuan)*

are produced in a budding pouch at the basal end or along the lateral margin of the parent plant. They often remain attached to the parent plant by a short stalk. *Wolffia globosa* possesses minuscule stomata that are concentrated on the upper surface of the plant, and also has air pockets to keep it buoyant on the surface of the water.

The highly reduced morphology results in a dearth of characters that distinguish members of the genus *Wolffia* from the rest of the aroids, and indeed it seems that *Wolffia* and other aroids are as different as chalk and cheese. Prior to the end of the 20th century, members of *Wolffia* were classified as a separate family – the Lemnaceae or Duckweed family. Originally, the Lemnaceae contained five genera and at least 38 species. However, recently renewed evaluation of the duckweeds using molecular data has led to their reclassification into a subfamily (Lemnoideae) under the Araceae. However, there is much dispute about this classification and no unanimous consensus has been reached. The paucity of information for inferring relationships on the duckweeds may be attributed to the scarcity of conspicuous morphological characters.

Wolffia globosa was first reported in Singapore by Henry Ridley in 1899, so we know that it is no stranger here. However, due to inadequate biogeographical or historical evidence to determine its native status, and given its confinement to habitats modified or otherwise disturbed by humans, this plant is considered of 'uncertain origin'. So then, how has this obscure plant found its way to this sunny island? Singapore is part of the East Asian-Australasian flyway, a migratory route used by birds flying south for the winter and north in the summer. There is a possibility that it is being picked up along this route and brought here by migratory birds, hidden among their feathers and the small parts of their feet. The Sungei Buloh Wetland Reserve serves as an important wintering and resting point *en route* to Australia, so it makes perfect sense that *Wolffia globosa* can be found in the waterbodies at the reserve.

Although modest, this tiny flowering plant is truly a wonder of the world. And we are glad that this tiny green 'dot' makes this little red dot its home.

Ho Boon Chuan
Herbarium

Regina Yeo
National Institute of Education

Six interesting plants encountered in Nanga Bloh of the Lanjak-Entimau Wildlife Sanctuary

On the last week of February 2017, we embarked on our second expedition to the Lanjak-Entimau Wildlife Sanctuary (LEWS) in Sarawak. As with our first trip to LEWS, this survey was organised by the Sarawak Forestry Corporation (SFC) as part of the RIMBA (Research for Intensified Management of Bio-Rich Areas of Sarawak) project (see *Gardenwise* 48: 8–11, 2017). Besides SFC and the Singapore Botanic Gardens, a new addition, the Royal Botanic Garden Edinburgh (RBGE) participated in this trip. Our aim was to continue the botanical assessment of the forests in LEWS, this time focusing on Nanga Bloh along the upper Katibas and Bloh Rivers that lie in the central region of the wildlife sanctuary. We have previously botanised the southern end at Nanga Segarak, thus this trip also facilitates a comparison of the two forest regions within LEWS.

A total of 400 specimens with up to four sets each were collected over the twelve days spent in the forest, and information pertaining to the collections was databased. The duplicates will be sent to the Singapore Herbarium (SING), RBGE and other herbaria. Interestingly, the representation of plant families collected somewhat echoes that of the first trip. The most represented families by percent of the total number of specimens collected are Rubiaceae (11.5%), Begoniaceae (8.8%), Gesneriaceae (7.5%), Melastomataceae (6.3%), Urticaceae (5.5%) and Zingiberaceae (4.8%).

Despite some unpredictable weather which brought unusual rain that disrupted our surveys, we managed to collect a reasonable amount of flowering and fruiting specimens from some very interesting species. We highlight six of them here.

Beccarianthus pulcher

When we showed pictures of this plant to a visiting researcher specialising in Melastomataceae, the plant family to which it belongs, he was absolutely thrilled, as species in the genus *Beccarianthus* are very rarely seen in the wild. We can attest to their rarity as this was the only plant of this genus that we encountered on either of our two expedition trips to LEWS. At SING, there is only a single previous collection of another species in the genus *Beccarianthus* from the entire island of Borneo! We discovered it when our longboat entered a rather shady small tributary of the Katibas River. Growing near the river's edge in clay substrate, this small-statured tree about 10 m tall quickly stood out from the rest of the vegetation.

Beccarianthus pulcher is a stunning beauty, even when compared to other species in this large family that boasts horticultural favourites such as *Medinilla magnifica* and *Tibouchina granulosa*. Its large, leathery, glossy leaves are dark green above and a beautiful coppery brown below, and especially striking when one is underneath the tree and looking upwards. They are decussate (arranged in pairs and set at right angles to the pairs above and below) and have a long hairy petiole. At the apex of the branchlets, the tubular flowers are a contrasting scarlet red. The inflorescences are short and consist of more than 20 flowers, each about 6 cm long and with a long, dark red pedicel and a pronounced calyx.

Leaves and inflorescence of *Beccarianthus pulcher*. *(Photo credit: Paul Leong)*

Flowers of *Beccarianthus pulcher*. *(Photo credit: Michele Rodda)*

Habit of *Bulbophyllum* aff. *bruneiense*.
(Photo credit: Peter Wilkie)

***Calamus sparsiflorus* being examined at close range.** *(Photo credit: Michele Rodda)*

Side-view of the flower of *Bulbophyllum* aff. *bruneiense*. *(Photo credit: Peter Wilkie)*

The yellow flowers contrasting with the red inflorescence of *Calamus sparsiflorus*.
(Photo credit: Michele Rodda)

Bulbophyllum aff. *bruneiense*

We encountered this epiphytic orchid perched on an angled fallen tree trunk some 2 m off the ground, in a rather open area that showed signs of natural disturbance. Each pseudobulb held a single leaf (typical of the genus *Bulbophyllum*) and the plant had short internodes that made the pseudobulbs appear close together in a small clump. Our attention, however, was quickly drawn to its single flower, dangling from a peduncle about 25 cm long – as if the plant was using it as a fishing line, and the flower with its swivelling lip (also typical of this genus) the bait to entice its pollinator! About 6 cm wide and 3 cm high, the flower was showy and somewhat laterally compressed, such that it was more attractive if viewed from the side than from the front, not unlike a wing-folded butterfly. Its sepals and petals were orange with red stripes, and the lip was orange.

This orchid appears somewhat similar to *Bulbophyllum bruneiense* but with discrepancies such as a much narrower lip, recurved teeth at the lower margin of the column, and hair-like appendages at the base of the lip that *B. bruneiense* does not exhibit. More studies and collections are needed to establish if it could be a different, new species.

Calamus sparsiflorus

Climbing palms, predominantly rattans, are a common sight in the lowland rainforests of Borneo and can often be seen along rivers and streams where they dangle down from the tree canopy. When first setting up camp at Sungai Bedawak, just off the upper Katibas River, we noticed this rattan growing very close to the water's edge, only 4–5 m tall and with particularly showy red inflorescences. Later, when heavy rain had dampened our botanising efforts elsewhere, we had an opportunity to investigate it a bit further. It was perched on a steep bank along the river, and not only covered in long thorns

Peter Wilkie with his prized specimen of *Chisocheton* aff. *polyandrus*. Note the length of the inflorescence. *(Photo credit: Roslina Ragai)*

Habit of *Mucuna biplicata*. *(Photo credit: Paul Leong)*

Flower of *Chisocheton* aff. *polyandrus*.
(Photo credit: Peter Wilkie)

but its leaf bases were crawling with biting ants. Additionally, the tip of this rattan's leaves has a long spiny cirrus to secure the palm to nearby vegetation, so pulling the plant down to get to the flowers was not an easy task!

Until 2015, *Calamus sparsiflorus* was included in the genus *Daemonorops*. However phylogenetic evidence proved that *Daemonorops*, as well as other rattan genera, should be included in *Calamus*, making it the largest rattan genus. This species is endemic to Borneo and abundant in Sabah and Sarawak, both in primary and disturbed forests from the lowlands to about 1,000 m in elevation.

Chisocheton aff. *polyandrus*

This plant announced its presence to us by its sweetly fragrant flowers, which could be smelled over 100 m away. When we located the source, a tree in the family Meliaceae, we were not disappointed. Overhanging the river, this magnificent tree roughly 20 m tall had large, spirally arranged compound leaves around 2 m long, with each leaflet green and glossy and shining in the sun. Originating from the base of these leaves were many spectacular hanging inflorescences up to 3 m long which were laden with the fragrant flowers. The scent attracted small bees which could be seen all around.

This plant's distinctive flower buds have a beautiful thick red-orange calyx with fleshy peach petals. When opened, the eight fleshy petals are recurved to expose their pure white inner surface and a fleshy white staminal tube that supports brown anthers at its apex. The flowers remain attractive even as the petals age to black-brown, as this colour contrasts

Inflorescences of *Mucuna biplicata*.
(Photo credit: Paul Leong)

beautifully with the red-orange calyx and protruding white style with its single grey-brown stigma.

Our plant appears to be a close match to *Chisocheton polyandrus*, except that the calyx of *C. polyandrus* is densely ferrugineous-pubescent whereas the calyx of our specimen is glabrous.

Mucuna biplicata

We encountered many dropped flowers of this species on the forest floor in several localities of Nanga Bloh, but could not immediately trace them to their source. We suspected that they came from a climber,

Habit of *Poikilospermum* sp. nov. *(Photo credit: Paul Leong)*

Michele photographing an *Elatostema* species of the family Urticaceae. *(Photo credit: Paul Leong)*

Individual flower of *Poikilospermum* sp. nov. *(Photo credit: Michele Rodda)*

possibly one of those lianas that exhibit its flowers high up in the canopy where there is light while its stems dangle below the canopy, devoid of leaves. With its keeled petals, we knew that it must belong to the subfamily Papilionoideae of the Legume or Bean family (Fabaceae). It was only several days later, while on a boat plying the river along the edge of the forest that we chanced upon a plant in full bloom, scrambling over trees and jostling with other climbers to bask in the bright sunlight.

The plant belongs to the genus *Mucuna*. Almost all species in this genus are lianas, and their flowers range from white to purple, red and orange. Several species such as *M. novo-guineensis* and *M. bennettii* are cultivated in gardens for their beautiful pendent inflorescences of large reddish orange flowers. Our plant was identified as *Mucuna biplicata*. Its leaves are trifoliate, glabrous and leathery, and have a long petiole. Its flowers and fruit are produced on its upper bare stems. The flowers are purple and held in short and branching inflorescences that arise in groups from the same node of the stem. When well-formed, more than 30 flowers from these inflorescences can form a tight ball about 20 cm in diameter. Each flower is about 6 cm in length.

Poikilospermum sp. nov.

Most members of the Urticaceae (Nettle family) produce flowers that are all but spectacular. They tend to be extremely small and not colourful or scented. Members of the genus *Poikilospermum*, however, are an exception. In Borneo, *Poikilospermum* species can often be encountered along rivers and streams where they are large woody scramblers that produce leathery leaves and attractive large inflorescences bearing pink or purple flowers in tight round clusters.

As expected, we encountered the common *Poikilospermum scabrinervium* during our trip, but we also found an enigmatic climbing species with lots of adventitious roots along its stems, and flowers arranged in loose clusters. Examination of our collection back at SING confirmed that it is a species of *Poikilospermum*, however a very unique one. It is in fact the first true climber in the genus and the first representative of *Poikilospermum* subgenus *Poikilospermum* ever identified in Borneo. It is being published as a new species. There are four other species in this same subgenus which also do not have tight clusters of flowers, but in contrast to the plant we found, they are not true climbers and also do not produce roots along their stems. It can also be separated from the other species in the subgenus by its larger flowers with more numerous tepals.

Paul Leong
Michele Rodda
Herbarium

Peter Wilkie
Royal Botanic Garden Edinburgh

The launch of the Learning Forest

The Gardens' Learning Forest was officially opened on 31 March 2017 at a ceremony graced by Prime Minister Lee Hsien Loong. The 10-hectare nature area has over 700 plant species, including many species native to freshwater swamp forest habitats in the region, such as *Dillenia reticulata* and *Cyrtosperma johnstonii*. The first completed feature of the Gardens' new Tyersall-Gallop Core, the Learning Forest was carefully planned to complement the adjacent UNESCO World Heritage Site. It also provides additional educational and recreational opportunities for visitors to the Gardens.

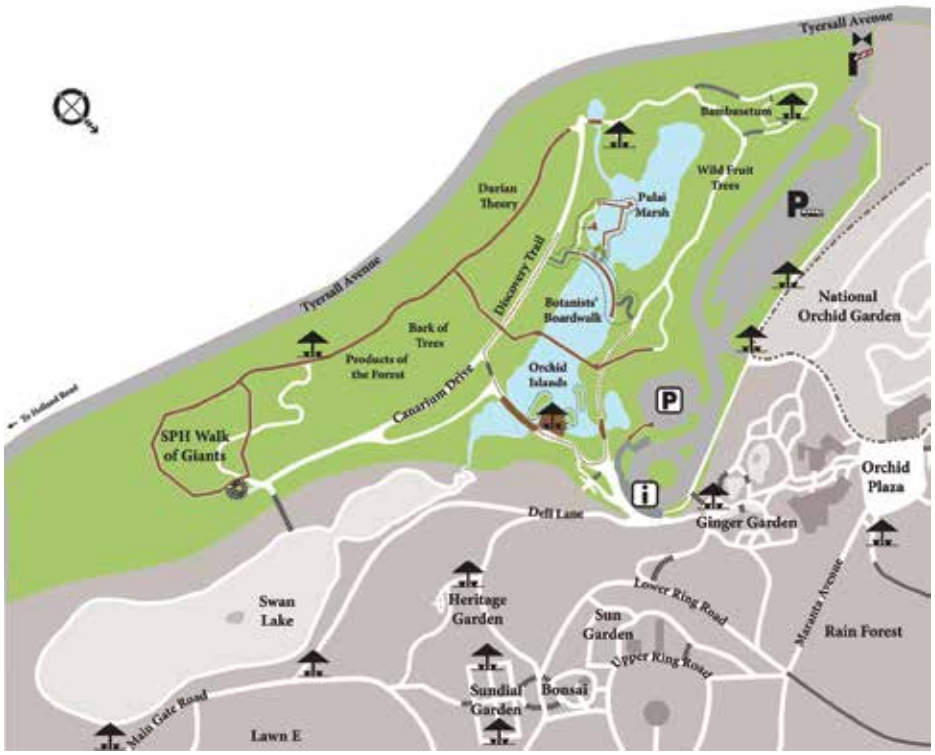
The history of the land and the development of the Learning Forest

The land on which the Learning Forest sits was first acquired by William Napier, who was the first resident of the Tanglin district, as well as Singapore's first lawyer. He built his house and named it 'Tyersall' after a place near Leeds in Yorkshire (the reason why he named it so is a mystery). Napier originally owned 27 hectares of land, but sold it off over time in parcels for others to build their own residences. These residences were abandoned in the early 1900s, leaving the land to revert to nature, and over time it has developed into a secondary rainforest.

Planning for this project began shortly after the land was acquired in 2009, the year of the Gardens' 150th anniversary. A preliminary vegetation survey revealed that more than 300 tree species were present in the secondary rainforest, along with many mature tree specimens. The mature trees were preserved in place as much as possible during the site's development, or salvaged and relocated on-site if they could not be avoided. The preliminary survey also revealed that some of the mature tree specimens are of the same species as those present in the Gardens' Rain Forest, suggesting that there was once an unobstructed ecological connection between the site and the Rain Forest. In order to restore this connection, the old Tyersall Ave, which separated the Learning Forest from the rest of the Gardens, was removed as part of this project.

The new Learning Forest comprises the southwestern portion of the Botanic Gardens and is part of the buffer zone for the UNESCO inscribed site.

The expunction of the old Tyersall Ave was a significant achievement, not only for the ecology of the Gardens but also for the restoration



The Learning Forest is highlighted on this map of the Botanic Gardens. The map also illustrates the hydrological connection between the Keppel Discovery Wetlands (shown in blue) and Swan Lake.

(Left) Large areas of the Learning Forest were once overgrown with invasive weeds such as Zanzibar Yam (*Dioscorea sansibarensis*) and African Oil Palm (*Elaeis guineensis*). (Right) Extensive areas had to be cleared of weeds and debris. *(Photo credits: Lim Siu Ann)*

An elevated boardwalk provides visitors with a 360 degree view of the Keppel Discovery Wetlands. *(Photo credit: Lim Siu Ann)*

of a hydrological connection from the past. Before the mid-1900s, there was a pond at the site of today's Learning Forest that collected rainwater from the surrounding area, which then fed into Swan Lake. The pond was drained sometime early in the 20th century, but a new on-site water catchment has been created in the northern portion of the Learning Forest, named the Keppel Discovery Wetlands. Controlled by a series of weirs, water now flows through the Wetlands and ultimately into Swan Lake. Thus, the hydrological connection that formerly existed between the site and the Lake has been re-established.

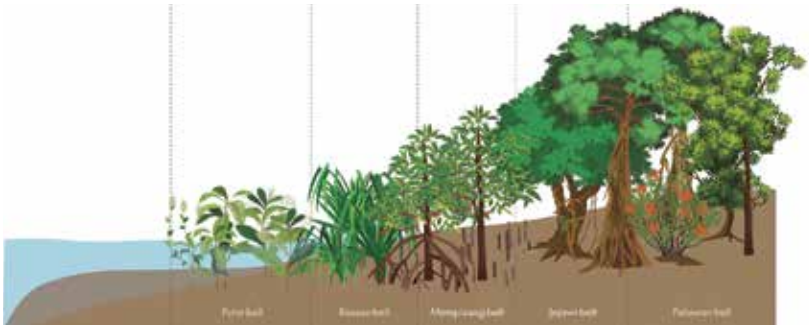
The design and plant palette of the Keppel Discovery Wetlands were based on the vegetation belts of freshwater swamp forests that E.J.H. Corner studied in the 1930s. Corner, former Assistant Director of the Gardens, was fascinated by the exceptional diversity and peculiarity of species found in this type of habitat and made countless visits to freshwater swamp forests in southern Johor and Singapore. He came near to death when he contracted Japanese river fever on one of his explorations, but eventually recovered and years later documented his findings in his research paper, *The Freshwater Swamp-forest of South Johore and Singapore* (1978). The Keppel Discovery Wetlands is not only a restoration of a rare and endangered habitat type in the region, but a testament to the research conducted by Corner, who is commemorated at the Botanists' Boardwalk which traverses the wetlands.

One of the initial ideas for the Learning Forest was to have an aerial walkway to bring visitors up into the canopies of the site's mature trees. This was realised in the form of today's SPH Walk of Giants, an 8 m-tall boardwalk that loops around the southern parts of the rainforest. Amongst the tall trees, visitors to the SPH Walk of Giants can also see forest palms and climbers that enrich the rainforest habitat and help to attract a diversity of fauna. The "Giants" are the tall-growing species that have been newly introduced to the forest as part of the development, not the existing species.

Outside of the Keppel Discovery Wetlands and SPH Walk of Giants, the Learning Forest contains several notable living collections. The Products of the Forest, Bark of Trees and Durian Theory collections can be found in the forested areas south of the wetlands, while the Wild Fruit Trees and Bambusetum collections are located at the northeastern

A view of the wetlands from the boardwalk, facing downstream toward Swan Lake. *(Photo credit: Lim Siu Ann)*

Tembusu trees (*Cyrtophyllum fragrans*) that are more than 150 years old line Canarium Drive, the road that separates the freshwater swamp forest from the secondary lowland rainforest. *(Photo credit: Kathleen Yap)*



Corner observed eight different vegetation belts associated with freshwater swamp forests in the region. Five of these are shown here (from left to right: Putat-belt, Rassau-belt, Mempisang-belt, Jelawi-belt, Pelawan-belt), and are also represented at the Learning Forest.

The SPH Walk of Giants brings visitors from the forest floor up into the tree canopy. *(Photo credit: Lim Siu Ann)*

The Canopy Web is found under the canopy of two towering Tembusu trees at the SPH Walk of Giants. *(Photo credit: Kathleen Yap)*

Living Collections at the Learning Forest

Products of the Forest

Many tropical rainforest species that are known to yield useful products can be found in the Learning Forest. Species such as *Gnetum gnemon* (Belinjau) and *Cyrtophyllum fragrans* (Tembusu) were carefully protected-in-place during development and can be seen adjacent to the boardwalk that loops through the forested part of the Learning Forest.

Bark of Trees

In the middle of the forest is a feature that exposes visitors to bark morphology. Here, visitors can learn about a variety of bark types and how they are formed.

Durian Theory

The Durian Theory collection includes some of the species that inspired Corner's 1949 theory on the evolution of plants. He conducted detailed studies on the morphology of fruits, and in particular, the arils of members of the genus *Durio*. Although his theory has long been debunked by modern molecular biology, his meticulously prepared botanical descriptions of fruit morphology are a valuable reference for researchers.

Bambusetum

Significant contributions to the knowledge of tropical bamboos have been made by two of the Gardens' former directors, H.N. Ridley and R.E. Holttum, as well as by our current Principal Researcher, Dr Wong Khoon Meng. The Bambusetum contains several clumps that were split from the bamboo collection at the Eco Garden, including *Dendrocalamus giganteus*, one of the world's largest-growing bamboo species.

Wild Fruit Trees

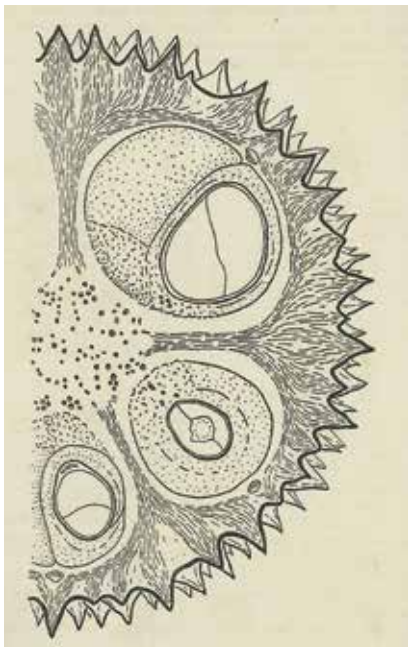
The Wild Fruit Tree plot has over 50 species of wild fruit trees that were planted by NParks staff in November 2015. Here, visitors can view trees from the families Moraceae, Clusiaceae, Anacardiaceae, Ebenaceae, Sapindaceae, Annonaceae and Myristicaceae.

The fruit of the Belinjau tree (*Gnetum gnemon*). This species is included in the Products of the Forest living collection. *(Photo credit: Boo Chih Min)*

A rare timber tree, the Borneo Ironwood (*Eusideroxylon zwageri*) is featured opposite the Products of the Forest collection. It is a slow grower (around 0.5 cm in height per year) but yields one of the most durable and heaviest timbers in the world. *(Photo credits: Lim Siu Ann)*



In the Bark of Trees, a range of bark types are on display, including (from left to right): The scaly bark of the Dammar Minyak (*Agathis borneensis*), the spiny bark of the Kapok tree (*Ceiba pentandra*) and the papery bark of the Paper Bark tree (*Melaleuca cajuputi*). *(Photo credits: Lim Siu Ann)*



A cross-section of a durian fruit, from E.J.H. Corner's *The Durian Theory or the Origin of the Modern Tree* (1949). He postulated that flowering plants have evolved from large tree species that produce large fruit with seeds covered in bright arils to attract seed dispersers.

A large clump of *Dendrocalamus giganteus* (one of the largest bamboos in the world) towers over the Bambusetum. *(Photo credit: Lim Siu Ann)*

The fruit of Asam Gelugor (*Garcinia atroviridis*), one of the tree species found in the Wild Fruit Trees collection. *(Photo credit: Ang Wee Foong)*

edge of the Learning Forest above the Keppel Discovery Wetlands.

With the completion of the Learning Forest and the development of the new Gallop extension underway, we can look forward to an exciting future in the Gardens' new Tyersall-Gallop Core.

Lim Siu Ann
Horticulture and Operations

The author would like to thank Dr Nigel Taylor and Shee Zhi Qiang for their contributions to this article.

New art at the Botanic Gardens

During 2017 visitors will have the opportunity to view botanical artworks by two celebrated artists from the 19th century, when European interest in the distant tropics had already been awakened, though few had seen it for themselves. Before the widespread use of photography it was artists that brought the plants and wildlife of the mega-diverse Malay Archipelago to the eyes of the folk back home. Through two consecutive exhibitions we will bring you examples of the artworks of Dutch artist Berthe Hoola van Nooten and Englishwoman Marianne North, both brave and enterprising ladies, but with very contrasting life histories.

Painting of Berthe Hoola van Nooten by Moritz Calisch, c. 1828–1870.
(Photo credit: Collectie Stichting Nationaal Museum van Wereldculturen, licensed under Creative Commons (CC BY-SA 3.0))

The talented botanical artist, Berthe Hoola van Nooten (1817–1892) was born at Utrecht in the Netherlands and died in Batavia (now Jakarta) in the Dutch East Indies or present day Indonesia. She married a judge from the Dutch colony of Suriname (South America), and they later moved to the USA where she established a school for girls. Her husband died prematurely of yellow fever leaving her with five children. She fell into debt and decided to join her brother in Java where she made her drawings; these were eventually published, but sadly she died there in poverty. Her book, *Fleurs, Fruits et Feuillages Choisis ... de L'ile de Java* (1863), of 40 paintings got published through the patronage of the Dutch king's wife. They were reproduced as chromo-lithographs engraved by Belgian lithographer, Pieter De Pannemaeker, from her originals. They display a selection of the plants cultivated widely in tropical countries and are from various continents, but all grown in Java. The book went through three editions. The examples reproduced here are from the first edition, kindly donated to the Botanic Gardens by British art philanthropist, Dr Shirley Sherwood, OBE. All 40 paintings were exhibited in the CDL Green Gallery until mid-July and 13 of them have been selected for the Gardens' 2018 calendar.

The Victorian botanical and landscape artist, Marianne North (1830–1890) was born into a wealthy aristocratic family at Hastings, Sussex, England, where her father was the local MP. After the death of her mother, she cared for her father, travelling much and painting until he passed away in 1869, leaving her an inheritance enough for the rest of her life. In 1871, she began travelling the world on her own to paint plants in their landscapes in oil on paper, later building a gallery at, and donating all her paintings to, Kew Gardens, London, from 1882 to 1885. She was in Singapore in January 1876, when she visited the Botanic Gardens and described our Rain Forest, noting pitcher plants, and pictured the Sultan of Johore's first Istana (perhaps the only publicly accessible image of this building which was later destroyed by fire). Then in February she visited Sarawak (Borneo), returning to Singapore before taking the boat to Java, where she visited various sites after arriving in Batavia (Jakarta), including the famous botanic gardens at Buitenzorg (now Bogor) and the temple at Borobudur. She returned to England via Ceylon (Sri Lanka) in February 1877. Excluding Ceylon,

The Marianne North Gallery at Kew. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

The Marianne North Gallery at Kew. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

she made over 150 paintings on this trip and copies are at the Singapore Botanic Gardens courtesy of the Royal Botanic Gardens, Kew. These will form the basis for our exhibition on display in the CDL Green Gallery from 4 August until 26 November. At other times she visited California, eastern North America, Brazil, New Zealand, South Africa, Egypt, Canary Islands, Australia, Japan, India, Jamaica, Seychelles, Syria, Italy and Chile, making nearly 900 paintings altogether. She must rank as the most widely travelled botanical artist ever and long before the age of air travel! In retirement she wrote up a journal of her life's experiences and thus we know much more about her than her Dutch counterpart, Berthe Hoola van Nooten. Those interested in learning more about this intrepid explorer should read *A Vision of Eden. The Life and Work of Marianne North*, first published by the Royal Botanic Gardens, Kew in 1993 and followed by various editions and reprints.

Nigel P. Taylor
Group Director
Singapore Botanic Gardens

Some of the works from the Berthe van Nooten and Marianne North exhibitions are reproduced on the following pages.

***Jambosa domestica* (now known as *Syzygium malaccense*), by Berthe Hoola van Nooten.**

***Carica papaya,* by Berthe Hoola van Nooten.**

***Poinciana regia* (now known as *Delonix regia*), by Berthe Hoola van Nooten.**

***Saraca declinata*, by Berthe Hoola van Nooten.**

Foliage, flowers and fruit of *Saraca declinata*, by Marianne North. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

Gardener's Cottage, Buitenzorg Botanic Garden (modern day Bogor), Java, by Marianne North. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

View of the Salak Volcano, from Buitenzorg (Bogor), Java, by Marianne North. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

Foliage and flowers of *Medinilla magnifica*, cultivated in Singapore, by Marianne North. *(Copyright Royal Botanic Gardens, Kew, used with permission)*

Flowers and fruit of *Barringtonia speciosa* (known today as *B. asiatica*) with *Diadema bolina* butterflies, Borneo, by Marianne North.
(Copyright Royal Botanic Gardens, Kew, used with permission)

Gardenwise · Volume 49 · August 2017

The propagation and reintroduction of *Thrixspermum amplexicaule* in Singapore

The genus *Thrixspermum* was established by the Portuguese botanist João de Loureiro in 1790 on the basis of the species *Thrixspermum centipeda*. Members of this genus are monopodial orchids; some are climbers with long stems, while others are branching or 'twig' species with short stems. Most are epiphytes or lithophytes, although some are terrestrials. Their leaves are flat, generally leathery and fleshy, and bi-lobed at the tip. Their inflorescences elongate over a long period of time, with only one or two flowers open at any one time. The flowers are short-lived, lasting for only about a day. Flowering is gregarious and triggered by a sudden lowering in temperature, a strategy to maximise pollination amongst individuals of the same species within a particular area. The genus can be divided into two sections: species in the section *Thrixspermum* have their flowers side by side and the floral bracts are positioned in two rows, while those in the section *Dendrocolla* have flowers that face all directions.

There are about 168 species of *Thrixspermum*. They are distributed over a wide range, from Sri Lanka to Samoa, with most of them in Malaysia, the Philippines, Indonesia and the Pacific Islands. Twenty-nine species occur in peninsular Malaysia. They are found in rain forests, mangroves, peat swamp forests, amongst roadside vegetation, and in riverine and wet evergreen forests, from sea level up to 3400 m in elevation.

There are several species of *Thrixspermum* native to Singapore, but sadly only two are known to still exist in the wild. Both of these, *T. amplexicaule* and *T. trichoglottis*, are classified as Critically Endangered in Singapore. In the past several years, *T. amplexicaule* has been discovered at several locations in Singapore, and we have been working to conserve this species through the Orchid Conservation Programme.

Thrixspermum amplexicaule is a terrestrial climber, usually scrambling over other vegetation in bright places near swampy areas or in open areas of the forest. It produces branching stems that grow 3–4 m long, and leathery, heart-shaped leaves with a broad base. The leaves are 3–6 cm long by 1–2 cm wide, and are arranged in two opposite rows along the stem. The inflorescences are erect, 15–25 cm long, and have pronounced floral bracts. The sepals are 17 mm long by 11 cm wide, while the petals are slightly smaller. The lip resembles a sac and has a yellow callus inside the front wall with some orange hairs below it; the side lobes are small and acute and the mid-lobe is fleshy.

The Singapore Herbarium contains early specimens of this species collected from Ang Mo Kio, Pulau Ubin, Bukit Mandai, Changi, Lim Chu Kang, Poyan, Seletar and even the Singapore Botanic Gardens, with early records made by Henry Ridley, director of the Gardens from 1888 to 1912. Our more recent discoveries of this species were at MacRitchie Reservoir, Poyan Reservoir, Upper Peirce Reservoir and Pulau Ubin. At MacRitchie Reservoir, it was found growing with grasses on sediment deposit mounds, together with *Alstonia spatulata*, *Dillenia suffruticosa* and *Nepenthes gracilis*. At Poyan Reservoir, the species was found together with *Dillenia suffruticosa* and *Stenochlaena palustris*. At Upper Peirce Reservoir, it was encountered in a swampy area, and

The leaves of *Thrixspermum amplexicaule* are arranged in two opposite rows along the stem.

The flowers are attractive but short-lived, lasting for only a single day.

A reintroduced plant of *T. amplexicaule* growing vigorously on Pulau Ubin.

in Pulau Ubin, it was discovered in a back mangrove habitat, scrambling over *Dalbergia candenatensis, Dolichandrone spathacea, Flagellaria indica, Taliparititi liliaceum* and other plants.

Propagation

Seed capsules were collected from the population at Pulau Ubin and the seeds were successfully germinated in our orchid breeding and reintroduction laboratory. After 12 to 15 months in the laboratory, seedlings that had reached about 5 cm tall were sent to the nursery, where they were planted in communal pots in a planting medium consisting of 50% compost and 50% fine charcoal chips. After two to three months, the larger seedlings were planted individually in 10 cm containers. Since this species is a climber, the seedlings were provided with wooden sticks wrapped with sphagnum moss for support. Once they reached 40–50 cm in height, they were ready for reintroduction into suitable habitats.

Reintroduction

The seedlings were reintroduced to suitable locations at Pulau Ubin and the Singapore Quarry. All of the selected locations experience high humidity and are close to a freshwater body, and the seedlings were planted during the rainy season to ensure they would have a sufficient water supply to enable them to quickly become established in their new homes. They were planted near Mangrove Ferns (*Acrostichum aureum* and *A. speciosum*) and Patidoi (*Schumannianthus dichotomus*), which could provide support for them to climb on and also some shade.

Lessons learnt and future plans for reintroduction

The plants reintroduced to Pulau Ubin are doing well, as they have produced new shoots and have also flowered. Unfortunately, while those at the Singapore Quarry grew vigorously after planting and also flowered several times, they were damaged by the long drought of 2014 and were not able to recover. We know that prolonged drought can also threaten this species if it is planted near grass such as Lalang (*Imperata cylindrica*), as the orchid can be destroyed if the grass catches fire.

Thrixspermum amplexicaule grows naturally in nutrient deficient soils, where the growth of potentially competing vegetation tends to be less vigorous than in fertile soils (in Singapore, we find it growing in sandy-clayey soils, or on waterlogged, acidic soils). We also know from Comber's *Orchids of Sumatra* (2001) that the size of individual plants varies according to the fertility of the soil; it can survive in very infertile soils where there is little competition, but then the plants are very small. Conversely, when the soil is rich the plants can be much larger, but they then run the risk of being smothered by competitive vegetation.

So we have learnt that with this species, we must pay more attention to reintroduced plants during environmental extremes such as prolonged drought. Also, we must continue to experiment with planting locations which have soil fertile enough to foster robust growth but deplete in nutrients to restrict the growth of competing vegetation, while at the same time offering suitable support plants for the orchids to climb on.

For future reintroductions, we plan to plant some individuals at the base of small plants of *Dillenia suffruticosa* and *Stenochlaena palustris*, to replicate how they grow naturally in some areas in Singapore. The species is also found in back mangrove habitat at Pulau Ubin, so when the next batch of seedlings are ready, they will be planted near plants such as *Dalbergia candenatensis, Dolichandrone spathacea, Flagellaria indica* and *Taliparititi liliaceum*.

Yam Tim Wing
Peter Ang
Felicia Tay
Orchid Breeding and Reintroductions

All photos by Yam Tim Wing

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The Flora of Singapore

Our collaborators Drs Willem de Wilde and Brigitta de Wilde-Duyfjes from Leiden, the Netherlands. They are contributing several families to the Flora. *(Photo credit: Paul Leong)*

In most countries in Europe anybody interested in identifying a plant that they do not know can simply pick up a book and use it to find out what their unknown plant is. A book of this kind is called a Flora and contains a complete listing of all of the plants in the country or region along with descriptions of the species, illustrations and keys to identify them. These have developed over centuries of plant collection and study by dedicated botanists, mostly working in universities and botanic gardens. Each generation of botanists built on the foundations laid by their predecessors to produce works which reflected the current state of research and knowledge in each country.

Far fewer tropical countries, however, can boast a completed Flora. There are good reasons why this is the case, not least that the plant diversity of tropical countries is generally much greater than that of temperate countries. For example there are far fewer native flowering plant species in the United Kingdom than in Singapore, even though the UK is more than 300 times larger than Singapore. Also, tropical countries have often lacked the resources and expertise to tackle such large projects. Nevertheless, many tens of thousands of plant species have been described from tropical countries, attesting to the tenacity of dedicated botanists from throughout the tropics along with their collaborators around the world.

Singapore has never had its own comprehensive Flora, although our plant diversity has been catalogued in various other ways and Singapore has the highest number of collections per unit area of any tropical country. Singapore Botanic Gardens' Henry Ridley published a *Flora of Singapore* in 1900 but this work is actually a simple checklist of the species known at the time. Later, Ridley published his *Flora of the Malay Peninsula* in five volumes which included Singapore. The most detailed contributions specifically on the plant diversity of Singapore to date are the two volumes of the *Concise Flora of Singapore* by Hsuan Keng and his co-authors, published in 1990 and 1998. This work built upon the numerous papers published by Keng in the *Gardens' Bulletin, Singapore* in the preceding years. The *Concise Flora* has keys to genera and very short descriptions for the taxa recognised. It served its purpose well, to be a listing of the species with concise information. It does not include nomenclatural information, synonyms of the taxa recognised, nor keys to species but that was never its aim. Apart from this concise Flora there have been a number of checklists made since Ridley's 1900 publication, notably by Ian Turner in 1993 and, most recently, *A Checklist of the Total Vascular Plant Flora of Singapore* by Chong Kwek Yan and his co-authors in 2009. This latter work is currently under revision and a new edition is planned.

In *A Checklist of the Total Vascular Plant Flora of Singapore* it was estimated that the total number of vascular plant species in Singapore is 4,180; of these, 2,145 are native, 1,826 are exotic (including the naturalised) and the rest are of uncertain origin. In Ian Turner's 1993 checklist he estimated there to be around 2,500 species of native, naturalised and casual vascular plants in Singapore. There are, in addition, over 250 species of bryophytes. About 640 of the species included in *A Checklist of the Total Vascular Plant Flora of Singapore* were categorised as nationally extinct, but nearly a hundred of these were later found to be erroneously listed or have been rediscovered.

It is time that Singapore had a new Flora based on original taxonomic work. It should have detailed descriptions and keys to the genera and species. It should also have extensive photographs and illustrations so that the user can identify any plant found in the wild in Singapore and find out more information about it, including its wider distribution, local names, and conservation status. It should also include any possibly extinct taxa so as to record what we have lost but also to allow for the possibility they may not be extinct or may recolonise from Malaysia or Indonesia. Therefore, we intend to research and publish a new *Flora of Singapore* in 14 volumes over a period of about 10 years that will include all native, naturalised and casual plant species in Singapore, from mosses to





NParks' staff conducting botanical work around Singapore. Clockwise from top left: Ho Boon Chuan in Bukit Timah *(Photo credit: Lua Hock Keong)***; Lua Hock Keong, Paul Parusuraman Athen and Ho Boon Chuan in Bukit Timah** *(Photo credit: Bazilah Ibrahim)***; Dr Wong Khoon Meng in the Herbarium** *(Photo credit: Seah Wei Wei)***; Koh Sin Lan and Ali Ibrahim at Pulau Ubin** *(Photo credit: Lua Hock Keong)***; Aung Thame and Koh Teng Seah at Pulau Semakau** *(Photo credit: Jana Leong-Škorničková)***.**

flowering plants. All plant families have been pre-assigned to one or other of the volumes with the families arranged according to our understanding of evolutionary relationships. The arrangement of mosses and liverworts will follow standards laid down by researchers in this field (Volumes 1 and 2); the arrangement of ferns will follow the recently published suggestions of the Pteridophyte Phylogeny Group (Volume 3); and the arrangement of flowering plants will follow the Angiosperm Phylogeny Group IV (Volumes 4–14). Volume 1 will also include chapters on the history of plant taxonomic research in Singapore, an overview of family and genus delimitation, the major families and genera in Singapore, the vegetation of Singapore, and conservation in Singapore. We plan to publish three volumes in 2019 and then regularly thereafter. As each volume will be published when all content for it is ready, they will not necessarily appear in numerical order. For example, we currently expect Volume 1, with the introductory materials and mosses, Volume 7, with the grasses and sedges and related families, and Volume 13, with the Coffee, Tembusu and Frangipani families, to be the first to be published. We do, however, plan to make completed accounts available online pending their inclusion in the printed volumes.

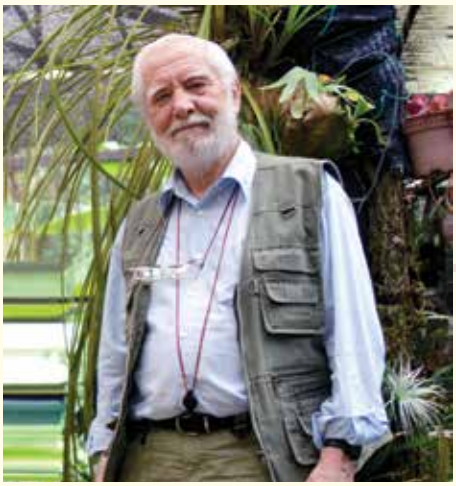
Needless to say this is a major undertaking by the Gardens but we shall not be working on this alone. Instead we are forging partnerships with institutions such as the Forest Research Institute Malaysia (FRIM) and the Royal Botanic Gardens, Kew. FRIM has its own project called the *Flora of Peninsular Malaysia*. As there is a large overlap in species between our two projects, we are working closely together to pool people and resources to the mutual benefit of both projects when we are able. Kew has many specimens from Singapore and access to them is vital for the success of our project. Kew has begun the process of digitising their Singaporean collections and making these available online. They are also digitising other related materials in order for the Singapore-based researchers to be better able to conduct the necessary research for the *Flora of Singapore*. These digitised specimens cannot replace the real thing in taxonomic research but for many easily identified species it means that distributions can be checked and the collections pre-screened to identify those specimens that are vital for further study. The staff of the Gardens and colleagues from other divisions of the National Parks Board will be providing a lot of content for the *Flora of Singapore*. We will also be joined by many experts on particular groups of plants from throughout the world who will research and write up their specialist families for the *Flora*.

The *Flora of Singapore* will be a challenge. Now we must do the work! A daunting but exciting prospect.

David Middleton
Herbarium

Kick starting the Flora of Singapore project

Over the past year we have had the pleasure of hosting the following internationally renowned researchers at the Singapore Herbarium (SING). Working with us on the *Flora of Singapore*, their rich field experience and specialised knowledge make them invaluable collaborators in this challenging project.



(Photo credit: Ong Poh Teck)

Mark J.E. Coode is a retired botanist who worked for many years at the Royal Botanic Gardens, Kew. His expertise is on the Elaeocarpaceae and the plant diversity of the Malesian region, particularly through his work in Papua New Guinea and Brunei. In addition he was the editor of *Kew Bulletin* from 1977 to 1990. He was here for a short visit, from 5 to 12 Mar 2017, to study our collections of Elaeocarpaceae for his revisions of the family for the *Flora of Peninsular Malaysia* and the *Flora of Singapore*.

Rogier de Kok, originally from The Netherlands but based in London in the UK for many years, is no stranger to the Singapore Botanic Gardens. He has been here a number of times over the last few years to study specimens of Lauraceae and Lamiaceae for his revisions of these families for the *Flora of Peninsular Malaysia* and the *Flora of Singapore*. This time he was with us for a month, from 4 Mar to 4 Apr 2017. Rogier was formerly Head of the South East Asia and Pacific Regional Team at the Royal Botanic Gardens, Kew.

(Photo credit: Serena Lee)

(Photo credit: Serena Lee)

George W. Staples from the USA is particularly well known for his work on the family Convolvulaceae but has also widely published on other plant groups and is the author of a well-received book on tropical garden plants. He is also a former colleague of ours, having worked at the Gardens between 2007 and 2013. On this occasion he was here from 15 to 28 Mar 2017 to work on the Convolvulaceae for the *Flora of Singapore*.

Jan Frederik Veldkamp, better known as Jef, is from the Netherlands and an Honorary Scientific Collaborator of the Herbarium of Naturalis Biodiversity Center in Leiden. He was with us for just under a month, from 11 Mar to 9 Apr 2017. Jef focuses his research on the Poaceae as well as on botanical nomenclature, and has no fewer than 10 species of grasses and a genus named after him.

(Photo credit: Ali Ibrahim)

(Photo credit: Siti Munirah M.Y.)

Willem J.J.O. de Wilde and **Brigitta E.E. Duyfjes-de Wilde** from the Netherlands are retired but Honorary Scientific Collaborators of the Herbarium of Naturalis Biodiversity Center in Leiden. They were with us from 18 Jan to 13 Feb 2017, pursuing revisions of various plant families for their many projects throughout Southeast Asia. Although they both celebrated their 80th birthdays in 2016, they show no signs of slowing down. Their zest for both life and botany is infectious, and their database and internet savviness would put many to shame. Together they have published over 600 new taxa and taxonomic combinations. Between them, 22 species from a wide spectrum of plant families have been named for Willem and Brigitta, Flora Malesiana's golden couple!

(Photo credit: Postar Miun)

Last but certainly not least, we at SING would like to remember **Colin E. Ridsdale**. Colin was with us from 3 to 31 Oct 2016 to study the Rubiaceae, as he was working towards a revision of various genera in this family for the *Flora of Singapore* project.

It is with great sadness that we report that Colin passed away on 5 Jan 2017, at 72 years of age. He was originally from the UK but was based for most of his adult life in Leiden in the Netherlands. Colin had a genus and 13 species named after him, mostly from the family Rubiaceae. He will be sorely missed by the botanical community here in Singapore.

Serena Lee
Herbarium

Gardenwise · Volume 49 · August 2017

The 'elusive silver eggs' of the Bird's Nest Fungus

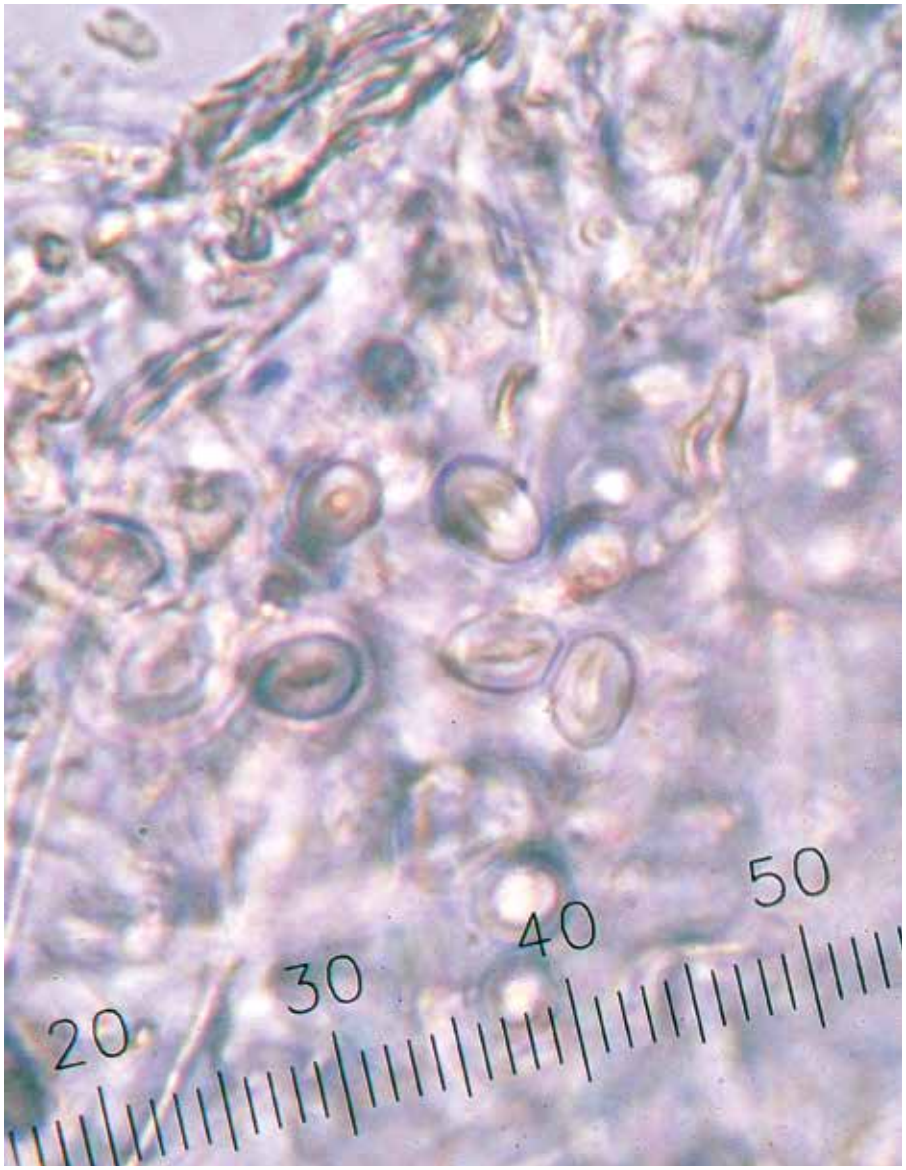
Most of us are familiar with the Bird's Nest Fern (*Asplenium nidus*) commonly seen around Singapore, but what about the Bird's Nest Fungus? Unlike typical mushrooms that you might find in the supermarket, like shitake or button mushrooms, the fruiting bodies, or basidiomes, of this fungus look very much like bird's nests, complete with eggs! Although they might seem elusive, these mushrooms are fairly common around Singapore, once you know what to look for.

'Bird's Nest Fungus' is the common name for any of several species of fungi placed in the family Nidulariaceae (*nidus* is Latin for 'nest'). In fact, if you were to do a Google search for images of 'Nidulariaceae', you would see a whole range of nest shaped basidiomes and their 'eggs'. At least one species is widespread

The fruiting bodies of *Cyathus striatus* growing on a rotting tree branch. *(Photo credit: Ho Boon Chuan)*

Peridioles of *Cyathus striatus*. *(Photo credit: Serena Lee)*

A longitudinal section of a fruiting body of *Cyathus striatus*, showing the shaggy brown hairs on the outside, and the striations on the inside which give this species its scientific name. *(Photo credit: Serena Lee)*



The spores of *Cyathus striatus* viewed under a microscope at 18–20 µ × 8–10 µ.
(Photo credit: Serena Lee)

in Singapore, *Cyathus striatus*. Its scientific name comes from the striations found on the silvery inner walls of the basidiomes, which are 7–15 mm high and 6–8 mm wide when fully opened at maturity. Their outer walls have shaggy brown hairs. They can be found growing on dead branches and other debris on the forest floor, or growing on landscaping mulch and woodchips, particularly during rainy periods.

Bird's Nest Fungi have an interesting mechanism of spore dispersal. The silver 'eggs', known as peridioles, contain millions of spores and are ejected from the 'nest' using the kinetic energy in falling raindrops. The raindrops are most effective at ejecting the peridioles if they land on the rim of the basidiome. After the peridioles are launched from the basidiome, they become attached to surrounding vegetation. There they wait until conditions are right for the spores to germinate, or else they are eaten by herbivores and carried away to germinate further afield.

The next time you take a stroll in nature, keep an eye out for these awesome looking fungi. If you do see one that has a bird's nest shape but otherwise looks different than the species shown in these pictures, collect it and bring it down to the Herbarium. You many have found a new species in Singapore!

Serena Lee
Herbarium

The fruiting bodies of the Bird's Nest Fungus in varying stages of maturity.
(Photo credit: Serena Lee)

Planting giants, seeding dreams

Through rapid urbanisation and development, many people have become disconnected from their natural surroundings. For the youth of our nation, traditional learning occurs within the four walls of a classroom. However, educators today recognise the need for students to engage with the natural environment in order to develop an interest in their surroundings and a desire to understand how things work.

The Singapore Botanic Gardens recently opened the Learning Forest (see pages 8–12), a unique area consisting of a carefully restored freshwater forest wetland and a majestic lowland forest. Attracting more than 100 species of birds, 20 species of amphibians and reptiles, 19 species of butterflies and seven species of mammals, and with a rich and diverse collection of flora, it is the perfect outdoor classroom for students to learn about the great outdoors through hands-on education.

The Gardens is collaborating with three schools in an effort to monitor and improve the long-term ecological health of the Learning Forest. The seven-session Learning Forest Programme for Schools is designed to educate students about habitat enhancement and seed a love of nature in their hearts. As part of this programme, participants will plant native trees at a designated location within the Learning Forest, and then provide follow-up horticultural care and weed removal within their reforested plot. They will also learn how to measure trees and locate and record the precise location of trees in a forest using GPS technology. Definitely not something that would be covered in a typical school curriculum!

Students from CHIJ St Theresa's Convent learning about the rainforest habitat in the Learning Forest. *(Photo credit: Steffi Loe)*

Students from Yuan Ching Secondary School listening to a briefing before planting trees. *(Photo credit: Mr Tan Ying Yang)*

Students from Tanglin Secondary School touring the SPH Walk of Giants in the Learning Forest. *(Photo credit: Cyrena Lin)*

Through their participation in the programme, the students will also get the chance to learn more about the native biodiversity that is attracted to the area. They will be equipped with the skills and knowledge to identify birds, butterflies and dragonflies, and will also conduct biological surveys for these animals. Their collected data will be recorded into NParks' citizen science-based app, SGBioAtlas, and will help us to monitor the health of the Learning Forest over time.

At the end of the programme, students will be given time to reflect and share their findings and experiences through a short presentation. As the Learning Forest is open to the public, students who have completed the programme will be able to visit and observe future changes to the habitat which they had an active role in enhancing. If they wish to bring their friends and families along, the Gardens' education team has also developed an activity sheet to encourage exploration of the Learning Forest.

It is hoped that the Learning Forest will be a place to bring people of all ages a bit closer to the natural environment and help them discover the many fascinating wonders that Nature has to offer.

Steffi Loe
Cyrena Lin
Education Branch

The SGBioAtlas app is can be downloaded from NParks' website at www.nparks.gov.sg

The activity sheet mentioned above is aimed at visitors aged 5 to 12 and can be picked up at the Tyersall Visitor Services Counter at the entrance to the Learning Forest.

Bean business

Beans are a common crop in edible themed gardens. Characteristic of the Bean family (Fabaceae), beans, also called legumes, have nitrogen-fixing bacteria in specialised root structures called root nodules. These bacteria take in nitrogen gas from the air and convert it to a form of nitrogen that plants can use. In crop rotation practised by edible plant growers, a leafy vegetable crop often follows a bean planting to take advantage of the nitrogen added to the soil by the legumes. In the garden, bean plants are best grown in moist and well-drained soils and must be given full sun exposure for healthy growth.

In this part of the world, most of us are familiar with the Long Bean, which is also called the Yardlong Bean, Snake Bean or Cowpea. There are various cultivars of this bean, which is known botanically as *Vigna unguiculata* subsp. *sesquipedalis.* The fruits are usually harvested when they are young and the seeds are still small and immature. The harvested fruits are prepared by cutting them into short sections and they can be consumed both fresh and stir-fried. Two interesting cultivars are what seed catalogues name as 'Chinese Red Noodle' and 'Thai Soldier'. Unlike the fruits of the common Long Bean which have a green exterior, those of the 'Chinese Red Noodle' are all red, while those of 'Thai Soldier' are green but streaked with purple. The fruits of the 'Chinese Red Noodle' tend to fade in colour slightly during cooking.

Long Bean plants are considered annuals as they decline soon after cropping. It is advisable to leave a few fruits to mature on these plants towards the end of the cropping cycle so that the seeds can be harvested for planting later on. Long Beans are climbers but do not grow large. They can be cultivated in large containers and effectively trained to grow on a trellis which can be used to add height to an outdoor vegetable garden. They are susceptible to aphid infestations and the fruits can be eaten by snails and slugs during the wet season.

Another commonly cultivated Asian legume is the Winged Bean, also known as the Four-angled Bean or Kacang Botol. Its botanical name is *Psophocarpus tetragonolobus*. In

The fruits of the 'Chinese Red Noodle' (left) and 'Thai Soldier' (right). *(Photo credit: Nuradilah Bte Aidi)*

The fruits of the Winged Bean (left). Although not as common as the blue-flowered variety, the white-flowered variety (right) of the Winged Bean is sometimes encountered in Singapore.

Singapore, the blue-flowered variety is the most commonly cultivated, although there is also a variety that produces white flowers. Locally, the immature, tender pods, usually produced in abundance, are sliced thinly and either enjoyed raw in a salad or stir-fried in spicy prawn paste (*sambal*).

Winged Beans are larger and more vigorous climbers than Long Beans and can easily take over a fence. Unlike Long Beans, they are perennial and continue to grow after numerous cropping cycles. New plants need to be started from fresh seeds. Their fruits are often difficult to spot as they blend very well with the plants' dense foliage. Winged Beans are sometimes planted in ecological gardens to serve as food for the caterpillars of the Common Sailor (*Neptis hylas papaja*). They are generally disease-free but their leaves are commonly attacked by spider mites.

The flowers, fruits and foliage of the Lablab Bean.

Seeds of the Sword Bean.

The flowers (left) and a developing fruit (right) of the Sword Bean.

The next legume may not be familiar to many Singaporeans. The immature, tender seedpods of the Lablab Bean (*Lablab purpureus*) are sold mostly in ethnic markets like those found in Little India. It is also known as the Dolichos Bean or Hyacinth Bean. Numerous cultivars exist which produce fruits that vary in shape, size and colour. The immature fruits are sliced and cooked in a variety of ways, such as in stir-fries and in curries. The dried mature seeds are reported to be toxic and need to be boiled and the water changed during the boiling process to eliminate toxic cyanogenic glucosides before they are safe for consumption.

The Lablab Bean is a medium-sized vine and can be considered a long-lived annual. There is a particular variety known by the name 'Ruby Moon', which is grown and admired for its highly ornamental red-tinged foliage and deep purple flowers and fruits. The flowering and fruiting shoots may be harvested for short-term floral displays. Note that some varieties of the Lablab Bean are affected by day length and those that require long periods of darkness (known as 'short day' plants) may not flower and fruit in Singapore. In general, Lablab Bean plants are not bothered by pests and diseases when grown under optimal conditions locally.

The Sword Bean or Jack Bean is a legume that was introduced to the local nursery trade as a novelty item. The large red seeds of *Canavalia gladiata* were once sold inside small ornamental pots or egg-shaped containers with a small quantity of vermiculite provided as growing media. Its seeds were often laser-engraved with auspicious 4D lottery numbers or short greetings, which would be revealed on the newly emerged cotyledons after the seed germinated. There is also a Sword Bean that produces white seeds. This was formerly considered a separate species, *Canavalia ensiformis*, but genetic studies have led scientists to regard it instead as a different form of *C. gladiata*. Both forms can be found in local community gardens. Their slightly curved seedpods grow quite long, and when mature, they bear some resemblance to swords.

Like the Lablab Bean, the young fruits of the Sword Bean must be cooked before eating. The mature seeds contain anti-nutritive substances and require soaking and several rounds of boiling before they can be consumed. The seeds are a source of urease, an enzyme which is used in molecular biology. The Chinese *Materia Medica* documents that the dried seeds of the Sword Bean, referred to as Semen Canavaliae, possess the properties of being able to warm the spleen and stomach.

Of the legumes described here, the Sword Beans are perhaps the most pest and disease resistant of all. They are generally fuss-free and highly adaptable. Locally, they behave largely as perennials and being vigorous vines, they require space to grow and a large trellis to climb on.

To learn more about growing beans and other edibles in Singapore, stop by NParks' next Community Garden Festival. This event will be held at HortPark from 3 to 5 November 2017.

Wilson Wong
Horticulture and Operations

All photos by Dr Wilson Wong, unless otherwise indicated.

Dragon Fruit explained

A familiar and popular fruit in Singaporean markets is the dragon fruit. I suspect few of those who purchase these delicious fruits realise that they are produced by a vining cactus, or rather vining cacti (plural), since there is more than one species involved. I have heard people remark that the three different kinds on offer are varieties of the same plant, but this is definitely not the case, so here I will explain and illustrate their different identities.

Dragon fruits are produced by species of the genus *Hylocereus*, all of which originate from the tropical parts of the Americas, including the Caribbean, although two of the species discussed here are commonly cultivated in tropical Asia (especially in Thailand and Vietnam) and may thus appear to belong here. The name refers to *Hyle*, Greek for 'forest', and *Cereus*, the name historically used for various kinds of columnar or elongate-cylindrical cacti (in the modern sense *Cereus* is used for a smaller group of 20–30 species of columnar cacti). A recent alternative classification merges *Hylocereus* with *Selenicereus*, the Queen of the Night genus. In nature these plants climb on trees or rocks by means of the abundantly produced aerial roots and can be classed as epiphytic climbers. At maturity the stems are triangular with one surface usually adpressed to the branch of the host tree or rock face. The flowers that precede the fruits are amongst the largest in the Cactus family (Cactaceae) and are even amongst the largest of any flowering plant, save for giants like *Rafflesia*. The flowers can be nearly 40 cm long and open to be as much as 30 cm wide. They expand as night is falling and close for good the following morning after exhaling a powerful sweet fragrance during the night to attract hawk moths and sometimes bats.

The three species illustrated here with their respective stems are, from left to right, *Hylocereus megalanthus*, *H. triangularis* and *H. undatus*. The yellow-fruited *H. megalanthus* from the northern Andes (Colombia to Peru) is not closely related to the others, as it is classified in *H.* subgenus *Salm-Dyckia*, while the other two are in *H.* subg. *Hylocereus*. The subgenus *Salm-Dyckia* is characterised by having spiny young fruits as opposed to the scaly fruits in subg. *Hylocereus*. At maturity, however, the spines on the fruit of *H. megalanthus* fall off to enable it to be more easily eaten and its seeds dispersed by animal vectors in habitat. As can be seen in the photograph reproduced here, this species also has much larger seeds than the other two. The yellow fruit is cultivated in Ecuador and Colombia then flown to Singapore, making it rather expensive at $15 per fruit (!), but in compensation it is extremely sweet. It can be seen in cultivation in at least one location in Asia, namely at the Tropical Fruit Farm situated on the north-west slopes of Penang Island, Peninsular Malaysia. The stem is easily distinguished from the other two species by having the spine clusters (areoles technically speaking) raised upon the undulating ribs, a feature which no doubt aids the plant to climb in habitat.

From left to right: *Hylocereus megalanthus, H. triangularis* and *H. undatus*. The hair-like structures on the stems are aerial roots. *(Photo credit: Nigel Taylor)*

The large, rather broad fruit of the Caribbean *Hylocereus triangularis* has beetroot-coloured pulp and when harvested at full ripeness is also rather sweet. However, I suspect it does not travel as well as the others and may thus be picked before it is fully ripe, causing its flesh to be less than optimally sweet. Its stem ribs are straight-sided with green edges and as a seedling and juvenile plant it retains four to five ribs for much longer than the other species before the adult triangular stem is developed.

The commonest Dragon Fruit species on sale in Singapore is *Hylocereus undatus*, with white fruit pulp and the smallest seeds. This species was first described from cultivation in China and its wild origin is not known for certain, though it is surely from the American tropics. While it may not be known in the truly wild state, it has become naturalised in many places, even in Singapore, where it can be seen invading trees in East Coast Park and along Margaret Drive in Tanglin. The stems have ribs with a characteristically corky edge as can be seen in the photograph.

The fruits illustrated here were obtained from Tiong Bahru Market on the advice of NParks' Lilian Kwok. The stems illustrated for each are from the author's private garden and were raised from seed some years ago. They can also be seen at the Singapore Botanic Gardens at the Sun Garden and in the Bukit Timah Core (Eco-Lake area). If cultivating these plants for their fruit, a very sunny location is needed and more than one clone of each species will be required, as like most cacti these plants are usually self-incompatible, i.e. pollen from a genetically different individual will be needed to achieve fruit set.

Nigel P. Taylor
Group Director, Singapore Botanic Gardens

A blooming giant alien …

At the end of last year, near the *Ensete* collection located at the far end of Palm Valley, an unusually large green spike was observed protruding from a medium-sized plant that looked like the well-known Traveller's Palm, *Ravenala madagascariensis*. However, on closer inspection, it turned out that the plant was not a Traveller's Palm but rather a close relative, *Phenakospermum guyannense*. Known as the South American Traveller's Palm, Big Palulu or Patuju Gigante, the plant in question was purchased by the Gardens in 1994, and this was the first time that it had flowered. An extraordinary event to witness!

The genera *Ravenala* and *Phenakospermum* both belong to the family Strelitziaceae. Also in this family are the Strelitzias (Bird-of-Paradise plants). Members of this family have a strong resemblance to one another, and to an untrained person may even look identical. In fact, the South American Traveller's Palm and the more commonly cultivated Traveller's Palm are easily mistaken for each other due to their similarity in form and habit. One obvious difference between them is that the former produces terminal inflorescences while the latter's are produced laterally.

The South American Traveller's Palm that recently bloomed for the first time in the Singapore Botanic Gardens.
(Photo credit: Nura Abdul Karim)

A close-up of the large inflorescence with its creamy flowers protruding out of the green bracts.
(Photo credit: Nura Abdul Karim)

Phenakospermum guyannense is a rather large, rhizomatous, arborescent species that forms clones with palm-like pseudostems that grow around 7 to 8 m tall, and erect, leafy shoots that can range from 3 to 10 m in height at reproductive maturity. The leaves have a long petiole and resemble those of a banana; they are arranged at the top of the trunk in a fan-like shape. The stalk of the remarkably large inflorescence emerges conspicuously above the leaves to reach a height of about 3 to 4 m. The boat-like green floral bracts, which are very similar to those of the Bird-of-Paradise, appear distichously, with four to six on either side of the stalk. Each bract contains up to 25 cream-coloured flowers that are hermaphrodite. The flowers emerge from the bracts just before sunset, and are receptive for only a single night, but the whole inflorescence can continue to produce flowers for as long as two months.

The South American Traveller's Palm is naturally distributed throughout the Amazônian Basin, where it is abundant in transitional habitats between tall wet forests and open areas of savannah. People in the northern and central areas of its range use its large leaves as roofing material. In Brazil, the leaves are also used to wrap fish. The seeds are collected and used as beads for making accessories, and it has also been recorded that they are cooked and eaten by some indigenous people.

In its natural habitat, flower-visiting bats in the genus *Phyllostomus* have been observed to be its main pollinators. Once the flowers are successfully pollinated, they develop into woody capsules containing small black seeds (approximately 8–10 mm long and 6–8 mm wide) with bright red-orange, thread-like arils. The seeds are most likely dispersed by birds that are attracted to the arils which are exposed when the fruit capsules split open at maturity. After flowering and seed-set is complete, the individual trunk dies off but the rhizome and rest of the clump continues to live.

So this year, staff and visitors were indeed fortunate to witness the giant alien-like inflorescence of the South American Traveller's Palm, which waited more than 20 years to bloom at our Gardens. Although it has succumbed, we look forward to the flowering of our other specimens in the future.

Nura Abdul Karim
Library, Training and External Relations

Reaching out to connect …

A group photo to mark the occasion of the visit. From left to right: Dr Nura Abdul Karim (Singapore Botanic Gardens), Mr Richard Piacentini, Dr Christopher Dunn, Mrs Mary Pat Matheson, Mr Kenneth Schutz, Mr Paul Redman, and Dr David Middleton (Singapore Botanic Gardens). *(Photo credit: Benjamin Aw)*

On 10 January 2017, the Singapore Botanic Gardens had the honour of hosting heads of five leading public gardens from the United States of America. The group comprised Mrs Mary Pat Matheson, President and CEO of the Atlanta Botanical Garden (Atlanta, Georgia), Dr Christopher Dunn, Executive Director of Cornell Botanic Gardens (Ithaca, New York), Mr Kenneth Schutz, Executive Director of the Desert Botanical Garden (Phoenix, Arizona), Mr Paul Redman, President and CEO of Longwood Gardens (Kennett Square, Pennsylvania), and Mr Richard Piacentini, Executive Director of Phipps Conservatory and Botanical Gardens (Pittsburgh, Pennsylvania).

The distinguished visitors were here to view for themselves the diversity of the Singapore Botanic Gardens' tropical plant collections. They were also interested in learning about collaborative conservation efforts between the Botanic Gardens and NParks' Conservation division. Teams from these two branches of NParks have been working together to document the flora of Bukit Timah Nature Reserve, as well as to propagate and reintroduce threatened plant species back into its rainforest habitat.

It is not often that we have the opportunity to host such a number of important leaders from other botanic gardens, and it was especially exciting that they agreed to give a presentation to NParks' staff, volunteers and invited guests while here. During the presentation, entitled 'American leading gardens – what they do and how they do it', each speaker talked for about 20 minutes about their respective garden, highlighting their unique living collections and conservation work, among other topics. Mr Redman spoke about Longwood Gardens' international educational programmes for advancing botanical garden management and horticulture, and Mr Piacentini from Phipps spoke about the use of new technology to build and operate award-winning green buildings such as their Welcome Center, production greenhouses and Tropical Forest Conservatory. All of the presentations were stimulating and very informative, and undoubtedly inspired the listeners with ideas that might be applied in Singapore as well.

This visit was undisputedly beneficial to both sides, as we were able to learn from each other and establish potential avenues to allow us to work together in the future. For instance, Singapore Botanic Gardens was invited by Longwood Gardens to host interns from their prestigious Longwood Fellows Programme, and we look forward to this collaboration in the coming years.

Nura Abdul Karim
Library, Training and External Relations

NParks signs a Memorandum-of-Understanding with the Sabah Forestry Department

On 9 February 2017, the Singapore Botanic Gardens hosted members from the top echelon of the Sabah Forestry Department (SFD). The reason for the visit was to officially sign a Memorandum-of-Understanding (MoU) agreement with Singapore's National Parks Board (NParks).

The MoU was signed in a simple ceremony at Ridley Hall by the CEO of NParks, Mr Kenneth Er, and Datuk Sam Mannan, the Chief Conservator of Forests at SFD. Also present to witness the signing were Dr Nigel Taylor, Group Director of the Singapore Botanic Gardens, and Mr Frederick Kugan, Deputy Chief Conservator of Forests (Forest Sector Planning) at SFD.

The scope of the MoU covers, amongst other things, the exchange of knowledge and skills between the two institutions in relevant areas of botanical interest, including capacity building in the curation and management of living collections, herbarium management, floristic and molecular studies, and conservation work. The agreement will be in effect for five years.

Briefing to the Sabah Forestry team on the development of the Learning Forest. *(Photo credit: David Lim)*

The signing of the MoU proceeded with presentations on forest research, conservation and restoration by representatives from both NParks and SFD. Following the presentations was a brief tour of the Learning Forest, which was still under development at the time. The SFD delegation was also taken to the Bukit Timah Nature Reserve and Pulau Ubin for a look at some of the conservation efforts being carried out by NParks.

While the Gardens and SFD have had a long-standing working relationship, it is hoped that this agreement will facilitate more collaborations that will enable greater conservation of the diversity of flora and fauna in both Singapore and Sabah.

Nura Abdul Karim
Library, Training and External Relations

A group photo taken at the Learning Forest. *(Photo credit: David Lim)*

The 6th Southeast Asia Botanic Gardens Network Conference

Participants of the 6th Southeast Asia Botanic Gardens Network Conference. *(Photo courtesy of Biduop-Nui Ba National Park)*

The beautiful Bidoup-Nui Ba National Park in Dalat, Vietnam, was the venue of the 6th Southeast Asia Botanic Gardens (SEABG) Network Conference that ran from 24 to 28 April 2017. The meeting brought together more than 60 participants representing 20 countries from Southeast Asia, including Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. Also invited were colleagues from Australia, China, Papua New Guinea, the Seychelles, Sri Lanka, Taiwan, the United Kingdom and the United States of America. The conference was organised by the Bidoup-Nui Ba National Park and facilitated by Mr Joachim Gratzfeld, the Director of Regional Programmes of Botanic Gardens Conservation International (BGCI), and Ms Jean Linsky, the Coordinator of the SEABG Network.

The Bidoup-Nui Ba National Park was established in 2004 and is named after the two highest peaks of the Langbiang Plateau, Bidoup (2,287 m) and Nui Ba (2,167 m). With a total area of 70,038 ha, it ranks as one of Vietnam's largest national parks. It is home to at least 14 of the 33 conifer species known to occur in Vietnam, including the rare *Pinus krempfii*. With flat leaves rather than the standard needle-like leaves that most pines have, this interesting conifer looks like it should belong instead to the genus *Podocarpus*.

Besides the opportunity to admire the flora of the park, the conference included the biennial SEABG Network business meeting and a capacity building workshop. During the meeting, we had a discussion about the existence of national network groups in each member country to formulate cohesive and complimentary projects in conservation and/or education. Participants further discussed how to promote the formation of such networks in member nations currently lacking them.

During the meeting, participants were also encouraged to contribute details of their institutions to two online databases created by BGCI – GardenSearch, which contains general information about the world's botanic gardens, and PlantSearch, a global database of living plant collections. They were also asked to share interesting news of their institutions on the SEABG Network's social media site. These actions will help to promote Southeast Asia's botanical gardens to the rest of the world, and will also help to keep members abreast of the work being done by other botanical institutions within the network.

An early morning view of the pine forest and lake at the Bidoup-Nui Ba National Park.
(Photo credit: Nura Abdul Karim)

A close-up of the flat leaves of *Pinus krempfii*, which are atypical of pine trees.
(Photo credit: Nura Abdul Karim)

Another major part of the meeting was a lengthy discussion about possible collaborations and funding sources. There were a couple of projects mooted having to do with capacity building within the region and the conservation of 'exceptional species' (those that cannot be conserved *ex situ* through standard seed banking methods, generally plants that produce recalcitrant seeds). The participants all agreed that it might be effective for multiple organisations to combine their strength, capabilities and expertise toward one selected conservation initiative.

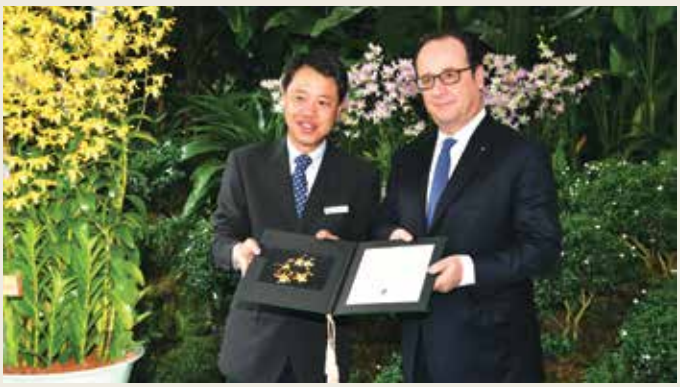
At the workshop, exceptional, woody species were a key focus. A taxonomic overview was given of the major groups of plants considered within this category, both at the global level and specifically in Southeast Asia. The experts also delved into how to prolong the longevity of seeds in storage via cryopreservation, and a couple of presentations looked into the challenges of ensuring the genetic diversity of living, *ex situ* collections of woody species of concern.

Overall, the conference was a resounding success. It generated many useful discussions and new ideas, and also opened possibilities of collaborations between various institutions within the network to work together to advance conservation in the region.

At the closing ceremony, it was announced that the next two SEABG meetings will be hosted by the Queen Sirikit Botanic Gardens in Chiang Mai (Thailand) in 2019, and by the Makiling Botanic Gardens in Los Baños (Philippines) in 2021.

Nura Abdul Karim
Library, Training and External Relations

January–June 2017



Mr Kenneth Er, CEO of NParks, with His Excellency Mr François Hollande, President of France, on the occasion of his visit on 27 March 2017.

His Excellency Mr Malcolm Turnbull, Prime Minister of Australia, and Mrs Lucy Turnbull, during their visit on 2 June 2017.

Prof. Ada E. Yonath, winner of the Nobel Prize in Chemistry, and **Prof. Tan Tiang Hugh**, National University of Singapore

Dr Akiyo Naiki, University of the Ryukyus, Japan

H.E. Ali bin Ibrahim Al-Naimi, former Minister of Petroleum and Mineral Resources, and Advisor at the Royal Court and Chairman of the board of the King Abdullah University of Science and Technology, Kingdom of Saudi Arabia

Dr Axel Dalberg Poulsen, **Dr Peter Wilkie**, Royal Botanic Garden Edinburgh, United Kingdom

Dr Bai Lin, South China Botanic Garden, People's Republic of China

Dr Barbro C. Axelius, Stockholm University, Sweden

Mr Ben Janse van Rensburg and **Mr Johannes Stahl**, CITES Secretariat, Geneva

Mr Bhanumas Chantarasuwan, National Science Museum, Thailand

Dr Brigitta Duyfjes, **Dr Jan-Frits Veldkamp**, **Dr Peter Hovenkamp**, **Dr Willem de Wilde**, Naturalis Biodiversity Centre, The Netherlands

Dr Bruce Maslin, Western Australia Herbarium, Australia

Dr Daike Tian, Shanghai Chenshan Botanic Garden, People's Republic of China

Ambassador Danny Danon, Israeli Permanent Representative to the United Nations

Dr Darin S. Penneys, University of North Carolina Wilmington, United States of America

Mr Dawud Mume Ali and **Mr Daniel Paulos**, Ethiopian Wildlife Conservation Authority

Delegation of attendees from the 5th Forum of Small States (FOSS), including **H.E. Mrs Aichatou Sanni Aoudou**, Gabon, **H.E. Mr Bocchit Edmond**, Haiti, **H.E. Mr Cenio Elwin Lewis**, Saint Vincent and the Grenadines, **H.E. Mr Derick Ally**, Seychelles, **H.E. Mr Guy Arlington Kenneth Hewitt**, Barbados, **H.E. Mr Guy Mayers**, Saint Lucia, **H.E. Dr Ivan Romero-Martinez**, Honduras, **H.E. Mr Jean-Marc Hoscheit**, Luxembourg, **H.E. Dr Kevin M. Isaac**, Saint Kitts and Nevis, **H.E. Ms Rhoda M. Jackson**, Bahamas, **H.E. Ms Saja S. Majali**, Jordan, **H.E. Mr Steve Katjiuanjo**, Namibia, **H.E. Mr Vojislav Šuc**, Slovenia, and **H.E. Ms Yvette Elizabeth Stevens**, Sierra Leone

Delegation of leaders from gardens in the United States of America, including **Dr Christopher Dunn**, Cornell Botanic Gardens, **Mr Ken Schutz**, Desert Botanical Gardens, **Ms Mary Pat Matheson**, Atlanta Botanical Garden, **Mr Paul Redman**, Longwood Gardens, and Mr **Richard Piacentini**, Phipps Conservatory and Botanical Gardens

Dzulmi Eldin, Mayor of Medan City, and delegation, including **IR Samporno Pohan**, **Khairul Synhnan**, **Muhammad Husni**, and **Dr H. Mussadad**, Indonesia

Dr Ethan Freid, Leon Levy Native Plant Reserve, Bahamas National Trust

Mr Fong Vai Seng, Head of Department of Environment, Macao Civic and Municipal Affairs Bureau

H.E. Mr François Hollande, President of France

Dr George W. Staples, United States of America

H.E. Mr Grigori Marchenko, former Honorary Consul to Singapore in Almaty, Kazakhstan

Ms Hetty Ford, Naples Botanical Garden, United States of America

Mr Igor Philtjens, Regional Minister of Tourism of Limburg, Belgium

Mr Jacek Bogucki, Minister of State for Agriculture, Poland, and delegation

Mr Jimmy Turner, Director of Horticulture, Botanic Gardens and Centennial Parks, Royal Botanic Garden Sydney, Australia

Mr Justin Schroeder and **Mr Ben Eiben**, Amazon.com, United States of America

H.E. Mr Kenji Shinoda, Ambassador of Japan to Singapore, **Mrs Yuko Shinoda**, and **Mr Kenichiro Iedo** and **Ms Junko Minagawa** from the Embassy of Japan in Singapore

Mr Khaw Boon Wan, Coordinating Minister for Infrastructure & Minister for Transport, Singapore, and family

Ms Laura Holzmeyer, Leipzig University, Denmark

Ms Liz Clarke, National Arboretum Canberra, **Mr Andrew Barr**, Chief Minister of the Australian Capital Territory, and staff, Australia

H.E. Mr Malcolm Turnbull, Prime Minister of Australia, and **Mrs Lucy Turnbull**, Australia

Dr Mark Coode, Royal Botanic Gardens, Kew, United Kingdom

Mr Muhammad Amirul Aiman, Universiti Kebangsaan Malaysia

H.E. Ms Nancy Lynn McDonald, High Commissioner of Canada in Singapore

Mr Neil McGregor, Group President and CEO of Sembcorp Industries

Mr Nguyễn Văn Trăm, Chairman of the People's Committee, and delegation from Binh Phuoc, Vietnam

Ms Penelope Belmonte, National Parks Development Committee, **Aimee T. Neri**, Department of Justice, and delegation from the Philippines

Prof. Sir Peter Crane, formerly of Yale University, and his research colleague, **Asst Prof. Vinod Kumar Saranathan**, YaleNUSCollege

Dr Robert Harwood, Forest Herbarium, Bangkok, Thailand

Dr Robin Wilson, The Alnwick Garden, United Kingdom

Dr Rogier de Kok, formerly of Royal Botanic Gardens, Kew, United Kingdom

Mrs Sally Thornberry, **Mrs Rebecca Byrne** and **Mrs Vivien Scott**, spouses of United States Congressmen, **Major Eric Skoczenski**, United States House of Representatives Liaison Officer, and **Nashwa Elgadi**, United States Embassy in Singapore

Datuk Sam Mannan, Chief Conservator of Forests, and delegation from the Sabah Forestry Department, Malaysia

Dr Santi Watthana, Suranaree University of Technology, Thailand

H.E. Sheikha Fatimah Bint Mubarak, Mother of the United Arab Emirates

Shinichiro Ito, **Kengo Minami**, **Sayoko Nagai** and **Miki Sakamoto**, Miyazaki Parks Association and Miyakoh Botanic Garden Aoshima, Japan

Mr Shinya Izaki, Urban Policy Division City Bureau, MLIT, Japan, and **Kenichiro Ieda**, First Secretary at the Embassy of Japan in Singapore

Ms Sukontip Sirimongkol, University of Dublin, Ireland

Ms Tamae Kawaguchi, **Ms Rie Fumoto**, **Mr Kenichi Yanai** and **Mr Akihiro Higaki**, Yokohama City Council, Japan

Dr Tao Xu, Jiangsu Normal University, People's Republic of China

H.E. Mr Thongloun Sisoulith, Prime Minister of Laos

Mr Trần Hữu Đăng, Southern Institute of Ecology, Vietnam

Mr Twu Shing-jer, Mayor of Chiayi City, and **Chen Bao-tung**, Aide to the Mayor and Director-General, Administration Department, Taiwan

Dr Vivian Balakrishnan, Minister of Foreign Affairs, Singapore

Dr Wu Shasha, Fujian Agricultural and Forestry University, People's Republic of China

Dr Yong Kien Thai, University of Malaya, Malaysia

Dr Zhai Junwen, Fujian Agricultural and Forestry University, People's Republic of China

The Tea Kiosk

In 1950, a large tea kiosk was built on Lawn H. With overhanging trees and overlooking Swan Lake, it provided refreshments for visitors and staff for 35 years. Casually referred to as the Tea Kiosk, Orchid Garden Snack Bar and Botanic Gardens' Café, it offered light meals like sandwiches, salads and baked goodies and was known for having excellent coffee. The kiosk provided a perfect spot for visitors to take a break while exploring the Gardens. Open from 8.30 am to 10 pm each day, according to the *Straits Times* in March 1985, it offered local dishes like *mee siam*, *laksa* and *popiah* at $1.90 each, fried rice and Hong Kong style noodles for $2.90, and western food like steak and lamb chops for $5.90 each. With a rating of 8 out of 10, it was deemed to be pretty good by the paper.

I personally had the opportunity to eat at the café, and indeed it was a very pleasant experience. Swans and ducks swam leisurely while children ran around the grounds,

and the traffic noise from the busy Holland Road was blocked out by the Gardens' trees. The kiosk itself was rustic with simple formica seating. A few steps down from the building, stone tables offered additional seating with large umbrellas for shade.

It was unfortunate for the tea kiosk that the well-known Taman Serasi Hawker Centre was located across the street from Tanglin Gate. With famous dishes like *sate*, *mee rebus* and *roti john*, along with fruit juices and *teh terik*, the hawker centre drew locals and tourists for breakfast, lunch and dinner. On 25 December 1985, a fire broke out and destroyed the tea kiosk, and because of the famous hawker centre across the street, a new kiosk was never built.

Christina Soh
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