Gardenwise

The Magazine of the Singapore Botanic Gardens · Volume 56 · February 2021 · ISSN 0129-1688

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Volume 56 · February 2021

Articles

Regular Features

Cover
Esther's Heliconia, a stunning plant featured in this edition of 'Ginger and Its Allies'.
(Photo credit: Jana Leong-Škorničkova)

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Message from the Director

The Education and Outreach team run a variety of environmental education programmes that help to inspire the youth to connect with nature and foster pro-environmental attitudes. Here, students from Tanglin Secondary School are participating in a four-session habitat enhancement programme that involves hands-on activities such as tree planting, wildlife surveys and plant recording. *(Photo credit: Steffi Loe)*

The release of *The Economics of Biodiversity: The Dasgupta Review* by Professor Sir Partha Dasgupta in February 2021 is a much-needed boost to nature conservation. Many of us in this field are acutely aware that the progress in our material well-being over the past few decades has come at the expense of nature, but yet, we seem incapable of breaking out from our current systems with our mindless pursuit of growth. By 'we', I refer to human societies in general, and by 'systems', I refer to global trade systems, food systems, global resource consumption, etc., that fundamentally deplete rather than conserve Nature. Many of us will also agree that unless there are transformative actions that arrest the precipitous decline in biodiversity, we will sooner than later cross a 'tipping point', to the detriment of the well-being of current and future generations.

The *Dasgupta Review* is a high-profile report that has already received attention worldwide, with several key messages which I will not repeat here. In reading the report, one recommendation struck me as particularly meaningful to our work in the Gardens, and I share my perspective on how the Gardens can also contribute to supporting this recommendation.

The *Review* highlights a logical but conveniently forgotten fact, that "the discipline to draw on Nature sustainably must, ultimately, be provided by us as individuals". The immediate hurdle to this, however, is that modern living has made us disconnected from Nature, and given us the false sense that the built capital that is pervasive in urban living is an adequate substitute for the capital from Nature, or 'natural capital' for our well-being. The *Review* dismisses this. Therefore, if there are more people who are aware of the consequences of our material consumption and habits on Nature, believe in the impact of personal lifestyle choices, avoid products that have a negative environmental impact, and lend support to the environmental sustainability movement, then surely, the collective clout consumers bring must be significant enough to spur transformations in the way that major businesses deal with Nature. The *Review* thus recommends transformation of our educational systems to systematically incorporate environmental education, among others, as a step towards building a more sustainable relationship with Nature.

The Gardens can contribute to this in at least three ways. First, it must continue to ensure that our landscapes inspire in our visitors an appreciation of the beauty and wonders of Nature. The Gardens' landscapes, from their design to maintenance to collection curation, should epitomise the spirit of biophilic design and forge an emotional connection between people and the natural world.

Second, the Gardens should push on in its environmental education efforts. The Education and Outreach team has, for several decades, done a marvelous job in educating generations of school children as well as adults on the environment and gardening. With the recent adoption of an environmental education framework to guide its efforts (see *Gardenwise* volume 55, pages 31 to 34), accompanied by a shift in its programme offerings towards those that are more explicitly about driving pro-environmental attitudes and behaviour, we hope that this will bring about a gradual, but steady change in participants who are more inclined to care for Nature in their daily activities.

Third, the Gardens must also embrace environmental sustainability as a core value in the way it runs in operations, and reduce to the minimum possible, the ecological footprint arising from its activities. This calls for a broad-based adoption of this value across all levels of the Gardens' staff, guided by a framework to pursue environmental sustainability as a long-term journey. Through this approach and over time, we will also want to be the instigator of change among our peers in gardens and parks management. The Gardens' environmental sustainability framework is currently being developed, and I will be glad to share more details in the next editions of *Gardenwise*.

Tan Puay Yok
Group Director
Singapore Botanic Gardens

In Memorium: Christina Soh Jeng Har (1955–2020)

(Source: The Straits Times © Singapore Press Holdings Limited. Reprinted with permission)

On 21 October 2020, the Singapore Botanic Gardens lost one of its most dedicated employees, Christina Soh Jeng Har, due to cancer. Chris, as she was fondly known among colleagues and friends, was 65 when she passed away. The disease was discovered early in 2020, and she fought hard against it for months with moral support from a close-knit group of friends and family. Uncertain as to how long the battle might take before she would fully recover, she tendered her resignation as manager of the library, and left service by the end of June. Unfortunately, her condition took a turn for the worse. Chris succumbed to the disease and passed away peacefully at a hospital surrounded by her siblings.

(Photo courtesy of the Soh Family)

Delegates of the 1992 workshop on an ethnobotany database training held at the National Library of Singapore (Chris is standing in the front row, seventh from the left).
(Photo courtesy of the Soh Family)

Chris (right) with Mrs Mary Kogan, author and journalist, in the stacks at the old library building in the 90s.
(Photo courtesy of the Soh Family)

Chris was born on 15 October 1955, in Singapore. She was the daughter of Mr Soh Thye Peng and Madam Cheong Soo Peng, and the second child of four siblings. As her father worked at the Middleton Hospital (the present-day National Centre for Infectious Diseases, off Moulmein Road), she spent some of her childhood years living in the staff quarters. She reminisced once to me of her family's walking trips to the Newton Food Centre for supper. Upon completion of her Singapore-Cambridge General Certificate of Education Advanced Level (GCE A-Level) examination, she joined the clerical staff at the Ministry of Finance in 1973, and her office was located at the General Post Office Building (now the Fullerton Hotel Singapore). After a few years, she realised that she did not want to pursue a career in accounting and joined the National Library as a library technician. She was posted to the Bukit Merah Public Library before being seconded to the Botanic Gardens' library in 1983.

The library of the Singapore Botanic Gardens, together with the herbarium, was established in 1875 by the British. Since the library's inception, its staff have played an important role in supporting botanical research activities carried out by resident and visiting botanists at the Gardens. For over three decades, with the support of various past and present library staff such as Mr Che' Aziz, Madam Rohanah binte Mohaimin, Madam Soh Qiu Xian and Ms Zakiah binte Agil, Chris performed that role with upmost dedication and professionalism not just to botanists and scientists, but also other staff of NParks. She also went the extra mile to assist members of the public. The library consists of two reference sections, one reserved for staff and the other available to the public. During Chris's stewardship, the staff library's collection grew from 20,000 to more than 30,000 books, while the public reference section contained over 2,000 books at the time that she left service. Besides overseeing the library, she was responsible for managing and preserving the Gardens' important archives, such as botanical artwork dating as far back as the 1890s, maps, catalogues, and many other artefacts. Apart from that, for many years, she was also tasked with the responsibility of distributing, storing and overseeing sales of all of NParks' publications.

Her devotion and love for the library and the Gardens were not a secret to those of us who were close to her. Chris, together with Zakiah, survived three back-breaking moves of the library's collections, most recently in

We made it to the finals!!! Chris (front row, third from left) was part of an energetic and talented group of young officers from the Gardens who competed in 'Sing Singapore', a public sector competition held in 1988. The Gardens finished as runner-up in the highly competitive contest. *(Photo courtesy of the Soh Family)*

Chris (front row, second from right) and fellow athletes with their trophies won at the 3rd Ministry of National Development Recreation Club (MNDRC) cross country competition, held in 1987 at the MacRitchie Reservoir. *(Photo courtesy of the Soh Family)*

2016 to accommodate the installation of a compactor system in the staff library section. She preferred to pack up the entire collections in-house to ensure that they were kept safe. While the Gardens' library has an online catalogue to search for book titles in the collections, many staff preferred to seek help from Chris instead, as her exceptional memory would often guide us directly to the shelf without having to refer to the online catalogue or even the library card system.

In her nearly 40 years of service in the library, the most memorable project that she had undertaken was being part of the team in supporting Singapore's bid to nominate the Gardens for UNESCO World Heritage status. In 2011 and 2012, she was sent to the Royal Botanic Gardens, Kew, in London. There, she spent weeks scanning through boxes of archival materials, mostly handwritten letters dating as far back as the mid-1800s, in search of information pertinent to the Gardens' history. The Gardens was inscribed as a UNESCO World Heritage site in 2015, and the team's effort was duly recognised with a Minister's Award from the Ministry of National Development. To many of us, her work-life motto seemed to be "The early bird catches the fattest worm", as she would leave home on the first train to work every day.

Those of us who worked and interacted with Chris would agree that she was an extremely kind, generous and down-to-earth person. Her good nature was reflected in the number of friends that she kept in contact with over the years, some since her primary school days. Chris was a keen naturalist and an avid hiker, and during her younger days she scaled Mount Tahan, the highest peak in Peninsular Malaysia, three times. Her love for animals was an open secret, as her office cubicle walls were adorned with photos of beloved pet cats and dogs which had passed away. Chris was also a mineral and gemstone enthusiast, as well as an avid book lover, especially on subjects related to Singapore. She is survived by her sister Margaret and brothers Michael and Jack, along with sisters-in-law, numerous nieces and nephews, a grandniece and a grandnephew.

In a 2015 interview for *The Straits Times*, when she was already 60 years old, she professed that she still had much work left to do in the library. This especially included the processing of close to 4,000 archival records in storage requiring digitisation and restoration. Her untimely departure was an ultimate loss to the Gardens.

Low Yee Wen
Herbarium

The author would like to acknowledge the input of Mr Ali bin Ibrahim, Ms Zakiah binte Agil, Mr Michael Soh and Mr Rehan bin Yusoff, which is very much appreciated.

Return of a giant reed – the *Phragmites karka* story

In January 2019, while on a trip to Kranji Marshes to collect plant samples for the ongoing Flora of Singapore project, staff from the herbarium noticed several patches of tall reeds growing near the Raptor Tower. What immediately caught our attention was that these grasses were much taller than any that we had previously encountered in our routine wildflower surveys. Most of the larger grass species in Singapore are less than 2 m tall even in flower, but the stands we were looking at were almost twice that height. A number of the flowering stems were well over 3 m, with a few coming close to 4 m in height.

(Top left) *Phragmites karka* in Kranji Marshes, with plants well exceeding 3 m in height. (Top right) The large, feathery inflorescence. (Above) A close-up of the inflorescence. *(Photo credits: Lily Chen)*

Puzzled by what this tall reed could be, we decided to collect a specimen for further investigation. Detailed photographs of the specimen were subsequently sent to our colleague Dr Leni Duistermaat in Leiden, an expert on the Poaceae who was contributing to the taxonomic account of the family for the *Flora of Singapore*.

To our surprise, the plant turned out to be *Phragmites karka*, or the Common Reed. Though this native species does live up to its name as being common elsewhere within its extensive range (tropical Africa to Japan, down through mainland Southeast Asia and to the Pacific Islands), it is certainly not so in Singapore. In fact, the species has not been seen locally for more than 140 years, since it was collected by Henry Ridley from a "freshwater isle" in Pulau Bukom in the 1880s.

But there was one more question on our minds – could the plants have been introduced from a horticultural source, since the specimens were growing in a publicly accessible, redeveloped area? A quick check by the team managing the marshes revealed that the plants were indeed planted, but they had been propagated from individuals already present in the vicinity prior to its conversion into a protected area. One of the key ideas for the redevelopment of the marshes was to amplify the natural vegetation to create more areas where birds and wildlife could take refuge. The managing team, together with the help of a horticulturist, propagated some of the existing vegetation, including the tall reed, and subsequently transplanted this material into other parts of Kranji Marshes.

In the taxonomic account detailing the Poaceae in the *Flora of Singapore* (volume 7, published in October 2019), Dr Duistermaat listed the provisional conservation assessment for *Phragmites karka* as being 'Data Deficient'. This was because, although we had recorded

Two of the taller specimens that have been successfully propagated by the Native Plant Centre.
(Photo credit: Cherish Yong)

Plants propagated from older culms are already forming plantlets of their own (indicated by blue arrow) that can be used for future propagation. *(Photo credit: Cherish Yong)*

the species at Kranji Marshes before the volume was published, the actual population size at the nature area had not yet been estimated. Currently, the team managing Kranji Marshes is surveying the area to assess the number of plants present, in order to determine the conservation status of the species in Singapore. Based on this, corresponding measures will be developed for the long-term survival of this species in the area.

In the wild, this tall, majestic grass with feathery flower heads is associated with wetlands and freshwater marshes, where it forms large and continuous stands if the growing conditions are ideal. The dense growth creates hiding places and nesting sites for waterfowl and numerous wetland animals, and the seeds provide food for birds.

Phragmites karka is not just a plant in the landscape or useful as a refuge for wildlife – studies have shown that the species is highly effective in removing excessive nutrients and heavy metals from waterbodies. It is hence an ideal candidate for use in phytoremediation and can be planted in or near waterbodies to prevent algal blooms where there tends to be high levels of fertiliser run-off from surrounding areas.

While Kranji Marshes may be the only place in Singapore where you can currently see this species, the herbarium is collaborating with two other teams in NParks, the Native Plant Centre and the team managing Kranji Marshes, to propagate it for introduction to the Singapore Botanic Gardens. Although this is a clumping species that can be easily propagated by division, this method was ruled out to minimise disturbance to the existing population. Thankfully, upon further examination of the plants in Kranji Marshes, we located several individuals bearing aerial plantlets along the nodes of the stems. A portion of these plantlets were harvested and used for propagation by the Native Plant Centre.

It is estimated that the plants will be ready in the next one to two years for transplanting into the Gardens, where they can be featured in and around the waterbodies. Subsequently, the Native Plant Centre also intends to make more plants available for distribution to urban parks around Singapore, where they can be planted into floating plant platforms to enhance habitat for biodiversity.

Lim Hui Xuan
Yang Shufen
Sungei Buloh Wetland Reserve

Cherish Yong
Native Plant Centre

Lily Chen
Herbarium

Arundina graminifolia and *Spathoglottis plicata*, two common orchids in Tengah

Singapore has 224 species of native orchids. Of these, 154 are Presumed Nationally Extinct, 62 are Critically Endangered, three are Vulnerable, and only five are considered to be common. The most common species in Singapore is the epiphyte *Dendrobium crumenatum*, while the other four common orchids are terrestrial species, *Arundina graminifolia, Bromheadia finlaysoniana, Eulophia graminea* and *Spathoglottis plicata.* In September 2020, we came across two of these terrestrial orchids, *Arundina graminifolia* and *Spathoglottis plicata*, growing in the Tengah forest in the western part of Singapore.

Tengah is currently being developed into a new HDB (Housing and Development Board) town. It is bounded by Choa Chu Kang to the northeast, Jurong East and Jurong West to the south, Bukit Batok to the east and the Western Catchment to its west and north. The Tengah area used to be home to *kampungs* and plantations, and brick factories were set up there in the 1960s, but villagers began moving out in the 1980s. Secondary forests and other spontaneous vegetation types such as open grasslands have regenerated since then. One of these grasslands is where we spotted the two beautiful orchids *Arundina graminifolia* and *Spathoglottis plicata*, growing in the full

The grassland habitat where we encountered *Arundina graminifolia* and *Spathoglottis plicata* growing together, with secondary forest in the background.

***Arundina graminifolia* growing amongst the fern *Cyclosorus interruptus*.**

***Arundina graminifolia* has slender bamboo-like leaves.**

sun. Besides wild grasses, we also noted large populations of *Cyclosorus interruptus* (the Hottentot Fern or Swamp Shield-fern), scattered shrubs such as *Dillenia suffruticosa*, and several species of low-growing weeds amongst the grasses.

Arundina graminifolia is commonly called the Bamboo Orchid because of its slender bamboo-like leaves. The size of the flowers varies considerably, ranging from 4 to 8 cm across. The petals and sepals are white and flushed with purple towards the tips, and the prominent purplish-red lip resembles that of a *Cattleya*. It is a very beautiful, free-flowering plant that makes it a popular species for landscaping. It is also one of the most common orchids found throughout Southeast Asia, in open grassland habitats from the lowlands to several thousand metres in elevation. It can be found in Borneo, China, India, Indonesia, Japan, Laos, Myanmar, Nepal, Peninsular Malaysia, Singapore, Thailand, Vietnam, the Philippines and the Pacific Islands. Locally it has

***Arundina graminifolia* produces flowers all year round.**

Seed capsules of *Arundina graminifolia*, suggesting the presence of pollinators around the Tengah forest.

The attractive flowers of *Spathoglottis plicata*.

been recorded in many areas, with herbarium specimens having been collected from Sembawang, "Peirce Reservoir" (as indicated on the herbarium voucher) and Simpang, as well as along Lentor Avenue, Chestnut Drive and Jurong Road. In the Tengah forest, we found several hundred individuals growing in the large open grassland, where we observed them flowering profusely. Some also had seed capsules, suggesting the presence of natural pollinators in the area.

Spathoglottis plicata is a robust plant which produces crowded pseudobulbs at its base, with each pseudobulb bearing three or four large leaves. The inflorescence can reach 1.5 to 2 m in length and bear 20 to 30 flowers. There are two varieties of the species found locally, one with dark pink flowers and the other an alba form. It is also used as an ornamental in Singapore, and cultivated varieties that produce fully open flowers are selected for landscaping and breeding. In fact, the first hybrid produced by Eric Holttum, assistant director and then director of the Gardens between 1922 and 1949, was a cross between *Spathoglottis plicata* and *S. aurea*, *Spathoglottis* Primrose. The species occurs naturally in Borneo, China, India, Indonesia, Laos, Myanmar, Peninsular Malaysia, Singapore, Thailand, Vietnam, the Philippines, Papua New Guinea and the western Pacific including Tonga and Samoa. It is a self-pollinating species that develops seed capsules spontaneously after flowering, usually resulting in a large number of seed capsules being formed on a single inflorescence. This undoubtedly helps to explain the large population that we encountered at Tengah in September 2020, and why it is the most common terrestrial orchid in Singapore.

The development of Tengah will revolve around nature and the community. Part of the secondary forest habitat will be kept, and more species of local rainforest

Dozens of *Spathoglottis plicata* individuals scattered in the grassland, thriving in the full sun.

***Spathoglottis plicata* self-pollinates and produces seed capsules spontaneously after flowering.**

The inflorescence of *Spathoglottis plicata* can bear up to 30 flowers.

trees will be planted as part of habitat enhancement efforts. Other forested areas, such as a forest corridor, will be incorporated into and around the town as well. We will work with our colleagues and HDB to see if these orchids can be incorporated into the planting palette of suitable park spaces in the new town.

Yam Tim Wing
Research and Conservation

All photos by Dr Yam Tim Wing

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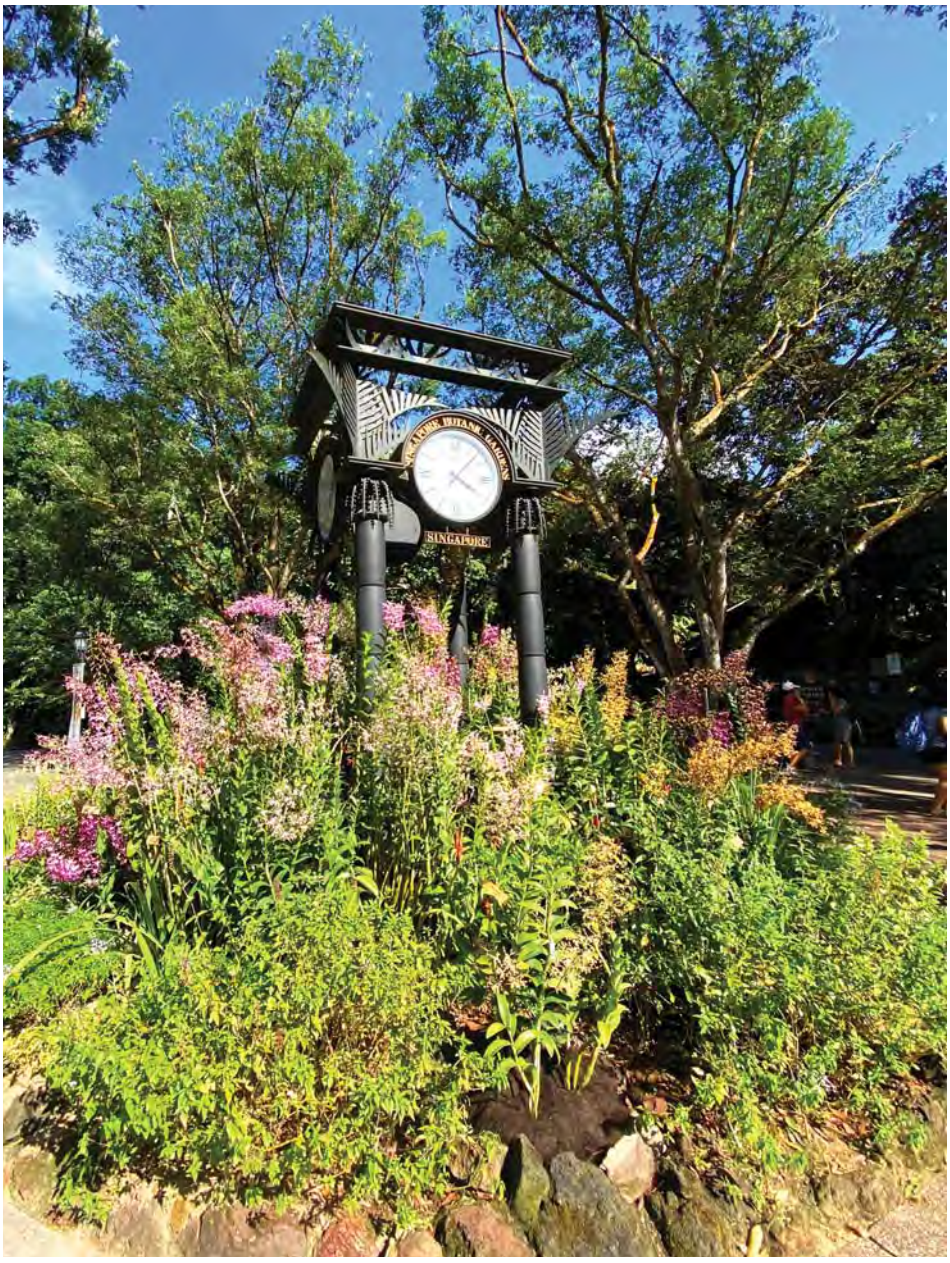
A celebration of orchids at the Heritage Festival



During the Heritage Festival, visitors were treated to a colourful display of vibrant antelope dendrobiums landscaped around the clock tower at the entrance to the National Orchid Garden. *(Photo credit: Tan Zhijian)*

The annual Singapore Botanic Gardens' Heritage Festival celebrates the rich heritage of Singapore's first UNESCO World Heritage Site. The most recent instalment was held from 24 October to 1 November 2020, in conjunction with the Community Garden Festival, and included a special exhibition of orchids in and at the entrance to the National Orchid Garden. The exhibition featured heritage orchids with varieties of species and hybrids from the Gardens' collections, and also showcased our orchid hybridisation programme.

Singapore is famous for many outstanding antelope dendrobiums as extensive hybridisations over the years have resulted in a wide array of flower colours, sizes and shapes. On display at the entrance to the Orchid Garden were two of our heritage antelope dendrobiums – *Dendrobium* Ursula, named after the wife of former Gardens' director Eric Holttum, and *Dendrobium* Kakela, a hybrid originated by F. Atherton in 1946 and recreated by the Gardens. Showcased in the Enchanted Garden were Spathulata-Phalaenanthe intersectional hybrids such as *Dendrobium* Caesar Red, *Den.* Yong Kok Wah and *Den.* Shavin White, which are also popular cut flowers.

In conjunction with the 2020 Heritage Festival, the Gardens collaborated with the Orchid Society of South East Asia (OSSEA) on an orchid show which was judged by a panel of OSSEA judges. Over 300 entries of orchid species and hybrids that were cultivated in local conditions were submitted by OSSEA members, dedicated hobbyists and professional growers. In this show judging, the plants were entered by classes according to the type of orchids, with 21 exhibitors and 318 entries vying for prizes in 21 classes and 6 sub-classes. A total of 27 plants were named Best in Class for the most outstanding plant in each group. In addition, 23 plants that were recognised for horticultural excellence or historical importance were given a Judges Commendation (JC), while three of the best entries across all classes were recognised with ribbon rosettes. Ten specimens of exceptional beauty and outstanding performance captured the judges' vote and were selected for award judging. These orchids are prized for their exceptional flower colour, flower size, flower shape, floral presentation and other considerations such as

Gardens' staff beautifully decorated the inside of Burkill Hall using competition plants submitted by OSSEA members.
(Photo credit: Kee Kai Ying)

The Bird Cage in the Enchanted Garden was decorated with colourful hybrids. *(Photo credit: Kee Kai Ying)*

the condition of the plant, rarity, difficulty of cultivation and floriferousness. The awards included a First Class Certificate (FCC) for orchids scoring 90 points or more, an Award of Merit (AM) for 80 to 89 points, and a High Commendation Certificate (HCC) for 75 to 79 points.

The Gardens submitted 96 orchids and won 27 prizes including five awards. Several of the Gardens' orchids are showcased in this article. Note that the awards are provisional and subject to final approval by the General Committee of the Orchid Society of South East Asia.

Whang Lay Keng
National Orchid Garden

(Photo credit: Whang Lay Keng)

Papilionanthe **National Parks Board**
(*Papilionanthe* Snowdon × *Papilionanthe* Miss Joaquim 'Douglas')

Awards: Best in Class, Red Ribbon, FCC/OSSEA

This entry had an upright flower spray with eight flowers and three buds at the time of judging. It is a free-flowering hybrid that produces attractive flowers which measure about 7.5 cm across and have a large pinkish-purple lip.

(Photo credit: Dr Teoh Eng Soon)

Papilionanda **Xi Jinping-Peng Liyuan**
(*Vanda* Kulwadee Fragrance × *Papilionanthe* Miss Joaquim)

Awards: Judges Commendation, HCC/OSSEA

This entry had one strong and upright inflorescence with 16 flowers and two buds. It is a vigorous and free-flowering hybrid with large beautiful flowers measuring approximately 10 cm across. All parts of the flowers are richly coloured and vividly spotted. This orchid was named in honour of President Xi Jinping and his wife Peng Liyuan of China during their visit to the National Orchid Garden on 7 November 2015.

(Photo credit: Dr Teoh Eng Soon)

Dendrobium wulaiense

Awards: White Ribbon, AM/OSSEA

This attractive entry had four upright inflorescences with more than 200 sweetly scented flowers at the time of judging. It is a species native to Papua New Guinea and commonly known as the Wulai Island White Orchid.

Dendrobium **Joe and Jill Biden**
(*Dendrobium* Jane Denny × *Dendrobium* Anne Rogge)

Award: HCC/OSSEA

This beautiful entry had three upright flower sprays with a total of 65 well-arranged flowers and eight buds. It is a vigorous and free-flowering hybrid with individual flowers measuring about 5 cm across. Its sepals and petals are bluish violet in colour. This orchid was named in honour of Joseph R. Biden, Vice President of the United States at the time, and Dr Jill Biden during their visit to the National Orchid Garden on 26 July 2013.

(Photo credit: Whang Lay Keng)

(Photo credit: Whang Lay Keng)

Dendrobium **David Baltimore**
Dendrobium Michiko × *Dendrobium* Amytan

Award: HCC/OSSEA

This vigorous and free-flowering hybrid bears long and upright sprays with numerous well-arranged flowers. The distinctive flowers are greenish yellow and around 4 cm across. This orchid hybrid was named after Dr David Baltimore, an American biologist who contributed to Singapore's development as a centre of excellence for the life sciences.

Successful translocation of the Cinnamon Bush Frog into the Rain Forest

One important aspect of NParks' work is conservation. Native flora and fauna that are endemic, rare or threatened are targeted for species recovery through habitat conservation, enhancement and/or reintroduction efforts. Some of these species have a very limited distribution and small populations in Singapore. Our efforts are aimed to help their future survival, particularly to mitigate the impacts of urbanisation and global climate change and its associated extreme weather events on their populations.

The Gardens' Rain Forest is a 6.2 ha remnant of primary forest in the heart of the city, making it a unique and important conservation site for a number of threatened species. Great effort is taken to preserve the integrity of this tropical rainforest through intentional yet minimal maintenance efforts. For instance, the thick layer of leaf litter that naturally accumulates on the forest floor is largely left alone to retain moisture in the soil and help to humidify the forest environment. There are also ongoing reforestation efforts to restore the genetic diversity of flora that was historically found in our fragile rainforest patch.

Conservation of native flora in the Rain Forest also helps to support animal biodiversity, as plants provide important habitat for fauna. For instance, the tall Meranti trees (*Shorea* spp.) offer high vantage points which attract raptors such as the Changeable Hawk-Eagle (*Nisaetus cirrhatus*) to nest,

An aerial view of the Singapore Botanic Gardens' Rain Forest. *(Photo credit: NParks)*

Logs such as this one are important to the health of the Rain Forest; they provide habitat for a variety of organisms and also add nutrients to the soil as they decompose.
(Photo credit: Lai Simin)

Eggs of the Cinnamon Bush Frog deposited on a branch. *(Photo credit: Daniel Ng)*

A froglet with a tail. *(Photo credit: Daniel Ng)*

Tadpoles inside phytotelms. *(Photo credit: Daniel Ng)*

An adult Cinnamon Bush Frog on a leaf. *(Photo credit: Daniel Ng)*

A froglet. *(Photo credit: Daniel Ng)*

and populations of the Knight Butterfly (*Lebadea martha parkeri*) have become established since the introduction of the native *Ixora congesta*. As the Rain Forest is the only patch of rainforest within the highly built-up vicinity, it is an important refuge for wildlife in the city.

The Cinnamon Bush Frog (*Nyctixalus pictus*) is a native rainforest species that, in Singapore, is mostly confined to the Bukit Timah and Central Catchment Nature Reserves. The adults are around 4 cm in length, and bright orange or brownish with small white spots. It is a nocturnal species that feeds on small insects and arthropods, and it breeds in phytotelms (usually water-filled cavities in trees), laying its eggs above the water's surface. After the eggs hatch, the tadpoles drop into the water below and begin their free-swimming stage. After a few months of growth and development, the tadpoles undergo metamorphosis and emerge from the water as miniature frogs. Classified as locally Vulnerable, the Cinnamon Bush Frog is one of the species targeted under NParks' species recovery programme. One of the actions taken to help the species is to expand its distribution to forest sites outside of the nature reserves, and the Gardens' Rain Forest was selected as the pilot site for this work as it has suitable habitat for the species. One area of the Rain Forest was selected for reintroduction, in part because of its high canopy cover, and artificial phytotelms were installed to provide it with habitat for breeding.

Between December 2017 and March 2018, staff from the National Biodiversity Centre carefully translocated Cinnamon Bush Frogs into the Rain Forest. The population was then monitored regularly to see how they were doing. The trial was a success! Within a few months, the frogs were observed to be breeding, with eggs and new tadpoles sighted in some of the phytotelms that staff had put out for them. Buoyed by the good result, staff then worked on increasing the number of breeding microhabitats further, using recycled logs from trees collected from parks around Singapore. The species appears to have established itself within the Rain Forest as breeding is regularly observed. Following our success in the Rain Forest, translocation efforts are ongoing at other suitable forested sites in Singapore.

We are happy to welcome the Cinnamon Bush Frog to the Gardens. It is only active at night, so if you are passing by the Rain Forest in the evening, listen out for the six peeps which form its unique call. If you do enter the forest, remember to keep strictly to the trail to avoid disturbing our flora and fauna.

Daniel Ng
National Biodiversity Centre

Nurul Izzah Binte Taha
Horticulture and Operations

Connecting plants and people, an exhibition

A display of edible plants in recycled tyres outside of the CDL Green Gallery, reflecting the theme of the exhibition and aimed at grabbing the attention of regular visitors to the Gardens. *(Photo credit: Grace Lee)*

The year 2020 disrupted many lives, changing the way people live and work. Residents were kept indoors for much of the year, especially during the early-April to early-June Circuit Breaker period, which led to a botanical bloom in many households. This ranged from people introducing houseplants to their living spaces, to those trying their hands at growing flowering plants and edibles on balconies, in community gardens and along high-rise apartment corridors. To support the growing interest in gardening, in June 2020 the National Parks Board (NParks) distributed free fruiting and leafy vegetable seed packets to 400,000 households through a Gardening with Edibles initiative. But this was just the latest example of promoting gardening across the island in recent history, a subject explored in the 'Connecting People and Plants: A Century and More of Gardening Contributions' exhibition held in the CDL Green Gallery. Some of the key highlights from the exhibition are shared here.

Throughout its long history, the Gardens has been the primary centre for botanical and horticultural knowledge in Singapore. It is a place to learn about plants, from identification to propagation and care. The Gardens is also firmly established as a key tropical botanical institution in the world. Its remit is not limited to science, but also encompasses education and the sharing of practical knowledge on using plants in our daily lives.

Over the past century, the Gardens has been at the forefront of connecting plants and people in Singapore, with Eric Holttum playing an instrumental role early on in this period. Holttum was assistant director from 1922 to 1925 and then assumed the role of director until 1949. During his tenure, he influenced the cultivation of different plants in Singapore, organised gardening events and supported the activities of local gardening groups. He published numerous works to promote and share knowledge on gardening, with the aim of making gardening easy for the layman. His knowledge was not obtained from books alone but through experience of growing tropical plants in the region. For over 30 years, he befriended many gardeners – both hobbyists and specialists – in Malaya, including Chinese commercial gardeners, and learnt from their

The start of the exhibition traces the legacy of Eric Holttum in the fields of horticulture and botany. Holttum's work in these areas has had a lasting impact on the Gardens as well as in the local gardening scene. *(Photo credit: Grace Lee)*

A gardening pamphlet written by Holttum and published by The Straits Times Press in 1940; people could acquire it from the Colonial Government's Department of Information at the Fullerton Building.

Eric Holttum was a champion of local gardening and aimed to make gardening easy for the layman.
(Courtesy of the Singapore Botanic Gardens Archives)

successes and failures. He spent time discussing horticulture with them and studied their practices, such as the traditional Chinese method of using burnt clay as a potting medium.

Holttum also contributed to knowledge on vegetable gardening, particularly in the years leading up to and during World War II when there was an increased interest by the public in growing vegetables locally. In 1939, as war broke out in Europe, the Singapore Botanic Gardens created a demonstration plot for vegetables. The vegetables were labelled, and a list of varieties that could be grown locally – with instructions on their cultivation and propagation – was displayed on a notice board. In 1940, The Straits Times Press published a 10-page gardening pamphlet

written by Holttum in anticipation of the war. From 1942 to 1945, for self-sufficiency, a vegetable plot was set up at Lawn Y (in the vicinity of the present-day Symphony Lake), and beds were planted with a variety of vegetable crops, including brassicas, keladi, maize (corn), sweet potatoes, brinjals and tomatoes. A small area was also dedicated to the cultivation of 10 different varieties of tapioca. Citrus and papaya were planted in both the Gardens' nursery and on Lawn R (where the Ginger Garden is today), and different varieties of turnips, tomatoes, onions, leeks and beets were planted for trialling.

Holttum believed that the Gardens should be home to both beauty and science. In 1940, he became the first Gardens' administrator to recruit local officers for horticultural training. He wrote: "…without good horticulture you would have no gardens. And in botanic gardens you will need to grow new plants, which may require new treatment; the job is not a routine one like that of a commercial nursery. You must give your horticulturist, who is a professional man in his own right, some chance to show his talents for display of plants." Holttum also took an interest in trialling ornamentals, seeking plants that would flower regularly in a seasonless tropical climate and introduced them from other parts of the world into the Gardens' living collections. Some of these plants are grown in our city's streetscapes today, and they are perhaps one of Holttum's most visible lasting legacies.

After Singapore gained independence in the 1960s, the government began rapidly developing the island. Founding Prime Minister Mr Lee Kuan Yew started Singapore on its greening journey in 1963, with the aim of making the island liveable for its residents by planting as much and as quickly as possible. The Gardens was instrumental in supporting this effort through the provision of plants and horticultural knowledge. This period also saw Singaporeans moving *en masse* into high-rise apartments developed by the Housing and Development Board, which led to a growing demand for space to do personal gardening and set the stage for the introduction of skyrise greening. In 1972, a school of horticulture was set up at the Gardens to attract talent and help train people in the industry. Although the school is no longer open, it raised the level of horticultural expertise and knowledge on the island, a role that Singapore's polytechnics and NParks' Centre for Urban Greenery and Ecology (CUGE) are filling today. It was also the main organiser of the Skyrise Gardens Exhibition, which aimed to inculcate a love of gardening in high-rise apartments. First held in 1992, subsequent exhibitions followed in 1995, 1998 and 2001. These served as precursors to the Singapore Garden Festival (SGF), a biennial showcase of horticultural and landscape design skill and creativity by local and international talent.

Starting in 2005, NParks initiated a national gardening programme, Community in Bloom (CIB), and this has evolved over the past 15 years into a vibrant gardening movement across the island. As of October 2020, there were more than 1,600 community gardens across Singapore. These gardens compete yearly for the CIB awards – a recognition platform for outstanding gardens in design and plant variety. Many of

Targeted at local gardeners, the exhibition explains different propagation techniques, and also offers recipes for commonly grown vegetables and fruits, including one for tempoyak, a fermented durian dish. *(Photo credit: Grace Lee)*

This map marks the locations of community gardens across Singapore, with photos of some of these gardens left by visitors. *(Photo credit: Grace Lee)*

One of the photos put up on the map, showing gardeners at the Bukit Panjang Zone 8 Community Garden. *(Photo credit: Jacqueline Chua)*

these are led by CIB Ambassadors, and selected gardens are given the opportunity to participate in the SGF Gardeners' Cup. Separately, a Community Garden Edibles Competition is held every two years where gardeners present their most prized fruit or vegetable, such as the heaviest wintermelon or longest lady's finger. To further encourage interest in community gardening, the biennial Community Garden Festival combines displays of gardening skill with a suite of gardening masterclass workshops and a gardening bazaar.

Other than the distribution of free seed packets in 2020, NParks has introduced a variety of new initiatives to inspire Singapore's growing community of gardeners. One of the latest examples is the expansion of allotment gardens, which will allow more residents opportunities to lease raised planter beds for a low annual cost. More than 2,000 additional allotment garden plots will soon be made available in parks located near densely populated residential areas in the heartlands. The initiative aims to bolster Singapore's food resilience, help residents to bond through gardening, enhance their knowledge of growing edibles and empower them to green their environment. NParks is also producing a slew of materials to equip Singaporeans with horticultural knowledge, such as guides with ideas for bringing gardens inside homes through the CIB Indoor Gardening initiative. A training programme for community gardeners has also been developed to cover a variety of gardening topics, including a module on growing edibles. The lessons include both classroom tutorials and hands-on practicals to impart knowledge on propagation techniques, pest management, harvesting protocols and more. To support Singapore's growing number of gardeners, videos, brochures and gardening guides are continuously being added to NParks' YouTube channel (www.youtube.com/NParksSG) and website (www.nparks.gov.sg), which are available to the public to download for free.

The past century has seen many contributions toward local gardening and horticulture, with the Gardens playing a key role historically and more recently through its mission to connect plants and people. The popularity of gardening will undoubtedly continue to grow in coming years, as NParks rolls out new initiatives and programmes to engage more members of the community to get involved. Do visit the CDL Green Gallery to find out more about Singapore's history of gardening over the past century, and to learn about the range of NParks' current gardening initiatives. 'Connecting People and Plants: A Century and More of Gardening Contributions' is on until 14 March 2021.

Grace Lee
Events and Exhibition

Plants that Heal, an exhibition on medicinal plants

This exhibition featuring selected medicinal plants, including those from Singapore's rainforests, is currently ongoing on the second floor of the Gardens' Centre for Ethnobotany. Exhibited are photographs of these plants, as well as information about their distribution and medicinal uses. The exhibition also delves into the Gardens' early contributions to ethnobotany in the region and current ethnobotanical research on the jackfruit and fig family (Moraceae). There is also a focus on the science behind the discovery of drugs from plant sources, with notable plant-derived medicines featured.

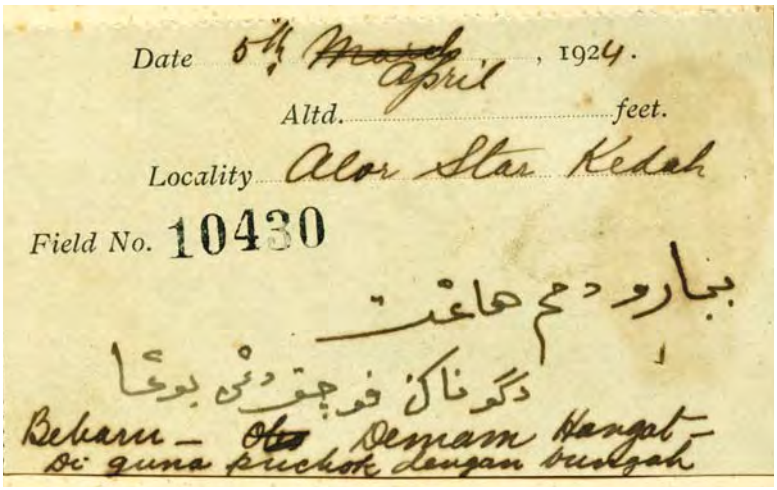
Here we would like to elaborate on the Gardens' early contributions to ethnobotany in this region, which were mostly through the efforts of I.H. Burkill, director of the Gardens from 1912 to 1925. Burkill was particularly interested in medicinal plants and is well-known for his monumental work, *A Dictionary of the Economic Products of the Malay Peninsula*. This two-volume, 2,402-page publication took 10 years to complete, and was published in 1935 after Burkill's retirement in England (more information about this work is at the Burkill exhibit on the ground floor of the Centre for Ethnobotany). Much of the information on medicinal plants for this publication was drawn from the earlier 'Malay Village Medicine' published in volume 6 of *The Gardens' Bulletin, Straits Settlements* (1930).

We are fortunate to have the specimens collected during the fieldwork for 'Malay Village Medicine' preserved in the Singapore Herbarium. These specimens, totalling 1,675 in all, are in excellent condition despite being almost a hundred years old. They were collected from 1923 to 1925, when Burkill travelled throughout Peninsular Malaysia with Mohamed Haniff, an expert plant collector from the Penang Waterfall Gardens (Penang Botanic Gardens). Burkill and Haniff interviewed knowledgeable members of the Malay and Orang Asli communities to record their medicinal knowledge in the form of prescriptions. Burkill asked his interviewees to bring samples of the plants (and fungi) used, and these were vouchered and deposited in the Singapore Herbarium. In this way,

The leaves and fruits of the Red Tree-vine (*Leea rubra*), a native of Singapore's rainforests, are used in folk medicine for a wide range of ailments. *(Photo credit: S.K. Ganesan)*

Anti-cancer drugs have been derived from Periwinkle (*Catharanthus roseus*), a native of Madagascar. *(Photo credit: S.K. Ganesan)*

A specimen of the Sea Hibiscus (*Hibiscus tiliaceus*) collected for 'Malay Village Medicine' with label information in Jawi. *(Scan courtesy of the Singapore Herbarium)*



In the above label, the Jawi script has been transliterated to romanised Malay as "Bebaru-Demam Hangat Di guna puchok dengan bungah", which can be translated into English as "Bebaru – used for high fever, use the shoots and flowers". *(Translation by S.K. Ganesan)*

Flower, buds and leaves of the Sea Hibiscus.
(Photo credit: Ang Wee Fong)

good scientific determination of the identity of the plants being used was made possible. Burkill was very much interested in the vernacular names of plants in whichever territory he was working in, and compiled an index of the Malay names together with their corresponding scientific names. Along with the collected prescriptions that were published in 'Malay Village Medicine', Burkill and Haniff included notes on ethnotaxonomy, as the vernacular names given by the local people were mostly based on their uses rather than appearances and were thus not necessarily intuitive. The labels of several of the specimens in the herbarium have information in Jawi, a modified Arabic script used to write Malay before the Roman alphabet was adopted as the standard.

Burkill's legacy is not confined to ethnobotany; he also made significant contributions to systematic botany, economic botany and many other areas of botanical science. His works include an account of the true yams (Dioscoreaceae) for *Flora Malesiana* that he completed when he was in his early eighties, and during his declining days and aided by his wife, a series of papers on the history of botany in India. Haniff continued to collect plants after retirement, and even on the day of his death he had been out collecting.

The 'Plants that Heal' exhibition will be on at the Centre for Ethnobotany until the end of April 2021. The Centre is open daily from 9 am to 6 pm, except for the last Wednesday of each month. Admission is free, so do stop by on your next visit to the Gardens.

S.K. Ganesan
Herbarium

We *would like to acknowledge our collaborators in this exhibition, Associate Professor Koh Hwee Ling, Department of Pharmacy, National University of Singapore, and Dr Elliot Gardner, The Morton Arboretum, USA*

The International Plant Names Index (IPNI)

When Charles Darwin passed away in 1882, he left a sum of money to the Royal Botanic Gardens, Kew, to be used for the "…compilation of an Index to the Names and Authorities of all known Flowering Plants…". This desire, it was reported, was due to Darwin's own frustrations when trying to identify plants. Kew's then-Director, Joseph Dalton Hooker, a close personal friend and staunch ally of Darwin, set Benjamin Daydon Jackson the task of realising Darwin's vision. The first fascicle of the resulting *Index Kewensis* was published in 1893 and was completed in a total of four fascicles by 1895. It included over 400,000 names, their places of publication, and the countries in which the species were to be found. From then on, supplements were published approximately every five years, eventually also including taxa at ranks other than genus and species. *Index Kewensis* and its supplements would go on to include well over 1 million names and were an indispensable resource for generations of plant taxonomists.

In 1999, the online International Plant Names Index (IPNI) was launched. It was created by combining the data in *Index Kewensis* and its supplements with two other major datasets: the *Gray Card Index* compiled by the Harvard University Herbaria (Cambridge, USA) and the *Australian Plant Names Index* compiled by the Australian National Herbarium (Canberra). In 2004 another major dataset, *Index Filicum* (an index of fern names) was added. The pooling and alignment of these four datasets has created the most comprehensive and accurate index of vascular plant names, their authors and dates and places of publication. Moreover, being an online electronic resource, the content can be kept more current, users can search for data more efficiently, feedback can be acted upon quickly, and mistakes can be corrected easily. As IPNI has developed, new features, such as links to the Biodiversity Heritage Library to see the original publication information, have been added. The IPNI database and website is hosted and administered by Kew but the editorial team consists of nomenclatural specialists at Kew, Harvard University Herbaria and the Australian National Herbarium. It is impossible to overstate the importance of IPNI for research on the plant diversity of Singapore. Although online taxonomic databases and many other resources have proliferated and are of varying quality and usefulness in research, often their data can be traced back to IPNI or its progenitors.

One project currently nearing completion involving NParks, the National University of Singapore and many local and overseas collaborators is an example of how vital IPNI is. We are compiling a new Checklist of all of Singapore's wild plant species, both native and naturalised, and making extensive use of IPNI in the process. This Checklist will detail the currently accepted name and correct spelling for each species, any synonyms previously used in the Singapore literature, names that have been misapplied (see below), and details of the publications in which these names have appeared. The new Checklist will complement the ongoing Flora of Singapore project by summarising data already published, will be a valuable resource for the ongoing research being undertaken to complete the remaining volumes of the Flora, and will be used for survey work and conservation planning.

For both the new Checklist and the Flora of Singapore, we have been very motivated throughout to avoid the perpetuation of mistakes from the past which all too often pass unnoticed into common usage. The two most common sources of such mistakes are that a species is identified with the wrong name and this incorrect identity becomes compounded as more material is matched to that original mistake rather than matched to the type specimen that fixes the correct application of the name. Mistakes such as these can only be corrected with original taxonomic research that leads to the identification of the correct name of the species. The second mistake is perhaps more complex and difficult to identify as it has to do with the validity and legitimacy of the name itself. In these cases, often there is no mistake in the identification of the species, but insufficient research has been done to check whether the name being used is acceptable in accordance with the rules of Botanical Nomenclature as discussed in *Gardenwise* volume 43. Correcting these mistakes requires interrogation

of the places of publication of all of the names involved; finding these publications in the first place requires an accurate index to all plant names – the International Plant Names Index.

The salient words in the previous sentence are 'accurate index'. IPNI now contains over 1.4 million entries, the vast majority of which provide concise and correct data on the original publication of vascular plant names. However, as was mentioned earlier, IPNI originated from the fusion of earlier datasets of plant names which began to be compiled in the 19th century when data standards were less important and verification processes were not as thorough or easy as they are now. IPNI incorporated into itself inaccuracies or omissions from those original sources and in the early days these were compounded by errors introduced from Optical Character Recognition (OCR) glitches and data-entry mistakes. Over time, the IPNI editors have constantly updated omissions and corrected mistakes brought to their attention and continue to do so.

The dataset that underpins the new Checklist of native and naturalised plants in Singapore as well as the Flora of Singapore project includes over 3,000 currently accepted names. These names are linked to over 36,000 literature records that document the occurrence of the species in Singapore and the region. The dataset also documents all names that are no longer in use including genuine synonyms and previous misapplications, altogether another 5,000 names. Unravelling the use and misuse of so many names over the last 270 years (since binomial naming began in 1753) is a monumental task but one which, when soon completed, will ensure a far more accurate use of names for plants in Singapore than has previously been the case. This, in turn, will ensure that communication about plants for conservation, research, horticulture, and any host of other reasons for which accurate names are important, will be less prone to misunderstandings.

Ensuring that the underlying data in IPNI is correct is important for research on plants in Singapore, but it is also important for research on plants in the rest of Southeast Asia and elsewhere. As research on the plant diversity of Singapore has progressed, we have been working closely with Kew to ensure that discrepancies in our understanding of plant names compared to the data in IPNI are addressed. This is a two-way process; sometimes the IPNI editors are able to provide information that we had overlooked and we can update our entries, but frequently we have been able to provide information to IPNI that has enabled them to update their data which is then available worldwide.

As its name suggests, the International Plant Names Index is an index of all names published, not a source of information on which names are the correct name for a particular species. The very early volumes of *Index Kewensis* did actually attempt to list the correct names and synonyms but this role as a nomenclator rather than just an index was abandoned in the supplements in favour of a straight listing of all names, regardless of their current status. Other resources (e.g., Plants of the World Online, World Checklist of Selected Plant Families) have attempted to fill this gap as a nomenclator, mostly drawing their underlying data from IPNI coupled with other sources to draw their conclusions. In time, most of the updates that we have provided to IPNI will also feed through to these other resources.

Indices of plant names hardly invoke the glamour of cutting-edge scientific research but without them, and without the laborious, highly skilled and unsung work of the indexers who compile the data and check that it is all done in accordance with the rules of nomenclature, botanical research work would be very much harder, very much slower, and potentially less accurate.

David Middleton
Herbarium

Stuart Lindsay
Native Plant Centre

Ian Turner
Singapore Botanical Liaison Officer at Royal Botanic Gardens, Kew

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Rediscovery of the Sculptured Amanita – *Amanita sculpta*

A *manita sculpta* first came to my attention when a friend and counterpart, Dr Amy Choong from the National University of Singapore, forwarded a Facebook post with a picture of a peculiar fungus in its bud stage. It was posted by a member of the public on 27 August 2020 and had been taken at the Bukit Timah Nature Reserve. Excited by the sighting, my colleagues and I kept an eye out for the species in the nature reserve, although we were uncertain of its exact location. Just a few days later however, it was spotted by Kenneth Er (NParks' CEO), together with Dr Adrian Loo (Group Director of NParks' Conservation and Wildlife Management team) and Ang Wee Foong (Director of the Gardens' Seed Bank). They found the fruiting body in its full glory in a fairly visible location along the main trail. It was a magnificent specimen! When collected for processing and identification at the Singapore Herbarium (SING), its pileus (cap) was 26 cm across and it was by far the largest non-bracket type macrofungus that we had ever seen in Singapore.

Amanita species in Singapore range from the tiny but common *A. obsita*, with a pileus around 2 to 4.5 cm, to *A. sculpta*. One of the most iconic species in the genus is the Fly Agaric, *Amanita muscaria* (not found in Singapore), a mushroom with a striking red cap around 20 cm in diameter on average. It is common in temperate parts of the Northern Hemisphere, where it would undoubtedly excite anyone who chances upon it. When our specimen of *Amanita sculpta* was collected, a very rich earthy scent permeated the air, reminiscent of fresh button mushrooms. Despite a few species around the world being edible according to traditional sources, Amanitas in general are known to be very toxic, and we would not bet our lives on testing the edibility of *Amanita sculpta*!

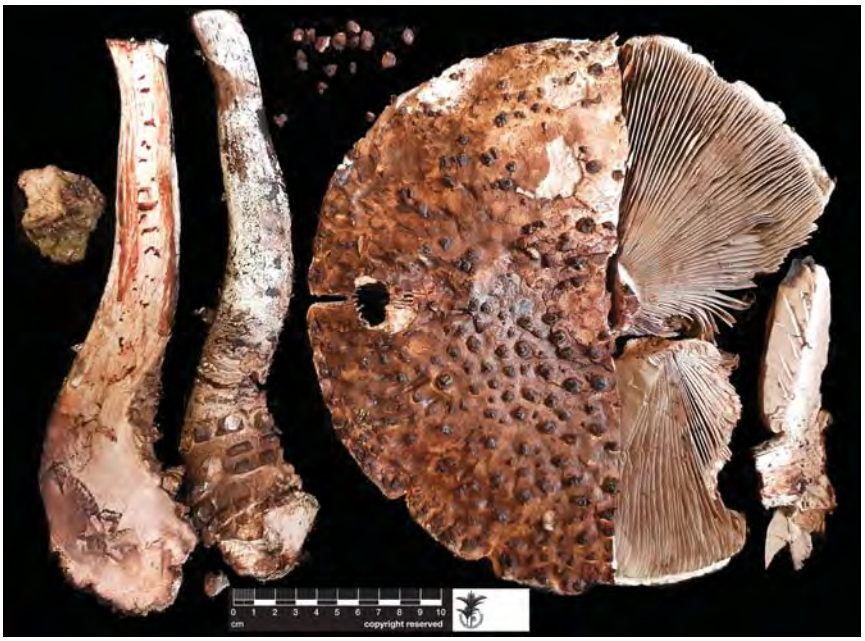
A watercolour by E.J.H. Corner, published in *Persoonia* in 1962.
(Courtesy of Naturalis Biodiversity Centre)

Amanita sculpta was first described in 1962 in the journal *Persoonia*, in a paper by E.J.H. Corner and C. Bas entitled 'The Genus *Amanita* in Singapore and Malaya'. The type specimen for this species,

Mature fruiting body of *Amanita sculpta*. *(Photo credit: Kenneth Er)*

Top view of the pileus. *(Photo credit: Kenneth Er)*

Picture of the young fruiting body of *Amanita sculpta* that was posted on Facebook on 27 August.
(Photo credit: Serene Chow)



Processing of specimen voucher SL1560 in the Singapore Herbarium.
(Photo credit: Serena Lee)

labelled '*E. J. H. Corner s.n., 9th July 1940, Singapore, Bukit Timah*', is housed in the Leiden Herbarium (L), where Bas, the junior author of the paper worked. From SING's database of herbarium specimens, we knew that the species had not been recorded in Singapore since this first collection that Corner made in 1940. So, after an 80-year hiatus this fungus would fall into the 'rediscovery' category, marking our collection of the species the first in Singapore since its original discovery 80 years ago.

So why did it take so long to be recorded again? Despite the large size of its fruiting body, its dark shadowy colours help it to blend very well into the background. Mycelium of such macrofungi usually stay close to their associated trees, and in the case of *Amanita sculpta* there seems to be an association with dipterocarps (Dipterocarpaceae). These are majestic trees which are dominant species of lowland forests in the Malaya region. Our specimen was found at the base of a *Shorea leprosula* tree, and a collection from Peninsular Malaysia was documented near *Neobalanocarpus heimii* trees.

In their paper, Corner and Bas noted that they had observed the species several other times in the same location (at Bukit Timah), but had not seen it elsewhere in Singapore or broader Malaya. Our modern-day collection may indeed have come from the very same spot on which Corner had collected the 'new to science' species! In the years since Corner and Bas

Specimen preserved in spirit, in the Leiden Herbarium. *(Courtesy of Naturalis Biodiversity Centre)*

Type specimen of *Amanita scuplta* in the Leiden Herbarium. *(Courtesy of Naturalis Biodiversity Centre)*

published their 1962 paper, *Amanita sculpta* has been documented from Selangor in Malaysia, as well as in Japan and China. It should be also noted that more collections of the species were also made by Corner from outside of Malaya – one from Malay Island in Indonesia dated 13 June 1961, and one from Brunei dated 15 February 1959, which are listed in the Edinburgh (E) Herbarium catalogue.

From the example of *Amanita sculpta* we can see the significance of a type site, or the location where a species first known to science is recorded from. Type sites are important for further research on already described species.

***Amanita muscaria* in Scotland.** *(Photo credit: Serena Lee)*

This is especially true for fungi in the tropics, as old specimens collected before the advent of air-conditioning would rehydrate after drying from moisture in the air and become mouldy. Such specimens make very poor samples for work such as DNA sequencing, and thus knowledge of the type locality enables us to potentially collect fresh samples.

In the Corner and Bas paper, Bukit Timah is given as the type site for 11 of the 21 species of *Amanita* known from Singapore and Malaya. Our recent discovery underscores the importance of natural conservation areas such as the Bukit Timah Nature Reserve, which are rich in biodiversity and provide homes for a variety of species that depend on each other for survival, such as *Amanita sculpta* and its associated dipterocarp trees.

If you find this article interesting, do join Mushroom Spotters (Singapore) on Facebook, which is a casual gathering of mycophiles from Singapore (and other parts of the world) to come together to share sightings of this amazing kingdom. Fungi are ephemeral in nature, with the fruiting bodies visible above ground for just a short time. By helping to document them before they disappear back into the earth, we can collectively expand our knowledge about these fascinating organisms. Also, by taking a greater interest in nature, we start to see things that we've never noticed before and the world becomes more beautiful to us.

Serena Lee
Herbarium

With contributions from Dr Adrian Loo, Ang Wee Foong and Kenneth Er

Esther's Heliconia, a rare Colombian beauty

Heliconias are very colourful and pretty plants. There are more than 200 species, with almost all being native to tropical America. A number of the easy-growing and free-flowering species are cultivated in the tropics worldwide, including in Singapore where they be seen in streetscapes, parks and gardens. Yet there are also many uncommon species which are not yet widely available in horticulture. One of these rare gems, grown in our Gardens, is *Heliconia estherae*.

Heliconia estherae was discovered in February 1982 by Gustavo Morales and José Abalo in the northern part of Colombia, near Samoré in the mountains, close to the border with Venezuela. Plants were found growing on the slopes at altitudes between 800 and 1250 m, in areas with high rainfall and on soils with silt and clay. One of the discoverers named this exceptionally beautiful *Heliconia* after his wife, Esther de Morales. The mature plants are up to 1.5 m tall with each leafy shoot bearing five to six dark green leaves that have a pale green midrib. The inflorescences are upright, consisting of about seven bracts which are almost white at the base, but become progressively bright pink towards the tip, with the lowermost bract sometimes having a dark green tip. Each of these bracts support seven to 10 tubular flowers that are 4 to 4.5 cm long, have a cream-white to pale green flower stalk, light green ovaries at the base which turn blue-green with age, and orange-yellow sepals that are almost covered by dark to bright red speckles. The flowers never really open and thus look like flower buds throughout the

A flowering plant which originally came from a flask in the tissue culture lab.

The ovaries at the base of the flowers start off cream-white to pale green (left) and turn blue-green as they mature (right).

The leaves are attractive and have a velvety appearance.

flowering period. Like almost all heliconias, they are pollinated by a specific hummingbird, and the shape of the flower perfectly fits the curvature of the pollinator's beak.

Despite its stunning looks, this species is not yet widely available in the horticulture trade, and we are one of the few lucky gardens to have it in cultivation. We obtained it in July 2010, during the 16th International Conference of the Heliconia Society International held in Singapore. One of the most anticipated events of these conferences is an auction where various items and curiosities connected to heliconias and gingers are sold to raise funds for the Society. During that year's auction, the appearance of a sterile bottle containing tissue-cultured plantlets of *Heliconia estherae*, donated by the Nong Nooch Tropical Botanical Garden, certainly raised the blood pressure of many! After a heated round of bidding, the bottle was finally pronounced as "sold" to Mr Tan Jiew Hoe, president of the Singapore Gardening Society and long-term patron of the Singapore Botanic Gardens. To our surprise and delight, the bottle was gingerly handed to us straightaway and

Flasks with plantlets in the tissue culture lab, ready to be removed from the flasks and planted into the nursery for acclimatisation.

Plantlets at different stages of development.

Plantlets being pampered in the nursery following explanting from flasks.

by the next day, the plantlets had found their new home in our tissue culture lab.

The journey from flask to flower was more tedious than anticipated and took a whole nine years. While keeping the tissue culture sterile and multiplying the plantlets in the lab was fairly smooth sailing, getting them acclimatised to outdoor conditions proved to be more difficult. Even after that hurdle was cleared and we had large plantlets growing in the nursery and in the ground, we were unable to get them to flower. Fortunately, our new nursery facilities, which opened in 2018, allow for better control of growing conditions. After moving our research collections into the new facilities and tweaking our fertilising protocol, the gorgeous inflorescences started to appear! Now that the process of getting the plants from flask to flower is established, we hope that within a year, flowering plants will appear on some of the lawns in the Gardens.

Heliconia estherae is endemic to Colombia, where it is known only from two municipalities. By cultivating such rare species, gardens around the world, including ours, continue to play an important role in plant conservation.

Jana Leong-Škorničková
Sarah Lim
Herbarium

All photos by Jana Leong-Škorničková

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Feasting on Ferns

Ferns are vascular plants that do not produce seeds or flowers but instead reproduce via spores. Some species are edible, although this is not a common practice today as they are mostly eaten only by certain ethnic groups. Edible ferns make ideal candidates for incorporating into a food forest, a type of landscape planted as a sustainable, low-maintenance and ecological approach for producing food. Highlighted here are some of the common edible fern species that can be found in landscapes around Singapore, most of which are available in local nurseries.

Bird's Nest Fern (*Asplenium nidus*)

The Bird's Nest Fern is a common native epiphyte that can grow quite large. It produces a whorl of large, simple fronds growing from a stout rhizome, forming a nest-like basket that traps fallen leaves. It does best under filtered sunlight and in a porous growing medium. The young unfurled fronds are reportedly eaten as a vegetable in Taiwan. Cut into roughly 2.5-cm-long pieces, the tender fronds are prepared by stir-frying with garlic and chilli. They can also be steamed or boiled.

The Bird's Nest Fern is a commonly seen epiphytic fern that grows on trees found in our parks and gardens. Its tender young fronds are the part of the plant that are consumed.

Pucuk Paku (*Diplazium esculentum*)

The Pucuk Paku is also known as Paku Tanjung or more generally as 'fiddlehead fern'. It is native to Singapore and grows as a terrestrial plant in wet places with filtered sunlight. As it matures, it develops a trunk-like rhizome that can either be upright or creep on the ground, and once established, the plant will quickly form a thicket. Bags of the tender, curled croziers are sold in the Geylang Serai and Tekka markets. The fronds can be eaten raw or prepared by steaming or boiling. They have a sweet taste and slimy texture after cooking.

The Pucuk Paku has a terrestrial growth habit. Its tender croziers are the edible part of the plant and they can be found on sale in a few wet markets in Singapore. The plant itself is hard to find in local nurseries at present.

Climbing Fern (*Stenochlaena palustris*)

The Climbing Fern is native to Singapore and known locally by a number of common names, including Akar Paku, Paku Miding and Paku Ranu. It grows as a scrambler and spreads via a long rhizome. It may become aggressive, however, and should be checked periodically to ensure that it is not smothering other plants in the garden. It can be grown either under direct or filtered sunlight, and the root zone should be kept moist at all times. This fern features pinnate fronds that are highly attractive when young; they take on a reddish-pink colour and are more tender in texture than the mature fronds. These young fronds are eaten as a vegetable and fried with *sambal belacan*.

As its common name suggests, the Climbing Fern has a distinctive climbing habit. Its growth needs to be checked periodically to prevent it from smothering the growth of surrounding plants.

The Clover Fern is a fern species with interesting foliage. It is grown for its association with the 'lucky clover' due to its four leaflets. The plant is interesting to observe as the leaflets close when it is dark – a habit called nyctinasty.

Clover Fern (*Marsilea minuta*)

The Clover Fern is an aquatic species which produces a long, creeping rhizome that bears fronds at intervals. Its foliage is reminiscent of a 'lucky clover' with its four triangular leaflets. It thrives under direct or filtered sunlight and in waterlogged conditions. Under optimal conditions it can grow aggressively and become difficult to remove as the rhizomes spread through the soil. For this reason, it is suggested to install root control barriers around this plant in the garden and to conduct periodic checks to remove any escaped rhizomes. This plant is harvested for food when young, and the fronds have a sweet and bitter flavour. They are sometimes eaten fresh, but this is not advised as the sporocarps (spore-bearing structures) are reported to contain thiaminase, and enzyme that destroys thiamine, or vitamin B1, which is needed for a healthy diet. It is recommended to properly cook the fronds before consumption to destroy the thiaminase. They can be boiled, fried or made into soups with other ingredients.

The Swamp Fern is a semi-aquatic, native fern species that can grow quite large. It thrives under both direct and filtered sunlight, making it an ideal focal candidate for growing in waterlogged locations in an edible garden.

Swamp Fern (*Acrostichum aureum*)

The Swamp Fern is a large-growing fern that features a rosette of fronds held on a stout, upright rhizome. It is a semi-aquatic, native species that can be found on the landward side of mangrove forests. It looks similar to *Acrostichum speciosum*, another species that can be found locally, but the two can be distinguished by their pinnae; in *A. aureum*, the pinnae tips are blunt while in *A. speciosum* they are pointed. The Swamp Fern grows best in full sun and is suitable for planting along the edges of ponds and in vegetated swales and waterlogged areas. The young, bright red fronds are the edible portion of the plant. These are cooked and eaten as a vegetable.

Water Sprite (*Ceratopteris thalictroides*)

Another aquatic fern, the Water Sprite can be found submerged or emersed in water, or growing along the edges of ponds. In the landscape, it can be grown in either direct or filtered sunlight. This fern features a stout rhizome bearing a rosette of finely divided fronds. The young, newly emerged fronds are edible and harvested when they are still tender, before they have unfurled. The thick petioles are eaten as a vegetable and reportedly used as an inexpensive substitute for asparagus.

The Water Sprite is an aquatic fern with finely textured foliage and can be grown fully submerged in water or above the water. It can be found for sale in local aquarium shops.

Wilson Wong
Jurong Lake Gardens

All photos by Dr Wilson Wong

It is never recommended to harvest plants from the wild or from along roadsides – not only is this illegal it can be dangerous as they may have been sprayed with pesticides. Before entering any private or protected property, always ask for permission to avoid trespassing.

Educational programmes for schools in the 'new normal'

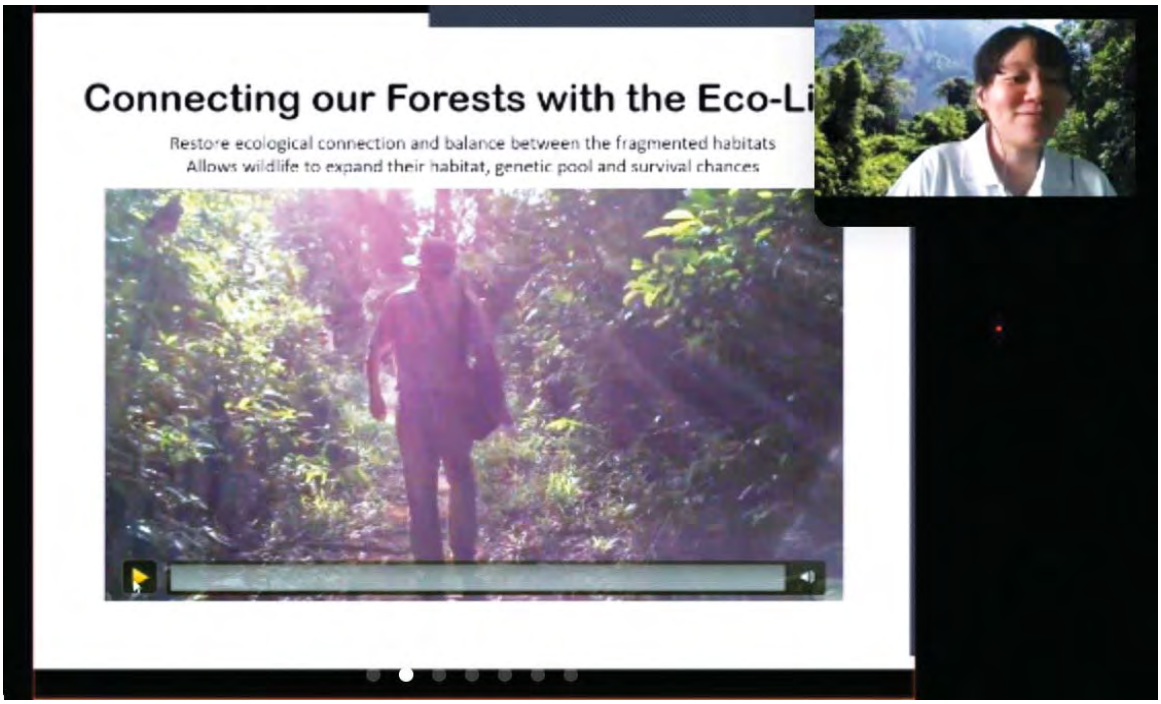
Screenshot from our virtual talk about the Gardens' heritage, given to Stamford Primary School. *(Photo credit: Winnie Wong)*

As Covid-19 continues to impact our lives, schools are withholding all outside-school activities, including outings to the Gardens and parks around Singapore. This has been a challenge given that before the pandemic, 80% of our programmes consisted of outdoor guided tours for schools. On the positive side, however, the situation has presented a window of opportunity to try new ways to reach students with our educational messages about nature and the environment. In order to stay relevant while we continue to fight the pandemic, we have developed a series of virtual talks focusing on the Gardens' heritage, biodiversity and plant collections. This reflects our continuous efforts to use our environmental education programmes to support school curricula and co-curricular activities in the 'new normal'.

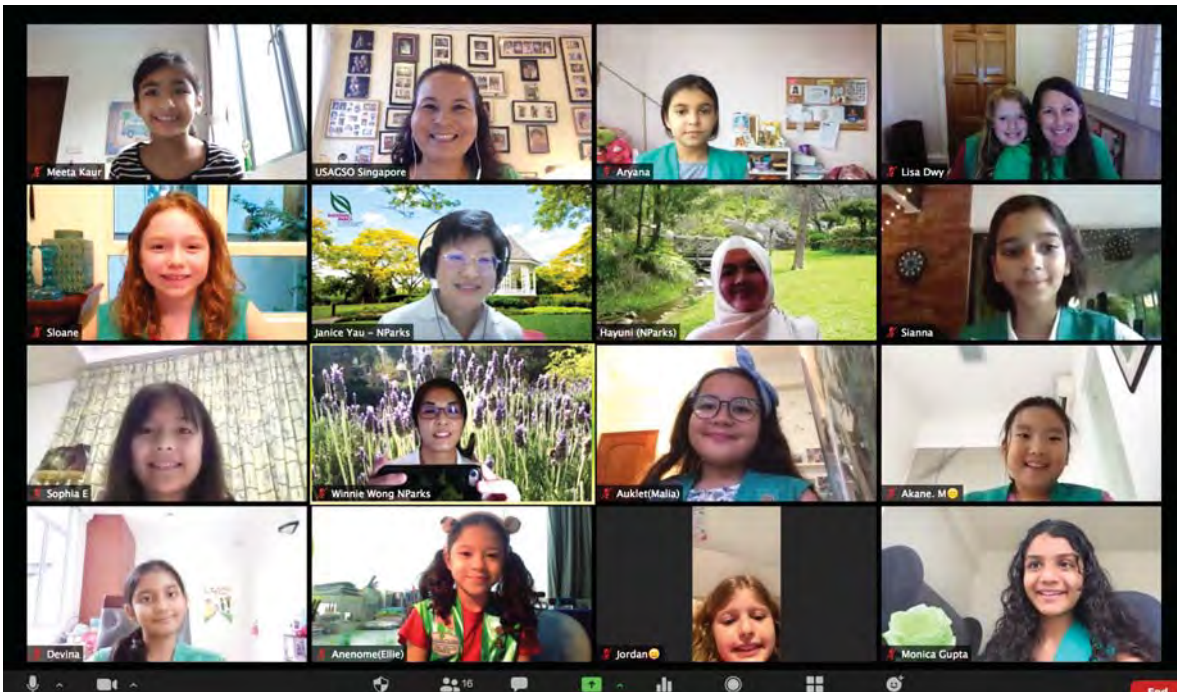
The virtual talks are conducted via Zoom, a platform that enables a large meeting capacity of up to 100 direct participants. This allows us to potentially reach hundreds of students concurrently, given that each classroom with at least one computer has 30 or 40 students. In fact, a virtual talk could easily cater to several student grade levels within a school, or even the entire cohort of students from primary 1 to primary 6 at the same time.

The core of the 30-minute virtual talks is a narrated presentation of pictorial slides by one staff member from the Gardens' education team, while another staff oversees the tech side of things to ensure that the talk runs smoothly. To assess the impact of our virtual talks, we give pre- and post-talk surveys asking participants questions relevant to the topic of the programme. For instance, at the start of our 'Friends of the Forest' virtual talk, we ask questions such as "Do you think forests give us benefits in our daily life?", and "Would you like to save forests?". At the completion of the talk, we present the same questions, and in all instances so far, we have obtained more "Yes" responses to the questions after the talk than before. We also use post-talk questions to measure how well the students are engaged in certain topics and assess their attitude toward sharing and applying their newly gained knowledge about nature. For example, following a recent talk about orchids and other flowers, 42% of respondents said that they would consider becoming a botanist in the future, while 92% said that they would share what they had learnt with their family and friends.

Interaction with our participants is a fundamental aspect of our educational programmes, as it allows



Screenshot from our 'Friends of the Forest' talk for Juying Secondary School. *(Photo credit: Winnie Wong)*



Screenshot of Girl Scouts from the Singapore American School participating in the 'Flowers and Orchids' talk. *(Photo credit: Mina Ohuchi Bregman)*

us to gauge their understanding of the content, hear their opinions and facilitate an exchange of ideas. Hence, our virtual talks also include a question and answer session. While we often get typed-out questions by the teachers on behalf of their classes, some teachers encourage students to verbally ask their questions and share their thoughts with us directly. It has been very heartening to hear about our young students' personal encounters with plants and animals!

Since the launch of our virtual talk series to schools in July 2020, the Gardens' education team has engaged over 6,000 students from 12 local and international schools. In this 'new normal', the team will continue to explore new and improved methodology to steer environmental education in the school community at large.

Winnie Wong
Janice Yau
Education Branch

The Cat's Claw

Flanking both sides of the entrance to the Evolution Garden, the Cat's Claw Vine or Cat Claw Ivy is one of many climbers that adorn the dull metal fence around the garden. It creates a deep green screen that each year suddenly breaks into splashes of brilliant yellow flowers. This lush screening plant is *Dolichandra unguis-cati*, formerly known as *Macfadyena unguis-cati* and *Bignonia unguis-cati*, and belongs to the Bignonia family (Bignoniaceae), which includes around 800 species in over 80 genera.

This vine's vernacular names and species' epithet, *unguis-cati*, are derived from its most distinctive feature, the small, three-pronged, claw-like climbing appendages that resemble the talons of a cat. These fragile looking but extremely tough appendages or tendrils help the plant to climb and grasp tenaciously onto other plants and surfaces. The tip of each prong is curved, stiff and so sharp that it is able to catch onto the individual ridges of a human fingerprint.

The Cat's Claw Vine is native to Central and South America and the West Indies, where it grows in tropical dry forests, tropical pre-montane moist forests, and occasionally in wet forests. It has been introduced into Singapore and around the world as an ornamental, and in fact now thrives on every continent except Antarctica due to its spread via the horticulture trade. It usually prefers fertile soils that drain well but can survive in most soils except those that drain poorly or are too salty. The species is very tolerant of low light when young, and grows more vigorously in open, sunny habitat. Basically, this hardy creeping plant can grow anywhere from the forest floor to the top of the forest canopy.

The dark green compound leaves usually consist of three leaflets; the bottom two are opposite each other and the third one at the tip is modified into the distinctive three-clawed tendril. Each 'claw' is about 3 to 17 mm long. The young leaflets are smaller and lighter green in colour compared to the mature ones. The showy trumpet-shaped bright yellow flowers are large – 4 to 10 cm long and up to 10 cm wide – and have five lobes that are each about 1 to 2 cm long. The flowers are bisexual and usually have very fine reddish-orange lines in their throat which act as nectar guides for pollinators. The flowers are mildly scented and borne singly or in small clusters originating in the leaf forks (i.e., axillary clusters). The plant is spectacular when the intertwining vines bloom in synchrony, which happens when grown in an ideal environment under direct sunlight and in fertile well-draining soil that is kept moist. Unfortunately,

The tiny but tough 'claws' of *Dolichandra unguis-cati*.

Close-up view of the brilliant yellow flowers of the Cat's Claw Vine.

The fast-growing Cat's Claw draping the fence around the Evolution Garden.

the plants at the entrance of the Evolution Garden do not usually flower so profusely, possibly because the area only receives partial sun.

The fruit is dark brown and strap-like in appearance, growing up to 50 cm long and 1.2 cm wide, and contains many papery, winged seeds. The plants in the Gardens do not produce fruit, but in its natural habitat the papery seeds are usually dispersed by wind or water. The vine also spreads vegetatively, via its tuberous root system, and the roots can be dispersed by floods and from human activities that result in soil disturbance. Given this vine's hardiness as well as its reproductive and dispersal mechanisms, it is not surprising that the Cat's Claw can become a problem in the landscape if not well controlled. Skilled horticulturists would advise regular pruning to prevent it from growing on other vegetation, and also cutting it back after flowering to reduce chances of fruit set.

The Cat's Claw is indeed a beautiful vine when properly maintained. Its luscious green leaves and impressive eye-catching flowers are a sight to behold when they fully cover the plant. Besides being planted as an ornamental, in its countries of origin it is used in folk medicine to treat multiple conditions including rheumatism, bronchitis, flu, headaches, snake bites, diarrhoea, fever and inflammation. Research has shown that extracts from the plant have significant anti-inflammatory and antioxidant properties. Perhaps one day this vine may be grown not just as an ornamental but cultivated for medicinal usage.

Nura Abdul Karim
Research and Conservation

All photos by Dr Nura Abdul Karim

Ridley the artist

Today, the Singapore Botanic Gardens has a collection of more than 2,000 botanical paintings, as well as hundreds of sketches, line drawings and photographs. These support its mission as a botanical institution and span its long history, dating back to Henry Nicholas Ridley, the first director of the Gardens from 1888 to 1912. Ridley was an extremely prolific botanist whose wider contributions included describing thousands of plant species new to science and establishing the reputation of the Gardens through its scientific publications. He employed artists to illustrate rare and poorly known wild species, and also made sketches of the plants that he himself studied.

The majority of Ridley's sketches were likely taken to London when he left Singapore, presumably to help him in his compilation of the *Flora of the Malay Peninsula*. They were donated by Ridley to Kew in 1935–1936. The illustrations depict plants in a variety of families, but are particularly rich in orchids, aroids and gingers. Many are richly annotated as an aid to identification. Most are unfinished, with the colour applied to only part of the plant, for example.

***Amorphophallus haematospadix*. A drawing executed by artists James and Charles de Alwis, Mohamed Hussain and Henry Nicholas Ridley. This drawing depicts the complete life cycle of the plant and was executed over a long period of time by different artists.**

***Etlingera maingayi* (as *Hornstedtia maingayi*). A sketch in the style of Ridley with numerous flower dissections as an aid to identification.**

Recent research at the Gardens' archives led to the finding of eight sketches which were earlier unattributed, but are believed to have been drawn by Ridley based on their style and sometimes on the associated handwritten notes. In the collection there are also two drawings painted by multiple hands – the artists James and Charles de Alwis, Mohamed Hussain and Ridley. These artworks give us a glimpse of the past art practices in operation at the Gardens. It is likely that Ridley not only made sketches for his own use, but also supervised the Gardens' artists directly, possibly making dissections and observations of microscopic details, and otherwise adding to the artists' work.

Michele Rodda
Herbarium