An Exploration into Global Horticulture: Singapore and the Global Botanic Garden Congress

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Report for the Merlin Trust 2024

Image: Central Catchment Nature Reserve

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Introduction and Aims

The purpose of this trip was to understand horticultural practices and the role of botanic gardens on a global scale by attending the Global Botanic Garden Congress. In addition, by spending one week botanising in the Nature Reserves and gardens of Singapore, I aimed to improve my skills in identifying tropical plants from a range of habitats. Finally, the last week was spent at Singapore Botanic Gardens, to learn about the cultivation of tropical plants – namely members of *Orchidaceae* and *Zingiberaceae,* and the varying ways in which botanic gardens can be ran to meet the needs of both people and plants.

Itinerary

Main Report

Week 1: The Global Botanic Garden Congress

Day 1: The Gardens by the Bay

Upon arriving in Singapore, I immediately took to exploring this ‘city in a garden’. I met up with a fellow horticulture student, and we made our way to one of Singapore’s most famous green spaces – The Gardens by the Bay. We decided to walk through the city to our destination and were surprised at the sheer amount of greenery in a relatively small space. Gardens were tucked away on balconies, and trees provided much needed refuge from the heat as we walked.

We were greeted by a sprawling garden, made up of wetlands, biomes, and of course, the famed Super Tree Grove.

Figure 1: Rain trees (Samanea saman) lining the streets.

Figure 1: Left to right:
Paphiopedilum appletonianum, Philodendron sp., Vanda 'Somsri Blue Classic'.

Day 2: The Global Botanic Gardens Congress

The first day of the Congress, and the opening ceremony. The first talk of the morning covered the biodiversity of Singapore, and how infrastructure can be used to accommodate native plants and wildlife.

In the afternoon, we had several of concurrent sessions– thankfully, these were recorded, as it was incredibly hard to choose just one to attend! I opted to attend talks on green and sustainable cities - these talks primarily covered the importance of urban ecology when developing urban areas, engaging communities in urban conservation, and implementing nature-based solutions for urban restoration.

After a much-needed tea break, we went on to the second round of concurrent sessions – again, I attended talks under the theme Green and Sustainable Cities, to better understand how cities around the world are brining nature into urban spaces.

Day 3: The Global Botanic Garden Congress

At the second day of the Congress, I attended talks on the illegal trade of plants, and how BGCI aims to tackle the issue. It was an incredibly eye-opening talk, and the scale of plant poaching from the wild and from the collections of botanic gardens was both astonishing and disheartening to see, though the development of a global behavioural change programme and public engagement seems to be helping raise awareness of the issue.

Another incredible talk by Amy Padolf covered the Million Orchid Project, and how mobile micro-propagation equipment was used by school children to help re-introduce native orchids to their local area. It was incredible to see an interest in conservation across generations and served as an excellent example of community engagement.

In addition, I attended a workshop on data analysis and data infrastructure, covering how it can be applied to assess the quality of plant collections and compare it to the collections of gardens around the world.

Finally, my last workshop of the day covered the implementation of pollen banking for the preservation of rare species. As this was something I hadn't heard of before, it was incredibly interesting to understand the process of assessing, processing, and storing pollen from a range of different plant species.

Day 4: The Global Botanic Gardens Congress

The conference opened with a talk on the restoration of Rifle Range Nature Park in Singapore, a previous quarry that had been re-developed as a buffer to primary rainforest at Bukit Timah Nature Reserve. The rate at which plants and wildlife had re-colonised the area was astonishing and served as an excellent example of a restoration project.

Later in the morning, I attended a workshop covering the challenges and solutions faced by increasing the role of botanic gardens in public engagement, research, and conservation.

In the afternoon, I listened to a diverse array of talks, covering plant collection policies, community perceptions of botanic gardens, and the impact of gardens on health and wellbeing, to name a few.

Day 5: The Global Botanic Gardens Congress

This was the final day of the Global Botanic Gardens Congress, and once again, we were presented with a number of talks we could attend. I found those covering the sustainability of foraging, the dynamics of ex-situ plant collections, and orchid conservation to be of particular interest. Overall, the congress was amazing, and it was an incredibly eye-opening event to attend – seeing the extent of collaboration between botanic gardens was inspiring, and it has cemented just how important the role of botanic gardens is when it comes to climate change. Community wellbeing, and conservation.

Day 6: The Southern Ridges

As a part of the congress, I opted to attend a tour of the Southern Ridges with other attendees of the congress. The trail is around 10km long, covering three parks across Singapore. Though the diversity here is not as high when compared to Singapore's nature reserves, it was still an amazingly varied walk. Along the way, we were treated to the towering, spiked trunks of Kapok (*Ceiba pentandra*), the epiphytic Tiger Orchid (*Grammatophyllum speciosum*), the Rain Tree (*Samanea* saman) and the Birds Nest Fern (*Asplenium nidus*), along with wildlife such as the King Bird and Long-Tailed Macaque.

Figure 2: Walking the Southern Ridges (above).

Figure 3: Ceiba pentandra (left). Grammatophyllum speciosum growing on rain tree.

Day 7: The Singapore Garden Festival

As the Singapore garden festival was occurring in conjunction with the Global Botanic Gardens Congress, I decided to attend to see the range of garden designs and planting schemes used in a tropical rainforest climate. It was interesting to see how integral small urban spaces were to the designs of some of the gardens – notably the 'balcony garden' section of the show – highlighting just how much can be achieved in a typical balcony space in Singapore. Alongside garden design, there were a multitude of exhibits involving plant life – from floral displays to clothing and sculptures.

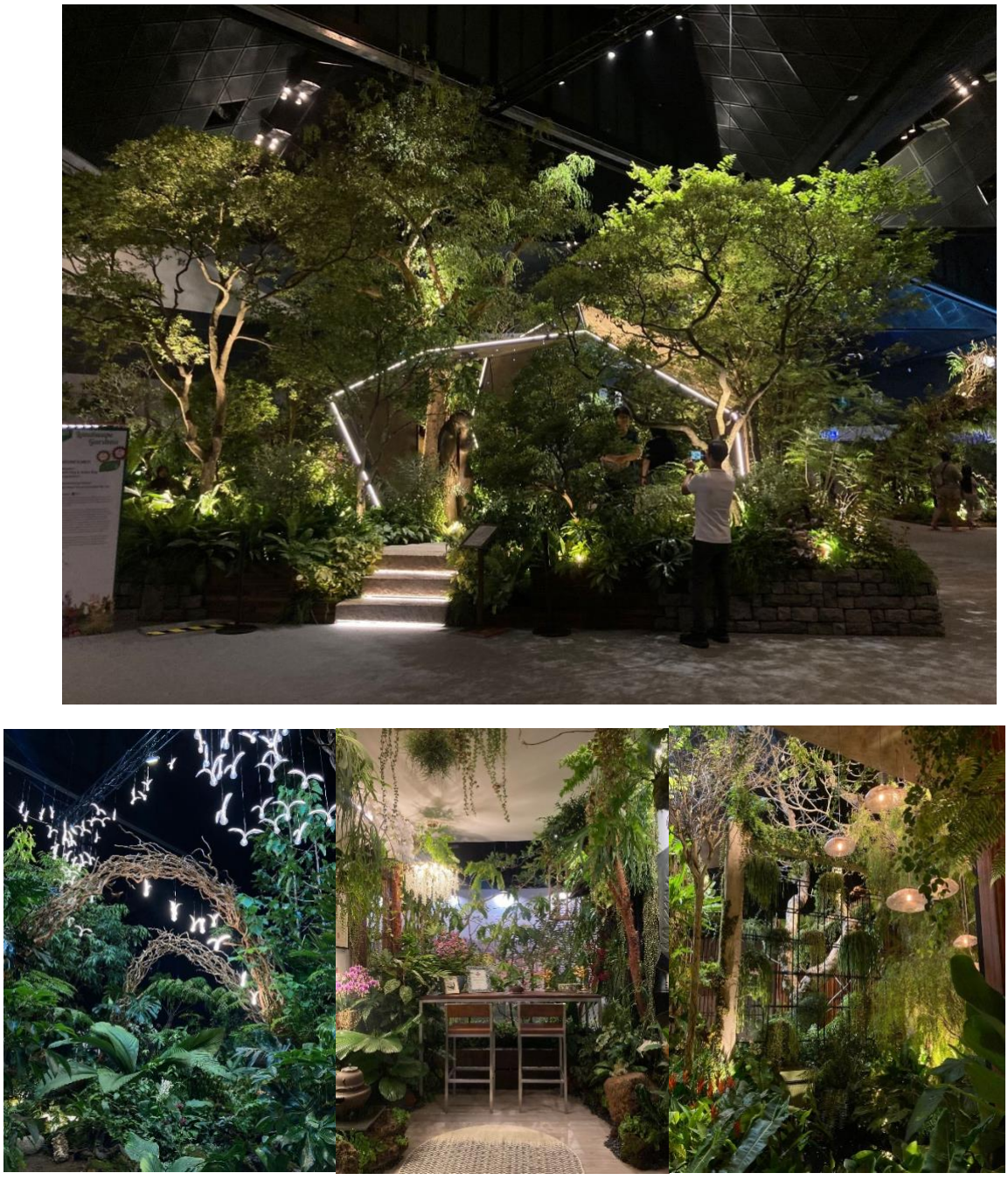

Figure 4: Display gardens at Singapore Garden Festival.

Week 2

Day 8: Rifle Range Nature Park & Bukit Timah Nature Reserve

After hearing about the creation of Rifle Range Nature Park from a disused quarry, I decided it would only be right to see just how quickly it has been restored. Along the boardwalks of the quarry, I was treated to the astonishing levels of greenery so close to the city. Plants such as *Mimosa pudica (*the sensitive plant), *Nymphoides indica* (Water Snowflake) and *Arundina graminifolia* (the Bamboo Orchid).

Venturing further into the reserve I then went on to enter Bukit Timah, one of the last sites containing primary rainforest habitat in Singapore. Here, the forest really took over, and a towering canopy of dipterocarps emerged towards the summit of the reserve.

Figure 5: Dilalum indum.






Figure 6: Clockwise from top left: Arundina grandiflora. Arundina grandiflora among Juncus sp. Oncosperma horridum. Ixonanthes reticulata. Mimosa pudica. Tectaria singaporiana.

Day 9: Sungei Buloh Wetland Reserve

To the North of Singapore lies Sungei Buloh Wetland Reserve – comprising of around 130 acres of mudflats, mangroves, and secondary forest. It was an excellent spot to observe wetland flora – including *Rhizophora stylosa* (Bakau pasir), White Teruntum (*Lumnitzera racemosa*), *Acanthus ilicifolius* (Mangrove Holly), *Avicenna alba*, and *Bruguiera parviflora*. Unfortunately, I did not manage to spot one of Singapore's most endangered mangrove species, *Bruguiera hainesii*, however simply observing the plant life here was an amazing experience.

Figure 7: Top: Rhizophora stylosa. Bottom Row, Left to Right: Lumnitzera racemosa. Avicennia rumphiana. Sonneratia sp. pneumatophores extending towards the bird hide at Sungei Buloh.

Day 10: Central Catchment Nature Reserve

Early in the morning, I set off to Singapore's largest nature reserve – Central Catchment Nature Reserve. This reserve sits in the centre of Singapore, providing a haven for plants and wildlife among the rainforest, lake, and swamps that cover the area. The levels of diversity here were astonishing, and while walking the trails found several wonderful tree species towering above the boardwalks.

Figure 8: Clockwise from top left: Platycerium coronarium. Calamus oblongus. Chempereia manillana. Nephelium lappaceum.

Day 11: Sentosa Island

After days of wandering nature reserves, it seemed apt to explore some of the urban plantings on offer. A recent development project had been planted up on the island, linking the Imbiah Nature area to the island's sensory gardens. Plantings here were lush, with dense sprawls of *Monstera deliciosa* and *Tradescantia spathacea* winding up the hilly terrain. Plants had been dotted throughout pedestrian areas – around trees, seating, under stairs, anywhere they could fit.

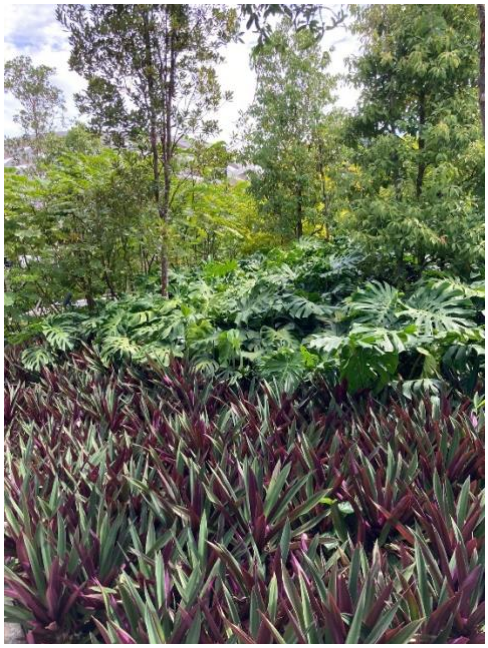

Figure 9: Top Right: Urban planting on Sentosa.

Bottom Left: Seating area on a walkway, containing Casuarina glauca, Podocarpus macrophyllus, and Sedum mexicanum.

Right: Plantings of Tradescantia spathacea and Monstera deliciosa.

Day 12: Fort Canning Park

I visited Fort Canning Park – the site of Singapore's first botanic garden, established in 1822. The site started out as a spice plantation, created by Raffles in 1819, and this history had been incorporated into the modern design of the site. A large spice garden covers the south-eastern slope of the hillside, displaying spices relevant to the colonial history of the site such as *Piper nigrum* (Pepper), *Myristica fragrans* (Nutmeg), and *Achillea ageratum* (Mace). This section of the garden holds around 180 varieties of herbs, spice trees, and other plants.

Figure 10: Pandanus amaryllifolius in the Spice Garden.

The Farquhar Garden to the south was well maintained and hosted interesting forms of interpretation such as picture frames highlighting plants of historical interest.

Figure 11: Entrance to the Farquhar Garden.

Figure 12: Young fruit of Ficus variegata.

Day 13: Hindhede Nature Park

As I ran out of time exploring the numerous nature parks earlier in the week, I decided to return to some of the reserves buffering Bukit Timah. Hindhede nature reserve is situated on a disused quarry, holding a pocket of biodiversity tucked away on the outskirts of Bukit Timah.

Here, crisscrossing boardwalks, footpaths, and trails guide you through the dense growth of the surrounding forest, and great effort had been made to engage people of all ages with the park – bird-watching spots, reading corners, and a play area was scattered across the site, interspersed with excellent interpretation showcasing some of the flora and fauna found in the park.

Day 14: Singapore Botanic Garden

Before starting a week's placement at the Botanic Gardens, I decided to explore as much of the garden as possible. The garden was vast, housing Orchid Gardens, Ginger Gardens, Bougainvillea lawns, art, and even a section of primary rainforest. The site was well signposted, and it was difficult to get lost despite the scale of the site. Locals and tourists alike used the garden for recreation and education, and no matter the time, there were always crowds of people enjoying the scenery.

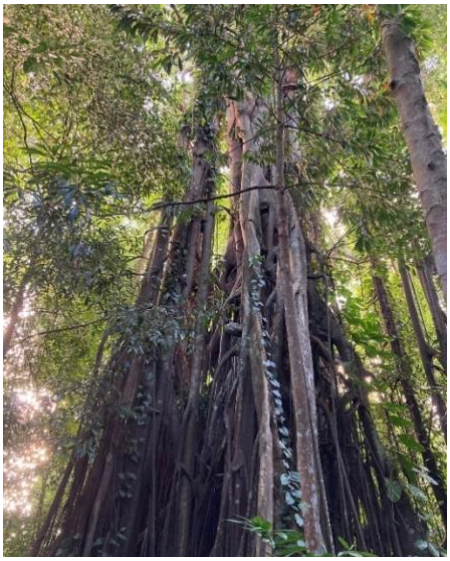

Figure 13: L to R: Couroupita guianensis. Ficus kerkhovenii. Nenga pumila var. pachystachys.

Week 3

Day 15: Singapore Botanic Garden (SBG): Seed Banking, The Learning Forest, and The Discovery Centre

On my first day of placement, I was greeted by Simin Lai and given a tour of the Heritage Area of the garden. Plants here are organised by their relationship to one another – whether that be though shared ecosystems, taxonomy, or historical interest, in alignment with the original planting designs of the area. Due to this history, this section holds numerous heritage trees, maintained to high standards. Extra care had been taken to preserve the trees with the installation of dynamic cable braces, props, and guying.

Later in the day, I was kindly given a tour of the seed bank and given an introduction into the seed drying and storing process used by the gardens, and their current aims to help preserve dipterocarp seeds. One of the main issues encountered when trying to save seeds in the garden are squirrels, who frequently eat the seed pods and fruits of many plants.

Figure 14: Left: Seeds being processed for storage. Right: The Discovery Centre Exhibition.

Day 16: SBG: The Ginger Garden, Herbarium, and Nursery

I was then taken around the ginger garden, home to hundreds of members of *Zingiberales*. The area is split into two parts – the first section focuses on aesthetics, catering to members of the public that may not have a particular interest in this group, then, the second part of the garden focuses on curated beds of biogeographical regions. When establishing a new species in the garden, they are usually planted in at least three areas of the garden, as changes in microclimate and rainfall often leave plants prone to rot.

The nursery held an even greater array of plants, and I was kindly walked through the labelling, care, and reintroduction programmes employed by the gardens to help reintroduce plants to their native habitat. Plants were kept in two coolhouses, two greenhouses, a mist house, and outdoors. Those adapted to the dry season are prone to spider mite and aphids, so systemic pesticides have been introduced around the base of the plant.

Finally, I visited the herbarium, and was shown the process of collecting, preparing, and storing herbarium specimens. Specimens here are kept in specialised plastic boxes, to help regulate temperature and keep visibility so contents can be inspected without needing to see the contents.

Figure 15: Top: The Herbarium. Bottom: Heliconia estherae.

Day 17: SBG: The National Orchid Garden

Upon arrival at the National Orchid Garden, I was greeted by assistant curator Mark Choo and given a tour of the practices employed in this specific area of the garden. As you must pay for entry, the standards here are incredibly high – yellowing leaves are promptly removed, and generally, orchids replaced every two weeks to maintain a luscious display. In order to add structure to the cycle of orchids used, colours are matched to seasons – yellow and pink for spring, red and orange for summer, purples for autumn, and finally, white for winter. Specific areas of the garden are designed for photo opportunities, to help engage the public, alongside conservation efforts involving native orchids – such as

Dendrobium secundum. Around 20 members of staff work to keep the garden in outstanding condition – misting, fogging, and feeding displays daily to keep the orchids looking healthy. Permanent displays are planted in charcoal, to allow irrigation and good water flow. The attention to detail in this section of the garden was remarkable, and it's clear that this area brings a sense of pride to those that visit and those who care for such a small yet spectacular area.

Figure 16: Left: Dendrobium secundum. Right: Bulbophyllum flabellum-veneris.

Day 18: The Orchid Nursery

The orchid nursery takes up 2.6 hectares and is separated across three different sites. Much of the space here is dedicated to storing and caring for the orchids used in the displays for the National Orchid Garden. Terrestrial plants are placed in the ground in a mix of sawdust and charcoal and misted as much as twice a day to retain humidity. Smaller, epiphytic plants are mounted on pine bark, then mounted on frames under cover to help protect them from the glaring sun.

In addition to the care and propagation of ornamentals, the garden also implements a native orchid conservation programme. Instead of micropropagating them, plants are hand pollinated to maintain genetic diversity. Notes of each plants parentage are recorded to help maximise the diversity within each species, with each orchid receiving an accession number. Efforts are being made to re-establish species in Central

Catchment Nature Reserve – about 60 species of orchids can be found there, and over 190 native species are held in the National Orchid Garden.

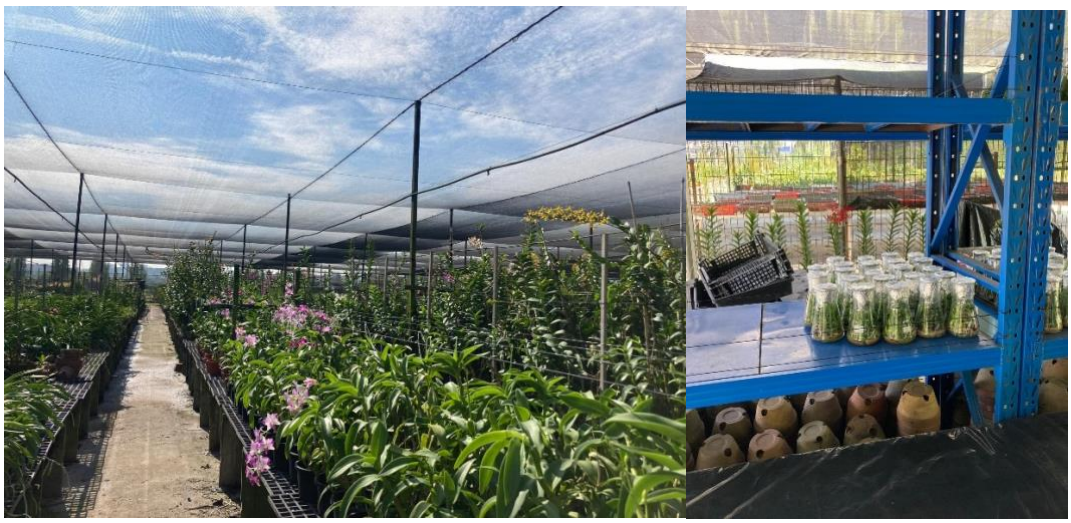

Figure 17: Left: One of the three orchid nurseries. Right: Micropropagated orchids ready for repotting.

Day 19: The Nursery

My final day was spent at the nursery, helping create growing various potting mixes for *Livistona* sp., *Areca ipot*, and *Koompassia malaccensis*. Sowing methods were dependant on the plant – those with samara were half-submerged in the medium, packed closely together in a sandy soil mix, while others were fully covered. I was informed that most of the plants here are grown in sub-optimal soil, so they will have an easier time acclimatising to the soil of the garden once established.

Figure 18: Left: A selection of seeds collected from the garden. Middle: Seeds of Areca ipot. Right: Seeds of Livistona sp.

Reflections

This trip has had a profound impact on my development and interest in horticultural conservation.

Attending the Global Botanic Garden Congress opened my eyes to the ways in which botanic gardens manage topics such as plant theft, public engagement, and the changing climate. There is a huge element of connectivity underpinning all gardens, and it was an absolute delight to speak to researchers, botanists, students, and horticulturalists from all over the world. Attending workshops also unearthed areas of interest I wasn't aware of prior to attendance – such as analysing the quality of collections within gardens, and how pollen banking can be used to conserve rare and threatened species. My week of exploring nature reserves and urban green spaces helped me build my plant identification skills and see plants in situ after caring for them under glass, while my placement at Singapore Botanic Gardens helped me hone my skills in tropical plant cultivation. The range of diversity over a relatively small area was astonishing – mangroves, rainforest, formal gardens, and swamps were intermingled with city skylines, creating an incredibly rich and unforgettable experience.

I hope to increase my knowledge and capabilities regarding horticultural conservation in the future though study, in-situ observations, and visits to other botanic gardens to understand as many approaches to conservation as possible; I hope to pass forward the culture of collaboration experienced at Singapore Botanic Gardens and the Global Botanic Gardens Congress. I have now decided to focus my studies on conservation, and I am planning on attending the next Global Botanic Garden Congress at the Morton Arboretum, Chicago, along with a trip to the American Society for Horticulture Science in summer 2025.