

Learning from the Tropical Collections in Belgium and the Netherlands

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Arnau Ribera Tort
Merlin N° 853

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Introduction

My background isn't originally in horticulture; I initially studied the molecular side of life and later shifted and integrated that focus into plants. My interest in plant collections emerged during my MSc program at a gene bank, which further fuelled my long-standing passion for caring for plants—particularly orchids, a fascination I've had since childhood. After completing my MSc, I had the opportunity to begin a specialist course in orchid cultivation at Kew Gardens and soon joined their team as an orchid specialist.

After my experience with orchids, I've been fortunate to work as part of the Curation and Plant Records team for the Living Collection at Kew, collaborating with the three main departments responsible for its care: Arboretum, Gardens, and Glass. This experience has pushed me out of my comfort zone, expanding my focus beyond orchids and other tropical groups, and has required me to adopt a broader and more strategic perspective on living plant collections.

It's an exciting time for living collections. Numerous managerial and collection improvements are occurring at this precise moment, including the development of new software and tools to manage collections and help sensibly develop them. There is a strong trend towards standardising workflows and measuring and increasing the quality of collections. Lessons have been learnt from seed banks and zoos, and we are quickly seeing how this knowledge is being applied to living collections. There is a widespread understanding in the need to collaborate to maximise results, and metacollections—collections of collections—are beginning to develop across the globe. Initiatives such as the BGCI's Global Conservation Consortia (GCC), mostly focused on woody plants, are rapidly expanding. These initiatives not only serve as a networking space to share experiences and connect with counterparts but also create significant opportunities for conservation, research and plant exchange.

For these advancements to continue and evolve, it's crucial not only to have a deep understanding of how collections operate but also to ensure the availability of professionals with a diverse range of skill sets and multidisciplinary expertise. Horticulturists with programming skills or taxonomists with horticultural knowledge may not be the most common combinations, but I believe we will see more of them in the future. Additionally, having a strong understanding of and working relationships with other botanical institutions, both British and international, is of utmost importance. Developing and expanding plant collections is increasingly challenging, often requiring going through extensive regulations and paperwork. Therefore, it's essential to build strong relationships and understand the needs of not only the sector but also the plants themselves. We must prioritise which plants to cultivate and enhance our knowledge of.

Belgium and the Netherlands are essentially neighbours to the United Kingdom. Not only are they in close geographical proximity, but their botanical institutions have also had close historical links with their British counterparts. Brexit and COVID have been disruptive, greatly hindering the exchange of materials and staff, resulting in limited interaction over the past few years. Resuming this relationship, learning how these collections operate, and finding common ground for collaboration are all desirable outcomes of the trip outlined in this report.

Aims of the project

- **Gain insights into Belgian and Dutch tropical collections**

The primary objective of this trip is to visit and learn from some of the most significant botanical collections in Belgium and the Netherlands, with a particular focus on what these institutions maintain and develop, and how they curate their tropical collections. This includes engaging with the teams at each botanic garden, gaining insights into their collections, and understanding the facilities they use.

- **Facilitate knowledge exchange and future collaborations**

The trip aims to establish connections with the horticultural and curatorial teams at the visited botanical gardens. These relationships are intended to promote ongoing knowledge exchange and lay the foundation for future collaborative efforts and standardisation initiatives between Kew and these European institutions.

- **Enhance British horticultural and curatorial practices**

A secondary aim of the trip is to reflect on the practices observed and identify opportunities for improving current horticultural and curatorial methods at Kew, especially those related to the management of living collections.

Sites visited

Belgium

Plantentuin Meise	Brussels/Meise	3 rd June
Ghent University Botanic Garden	Ghent	4 th June

The Netherlands

Hortus Botanicus Leiden	Leiden	5 th June
Hortus Botanicus Amsterdam	Amsterdam	6 th June
Utrecht University Botanic Garden	Utrecht	7 th June
Burgers' Zoo	Arnhem	8 th June

Plantentuin Meise

Meise is a relatively unknown botanical institution located on the outskirts of the European capital. Like Kew in many respects, Meise is a collections-based organisation with arguably the second-largest tropical plant collection in Europe, and an impressive herbarium containing around 4 million specimens. Despite these features and its proximity to Brussels—just over 30 minutes away from the city centre—Meise has remained relatively hidden from tourism and in my experience is not widely known among British plant people.

Meise's estate is mainly an arboretum with a massive display glasshouse and a castle in the centre of the garden. However, the great jewel of Meise is mostly behind the scenes, which is the recently inaugurated Tropical Nursery complex. It is a high-spec glasshouse complex that plays with different heights and has a total of 22 different zones. The design contemplates elements such as the shading gradient created by the canopy surrounding the nursery, or the careful consideration of the homogeneity of humidity, temperature and airflow by introducing elements such as astonishingly noiseless vertical fans, partially open floors to help with keeping humidity constant, two layers of shading, and high-quality—ultrafine—mist. Most zones have one or more propagation tents with state-of-the-art ultrasonic foggers and growing lights, and each zone's climate is completely automated and can be controlled via a phone app when required. Interestingly, the public is allowed to see part of the nursery via a courtyard, with rolling interpretation that can be changed according to season or needs. A great outreach initiative considering most collection glasshouses in botanic gardens are hidden from the public.



Section of the Arid collection in Meise's new Tropical Nursery. Note the collection benches (right side) alongside the display beds for the public (left side).

Meise's main tropical holdings include the *Rubiaceae* collection, the *Orchidaceae* collection and, most importantly, arid plants, with important collections of *Euphorbia*, *Cactaceae*, and Madagascar flora.

Collection management in this new complex is interesting. Instead of having the traditional focus on both taxonomy and climate that you see in many botanical collections, they shifted to giving more weight to plant ecology and less to taxonomy. Therefore, their zones are large and contain multiple plant groups that share growing conditions, many times sorted taxonomically playing with benches and bench-space. Their reasoning for doing this also sought to increase staff interaction by having several people responsible for collections working in the same zone. They also have a couple of quarantine zones and a couple of research zones, available for temporary research projects.

In the garden, two remarkable recent developments are the Rose Garden and the Island Garden. The Rose Garden had been smartly designed following the two clades of the *Rosa* phylogeny, each one represented by one side of a spiral of rose species aligned with the *Rosa* genus sections. Surrounding the spiral, rose cultivars had been planted following the breeding history of cultivated roses. It is a great example of careful design integrated with scientific research, creating outreach opportunities for the public.

The Island Garden is a brand-new development built during the previous year. It's a series of artificial garden islands connected by a visitor path, with interesting plantings of moisture-loving species. Several *Taxodium distichum* individuals were planted alongside the path, which hopefully will eventually become great specimens once established. There is also an impressive bog bed containing several *Sarracenia* species and rarely seen bog orchids like *Pogonia ophioglossoides*, among others.



The new island garden still requires plants to establish, but it is an ingenious garden that offers the opportunity to bring unusual plants closer to the public.

The collection at Meise is divided in two: indoor and outdoor. Each collection has its respective manager, and each manager leads a horticultural team. Meise's curatorial team have research backgrounds but developed rather impressive horticultural knowledge, so it is quite distinct from Kew's living collection.

Meise and Kew have similar and multiple botanical collections held in their estates. To manage their collections, both institutions interestingly decided to move to the same software system:

EarthCape. Kew has already moved most of its collections to this software, with the Living Collection module currently being designed with a migration date set around the end of 2024. Meise will first move the herbarium collection to EarthCape, with the Living Collection following soon after that. For this reason, this was a great opportunity to start discussing what kinds of standardisation and collaboration are possible between our Living Collections.

Ghent University Botanic Garden

Ghent's Botanic Garden is a university-affiliated institution located within the city and closely tied to education and research. The current collection manager at Ghent recently transitioned from the same role at Meise, strengthening the relationship between the two institutions. As a result, they also decided to adopt the same database system, EarthCape, in the near future.

Several smaller glasshouses form the nursery behind-the-scenes. A few prominent groups are represented there, with bromeliads, ferns and orchids being the highlights. The constant humidity and subtle airflow of the tropical zones was outstanding, with a rarely seen fogging system in place—generally they are misting systems. This system seems to have allowed the epiphytes, especially orchids, to develop extensive root systems, some of the best I've ever seen. From the plants present, it appears that Ghent was quite active in terms of collections during the 70s, with many wild-collected Neotropical plants.



Note the extensive root systems of Ghent's orchids.

The display glasshouse is a 3-compartment complex with an industrial design. The Victoria pond area is large, and the Victoria Longwood hybrid there really had the space to grow and develop as a magnificent specimen. The tropical and subtropical areas also have a character of their own, with really high ceilings that allows trees and palms to develop. Height is not a problem there.

The outside areas are compact, featuring a modest arboretum divided by geography to showcase the diversity of hardy woody plants. A great rock garden is located near the entrance of the faculty building, designed as a mount and divided geographically too.

The team at Ghent is relatively small but passionate and eager to develop their collections. The horticultural staff report to the collection manager, who oversees the full range of both indoor and outdoor plant holdings, as well as a herbarium with circa 300K specimens.

Ghent is planning restorations for both the display glasshouse and the nursery. They were currently engaged in completing a stock check of their holdings, which will be followed by a development plan for their collections. It was important for the collection manager and staff to improve the collections, so I'm sure we'll hear more about their progress soon.

As mentioned at the beginning of the section, Ghent seems to be extremely aligned with Meise, and both institutions are closely tied together. Workflows and management methodologies are aligned between the two, which are essentially the primary tropical plant collections in Belgium. Botanical institutions in the country have collaborated and made accessible their living collection lists on a [website](#), providing an extremely useful resource for anyone wanting to check their taxa and accessions.

Hortus Botanicus Leiden

Leiden is the oldest Dutch botanic garden and a world-renowned institution located in the centre of Leiden. Like Ghent, the botanic garden is part of the university University, so it has a strong focus on education and research. Leiden is also home to Naturalis, which now holds the Dutch National Herbarium following the unification of the three main Dutch herbaria—Leiden, Utrecht, and Wageningen. It is home to roughly 7 million specimens, putting it on the same scale as Kew.



One of the orchid zones from Leiden. Many rare New Guinea taxa are kept in these zones.

As with many institutions linked to large herbaria, Leiden has conducted extensive wild collection expeditions in the past that enriched its living collection. It is widely renowned for its orchid collection, one of the largest in the world and heavily focused on Asian and New Guinea orchids. In the Netherlands, botanic gardens are geographically specialised, and Leiden is the specialist in Asian plants. As such, it also houses important collections of tropical *Apocynaceae*,

Nepenthes, *Araceae* and *Rubiaceae* subtribe *Hydnophytinae*. Additionally, Leiden holds an extensive collection of temperate European orchids, probably one of the largest, if not the largest, in Europe.

The tropical collection is housed in a single complex renovated in 2013, which features two large display compartments: the tropical rainforest and the Victoria pond. Smaller zones in the form of potted plant compartments are also part of the complex, many of which are open to the public. This is unusual for most botanic gardens, which often worry about theft. Theft is present but not considered too problematic in Leiden; important accessions are duplicated behind the scenes, and they readily share their surplus and divisions with other institutions.

Although Leiden is primarily known for their tropical collection, it also has excellent outdoor displays, including the recently inaugurated and still-developing Mediterranean garden and the more established woodland garden.

In terms of collection management, Leiden adopted Hortis, one of the leading living collection software solutions available in the market. The collection is overseen by the horticultural director, who manages the horticulturists as well.

A notable feature of Leiden's approach is its adoption of unconventional policies regarding pest control and plant growth. Their display glasshouses host a range of critters rarely found in botanic gardens. For example, they use a certain species of slow-reproducing generalist stick insect (*Heteropteryx dilatata*) to slow down plant growth and help plants stay in constant defensive mode, which reduces overall pest incidence. No chemical pesticides are used at Leiden.



A female of *Heteropteryx dilatata*, the stick insect purposely introduced at Leiden.

Hortus Botanicus Amsterdam

The Hortus Botanicus in Amsterdam is a small botanic garden in the heart of the city. It used to belong to the University of Amsterdam but is now an independent institution supported by the city council as well.

The garden's history is linked to the Dutch East India Company, which helped built the initial plant collection and introduced many important tropical and subtropical species to Europe. South

Africa was one of the key sources of these plants, and the garden's current main focus is on the Cape Floristic Region.

Other important plant groups include medicinal plants—connected to the gardens' history as well— as well as cycads and carnivorous plants, the latter of which is a shared collection with Leiden.



The raised bog bed at Leiden showcasing temperate carnivorous plants, orchids and moss.

The garden features two large greenhouse buildings: a Palm House and a conservatory for both tropical and subtropical plants. The Palm House primarily contains potted cycads and palms and is also used for events. The conservatory is currently undergoing renovations, with an expected reopening in 2025. During the restoration, most plants were relocated to an external facility, leaving the conservatory mostly empty and occupied by builders. The renovated complex will emphasize South African flora, better aligning with the garden's focus.

Across the street, separate from the garden grounds, a behind-the-scenes two-level glasshouse and seed bank complex houses the South African and tropical potted collections. Many of the plants, including Proteaceae and Ericaceae species, were grown from seed and prepared for the restoration. Pelargonium is another key group present. A few orchid species, including African ones, were also there, mainly sourced from the famous Wubben nursery after it closed.

In the outdoor areas of the garden, there is a magnificent bog bed showcasing not only temperate carnivorous plants but also several *Sphagnum* and bog orchid species, including the showy *Platanthera ciliaris*. A heated pond allows *Victoria cruziana* to be grown outside, an unusual sight in Western Europe. Medicinal plants are also prominently displayed around the Hortus, which includes both a medicinal and a systematic garden.

The horticultural team is small, consisting of seven people who maintain the site. They use Hortis as their collection management system and were pioneers in using barcodes on botanical labels. These barcodes assist with their mobile software solution, Floria, which interacts with Hortis, and provide visitors with additional plant information. This is a neat solution that hasn't been extensively implemented elsewhere.



The main display glasshouse in Amsterdam is being renovated.

Utrecht University Botanic Garden



The rock garden in Utrecht is one of the largest in Europe.

The botanic garden in Utrecht is located on the outskirts of the city, within the university campus and science park east of the centre. It is the largest botanic garden we visited in the Netherlands, with a primary focus on Neotropical and alpine flora. The garden features three main elements: the tropical glasshouse complex, the rock garden, and the evolution garden.

The impressive rock garden, one of the best and largest in Europe, was built on and around an old defensive fort—Fort Hoofddijk—and is surrounded by a moat. Given the flat terrain, the rock garden forms a significant hill and is the highest point in the garden. It is organized geographically and even includes a brook with a waterfall. Various beds—such as bogs, peat terraces, and free-draining terraces—support a diverse range of plant species and several national collections, including *Arisaema*, *Epimedium* and *Trillium*.

A newly planted evolution garden, set to officially open next year, has been developed as an outreach and teaching tool. Designed as an evolutionary tree, the garden incorporates a system of canals and moisture gradients to accommodate a wide variety of species. Once established, it is expected to become one of the premier evolution gardens in the world. An elevated viewing point will also be created to allow visitors to view the plant tree from above.

The tropical glasshouse complex is an interesting, slightly industrial-looking complex that mixes display and potted collections areas alongside research compartments. Although the glasshouse facilities are extensive, there is limited space for potted collections. A renovation is currently being planned to expand the collection space and improve the current display areas. It will be interesting to return in a few years to see how the nursery and display glasshouses have developed.



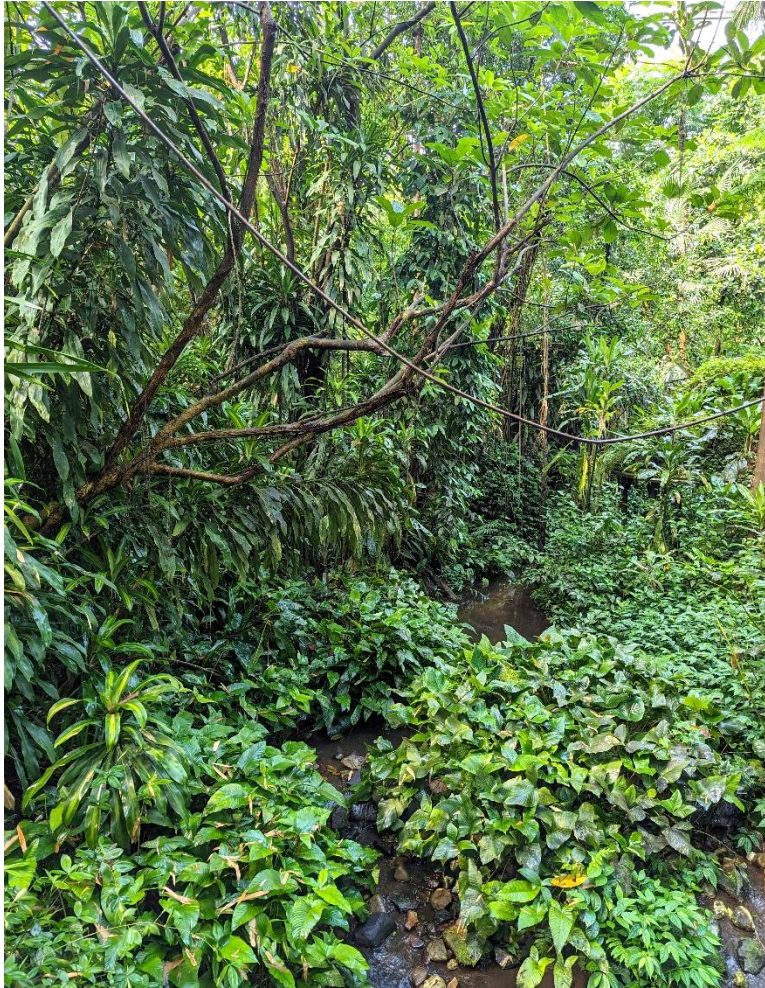
Part of Utrecht's *Bromeliaceae* collection. Many *Tillandsia* plants are kept outside under shading during the warmer months.

The most important tropical collections include epiphytic *Cactaceae*, *Bromeliaceae*—particularly *Tillandsia*, and *Orchidaceae*. However, the orchid collection lacked a specialist for a long time and has recently appointed one, so Leiden likely holds a larger Neotropical orchid collection at the moment. However, Utrecht plans to extensively develop the orchid collection over the next few years.

Like other Dutch collections, Utrecht also uses Hortis and Floria for collection management. They are also highly interested in managing and measuring the quality of accessions and plants. This involves addressing the quality decrease of plant data over time—or data staleness, and the completeness of plant data, which relates to the garden data associated with a plant. To develop this, they are working closely with Hortis and other institutions.

Burgers' Zoo

Burgers' Zoo is a rather interesting institution in Arnhem, close to Nijmegen and the German border. This zoo is highly acclaimed and often considered one of the best in Europe, not only



The lush, naturalistic display in the tropical biome is of high quality.

because it offers extensive facilities for the animals, but also due to its impressive glasshouses where many animals roam in semi-freedom and plantings follow naturalistic displays without labels.

The zoo also belongs to the network of Dutch botanical institutions and holds several national collections, such as *Dracaena*, *Aristolochia* and *Zingiberaceae*, among other tropical groups.

We visited Burgers' Zoo on a Saturday, so we visited on our own without meeting with the staff. The outdoor facilities are heavily focused on animals, so plantings are simpler and not that interesting. However, the indoor facilities are really striking. There are basically three tropical complexes: the tropical biome, the arid biome and the more recent mangrove biome.

The tropical biome is essentially an immense, columnless, and lush rainforest that immerses you in the sounds and colours of the living beings present. It genuinely feels as you are not in a man-made structure, but in a Neotropical rainforest many miles away from Europe. The plants look healthy and there are rather impressive specimens of tropical trees, *Aristolochia*, aroids and gingers. The constant bird and reptile activity does really trap you from the minute you step on that place, which makes it a completely different experience to most botanic gardens.

The arid biome emulates a more stereotypical Mexican desert, with *Agave*, *Yucca* and *Cactaceae* specimens scattered around the place. The planting density is much lower, in accordance with the ecosystem trying to represent. Although beautiful, the plants looked rather dry, so the experience was not as immersive as in the tropical biome.

Finally, the mangrove biome is another columnless glasshouse, this time circular-shaped and with a large brackish pond in the centre. The glasshouse was designed as a butterfly and manatee-house, so the design took such animals into account. For the butterflies, nectar plants and feeding plants for caterpillars are scattered all over. For the manatees, a very large mangrove section is also present to illustrate their habitat. I visited the zoo around 5 years ago, when the plantings were relatively recent, and this time you could tell the plants had developed extensively. A large mangrove bed holding several species, with enough space for all of them to grow as they do in nature, must be rare in Europe. This is the best example I've seen so far.

I wonder how they deal with collection management. The fact that the plants have no labels either means that the primary specimens are managed separately, maybe with GIS systems, or that they are loosely managed in terms of curation. Considering several of those plants likely belong to national collections, I'm inclined to think those groups are managed, and that the other plants are considered more like fillers. In any case, the recreations of a tropical rainforest and a mangrove ecosystem are superb and likely to be some of the best out there.



Part of the mangrove display (background) and the mud display (foreground). Interesting animal species such as fiddler crabs, horseshoe crabs, and mudskippers lived in these areas.

Reflection on the trip

The Netherlands is a prime example of how botanical institutions can coordinate effectively within a single country. The existence of a consortium to coordinate botanical institutions, combined with the degree of geographical specialisation in each botanic garden, has helped optimise resources and maximise opportunities. For instance, Dutch institutions are either using or transitioning to the same database system, Hortis from Species360, a novel web-based solution for botanical collections. Unlike traditional desktop-based solutions, Hortis offers improved user experience, cross-platform compatibility, and facilitates cross-institutional access to data and enhanced collaboration. It was also impressive to witness the strong working relationships between Dutch institutions. During our visit, we observed a joint training session for Dutch botanic garden horticultural staff—a valuable way to regularly meet and build relationships between institutions.

Similarly, Belgian institutions are closely connected with their Dutch counterparts. Both Meise and Ghent are in the Flemish part of Belgium, sharing a common language with the Dutch institutions. From what we learned, Belgian institutions are practically considered an extension of the Dutch network, which fosters continuous exchange of knowledge and plants among them. This level of cooperation is commendable.

I personally feel that this is something we are missing in the UK when it comes to living collections. Although we maintain good relationships with our counterparts, there is a lack of

joint developments and future plans, and no current national partnership aims to develop a British metacollection for tropical or herbaceous plants. Nevertheless, some degree of collaboration exists, with one notable example being the Cambridge University Botanic Garden. They are set to publish an R package designed to standardize and facilitate the analysis of living collections, which could significantly impact plant curatorial teams globally. At the British level, I believe only woody trees metacollections exist, such as Edinburgh leading the conifer GCC and Wakehurst the *Nothofagus* one. Anecdotal cases of herbaceous metacollections exist, like the *Tulipa* collection shared between Kew and Cambridge.

Interestingly, the two Belgian organisations we visited are not following the Dutch institutions and are instead moving to EarthCape, rather than Hortis. I personally found this a surprising move given their strong links to the Dutch institutions. Since Hortis focuses on living collections, I suspect Meise and Ghent had similar needs to Kew and required a unified system for managing all their botanical collections and not only their living one. The Dutch institutions, on the other hand, are almost exclusively focused on living collections, so their needs are more specific.

Kew and Meise sharing the same database system for the first time—managing two of the largest living and herbarium collections in Europe—presents an unprecedented opportunity for collaboration between our institutions, which we should actively embrace and develop. Similarly, all Dutch institutions moving to Hortis will create fantastic opportunities for them to enhance their work, particularly in plant conservation.

The current trend in collection management seems to heavily involve the standardisation of workflows and analytical methods. All the curatorial teams we met were interested in this, which provided a great opportunity for meaningful discussions. Since our visit, we have regularly met with Meise and Ghent to discuss our database migrations and work on standardising key concepts. Surprisingly, fundamental aspects like "What is an accession?" or "How do we manage sexual reproduction from a curatorial perspective?" are not standardised across gardens, which complicates the task of tracking the provenance and background of plants.

In parallel, we've also been in conversation with Hortis and EarthCape, and it's encouraging to see that everyone is on the same page when it comes to collections. It's great to witness the industry coming together to refine and develop best practices for managing collections.

It was also fascinating to see the development plans at various institutions—some already nearing completion, like Meise, and others still in the planning stages, like Ghent and Utrecht. I suppose the significant investment in the growth and expansion of botanical gardens is always a positive sign for the sector. Meise now boasts some of the best and largest glasshouse facilities I've ever seen, alongside the opportunity and ambition to become one of the most prominent botanical gardens in Europe and possibly the world.

Finally, I believe we have much to learn from these gardens in terms of improving our use of GIS solutions, barcodes, and enhancing the visitor experience. We now plan to incorporate barcodes on labels, not only to streamline work for our staff but also to improve the overall visitor experience. Maximising the availability of information and creating outreach opportunities for the public should always be a priority for any botanic garden. Education is central to our mission. A robust GIS system is also essential for properly managing a botanical collection and for keeping track of all collection items. While we do use GIS in our day-to-day operations, some of the gardens we visited cleverly utilise volunteers and specialist staff to further develop and apply this knowledge when making decisions regarding collections.

Acknowledgements

I would like to thank all the teams who warmly welcomed us and contribute to the excellent upkeep of the gardens we visited. It was a unique opportunity to meet them and learn more about their work. I would also like to thank the Merlin Trust for making this opportunity possible. Thank you all!

Breakdown of costs

Transport	£384.68
• Eurostar	£270
• Public transp.	£114.68
Accommodation	£339.97
• Brussels	£47.95
• Ghent	£49.57
• Leiden	£55.51
• Amsterdam	£56.78
• Utrecht	£46.82
• Arnhem	£83.34
Food	£270
Travel insurance	£30
TOTAL	£1024.65