Exploring future-proof plants for London in the gardens and natural landscapes of southern Spain

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Introduction

It is becoming commonplace during British summertime to see headlines like that of the Telegraph this year stating "South East could be as hot as the Mediterranean by 2033". During my first Summer gardening at Royal Botanic Gardens Kew, I found myself watering plants all day in 40°C heat with a sense of urgency akin to putting out a fire. As I looked around, green lawns resembled yellow savannah' and red alerts for hot weather kept visitors at bay. It became paramount that this emerging weather pattern causes extreme stress on the health of many plants found in English gardens and the health of our gardeners.

The IUCN classifies a Mediterranean climate as "mild wet winters and warm and dry summers". Scientists continue to declare growing evidence of our southeast England climate replicating this, which has sparked a desire to better understand Mediterranean planting in-situ before it changes significantly itself. Guided by professional connections with Anthony Hall, Head of Arboretum and Temperate Collections at RBG Kew and Andrew Gdaniec, Curator of Gibraltar Botanic Garden, a trip to southern Spain was planned to explore plant species that we might expect to see growing more successfully in the gardens of London.



The climate of Gibraltar and Málaga is subtropical-Mediterranean with mild winters when the year's rainfall occurs and warm dry summers with little to no rainfall. This is the climate scientists are seeing trends towards in southeast England and the reason why these two locations were suggested to visit by our colleagues.

Gibraltar has a particularly unique climate on the continent. With two main prevailing winds, the easterly Levanter bringing warmer sea currents and humidity from the Sahara in Africa, and the westerly Poniente bringing cooler sea currents and fresher air, enabling as much annual rainfall as London (see Table 1). When the Levanter wind is forced up the steep eastern side of the Rock, it forms a cloud of varying thickness, extent and duration. Gibraltar also has an interesting geological makeup that resembles North Africa more than Spain. It is marked by limestone rock and alkaline soils, which stands in stark contrast to its sandy, acidic surroundings. This geology and climate make for exceptional plant diversity with over 600 plant species across 330 genera and 90 families. Among these are *Silene tomentosa, Cerastium gibraltaricum,* and *Saxifraga globulifera var. Gibraltarica,* which are exclusive to Gibraltar. Iberis gibraltarica and *Thymus willdenowii* are native to North Africa but can be found in Gibraltar as the sole European habitat. And *Limonium emarginatum*, endemic to coastal regions flanking the Strait of Gibraltar, thrives on the Rock.

	London	Málaga	Gibraltar	Córdoba	Seville
Mean annual temp	10.8°C	17.6°C	17.6° C	17.9°C	18.8°C
Mean temp of coldest month	4.8°C	11.5 ℃	11.8°C	8.4°C	10.3°C
Mean temp of warmest month	17.8°C	25.1 ℃	24.8°C	28.7°C	28.4°C
Mean annual rainfall	690mm	485mm	686mm	518mm	483mm

Table 1: City climates with weather data collected between 1991 and 2021 (Climate-data.org, 2019).

The climate of Córdoba and Seville is "true" Mediterranean. These two cities in Spain have the highest average temperatures in Europe with significant droughts occuring in summer and rainfall taking place between winter and spring. With the main focus of our trip set in Málaga and Gibraltar, we thought we'd make the most of the opportunity being in southern Spain and extend the trip to Córdoba and Seville and discover how the gardens in these cities were designed to be resilient to such extreme conditions.

Aims and Objectives.

- Visit gardens in southern Spain and study their curation, design and plant selection.
- Identify native flora and fauna in their natural habitats in southern Spain.
- Observe how Mediterranean plants grow in their natural habitat.

Itinerary

Friday 30th June: Flight from Luton Airport to Málaga, Spain.

Saturday 1st July: Visit Málaga Botanical Gardens, Jardín Botánico La Concepción

Sunday 2nd July: Travel to Gibraltar via bus

Monday 3rd July: Tour of Gibraltar Botanic Gardens with Director Keith Bensusan

Tuesday 4th July: Tour of native flora and fauna on The Rock with Kian Khalilian

Wednesday 5th July: Lab time at Gibraltar botanic gardens

Thursday 6th July: Travel to Córdoba by bus and train

Friday 7th July: Visit the Alcázar de los Reyes Cristianos

Saturday 8th July: Travel to Seville, visit the Real Alcázar gardens

Sunday 9th July: Flight to London

The Trip

Málaga La Concepción Historical Botanical Garden

La concepción historical botanical garden in Málaga was established in 1943 as a "historical and artistic interest" garden spanning 3.5 hectares. Its significance lies in its original design, natural features, and diverse subtropical fauna. Situated on a hillside, the garden is home to water features, greenhouses, ancient trees, and Europe's top collection of centuries-old palms. Among the 3,000-plus species that grow in this botanical garden we were captivated by the century-old *Ficus*, *monstera*, *cycads* and giant birds of paradise growing happily outside. A unique *Wisteria sinensis* vine adorned a 19th-century iron gazebo that we sadly missed in bloom.



La Concepción Historical Botanical Garden treescape Photo: Fay Davies

Top: Derelict Glasshouse Bottom: Natural areas of the Garden Photo: Fay Davies

The botanical garden surrounding the Historical Garden is organised by scientific classification. The entrance begins with aquatic and prehistoric plant collections, a biodiversity-focused rockery, a carnivorous plant greenhouse, bromeliads, orchids, African plants, and bamboos. At the north end of the garden is the "Around the World in 80 Trees" route. A well-intentioned educational idea that perhaps falls short with the changing climate. There were some trees that stood out to us, like the *Brachychiton discolor* native to eastern Australia. It is typically found in drier rainforest areas, but its compact root systems make it a desirable street tree. In early summer it drops its leaves while producing bell-shaped, deep pink flowers which we all delighted in. It became clear that plants we were more familiar with growing indoors in the UK, were able to grow easily for display outside in Málaga. One example of this that surprised us was the *Pachira aquatica*. Commonly known as the money tree and usually sold with a plaited trunk, this outdoor example displayed its grandeur with its cannonball-like fruits. Another unexpected sight was seeing the *Aristolochia grandiflora* growing beside *Ipomeoa* on a hedge. Both plants I've only ever seen growing in the Waterlily House of RBG Kew. It was great to see the full nature of these plants growing in a habitat they can thrive in and perhaps alludes to the idea that our UK indoor tropical plants may become commonly seen outdoors in the future.



Brachychiton discolor flowers close up and tree. Photo: Fay Davies

Pachira aquatica with visible seed pods Photo: Fay Davies

We walked to the upper edge of the garden towards a viewpoint on to the city encountering arid plant species through their cacti and agave collection. The branched inflorescence of the *Agave salmiana* var. *ferox* stopped us in our tracks with its staggering height silhouetting against the bright blue sky. Originally from southern and central Mexico, it was introduced into gardens with a Mediterranean climate in Europe and has now become naturalised in some parts of southern Europe, particularly the Canaries. This variety of species can in fact already be found growing in parts of the UK, like the Isles of Scilly, where the mild winters and sandy soil encourage strong growth up to 2 metres tall and wide. Its broad arching leaves which terminate in vicious blackened-purple spikes create a show-stopping bold architectural appearance.



Agave salmiana var. ferox inflorescence Photo: Fay Davies



Agave salmiana var. ferox flower Photo: Fay Davies



Planted Arid landscape. Photo: Fay Davies

Málaga Alameda park

On the way to have dinner near the beach we stumbled upon Alameda park, a subtropical urban oasis nestled in the heart of the city. This park is designed as a landscape, with curved lines that frame and define rooms of different sizes, making you forget that you are in a rectangular space, let alone in the city or by the sea. Each room is designed to be a communally shared space, with bandstands, an auditorium, playgrounds and artistic focal points like fountains and statues. These spaces made the garden functional, playful and intimate; inviting you to stay and enjoy being outdoors for longer. An extensive palm-lined promenade connects it all offering ample amounts of shade to cool people down efficiently. It is one of the best examples I have seen of public outdoor landscaping, feeling as rich in plant specimens as the botanical garden.



Alameda park looking up Photo: Stephanie Li

In 30,000m², the park was planted with an array of tropical and subtropical plant species turning it into the lungs of the city. Despite it being graffitied, we were impressed to see a map and extensive species list by one of the park's entry points. From *Ginkgo biloba* to *Bismarkia nobilis, Pinus canariensis* and *Meryta denhamii*, the species are varied with some specimens being more than a century old. We particularly enjoyed seeing different tree species planted so close together, creating a mixed canopy of foliage textures; needles layered upon broad leaves broken up with palm fronds. Trees weren't displayed to stand alone, but more naturalistically grouped to create communities. Even though not officially deemed a botanical garden, this unassuming public park left a strong impression on us. It seamlessly balanced the ability to be a beautiful green space that people could enjoy and interact with while also being an educational display of plants.

The Rock, Gibraltar Photo: Stephanie Li

Gibraltar

The Alameda, Gibraltar Botanic Gardens

We were given a tour by the director, Keith Bensusan, who gave us a fantastic overview of the history, challenges and future direction of the botanic gardens. The Alameda is subject to long drought periods from late May to early October. They then receive the majority of their 800mm annual rainfall between November and February. These fill water tanks in the gardens, but that rainwater only accounts for 5% of what they use in the garden. The rest of their watering is from desalinated water which has a significant financial and environmental cost. The garden sits on an old fossil dune of Saharan red sand that is full of iron oxide. This substrate and its location of Gibraltar results in a high evapotranspiration rate, that is the process of transferring water from land to the atmosphere through soil evaporation and plant transpiration. Considering this and the lack of reservoirs or natural sources of water, the strategy for the survival of this garden depends on the planting.

The layout of the garden has remained the same over the last century, but a significant change to the planting occurred in the 1990s after several decades of neglect. Soil in new beds have been dug out and replaced with a foot of lava substrate sourced locally. With a neutral pH, lava substrate is light, holds nutrients well yet porous enough to be well-draining. This has made for near-perfect growing conditions for cacti and succulents. It is clear that xerophytic and succulent plants are becoming the main group of plants that make up the displays. With Gibraltar's subtropical climates and milder winters, becoming water-wise by increasing their collection with xerophytic plants makes good financial and environmental sense. They are resilient to drought and extensive in their diversity of shape, colour, texture, height, growing habits. It is an excellent example of actioning the gardening rule "right plant, right place". Their commitment to this planting strategy can be seen through their nursery where curator, Andrew Gdaniec, has successfully propagated wild collected plants from around the world.



Nursery at The Alameda Photo: Fay Davies



Fay in The Alameda looking at Aloe flowers Photo: Stephanie Li



The Alameda landscape Photo: Fay Davies

Along with the layout of the garden, the treescape has also remained largely unchanged. It is made up of *Pinus pinea, Olea europaea* and 46 impressive *Dracaena draco*. While the origins of these trees is unrecorded, it is without a doubt that these prominent structural pillars are as ancient as the garden. We learnt in awe, it is possible to determine the age of the dragon trees by the number of branches they have. According to Keith the trunk size reveals it to be 20-40 years old, and each branch adds an extra 15 years. In this case, some of these *Dracaena* are up to 200 years old.



Dracaena draco at the Alameda Photo: Fay Davies

The garden has moved away from arranging plants geographically, and opted to carry out a more landscape-focussed design which includes interpretation. This makes for eye-catching bed displays that draw visitors in, and allows for playfulness when creating. Because the Alameda is a public garden, the use of labels is less evident as they have experienced visitors vandalising and changing labels around. Instead the garden's education team runs a free gardening club aimed at families and children twice a week. In these sessions they are taught about the environment and climate change through horticulture.

There are 670 species recorded in Gibraltar, 500 of which are native. Within the garden lives on their native endemics, the Gibralta campion, *Silene tomentosa*. During 1979, 1985 and 1994, three plants of this species were documented growing in the wild. The last sighting of it was noted on the Rock in 2008, and it was only one plant that was found. As such it is no surprise the Gibraltar campion holds an official status as an Endangered Species, appearing on the IUCN Red List. The small woody perennial with two-lobed flowers in pale pink or violet, has been collected and seeds kept and grown on into adult individuals that were later reintroduced in the wild. It is though though due to climate change, that the seeds are unsuccessful in germinating in the wild due to the changing climate.

Alongside declining populations of native plants, as we can see already in the UK, climate change has also brought on different pests in the Gibraltar botanic garden. Usually they don't experience much pest damage, but pine moth have been increasing due to the milder winters they are experiencing. This is something worth considering as well when looking at what plants we introduce into the garden which will inevitably have to replace our native species. What pests will also be introduced into our ecosystems?

Gibraltar

Tour of native flora and fauna on The Rock

A serendipitous encounter blessed our visit to the Rock with the guidance of local amateur botanist, Kian Khillian, who led us on the Upper Rock and along the Mediterranean steps to identify plant species.

The Gibraltar Nature Reserve has evolved and expanded since its designation as a Reserve in 1993. In 2013, its size was increased to enhance biodiversity protection and habitat preservation in Gibraltar. It has been suggested in early 17th and 18th century text, that the Rock was once covered in evergreen forest, combined with cliff and open ground in the sandy areas. But it's flora has transformed significantly in recent centuries due to urban expansion, vegetation succession and the disappearance of natural seashore areas. This has as expected led to a decline and sometimes loss of open ground species and littoral plants (any aquatic plant along a lake shoreline).



Views from the Rock Photo: Fay Davies & Steph Li

The Rock is now predominantly home to Mediterranean scrub vegetation, and plant life that survive on coastal cliff faces, rocky outcrops and shorelines. With the flowering season over, it was invaluable having Kian teach us how to identify different plant species by their leaves, growing habit and dried flowers and seed heads. I found it fascinating observing the growing habit of plants I've worked with at RBG Kew out in the wild, like *Chamaerops humilis* which populates much of the Upper Rock. In the garden we prune back the dead fronds, but in its habitat we were able to see how these naturally peeled back, providing essential habitats for wildlife, and still a beautiful structural shape showing the lifecycle of the plant as it contrasts against its own green fronds.

We became familiar with the plants that make up the Mediterranean scrubland landscape: evergreen shrubs like *Phlomis pupurea, Bupleurum fruticosum, Pistacia lentiscus;* creeping and climbing plants that weaved through along the creviced rock habitat like *Aristolochia baetica* and *Smilax aspera;* and herbaceous perennial and biennial flowers like *Echium creticum, Campanula mollis* and *Palenis maritima*.



Acanthus mollis Photo: Fay Davies

Aristolochia baetica Photo: Fay Davies

The team botanising Photo: Fay Davies

As we walked in the baking heat, it became clear that the threats to plant species in Gibraltar not only stem from human influence, but more significantly natural causes. We learnt that the change in climate has increased the growth of scrub vegetation on the Upper Rock, and there has been a reduction in management of firebreak practices. We saw first hand examples of the consequences of this with the spread of *Acanthus mollis*, a plant that despite being native is seriously threatening the survival of many open ground plants including orchid family species.

Alcázar de los Reyes Cristianos Gardens Photo: Fay Davies

Córdoba

Alcázar de los Reyes Cristianos Gardens

We visited the Alcázar de los Reyes Cristianos, famed for its unique melting pot of history that is reflected in its architecture and as such was declared a Cultural Interest Heritage site in 1931. The palace is located in the centre of Córdoba and has a splendid interior with gardens and courtyards that have retained a Mudéjar style in spite of different cultural and religious successions in its long history.

Our focus lay in the 55,000m² garden that is designed on three levels: the upper, middle and lower terrace. Water is central to the beauty and creation of this garden. It is visible as soon as you enter, and makes perfect sense given Córdoba's climate and Moorish influence. At first sight, the upper terrace is made up of two large pools that collect water from the mountains and channel it to the lower terrace, where a further three large ponds are arranged in a line surrounded by a range of colourful plants and cypress hedges.



Gardeners at work in Alcázar de los Reyes Cristianos Gardens Photo: Fay Davies

Aquaducts in Alcázar de los Reyes Cristianos Gardens Photo: Fay Davies

In a less overt way, boxwood planted in a grid pattern revealed a complex irrigation system supporting a series of rose gardens. It is believed that in 822, an aqueduct was erected that brought the waters of Bejarano and Caño de Escarabita to the Palace gardens. This ingenious engineering still functions today and through channels with metal door blockers, water can be funnelled to flood specific rose beds with water from that same ancient aqueduct. Landscape design with integrated irrigation technology evolved with Muslim traditions and spiritual practices in ancient Persia. This garden serves as a notable example of the refined utilisation of water for both practical and aesthetic purposes.

Other islamic garden design traits became apparent as we continued to explore. A courtyard with a central water fountain placed on a grid of paths that divided the space into four to represent the four rivers of paradise, with *Citrus sinensis* and *Agapanthus africanus* planted beneath worked beautifully with its layers of colour, sacred geometry, scent and the sound of water.



Alcázar de los Reyes Cristianos Gardens Photo: Fay Davies

The lower terrace had an avenue bordered by lines of imperfectly topiaried cylindrical cypress trees around two narrow ponds. A note that evergreen plants set out in straight rows provide shade, wind breaks, and a strong design structure.

It became evident as we walked around that this garden design did not attempt to imitate nature, but rather work with it. The book "Islamic Gardens and Landscapes by D. Fairchild Ruggles", includes a long list of cultivated plants noted by Persian Ibn Bassal in the 11th century. His "Agricultural Treatise" listed drought-tolerant plants like acacia, oleander, cypress, hollyhock and roses—favourites in dry gardens today. In some ways, the Persians were so advanced in their thinking, and perhaps by reflecting on their engineering and design techniques we can bring them into the modern garden without falling into the current trend of mimicking nature with naturalistic planting equates to working with nature.



Seville Real Alcázar Palace Gardens

Like the Alcázar in Córdoba, the Real Alcázar in Seville is a blend of palaces and gardens, which showcases various architectural styles, from Mudejar to Gothic, reflecting the city's historical evolution over the past millennium. In 1987, it was granted UNESCO World Heritage status.

The historic gardens in the Alcazar were built from the 12th to the 20th century, showcasing various garden styles and serving as a living historical record of gardening. However, their uniqueness poses challenges for maintenance and preservation, as a balance must be struck between conserving their historical essence and accommodating daily use. While these gardens consider the Mediterranean climate in their design, they all require irrigation. Traditionally, a gravity-based water distribution system with ditches and floodgates was used, but in the 20th century, it was replaced with a pressurised system involving buried pipelines for sprinkler and drip irrigation. It is unknown whether this system is more efficient than the original.



Real Alcázar Palace Gardens Photo: Fay Davies

The garden is home to over 20,000 plants of 170 different species spread across 60,000m². The Islamic garden design concept of compartmentalised gardens, bringing water in with fountains, and scent through citrus trees is evident as you wander in and out of outdoor rooms. It is a discovery experience as you wander round corners not knowing what you might see next. We got lost in the maze framed by organically topiaried myrtle, cypress and thuja against sharp box hedges. In the soaring heat, we managed to find shade under the various palms: *Washingtonia robusta* and *Phoenix dactylifera*. One area that stood out was the Maiden courtyard with its sunken garden. I imagined walking the paths where the treetops were at eye-level height, so you could pick fruit or smell the sweet orange blossom with ease.

Challenges

Cancelled arrangements

Our original plan was to spend 5 days working closely with Andrew Gdaniec, the curator of the Gibraltar Botanic Gardens, for learning experiences related to garden curation, xerophytic plant care, propagation training, substrates, and a herbarium visit. However, on June 29, 2023, we received notice from The Alameda's administrator that they couldn't provide the planned training. We accepted a garden tour offer on July 3, 2023, but since our bookings were non-refundable, we adjusted our travel plans to southern Spain. In Gibraltar, we received valuable guidance from Kian Khalilian, an amateur botanist, who shared insights on native flora and fauna. This allowed us to shorten our Gibraltar stay and visit the Alcazar gardens in Córdoba.

The weather

In Seville the temperature reached 47°C during our visit, which made it unsafe to be outside. We were unable to visit other gardens due to fatigue. Our trip was also planned around the availability of the curator of the Gibraltar Botanic Garden, which was early July. But the ideal season to witness Mediterranean flora and fauna is Spring, when most plants are in flower and the temperatures are easier to stay outdoors in.

Funding

We were unable to meet our funding target, which meant we had to forgo our walk in Parque Natural Los Alcornocales. We made this decision based on the advice of colleagues like Tony Hall, Head of RBG Kew Arboretum advising us there would be little to see during the height of Summer.

Summary

Despite the last minute cancellation to the main part of the trip, it was a successful trip where we were still able to fulfil our main aims. We gained a significant insight into the plants of southern Spain and observed and experienced the curation of the gardens from a collective viewpoint.

It was a privilege to be able to see plants I have been working on in the Mediterranean garden of RBG Kew in their natural habitat. Observing their growth habits, the substrate they thrive in and to feel the climate and landscapes they survive has improved my personal knowledge of how to care for these plants better in the UK. It has made me realise how important it is to understand how plants grow in their native environments to ensure they can grow successfully elsewhere. But it's not as simple as cultivating more Mediterranean plants for our gardens. We must consider what impact these plants will have on our native species with possible introduction of invasive plants and new pests and disease.

Travelling as a team allowed us to examine and discuss garden design, which I appreciated given it can be a subjective topic. Seeing how our typical UK house plants were displayed ornamentally outside was captivating to imagine a sight we might become more familiar with particularly in London which tends to remain frost-free. What I appreciated most about the gardens we viewed in this region of Spain was the intelligence of their irrigation systems that date back centuries, but whose engineering is still relevant and practical at dealing with the climate conditions we face today. I have noticed in the UK a trend towards a more naturalistic planting style that mimics wild landscapes. However, visiting these magnificent public and private Moorish-influenced gardens whose designs are the opposite of natural, but instead aim to elevate your senses from sight to sound with colours and flowing water, to smell and touch through scentful citrus trees in sunken beds, is overwhelming. It reminded me of that feeling I had in the wild landscapes that first attracted me to learn more about plants, and I found myself wondering whether it was possible to bring this style of sensory-designed experience into botanical gardens to create a lasting visitor impression. Perhaps we don't always need to look for new ways to garden better but can look to our history to find solutions that can be modernised.

Future plans

Given our main plans were cancelled at such short notice, it was an insightful trip around some of the parks and gardens of southern Spain. A future trip would entail fulfilling the original aim of having more hands-on experience in a Mediterranean garden like The Alameda, learning about garden management and growing xerophytic and succulent plants. It would also be advantageous to organise horticultural focussed tours with staff from other gardens like the Alcazar and botanic gardens in Córdoba to understand their horticultural challenges better. With more time we would like to have visited other botanically interesting sites in and around Córdoba such as the ethnobotany garden, seed bank (both closed during our visit), and a certified organic wildflower seed company called Cantueso doing interesting work around in-situ conservation. More than anything we all agreed it would be much better if we came back during Spring when the plants were in bloom and the temperatures much cooler to function in.

Acknowledgements

I'd like to first thank my colleagues Andrew Gdaniec and Tony Hall for inspiring us to visit southern Spain in light of our interest in Mediterranean gardens and xerophytic plants, guiding us to see what might become of south-east England gardens.

Thank you to my student peers Stephanie Li, Charles Hunt and Anna Lim for broadening my botanical knowledge in a digestible way. To come together as a team, supporting one another in challenging temperatures and a constantly changing schedule is quite a feat.

Thank you to the RHS and the Merlin Trust whose generosity of funding enabled this trip to go ahead.

And lastly a very special thanks to the Khillian family, who have an aptitude for opening their hearts and home to strangers. And to Kian particularly for taking us under his wing when our plans fell apart and adding an unexpected but invaluable local perspective to our trip.

Final budget breakdown

Funding Body	Funding Received (£)	
The RHS	£1000	
Merlin Trust	£2400	
Total	£3400	

Expenses	Cost (£)
Accommodation	Gibraltar: £999 Seville: £207 Malaga: £155 Cordoba: £330 Total: £1691
Travel inc. flights, trains, buses and taxis	Flight: London → Malaga: £313 Flight: Seville → London: £740 Train: Cordoba → Seville £54 Coaches: £62 Total: £1169
Food	£30/day x 9 days= £270 each Total: £1080
Entrance fees to gardens	Malaga Botanic: £20 Gibraltar rock: £52 Cordoba Alcazar: £14 Cordoba Botanic: £10 Seville Alcazar: £36 Total: £132
Total	£4072