

Cambridge
University
Botanic Garden

Annual Report & Accounts

2021-22



Cambridge University
Botanic Garden



UNIVERSITY OF
CAMBRIDGE



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Cambridge University Botanic Garden (CUBG) supports University teaching and research while also being a place of enjoyment and inspiration to visitors of all ages. The Botanic Garden is one of the largest University-owned botanic gardens in the world. Opened to the public in 1846, the 40-acre Garden has an unparalleled living collection of over 8,000 species, including nine National Collections, with glasshouses, experimental plots, lake, herbarium and botanical library.

CUBG also collaborates with national and international researchers from a wide range of partner organisations, including universities, conservation bodies and botanic gardens worldwide, to promote the conservation and scientific understanding of global plant biodiversity.

The Garden offers year-round inspiration for gardeners as well as an exciting introduction to the natural world for families through a programme of family, school and adults' activities and events.

Cover image: *Bulbophyllum longiflorum* © Howard Rice.
Inside cover image: *Autumn's colours* by Diana Harrison – winner of 'The Spirit and Beauty of Cambridge University Botanic Garden' category, International Garden Photographer of the Year competition.
Design: Paul Oldman (www.smithltd.co.uk)

Thanks to Keith Heppell for use of his photograph on page 45.

Director's Report

Professor Beverley Glover
Director CUBG



The 2021-2022 academic year saw the Botanic Garden able to put the majority of the effects of Covid behind us, and we returned our attention to supporting a globally excellent network of research and teaching around plants while providing stimulating opportunities for educational groups and visitors to engage with our living collection. Visitors returned in substantial numbers, and it has been a pleasure to see people enjoying the opportunity to explore the exciting world of plants. However, an extraordinarily hot and dry summer has reminded us that we will need to be flexible and resilient, and to think carefully about infrastructure and collection, if we are to meet the challenges that a changing climate will bring.

The academic year began with the Garden's finances back on an even keel, and with staff restructuring complete. Following some months of recruitment, we entered 2022 with an almost complete staff for the first time in two years. This has enabled us to focus our attention back on the Botanic Garden's core goals. Our Curation team have been working closely with the newly restructured Horticulture team to identify opportunities for developing the collection in line with our *Living Collections Strategy*, ensuring that we will have an exciting range of plants available to support research and learning for decades to come. Of course, it's equally important that our collection is beautifully presented, to inspire visitors and encourage a love of plants and horticulture. The newly developed Autumn Colour plantings that the team established this year are an excellent example of this, and are proving popular with visiting wildlife and visiting people alike. We have also been delighted to run a full Learning programme this year, with adult courses to suit most interests complemented by a full range of family activities, schools visits and community engagement. To ensure that all visitors have the opportunity to share in the excitement of plants, we have worked hard this year to develop new interpretation for some of our iconic specimens and to refresh and redevelop the interpretation boards on our Fen Display, which has also seen some major repair work to replace rotting timbers below the waterline.

However, amidst all this positivity has been a growing unease about the apparent changes to the pattern of the Cambridge weather. In 2019 we set the highest recorded UK temperature - but only three years later that record was broken by over one degree Centigrade here on site (and by over 1.5 degrees elsewhere in the UK). The heat over those two days in July was astonishing, and unbearable both for visitors and plants. But worse was to follow for the plants, with a continuous run of several weeks with no rainfall. Our horticulture staff worked hard to keep key elements of the collection alive, but inevitably we lost a number of specimens (we won't know exactly how many until the spring). The Garden was clearly parched, and visitors were deterred, reducing income streams and opportunities for engagement. A drought like this is something that our 175 year old Garden was not designed to withstand. Although we have an irrigation system, it is too dispersed and too low pressure to cover the whole site, and our rainwater collection tanks are being depleted earlier and earlier each year. So we will now turn our attention to this long term crisis and to its effects on our strategic goals. We will need to ensure our collecting strategy is future-proofed, reducing collection of species which need extensive watering and focusing on parts of the world where hot and dry summers are already the norm. Our infrastructure will need development, to ensure we're maximising capture of precious rainwater and providing suitable irrigation systems to all areas of the Garden. Horticultural procedures will also need to change. And perhaps most importantly of all, we must ensure that these decisions, and their consequences, and the science behind them, are communicated as clearly and as strongly as we can to our audiences. It will be vital for the Garden's survival that people understand how climate change is impacting our activities - but it is even more important for the planet that people hear the message and can relate it to their local environment.

A handwritten signature in black ink, appearing to read 'B. Glover'.

Beverley Glover
Director, CUBG



The year in pictures

October

2021



Visitors enjoying autumn colour.



November

Magic and Mayhem returned!



The Winter Garden featured on BBC *Gardeners' World*.

December



January

2022

A new *Green Planet* series aired which featured the Garden.



February

Newton's Apple Tree fell during storm Eunice.

Dr Samuel Brockington

April

Easter Trail.



May

The University's Herbarium is awarded 'Designated Status' by Arts Council England.

March



Autumn's colours by Diana Harrison - winner of 'The Spirit and Beauty of Cambridge University Botanic Garden' category, International Garden Photographer of the Year competition.

June

The Festival of Plants took place in the Garden.





July

We welcomed musicians and picnickers back for the 'Sounds Green' summer music series.



August

The effect of the drought on the lawns.

September

'Autumn Animals' trail.



Research

Professor Beverley Glover
Director

Dr Samuel Brockington
Curator

In the 2021-2022 academic year the volume of research supported by the Botanic Garden's living collections began to increase again, following the drop experienced over the first two pandemic years. Researchers have largely returned to their laboratories and are again eager to access living plants, although travel restrictions have still limited the extent to which colleagues have been able to visit to work with us in person.

Pages 38-43 of this Annual Report provide a summary of research conducted in 2021-2022, and it is clear that the range and variety of research requests remains impressive, if still not back to pre-pandemic levels. As well as our primary role in providing access to plant collections and offering horticultural support for botanical projects, the Garden also provides underpinning facilities supporting research in Archaeology, Architecture, Biochemistry, Chemistry, Earth Sciences, Engineering, Geography, Physics and Zoology. We welcome requests for material and resources from colleagues from all academic and research organisations around the world, and are delighted to be able to support such a diversity of projects.

The launch of our *Living Collections Strategy* in November 2019 formalised our intention to provide the most accessible living collection anywhere in the world. That collection is diverse, because many of the needs of researchers are unpredictable. It is also limited by what we can grow in the Cambridge climate, and that climate is changing. While we take stock of our collection and its resilience in the face of climate change, we have taken the opportunity this year to focus on a project that emphasises the importance of collections in supporting research to examine and potentially mitigate some of the consequences of that change.

CASE STUDY

National Tulip Collection & Central Asia



We are holders of the National Tulip Collection, designated by Plant Heritage, which puts on a fantastic horticultural show each spring. But in addition to horticultural appeal, we continually seek the opportunity to give voice to our collections through research, and to harness the power of these collections and our associated expertise to effect change beyond the confines of the Garden.

This type of thinking led the Garden's Curator, Sam Brockington, to form a tulip-focussed collaboration with Cambridge-based conservation organization Flora & Fauna International, with several key partners in Central Asia including tulip experts from the National Academy of Sciences of the Kyrgyz Republic. The goal of the collaboration, supported by a NERC-funded PhD and a DEFRA funded Darwin Initiative grant, is to better understand the evolution of wild tulips, their species diversity, and their natural distribution across Central Asia, which is the centre of diversity for wild tulips. Furthermore, we aimed to use our improved evolutionary understanding of tulip diversity and its distribution to inform *in-situ* and *ex-situ* conservation of tulips.



A new tulip species from Kyrgyzstan

One exciting output from this collaboration has been our recent discovery of a new and unusual tulip species from Kyrgyzstan. *Tulipa toktogulica* (T. sect. *Kolpakowskianae*; *Liliaceae*) is named after the Toktogul region, Kyrgyzstan, where it was discovered by Brett Wilson, a graduate student in the Curator's research group. It is specifically named after the region to draw attention to the floral diversity of the area, and to help raise awareness of the need for its conservation. It is known only from four populations northeast of the Toktogul reservoir in the mountainous Jalal-Abad Region, in the west of the country.

The slightly scented species has broad stamens and a prolonged tunic (an outer membrane of the bulb that protects the inside). An elongated tunic is quite rare in wild tulips with only *Tulipa talassica* well known for this trait. It grows in shrubland on stony soil at 1,000 - 1,500m altitude in areas where the species tulips *Tulipa biflora*, *T. greigii* and *T. heterophylla* are also found and which were used as comparator species in the research.

Many of the new tulips discovered over the past few years have been identified using their visible physical and morphological characteristics in the time-honoured taxonomic tradition. Notably, here, the researchers used DNA analysis to investigate and define the new species, which is otherwise fairly cryptic from a morphological perspective.



DNA analysis enables a deeper understanding of the interrelations between and among tulip populations, and helps provide new insight into characteristics and hereditary traits that remain undiscovered using traditional techniques.

Wilson, B., Lazkov, G.A., Shalpykov K.T., Brockington, S.F. 2022. *Tulipa toktogulica* (Liliaceae), a cryptic, endangered new species from the western Tien-Shan, Kyrgyzstan. *Phytotaxa* 566 (1): 001-012.

***Ex-situ* and *in-situ* conservation of wild tulips**

The discovery of the new species of tulip is just one of many results of an integrated analysis of Central Asia tulip populations that Cambridge University and the National Academy of Sciences in Kyrgyzstan are conducting with a range of partners to help understand and define needs and opportunities for conservation and management. The goal is an understanding of how tulips have evolved and speciated, and how threatened tulip diversity can be conserved through a combination of *ex-situ* and *in-situ* mechanisms.

In-situ work is led by Flora and Fauna International and a range of local partners including grazing management agencies, and a regional tulip conservation plan is in the early stages of implementation.

Ex-situ work has been led by the Bishkek Botanic Garden and the Cambridge University Botanic Garden, and as a consequence we have an increasing number of threatened tulip species as seed and bulb, and entering into cultivation. This conservation work is of particular importance, and relevance to the climate change narrative, because the habitats of these upland areas are changing at a rapid rate. As part of the project the team organised an international red-listing conference in Bishkek, earlier this year. Facilitated by Botanic Gardens Conservation International, and with tulip experts represented from across the region, the team conducted extinction risk assessments for 52 tulip species across Central Asia. These are shortly to be published by the International Union for the Conservation of Nature (IUCN), and highlight those species thought to be most vulnerable to the risks of mining, grazing, over-collection and climate change,

‘All tulips look like they will lose habitat due to the impacts of climate change and many will have no suitable habitat left by 2050 at all. A number of species will see their suitable habitat shift to higher altitudes and so will be forced to migrate, which may require human intervention.’

Modelling the effect of climate change on tulips

In work published in the journal *Biodiversity and Conservation*, we studied tulip distributions and the impacts of climate change on these in Central Asia. This is the first time climate change has been assessed in the context of tulips and the results are alarming. All tulips look like they will lose habitat due to the impacts of climate change and many will have no suitable habitat left by 2050 at all. A number of species will see their suitable habitat shift to higher altitudes and so will be forced to migrate, which may require human intervention. We also revealed that current protected areas are not adequately protecting these species and this inadequacy would be exacerbated under climate change. Horticultural tulips support a huge billion Euro industry. Wild tulips were originally at the heart of this trade and still harbour an enormous amount of genetic diversity that could be useful in breeding new cultivars with increased disease tolerance, better frost resistance, and new flower morphologies; potentially even cultivated varieties that may be hardier under climate change. They therefore remain, from a purely selfish human perspective, a crucial resource heading into the future. Combine this with their ecological role in insect lives, their cultural significance in many countries, and their ability to act as an indicator of broader ecosystem health, then you can see that they are extremely valuable to not only the global community, but crucially to the habitats in which they grow and their local communities. Given that we know that many of these species are in decline and are increasingly threatened with extinction, we must learn more so that we can effectively prevent this from happening.

Wilson, B., Dolotbakov, A., Burgess, B.J., Clubbe, G., Lazkov, G., Shapylkov, K., Ganybaeva, M., Sultangaziev, O., Brockington, S.F. 2021. Central Asian wild tulip conservation requires a regional approach, especially in the face of climate change. *Biodiversity and Conservation* 30 (6): 1705-1730.





Horticulture

Every garden is shaped by its local conditions, and here at CUBG our landscape and collections have been shaped over the years by a low average rainfall (our 30 year average is 557mm), which makes us one of the driest places in the country. This combined with our shallow alluvial soils and mild winters means that plants grown in the Garden adapt to these conditions and are better equipped to endure dry, hot spells than plants growing in wetter regions.

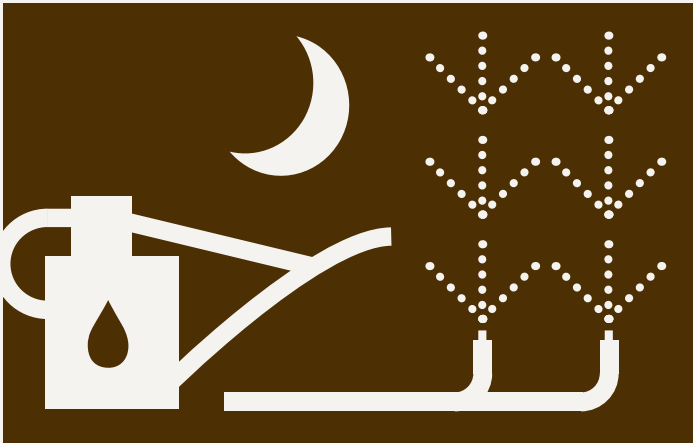
Sally Petitt
Head of Horticulture

A hot, dry summer

In most summers we expect to water newly planted annuals, perennials and trees and shrubs. Priority is also given to the Woodland Garden, whose collections require moist conditions, and the Winter Garden, which needs watering to ensure a good display of coloured stems for winter interest. Other plantings may be watered depending on weather conditions, and we may apply supplementary irrigation to herbaceous plantings, which may suffer in dry spells or intense heat.

An arid landscape - Summer 2022





‘We extended our watering to 24 hours a day to ensure that we could adequately water all plantings.’

Water for irrigation is primarily sourced from rainwater collection tanks in the Glasshouses, and this is used only in the Glasshouse Range and reserve glasshouses, and is supplemented with purified reverse osmosis water. In the open Garden water is extracted under licence from two boreholes, which are connected to an irrigation system running through much of the Garden to which we can connect hose pipe to water most plantings. We also use a bowser which we can tow around the Garden, and this is especially useful for watering young trees, or filling the watering reservoirs installed at the base of these.

We adopt best irrigation practice: watering at night; applying water at the roots of plants; applying adequate water infrequently, rather than little and often; and limiting watering of grass to high profile lawns at Brookside and Cory Lodge. The dry, hot summer of 2022 presented many more challenges to us, and watering of our collections became our priority. We extended our watering to 24 hours a day to ensure that we could adequately water all plantings, though our Mediterranean Beds, Dry Garden and mature trees received no additional irrigation. In the open Garden much of our time was spent setting up hose pipes, cannons and seep hoses, and in the Glasshouses watering and damping down filled most of our days.

Some plants showed clear signs of stress. *Populus violascens* in the Autumn Garden dramatically shed most of its leaves, while other trees also showed signs of premature leaf loss, going into senescence early to protect themselves from drought and heat stress. The *Cedrus libani* (cedar of Lebanon) at the crossroads on the Main Walk suffered from the phenomenon summer branch drop, which can cause mature, healthy trees to drop limbs without warning. Other plants, including *Magnolia x sprengeri* ‘Diva’ and *Gunnera manicata* suffered leaf scorch caused by the intense heat. Many of our herbaceous plants wilted, and lawns quickly browned. Many plants recovered quickly after watering or rainfall, and providing we have a cool, wet autumn and spring, should return to full vigour. Trees though may not show any effects of this summer’s weather for two or three years, and we will continue to monitor these in the coming years. We will also review our watering capabilities and procedures to ensure that we can water our landscape and collections as effectively as possible in the future, while also giving further consideration to new introductions to ensure that future plantings will be more tolerant of a changing climate.



Summer branch drop - *Cedrus libani*.

‘With a maturing tree population, adverse weather and increasing visitor numbers, tree management remains a constant feature of our work.’

Tree works

Our three-yearly external tree survey highlights essential works, and can cover all aspects of tree health and safety, from removal of ivy and dead wooding to crown reductions and removal. This survey is supplemented by an annual in-house survey which picks up any intermediary work. These surveys don't necessarily pick up any incidences of stress or death caused by disease, weather-related stress or storm damage. During the year we lost a mature *Pinus sylvestris* (Scot's pine) which was one of our early un-accessioned trees in the Old Pinetum. Although its cause of death was unclear it is likely that its demise resulted from a combination of age and a succession of springs and summers with lower rainfall.

Many of our visitors were familiar with our Newton's apple tree (*Malus* 'Flower of Kent') which had stood on the Brookside lawn since 1954. In summer 2021 we noticed that this tree had developed a thinner canopy, had begun to defoliate prematurely, and that its fruits had failed to mature. In autumn 2021 we noticed the fruiting bodies of honey fungus (*Armillaria sp.*), which we know is prevalent in this area of the Garden, and which can attack woody and perennial species, and can ultimately result in their death.

We decided to delay removal of this tree and review its condition in spring 2022. The decision about its fate was made for us when Storm Eunice hit the United Kingdom and blew the tree over, exposing the extent of decay in the roots. We had taken the precaution of grafting this tree, so have a replacement in our nursery, and had also had the genome of our tree sequenced by the Sanger Centre, who confirmed that our tree was indeed progeny of the original apple tree at Woolthorpe Manor, famously associated with Newton's discovery of gravity.

Following our annual tree inspection we removed a mature silver lime along the West Walk in September. During this year's inspection of the multi-stemmed *Tilia tomentosa* our Trees and Shrubs team noticed fissures had widened at the union of the multiple stems, and heard the cracking and popping of woody fibre as the stems moved. This movement and noise indicated that the five stems were pulling away from one another and would have continued to do so until the entire tree pulled apart. After consideration and given the lime's proximity to a major path the tree was removed, and we will identify a suitable replacement to further enhance the *Tilia* collection in this western boundary.



8

New members of
Horticultural staff

5

New trainee Horticultural
Technicians

Horticultural team

Staff restructure

In September 2021 we implemented a restructure of the horticultural team, which saw the roles and responsibilities of existing staff change and also resulted in us welcoming new members to our team. Through 2021 we said goodbye to a number of staff who either retired or left to progress their careers. Much of our year focused on recruitment, with invaluable support from the Administration Team.

We were delighted to welcome eight new members of horticultural staff, who took up roles in the Display, Glasshouse, and Trees and Shrubs Teams. As a result of the restructure and the subsequent recruitment process, our focus for the year was on settling in and familiarisation, but each of our new recruits has extensive relevant horticultural experience and brings valuable skills and knowledge to complement those of existing staff to enable us to move the Garden and collections forwards.

New trainees

In addition to welcoming new permanent staff we also welcomed five new Trainee Horticultural Technicians after a one-year Covid-enforced break. The Garden has a history of providing horticultural training since the late 1800's, and has supported a formal training scheme since the 1950's. We were all delighted to welcome the return of trainees to the Garden, who are not only invaluable in supporting us horticulturally, but also bring enthusiasm and a fresh outlook to our work, and contribute in the long-term to the wider horticultural profession and community. Trainees who complete the year-long traineeship are awarded the Cambridge Certificate in Practical Horticulture and Plantsmanship by the University's Institute of Continuing Education.

We are grateful to the Stanley Smith Horticultural Trust for their support towards our trainee scheme this year in recognition of the value of the training we provide through the accredited scheme, and also to a donor who wishes to remain anonymous, for their support of one of our trainee places.



Trainees machinery training session.

Learning

Hayley McCulloch
Head of Learning



Educational visits

It has been a real pleasure seeing our programme of educational visits getting back to full strength.

262

School Groups

62

Higher education group visits

6,741

Students

13

Visits from Horticultural colleges

63%

increase

There have been a total of 6,741 students learning in the Garden as part of the 262 school groups that have visited us during this reporting period. This is more than a 63% increase compared to the previous reporting period. This is likely because of schools returning to normal school trips post-covid and a return to normal staffing levels to support schools. Of these visits, the majority are coming from Primary schools (4,417 students), Secondary schools accounted for 1,295 students, 607 students attended educational visits from sixth forms and 422 from early years settings. We have also seen an increase in visits from home school groups with 48 visits by five different home education groups during this reporting period.

In addition, we have also had 62 visits (1,306 students) from Higher Education groups, 16 of these have involved facilitated activities from the Learning Team. We have also had 13 visits from Horticultural Colleges (227 students) during this reporting period.

We continue to facilitate sixth form students and those from Anglia Ruskin University (ARU) that are studying relevant degrees to access the Garden free of charge through a free-pass scheme. During this period 1,013 free student passes were issued, 175 being issued to students from ARU and the remaining going to students from four local sixth forms.

4,000

families took part in the Easter Trail



Family Trails, Activities & Workshops



Family Trails

During this year we have delivered four trails for families, these included two brand new trails. The first of these was the Great Garden Egg Hunt that was available for nearly 3 weeks, during the Cambridge Festival and for the school Easter holidays. This was one of our most popular Easter trails to date, with over 4,000 families taking part. The second new trail was the Bee School Summer Adventure, where children learnt more about bees as well as plant adaptations for pollination. We also made available two trails that we have run previously, Autumn Animals and Crazy Cone Caper.

Family Saturday activities

Family Saturday activities returned in 2022 and have proved very popular, these are free drop-in sessions for families on the first Saturday of every month from 10am-1pm. Each session involves a plant-themed craft activity suitable for children, and an average of 123 people attended each of the Family Saturday events.

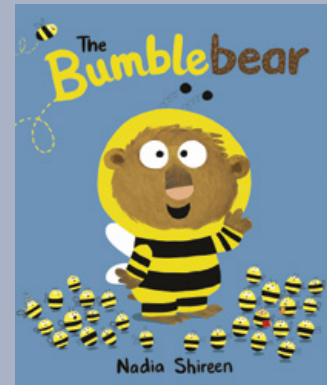
123

the average Family Saturday event attendance



Learning (continued)

100%
take-up on bookable events



150
participants making flower masks

667
Explorer backpacks borrowed

Festival of Plants

For the Garden's Festival of Plants event this year, approximately 150 people joined us for a family craft activity of making flower masks. During the summer holidays we also offered two additional drop-in family events, Summer Crowns and Lavender Bags. Both events were popular with 90 people coming to make a Summer Crown and 160 taking part in the Lavender Bags activity.

Explorer Backpacks

Children's explorer backpacks have also returned to the Garden this year, they were taken out of ticket offices as part of our Covid precautions and were back on offer from May 2022. The backpacks contain a new printed activity booklet that has received plenty of positive feedback. Since May, when they were reintroduced, 667 backpacks have been borrowed by children to use whilst visiting the Garden.

Family Workshops

Our family programme has also included bookable family events. These have included two Bumblebear workshops, a special workshop for 2-5 year olds inspired by the book, *Bumblebear* by Nadia Shireen. We have also offered two Bat Patrol events, these are evening bat walks for children aged 8+ with an accompanying adult. We are attempting to reach a wider audience with our family activities and so have trialled some bookable events for older children. We delivered a Christmas wreath making workshop for children aged 10+ and a printmaking workshop as part of the Cambridge Festival for children aged 11+. All of our bookable events were fully booked and feedback from children and parents was very positive. In July 2022 we delivered a workshop for families in collaboration with Cambridge University Library entitled *Darwin and the Power of Plants*. This was a drop-in session for families to learn about and have a go at a craft inspired by carnivorous plants.



Lifelong Learning

56

Adult Courses

523

Participants

From January 2022 we have been offering a full programme of courses from the classroom in the Garden as well as continuing with a smaller online offering. We have found that tutors and participants alike have been less enthusiastic about online courses now that in person is a viable option. Many of our courses, particularly those for Botanical Art, sell out and have waiting lists. The maximum class size for an in-person course is substantially smaller than that of an online course. During this reporting period we have delivered 56 adult courses to a total of 523 participants, 208 of which were joining us on a course for the first time. We have delivered 16 of these courses online to an audience of 176 people. Our adult courses have been the only area of the learning programme still affected by Covid; we have had to cancel a few courses as a result of tutors being unwell as well as participants dropping out at the last minute as a result of testing positive for Covid-19.



Interpretation and Exhibitions

In October 2021 we were awarded funding from BGCi to design and deliver a Sustainability Challenge, this could focus on any sustainability related theme. As well as running the challenge ourselves in the Garden, we also had to prepare a pack so that this challenge could be replicated by other Botanic Gardens. We chose the theme of sustainable gardening and more specifically houseplants so as to appeal to as wide an audience as possible, not just those with outside space for growing. Our challenge took the form of a simulated shopping experience, where members of the public would select houseplants they wished to “buy”. After being provided with information about sustainability issues around houseplants and their propagation, they were asked whether their choices remained the same. The challenge provided a new way to engage with visitors and was well received by those that took part.

1,449

viewers watched *Twilight* live



Working with the University of Cambridge Museums (UCM)



Twilight was a particular highlight for the Learning Team during this period. This year the UCM decided that *Twilight* would remain as an online event. Our contribution was ‘Mystery of the Moonflower’, a livestreamed adventure in the glasshouse range where people at home could watch and join in to help solve puzzles as part of an interactive escape adventure hosted by children’s TV presenter Maddie Moate. The Garden had never attempted anything like this before and as such we were unsure what sort of audience to expect. We were surprised and thrilled to see that 1,449 households watched along live and contributed 18,376 live comments to help solve the puzzles. The event was recorded and has, since the live show, had over 39,000 views (you can still watch it via the CUBG website). It was evident from social media the next day that families were then coming to the Garden to collect a prize for taking part and to see where the adventure had taken place.

We got some excellent feedback for this event, some comments we received were:

“Thank you so much, my son and daughter loved joining in with your adventure and so educational too. Please, please do more!”

“Absolutely brilliant, the kids (& grown ups!) loved seeing you explore our local Botanic Garden! Great adventure 😊”

“This was an absolutely amazing adventure game, Freya was so excited that she was counting down from 9am! Another place on our bucket list to go and see now :)”

“Great fun - not sure who enjoyed it more, the grown up or the child... thank you so much to all involved. Exciting and informative 🙌👏”



Changes to the Learning Team

Facilitated Sessions

During the summer 2022 we delivered a facilitated session to a group from the Cambridge City Council Children and Young People's Participation Service (ChYpPS). As well as taking part in the summer trail for children, they took part in a craft activity to make flower crowns from natural materials from the Garden. Also, during the summer holidays we delivered a workshop for Arts Pioneers, the University of Cambridge Museums (UCM) activity club for young people aged 11-16 who have physical and learning disabilities. We ran a workshop all about carnivorous plants. Young people learnt all about these fascinating plants, dissected plants and created outdoor artworks.

There have been a few changes to the team during this reporting period. Sandie Caine, Horticultural Learning Co-ordinator, left in October 2021 and Chantal Helm, Higher Education and Impact Co-ordinator, left the Garden in April 2022. We were thrilled to welcome Bronwen Richards back from maternity leave in February this year. Bronwen returned on a part time basis so we have recruited a second part-time Schools Learning Officer to ensure we have cover for schools across the full week. We welcomed Hannah Elkington into this role in June. The new role of Community Learning Co-ordinator was also introduced this year. The aim of this role is to grow and co-ordinate our programme for local community groups, increasing access to the Garden for a wider audience. Louise Campbell joined us in that role in August.

Curation

Dr Samuel Brockington
Curator

New staff members

In 2022, we finally feel that we have turned the corner, and are beginning to pick up speed again, after the previous two years of pandemic-related disruption. A great boost to the Curation team has been the recruitment of two additional staff members.

Firstly, we are delighted to have Margeaux Apple on-board as our new Collection Co-ordinator. Margeaux has come to us from the Cleveland Botanic Garden and Holden Arboretum, and has a wealth of experience in collections and extremely high standards with respect to collections management, whilst also being a very decent taxonomist. Her role is a new one, and she is tasked with generally improving operations across all our collections (living, seed, and herbarium) and ensuring that they best meet the needs of both internal and external stakeholders. Margeaux is currently heavily engaged in auditing and facilitating our external research requests but is also project managing our Living Collections Manual (more on that later).

We are also pleased to welcome Nadiia Rositska, an employee of Kyiv National Botanic Garden, who has come to the UK as a refugee. Nadiia has been working closely with Margeaux on collections auditing and research requests, but also mounting many of our herbarium specimens from various expeditions over the past few years. Finally, it is great to welcome Angela Cano back from maternity leave, and Angie is busily picking up on the collections analytics pipeline that I wrote about in a previous annual report.

Living Collections Manual

Having published our *Living Collections Strategy* in 2019, a subsequent goal has been to produce a *Living Collections Manual*. Living collections management is a surprisingly complex business. In effect, all individual plants (or accessions) are monitored and informationally tracked from the moment they are sourced for a collection to the moment they leave the collection. And between entering and leaving the collection, every action with respect to each accession is recorded, including information on processes such as sourcing, accessioning, mapping, verification, propagation, auditing, herbarium vouchering, seed banking, material transfer, utilisation, and de-accessioning. In addition to tracking the accessions through various collection processes over time, accessions may also accumulate a wealth of additional data including primary observations on phenomena such as leaf and flower phenology, hardiness and resilience, hybridisation, susceptibility to pests and diseases, as well as secondary data enrichment related to ethnobotanical uses and synonymy.

The *Living Collections Manual* seeks to document and formalise all the processes that govern our living collections management, to be used as a training guide, and to ensure all staff are following the same agreed procedures - this is essential for collections and data integrity.

Other projects

Other projects on the go include the revamp and re-organization of the seedbank, courtesy of a generous donation. And of course, with renewed possibility for travel, we are again looking hard at our material acquisition strategies and thinking ahead to a year in which collecting expeditions once again become an exciting possibility.

Left: The University's Herbarium was awarded 'Designated Status' by Arts Council England.



Memorandum of Understanding

One of the recent highlights of the past few months has been the signing of a Memorandum of Understanding with Donovan Kirkwood, Curator of the Stellenbosch University Botanical Garden in South Africa.

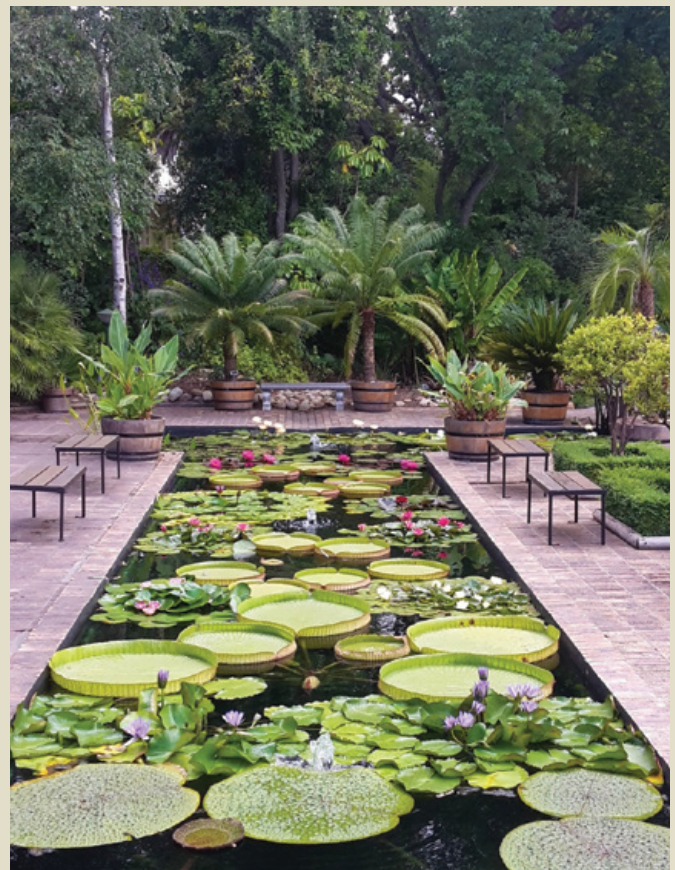
Stellenbosch University Botanical Garden is a much smaller outfit than CUBG but similarly allied to a university and situated in a remarkable biodiversity hotspot with enormous levels of endemism. Historically there are interesting botanical links between our two universities and botanical gardens.

The founder of Stellenbosch University Botanical Garden, Augusta Vera Duthie, spent time at Cambridge University. Stellenbosch University Botanical Garden is linked with Rudolph Marloth, a lecturer at Stellenbosch University and a mentor of Jan Smuts, during his time as a student at Stellenbosch. Smuts, an avid amateur botanist, later supported the establishment of subjects such as botany at the university level. Smuts also of course studied at Cambridge University and later in life became the Chancellor of Cambridge University. With these links there is clearly a precedent for closer ties between our two gardens.

I first met Don three years ago on a field trip to Namaqualand and we discussed the potential for close collaboration, but it was an initiative we had to put on hold until travel became a more realistic option. His work is incredibly important, both documenting diversity and saving plants from extinction, often to the point of visiting areas of urban development and removing some of the last remaining individuals of species in the face of approaching bulldozers.

Through the MOU, we hope to catalyse collaboration on several fronts, the sharing of horticultural and curation expertise through staff exchange, supporting the ex-situ cultivation of rare and endangered South African species, and the training of Cambridge undergraduates in field work and conservation through South Africa-based internships. This model of collaboration is likely one that we could adopt in other regions of the world which are important for our Living Collections strategy (i.e. the Balkans, Temperate South America, & Central Asia). Indeed, we recently welcomed a delegation from Central Asia, and are in the early stages of similar negotiations with Bishkek Botanic Garden, Kyrgyzstan.

‘Through the MOU, we hope to catalyse collaboration with Stellenbosch University Botanical Garden on several fronts.’

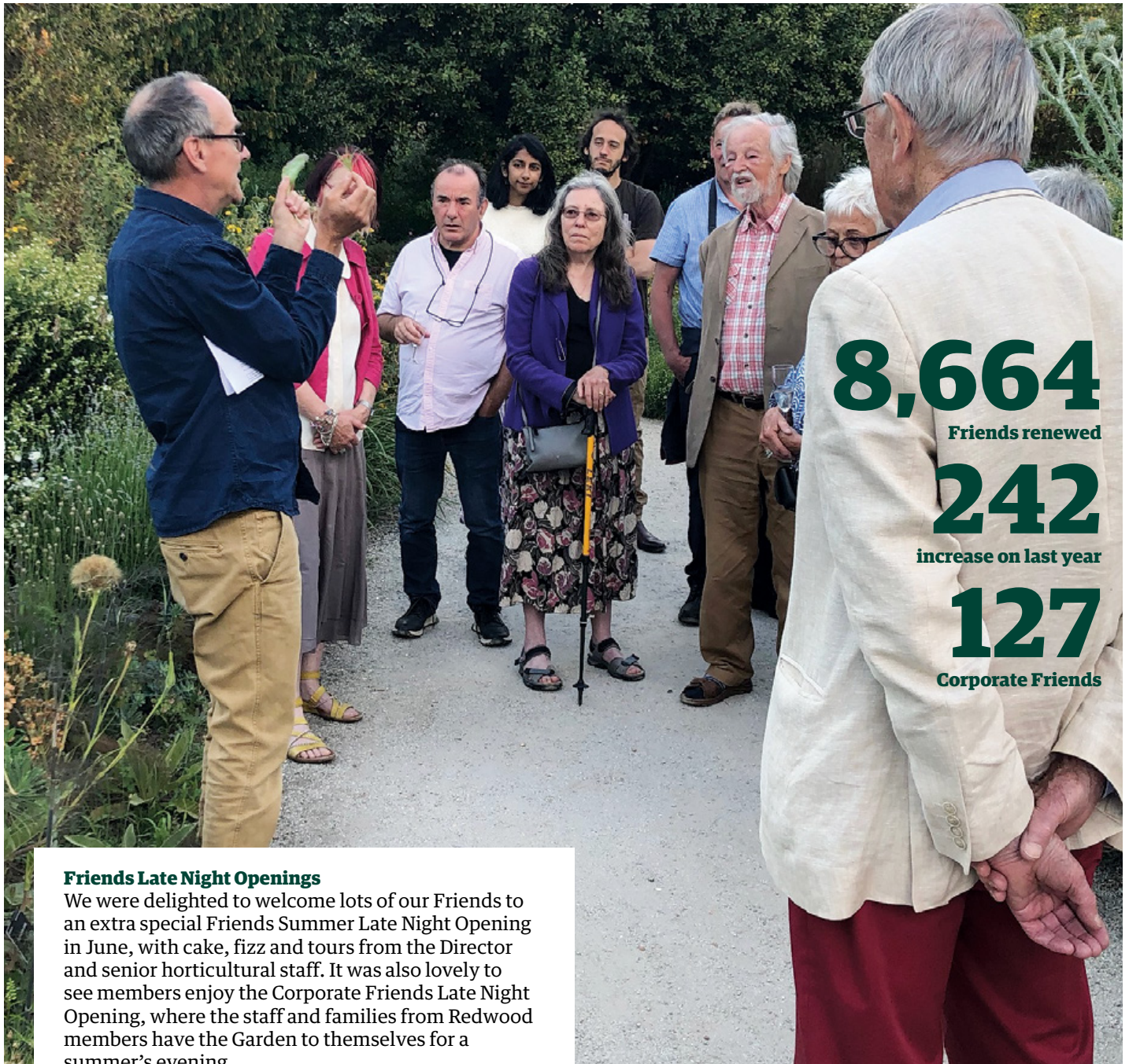


Right: Rare plant material in cultivation at Stellenbosch.

Friends

The Friends' programme continues to grow, with **8,664 Friends joining/renewing between 1 August 2021 and 31 July 2022. That's 242 more than the previous year and 1,725 more than the year before that.**

Anna Patterson Lee
Head of Development and Communications



8,664
Friends renewed
242
increase on last year
127
Corporate Friends

Friends Late Night Openings

We were delighted to welcome lots of our Friends to an extra special Friends Summer Late Night Opening in June, with cake, fizz and tours from the Director and senior horticultural staff. It was also lovely to see members enjoy the Corporate Friends Late Night Opening, where the staff and families from Redwood members have the Garden to themselves for a summer's evening.



This year the Friends celebrated their 40th anniversary.

Left: The CUBG Director welcoming Friends to the 40th anniversary party.

Reducing our Carbon Footprint

On the administrative side, there has been a lot of effort made to try to reduce the environmental footprint of the Friends. We have now moved to paper membership cards that are fully recyclable and compostable. Application forms are now scanned (instead of photocopied), we will be emailing Direct Debit advice letters from December 2022, and renewal reminders, which were previously posted to all Friends, are now emailed. It is now necessary to opt in to receive a hard copy of the Friends triannual newsletter as the default is now the email copy.

Events Programme

The events programme was back in full swing for Friends this year. Trips and events included tours of Murray Edwards College Garden, Hidcote Manor and Kiftsgate Court Gardens, and Blickling Hall and East Ruston Old Vicarage.

The Friends holiday this year was themed 'Gardens of the Far North' and was a great success. This year's trips had originally been planned for 2020 and were cancelled due to the pandemic. They were planned by Lesley Jakubowska and Jenny Egbe and were then run on the day by Clem Messenger and Shona Winnard - all of whom have our most grateful thanks. We would also like to thank Margaret Goddin for organising this year's Friends holiday.

Within the Garden, Friends enjoyed the ever popular Christmas Wreath-Making Workshops. In the spring, there was a focus on wildlife in the Garden with the 'Botanic Garden Creatures of the Night' talk, 'A Guide to Birdsong', 'Early Bird' Tours and a 'Spring Garden' Tour. We greatly enjoyed a fascinating Annual Lecture, which was given online by Tom Stuart-Smith, and look forward to bringing the Annual Lecture back in person in November 2022.

The Friends' Holiday to Scotland Margaret Goddin

This year's Friends' holiday was a great success. The scenery was spectacular and we visited a wide range of properties including castles, private gardens, a fascinating conservation centre and a Botanical Garden which was run by the local Council. We had some enlightening conversations with garden owners and head gardeners. The weather could not have been better. When we returned home I received an email from a Friend, part of which I can share with you:

"I am so grateful to have been welcomed into what felt like not so much a Friends' holiday but rather a group of friends in the general sense holidaying together" - Kay Bispham

Discussions are already underway for our holiday in 2023 and we hope that you will be able to join the group whether you have travelled with us before or you are thinking of doing so for the first time. It is a very inclusive group and you no doubt will make some new friends along the way.



Visitors & Events

Anna Patterson Lee
Head of Development and Communications



During the reporting period we saw the relaxing, and then lifting, of Covid-19 restrictions. By the middle of the year, all restrictions were lifted, masks were not required in the Glasshouses, Café or Shop and our visitor numbers were back to (or above) pre-Covid levels.

We were delighted to be able to bring back some of the most popular Garden events, which were welcomed by visitors and proved to be as popular as ever.

Total visitors for the period: an extraordinary 344,953 - thank you so much to every single one of you, it has been a joy to welcome you to the Botanic Garden.

344,953

**Total visitors
in the reporting period**

137%

**increase in gate takings
on the previous year**



Magic & Mayhem

There were also some good remainders from lockdown activities. Christmas 2021 saw the return of the mischievous elves to the Garden as 'Magic and Mayhem' returned. Visitors enjoyed some unexpected, fun surprises scattered around the Garden, as well as a yellow ribbon memorial installation which was very well received.



Festival of Plants

2,873

Festival visitors

The first big event that was back to 'business as usual' was the return of the Festival of Plants on Saturday 11 June. This year's Festival was a jolly return to the Garden, where visitors enjoyed a fun-filled, fact-finding day celebrating the wonder of plants. As with previous years, the Plant Science tent was full of scientists from around the University, the Talking Plants tent engaged visitors with some of the latest plant science research, tours took in the seasonal sights and smells of the Garden, there were family activities in the Schools' Garden and entertainment for all, plus plant and food stalls, on the Main Lawn. With 2,873 visitors, it was a great return for the Festival.

Visitors & Events (continued)



Sounds Green

Science on Sundays Drop-in Talks

7,531
visitors

One of the most eagerly awaited returns was of our summer music series, 'Sounds Green'. During the four Wednesdays of July, 7,531 visitors enjoyed evenings of live open-air music from the Cambridge Summer Music Festival on the Garden's Main Lawn. This season's performers were Honey & The Bear, Prime Bass, Camilla George Quartet and Classico Latino. This year the Garden was also open for an extra half an hour after each concert finished to enable visitors to continue enjoying the landscapes on a summer's evening, and to pack up their picnic and exit in a more relaxed manner.

This year's series was kindly sponsored by Birketts LLP.

Between March and July, once a month, visitors to the Garden could again enjoy Science on Sundays drop-in talks. This year's programme included a wide range of subjects - from fruit colours to caterpillars on slippery leaves, from plant memory to lost wheat genetic diversity.

16,350

Adult Trails used



Exhibitions



Guided Tours and Trails

The International Garden Photographer of the Year (IGPOTY) exhibition was back in the Garden 15 March - 6 May. This year there was an extra dimension, as the exhibition also included winners of the first competition for visitors' photographs of the Garden itself. Over 400 photographs of the Garden were entered and judged by a small panel comprised of IGPOTY and CUBG staff. First place was awarded to Diana Harrison, for her *Autumn's Colours* photograph (see inside front cover). Second place went to José Teles for his *Crisp Mornings* (top) and third place to Allan Hale for *Bended Boughs* (above). The three winning images featured in the Garden's exhibition, alongside a selection of highly-placed photographs from the competition's main categories. We then launched the second CUBG-specific competition - 'The Colours of Cambridge University Botanic Garden'. The winners will have their work displayed in the Garden in 2023 as part of the main IGPOTY exhibition and we look forward to seeing the entries.

Our fantastic team of volunteer guides have also been back in force, with 36 free tours given to 736 visitors, and 38 charged tours to 801 visitors.

Seasonal Trails

Over 4,000 families took part in the seasonal trails (this year it was the Great Garden Egg Hunt) and 16,350 of our adult trails were used - with more new trails coming out later this year.

FEATURE

Let's talk about the weather

Professor Beverley Glover
Director

The impact of a changing climate has been brought home to us at the Botanic Garden by a number of extreme weather events over the last few years. With the future prospect of increasingly hot, dry summers, what does this mean for the Garden's future and how can we plan ahead?

Extreme weather

In summer 2022 we experienced an extreme drought - 18 consecutive days without rainfall in July. This followed the dry summers of 2017 and 2018, when our collection suffered badly with 26 consecutive days without rainfall in July 2018. At the same time the summers have been getting hotter: in July 2019 the Garden famously recorded the (then) highest UK temperature of 38.7°C, only to see that record superseded in 2022 with a temperature of 39.9°C (and 40.3°C at RAF Coningsby in Lincolnshire).

Drought July 2018



26
consecutive
rain-free days

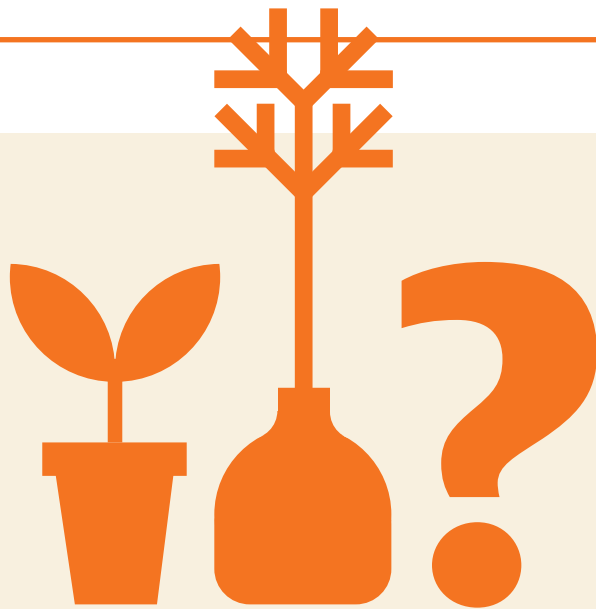
Temperature July 2022



39.9°C



Climate-proofing measures



1. Adapting our collections to climate change

As the climate changes, we need to consider which plants we source and from where, in order to match future climate projections. This is an especially important consideration for our perennial tree collection, as what we plant now has a potentially long life within our collections. In order for our tree collections to endure a rapidly changing climate we may need to plant different species, or different warmer and drier adapted eco-types of the species we currently grow.

Some of the thinking needed to adapt our collections to climate change has already been done. For example, our *Living Collections Strategy* already focusses on four geographical priority areas: Central Asia, the Balkans, South Africa, and temperate South America. These target areas are all temperate hot-spots, but also regions which currently experience hotter and drier climates than we currently experience. Sourcing our future plants from these areas should result in collections that are better adapted to our projected climate. In line with this thinking, the botanic garden network is developing ever more sophisticated tools that will allow us to understand how our current collections will cope with climate change and to “climate match” specific tree species to our current and future conditions. Despite all of the theorising and tool development, the very real challenge remains of sourcing and propagating potentially unusual or novel plants, and then learning how to keep them alive within our collections.

The scorched and bleached lawn in front of the Glasshouses.

Let's talk about the weather (continued)



2. Using more climate resilient horticulture

In order to provide our collections with the best possible chance of surviving and enduring in a changing climate we will also need to adapt our horticultural practices to ensure resilience.

We have always nurtured our soil to ensure that it is as healthy as possible to support good, healthy plant growth. We are now considering reducing digging, to maintain soil structure, and increasing mulching (which we already do extensively) to feed the soil and also to reduce loss of water through evaporation.

Plants must be thoroughly watered before planting so that root balls are thoroughly soaked; they must also be well-watered, or “puddled in”, at the time of planting so that roots and the surrounding soil are wet. We are becoming stricter about planting perennials only in autumn, so that plants have the best chance of establishing roots during wetter autumn and winter months, rather than the drier spring and summer season.

We are also assessing our methods of irrigation to limit waste: watering at night (again to reduce evaporation); assessing how much water plants actually require for adequate watering, and limiting application to this to ensure that we are not watering unnecessarily; using timers to apply the optimum amount overnight, rather than leaving irrigation on all night; watering at the base of plants using seep hoses, which deliver water directly to the soil surface and the roots of plants; watering plants thoroughly and less frequently, rather than little and often.

Even with these changes in practice it is clear that we will need to review our current infrastructure, so that plant care can keep up with changing conditions.



3. Water harvesting

Currently, the collection is watered using an underground irrigation system, fed from two boreholes under a license to abstract water granted by the Environment Agency. Elements of this system date from 1846, with small adjustments over the years. An irrigation system that was suitable to meet the needs of the living collection in the climate of 1846 does not necessarily meet the future needs of the Garden. There are no records of the irrigation pipe network installation, it is believed to be original with adaptations to the original network as repairs and ad hoc additions have necessitated. A small additional section of irrigation network was installed when the Sainsbury Laboratory was constructed.

The Eastern side of the Garden has very limited irrigation connectivity so needs specific development to provide the conditions required for horticulture throughout all seasons, regardless of how hot they may be, in order to enable adequate care. This is an area that underpins any future development plans for the eastern landscape.

In addition, we harvest rainwater from the roofs of the glasshouses which is stored in underground tanks for later use. The recent drought produced conditions that were far from conducive to rainwater harvesting, with the tanks empty by March. Clearly, the more we can collect in the wetter months, the longer it lasts in the dry. Plans are in the earliest stage of development to enhance or increase our water collection capacities and look at other buildings within the Botanic Garden site to harvest water from. We learned in 2019 that extreme external heat can be amplified sufficiently within the Glasshouse range to damage the collection within. During renovations in 2020/21 all the glasshouse vents were repaired and maintained, but the historic design of the building does not always meet with today's heat removal requirements. To assist in the movement of heat within the range, additional fans have been installed to move the hot air around and out, as required, helping to reduce extreme internal temperatures. We are also considering the need for greater cooling capacity in our Experimental Glasshouses, where plants grown for research may require specific temperature regimes.



4. Telling climate stories

One of our key challenges is to ensure that our visitors are given every opportunity to learn about Climate Change and its likely effects on the world's plants. In collaboration with the University's Cambridge Zero project, we have created a trail for adult audiences to use our collection to educate the public about plants and climate change. It is one of our most popular trails, with approximately 2,400 copies being taken by visitors in this reporting period. The trail explores the impact of climate change on various plants found in our collection including food crops such as banana, coffee and rice as well as examining how climate change is impacting the timing of plant pollinator interactions and the role of botanic gardens in climate change research.

In October 2021, we were awarded funding from BGCI to create a challenge for the public, with the goal of educating visitors about a sustainability issue. We chose to use the theme of sustainable gardening, more specifically houseplants, as we hoped that this would have a wide appeal to visitors interested in gardening but not limited to those with an outside space. Additionally, the interest in houseplants has grown substantially in recent years, in part because of the pandemic and therefore this theme was particularly timely. Our challenge took the form of a simulated shopping experience, visitors were encouraged to discover different aspects of sustainability surrounding houseplants, including where the plants were sourced, use of peat, watering etc. They were challenged to examine their current choices and asked to pledge a change they would make following visiting the exhibition. More than 5,437 people were recorded to have visited the challenge over a 12 week period, although it is likely that this was an underestimate as it was not possible to capture all footfall to the exhibition.

Feedback was very positive, some comments in the evaluation survey included: "We enjoyed it and it was food for thought", "Just extremely informative and gives the information in a simple way for everyone to understand".

There is also increasing interest from schools in education about climate change. Several of our schools workshops use the collection to explore this with children. It is particularly prevalent in sessions that we deliver on biomes, plant adaptations and plant products. Contact with plants and plant material from the collection means that these lessons are significantly more impactful than if they were taught in classrooms where the children may only be able to see pictures rather than touching and seeing real plants.

In true British style I imagine that we will continue to talk about the weather a lot in our next few annual reports. By discussing it now, we are doing our best to ensure the Garden and its collection is resilient in the face of changing climate, but also that we are playing our part in helping everyone to understand what climate change means and what we need to do to reduce its impact on us all.

'A drought like this is something that our 175 year old Garden was not designed to withstand... So we will now turn our attention to this long-term crisis.'

Professor Beverley Glover, Director CUBG

Communications

During a busy year, and a welcome return to promoting events in the Garden again, there are three stories that deserve highlighting...

Anna Patterson Lee
Head of Development & Communications



Green Planet



In January the new, much anticipated BBC series 'The Green Planet' aired on BBC One. Episode 3 of the series 'Seasonal Worlds' (which showed how plants contend with seasonal changes) featured plants from the Garden's collection and was filmed on site in the Garden during the summer of 2020. Seeing the Garden and our plants in the programme was the culmination of a lot of work to bring the crew (and Sir David Attenborough) into the Garden. Staff from many different teams were involved with the planning and the filming itself (which was during severe Covid-19 restrictions).

We were able to generate a lot of interest about the Garden's part in the series on social media and local press - including the BBC website - and we were delighted that our posts were shared by the University across their channels too.

The Green Planet effect

To give an example of the 'Green Planet effect', both Facebook and Instagram saw a doubling of reach during January (Facebook reach was twice as high as in December: 130,000 versus 65,000, Instagram went to 16,000 compared to 7,000).



200%
increase in reach



228%
increase in reach

Dr Samuel Brockington



BBC

The Newton's Apple Tree story

In the February storms, the Garden's scion of Newton's Apple Tree blew down. The loss of a tree in the Garden is always sad, but rarely national news, however the name 'Newton' added a much higher profile to this loss. A Twitter thread about the tree, its history and the science of grafting by the Garden's Curator received widespread attention and helped to focus a lot of interest on the Garden. We were amazed by the international interest, with features about the tree as far away as Indonesia and Canada!



The summer of 2022 on TV



The third story was not one that we generated ourselves, but one that came back to the Garden for a second time - the hottest temperature recorded in the UK. While the Garden is no longer the holder of the highest temperature recorded in the UK (a rather depressing record to hold), we were contacted by a lot of media in the lead up to the predicted hottest day, with many tv and radio programmes wishing to air from CUBG as the current record holder. We did allow the Garden to be used as a filming location - resulting in the Garden being a live location for the BBC News at 6 and at 10, Sky and ITV news amongst others - but we used this opportunity to talk about the impact that the heat had on the collection, our working patterns and the future of the collection, as well as the wider implications of climate change and food security.

Communications (continued)

The Botanic Garden in the media:

23

TV features

(Far right)
Filming for BBC's
Gardeners' World.



6

Magazine articles



13

Newspaper articles



5

Online articles



12

Radio articles



4

Podcasts



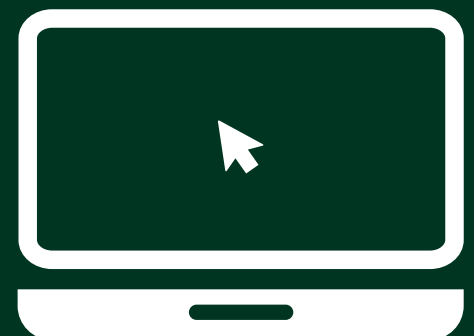
Our website

1,218,260

page views

1,020,005

unique page views





Development

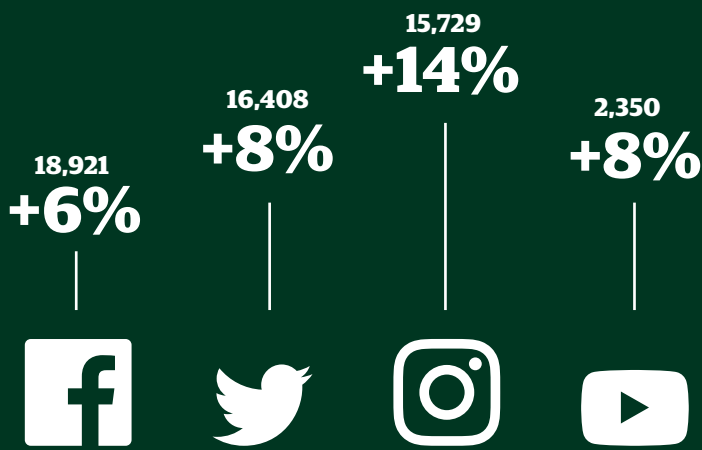
With the lifting of lockdowns, we started to think again about our capital projects - the Station Road Ticket Office, Eastern Landscape and Cory Lodge. We have formed a Development Committee to help us to fundraise for these, and other projects, and are most grateful to the Committee members - Jon Drori, Lavinia Nourse, Sara Oldfield and Clare Gilmour - for their support and guidance.

In the spring we held some breakfasts for senior representatives from some of our Corporate Friends to both say hello, and to introduce our projects to them. The projects were received well, and we were delighted to receive some offers of support with seeking funding.

We remain very grateful to the members of the Henslow Circle, our patrons, who continue to support us and bring joy and enthusiasm to their events. The resumption of Henslow Circle events - Summer Late Night Openings, tours and talks - has been very welcome.

We would like to thank the volunteers who help us to run the press office, social media channels and fundraising activities.

Social Media Followers



Research supported and facilitated

In the past year we have supported research by providing researchers with material of 133 accessions.

Cambridge University Botanic Garden

Professor Beverley Glover, *Director*

Research programme focussed on the evolution and development of flowers, plant/pollinator interactions, and plant surface properties, funded by the BBSRC, NERC, HFSP, EU Marie Curie Actions, Leverhulme Trust, Isaac Newton Trust, and the Cambridge University Botanic Garden Research Fund. Material maintained at CUBG, analysed in the experimental plots, or accessed from living collection, for projects including:

The relationship of floral morphology to pollination success in *Vicia faba*, with Dr Jane Thomas (National Institute of Agricultural Botany), Roger Vickers (PGRO) and Jake Moscrop (PhD student).

Molecular evolution of key developmental pathways in plants, with Dr Sam Brockington (Curator, CUBG), Thea Kongsted (PhD student) and Dr Eva Herrero (post-doc).

Development and evolution of insect-mimicking petal spots in *Gorteria diffusa*, with Dr Paula Rudall (RBG Kew), Dr Allan Ellis (Stellenbosch University), Dr Udhaya Ponraj and Dr Roman Kellenberger (postdocs), and Farahnoz Kohjayori (PhD student).

Development, function and evolution of iridescence in plants, with Dr Paula Rudall (RBG Kew), Professor Richard Bateman (RBG Kew), Professor Ulli Steiner (Adolphe Merkle Institute, Switzerland), Professor Jeremy Baumberg (Department of Physics, University of Cambridge), Professor Silvia Vignolini (Department of Chemistry, University of Cambridge), Dr Edwige Moyroud (Sainsbury Laboratory Cambridge University), and Dr Chiara Airoldi and Dr Humberto Herrera-Ubaldo (postdocs).

Evolution and development of nectar spurs in *Linaria*, with Ben Fisk (PhD student).

The relationship of floral morphology to pollination success in strawberry, with Hamish Symington (PhD student).

Development and evolution of prism cells in the epidermis of California poppy petals (with Kristina Buch, PhD student).

Provision of liverworts, mosses, ferns, lycophytes and cycads for undergraduate teaching.

Dr Sam Brockington, *Curator*

Research programme funded by NERC, the NSF and DEFRA, and using material grown in the experimental glasshouses, and across the living collections, and primarily focussed on three main areas: Caryophyllales and betalain synthesis, the genus *Tulipa* and the genus *Eriospermum*.

Sequencing transcriptomes in Caryophyllales in collaboration with Stephen Smith (University of Michigan) and Ya Yang (University of Minnesota).

Metabolomic survey of Caryophyllales, focussing on tyrosine-derived metabolites (with Hiroshi Maeda, University of Wisconsin).

Studying the phylogeny, evolution and diversity of tulip species with Brett Wilson (PhD student) and Flora and Fauna International (FFI).

Sampling material for genomic sequencing projects in Caryophyllales e.g. to generate highly contiguous assemblies for *Macarthuria*, *Stegnosperma*, and *Achatocarpus*, with Nathanael Walker-Hale (PhD student).

Studying the evolution of perianth development in Caryophyllales by morphological development, and transcriptomics, with Yi Zhang (PhD student).

Studying the evolution of transcriptional regulation in betalain pigmentation with Jasmina Dzurlic (PhD student).

Studying morphological patterns in betalain pigment distribution across separate origins of Caryophyllales, with George Garnett (PhD student).

Dr Chantal Helm

Bat survey in collaboration with Kevin Hand (National Bat Monitoring Project).

Moth survey in collaboration with Dr Helen Leggett (Cambridge University, Dept. of Zoology).

Department of Plant Sciences, University of Cambridge

Professor Sir David Baulcombe, FRS (RNA Silencing and Disease Resistance Group)
Use of the Experimental Glasshouses to propagate the progeny of *Solanum lycopersicum* x *S. pennellii* hybrids through to the F4 generation, to investigate segregation in hybrid plant populations. Transgressive segregation results in plants that have heritable properties that are outside the range of the parents, and this work aims to understand the molecular biology of this important trait so that it can be harnessed more efficiently for crop improvement.

Professor John Carr

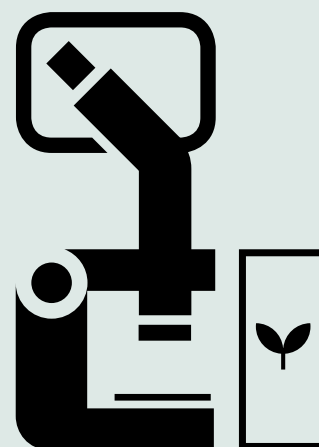
(Plant Virology Group)
Certain dicistroviruses reside in plants without causing disease but will infect and kill insects, such as aphids, a major crop pest, when they feed. It has been hypothesised that plant-resident dicistroviruses have a mutualistic relationship with plants by providing protection against aphids. Thus, it is conceivable that in addition to providing pollination services, bees might render plants an additional benefit by spreading aphid-pathogenic viruses. This idea will be investigated by sampling bees, aphids and plants under field conditions and by using deep sequencing to compare.

Professor David Coomes

(Forest Ecology and Conservation Group)
Analysing weather data collected at CUBG to inform studies of the impact of drought on UK woodland.

Professor Howard Griffiths

(Plant Physiological Ecology Group)
Maintaining collections of succulent plants



for analysis of those with Crassulacean acid metabolism. The diversity and evolution of epiphytic bromeliads from the neotropics are being investigated. The compromise between water use and carbon gain is also being used to infer evolutionary origins and biomass production potential in succulents and grasses. In grasses, many savanna species have evolved the C4 pathway to enhance productivity, and the selection pressures leading to changes in leaf vein anatomy and metabolic partitioning are being investigated. These processes led to the development of highly productive crops such as sugar cane, sorghum and maize. *Agave tequilensis*, *Aechmea*, *Guzmania* (*Bromeliaceae*); *Jatropha*, *Kalanchoe*, *Mesembryanthemum* and rice plants all are maintained at the Botanic Garden. Various moss species are also used from the collection in the Garden and cultured in shade for analysis of moss metabolism.

Professor Jim Haseloff and Dr Jennifer Deegan (Synthetic Biology for Engineering Plant Growth Group)

Anatomical studies of fern gametophytes and of liverworts, requiring access to the living collection.

Professor Julian Hibberd (Molecular Physiology Group)

Rice, millet and wheat are grown for anatomical analysis, RNA isolation and deep sequencing as part of a project to understand the genetic differences between the more common C3 photosynthesis and the more efficient C4 photosynthesis. We are also developing transformation protocols for hornworts, using plants from the Garden's living collection.

Dr Johannes Kromdijk

(Environmental Plant Physiology Group)
Growing plants in the research glasshouses to study the regulation of stomatal opening during C4 photosynthesis. Also growing maize for profiling mesophyll and bundle sheath cell-specific translationalomes in response to photoinhibitory conditions.

Dr Adam Pellegrini

(Disturbance Ecology and Ecosystem Function Group)

Prairies and grasslands cover an expansive portion of the world's surface and can contribute significantly to the Earth's carbon cycle. The largest driver of carbon dynamics in these ecosystems is fire. As the climate changes, the majority of grass-dominated ecosystems will experience increased fire frequency and intensity, leading to carbon flux into the atmosphere and soil nutrient depletion. The resulting communities that sprout after a fire are important for reassimilation of carbon and soil recovery; however, little is known about the physiology of these communities. Belowground traits are especially poorly explored and important drivers of ecosystem function. This project uses the rich diversity of grasses found in the Cambridge Botanic Garden to examine the belowground physiological traits of "fire-philic" and "fire-phobic" grass species to inform 1) the evolution of root traits in the Poales, and 2) the effect of fire on root functional traits - which in turn affect carbon and nutrient cycling. To complete this project, we will need to take root cores to access fine root tissue of a number of the grass species grown outside in the common garden area. Additionally, we would like to calculate aboveground to belowground biomass ratios by collecting entire plants where possible.

Professor Alison Smith (Plant Metabolism Group)

The Botanic Garden has provided space for the Algal Innovation Centre glasshouse facility, to allow different algal species to be grown to establish what role algae can play in the development of a low carbon economy.

Other Departments, University of Cambridge

Professor Nick Butterfield

(Department of Earth Sciences)

Laboratory demonstration material for a fourth-year course on Palaeobotany using CUBG-supplied plant material.

Professor David Cebon

(Department of Engineering)

Develop simple manufacturing methods for bio-packaging materials. This project will investigate methods for making simple cardboard (from banana leaves) and moulding it into shapes that can be used to package fruit. It will study the mechanical properties of the cardboard resulting from various thermal and chemical inputs to the paper-making process as well as the manufacturing process for shaping the packaging materials.

Professor Walter Federle

(Department of Zoology)

This project aims to investigate the role of physical defences in *Passiflora* plants and the counter-adaptation of *Heliconius* caterpillars to feed on them. The mechanical profile of different types of trichomes will be studied using behaviour feeding experiments and biomechanical approaches, to identify relevant adaptation in the butterflies and possible trade-off between chemical and physical defences in the plants.

Dr Eyal Maori

(Department of Biochemistry)

Use of the CUBG Research Plots to grow honeybee colonies and conduct polytunnel-based experiments on RNA communication between bees.

Dr Edwige Moyroud

(Sainsbury Laboratory)

The bullseye patterns in the centre of many flowers attract pollinating insects, but we do not know how plants control their formation. We are working with *Hibiscus trionum*, which creates a central bullseye of pigmented tissue in the middle of the flower, to understand the development of these patterns. In the Experimental Glasshouses we are screening a large population of mutagenized *H. trionum* plants to identify mutants with altered floral patterns.

Research supported and facilitated

Professor Gareth Rees

(Scott Polar Research Institute)

Øvre Dividal project is a land use analysis project in a national park in northern Norway, during which we will be using small drones to capture data on vegetation configuration. Our aim is to practice our data collection techniques at CUBG. This will involve flying small (class C0) lightweight drones near trees and perhaps also over the alpine collection and taking photographs using them.

Dr Sarah Robinson

(Sainsbury Laboratory)

The mechanics of plant growth. To compare the mechanical properties of plants with different cellular architecture we are sampling diverse species from the living collection.

Dr Sebastian Schornak

(Sainsbury Laboratory)

Plants engage with fungi to improve access to nutrients such as phosphate. We sample liverwort species from the Botanic Garden and stain them to detect fungal structures. Comparing early land plant symbiosis with the root symbiosis of higher plants will allow us to highlight evolutionary aspects of symbiosis establishment in different parts of plants.

Professor Silvia Vignolini

(Department of Chemistry)

We are harvesting the mucilaginous viscous tissue within mistletoe (*Viscum*) to analyse composition and understand the adhesive properties.

Dr Raymond Wightman

(Sainsbury Laboratory)

We will examine secondary wall ultrastructure in fully hydrated woody tissue of diverse tree species. This is part of a collaboration between Sainsbury Laboratory and Jagiellonian University, Poland. A small scale pilot survey, using garden material, was published in 2019. The work requires harvesting and examining the material on the same day using the Sainsbury Laboratory cryo electron microscopy platform and doing precise measurements of secondary cell wall thickness, cellulose microfibril diameter and orientation in

individual wood layers.

External Researchers – UK**Jonathan Shanklin**

(Cambridge Natural History Society)

Leading a “fungal foray” at CUBG to identify and record fungal diversity.

Professor James Hitchmough

(University of Sheffield)

I am developing a climate change demonstration wood pasture on 2.5ac of land in Somerset, to look at how species that are not very mainstream at present respond when planted with UK native tree and shrub species with better envisaged climate change performance. The ecological and visual value of this project will be documented via workshops and blogs etc over the next 20 years. As a “nearish” non-native, I have requested seed of *Malus trilobata* to use in this research, which will also involve coppicing at 10 year intervals.

Dr Julia Mackenzie

(Anglia Ruskin University)

My research is on urban birds. Specifically, I study breeding behaviour of blue tits and great tits and the impact urban living has on their breeding success. Data collection mainly involves monitoring approx. 40 nest boxes at the Cambridge University Botanic Garden and mist netting and colour ringing of the adult birds. Behavioural studies may also take place. The boxes have been monitored and the birds studied in the garden since 2003.

Martha Craven

(Oxford Archaeology East)

I am a trainee archaeobotanist at Oxford Archaeology East and as part of my traineeship I am trying to build my reference collection of native and archaeophyte cereals, “weeds” and other plant remains. I will collect seeds and some seed cases throughout the period of April to September; dependent on the time at which the various plants set seed.

Studying archaeobotanical assemblages forms such a fundamental part of understanding the past; especially in relation to such things as diet, trade, economy, ritual, textiles and climatic conditions. A modern reference collection is of vital importance to the examination of this material. Plant remains can be severely distorted due to the processes of waterlogging, desiccation, mineralisation, carbonisation and taphonomy and so it is of great importance to compare it to modern specimens.

Dr Honghao Su

(Earlham Institute, Norwich)

Plants synthesise a multitude of specialised metabolites, many of which are used to provide protection against pests and pathogens, as attractants for beneficial insects, or to model their microbiomes. The aster family (Asteraceae) is one of the largest plant families with over 25,000 species many of which have been cultivated for medicinal purposes. In some species, these therapeutic properties have been attributed to triterpenes. However, the genetic basis for the vast majority of these molecules is unknown. This project will investigate a group of pentacyclic triterpenes found in the floral and root tissues of Asteraceae aiming to investigate their biosynthesis, biological function and evolution.

Caglar Akcay

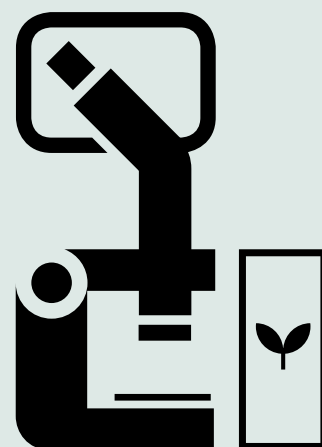
(Anglia Ruskin University)

In the present study we aim to examine how vocalizations and territorial behaviors of common songbirds found in and around Cambridge change with anthropogenic noise. To do this 1) we will be carrying out recordings at different hours of the day to track noise level changes as well the singing activity 2) carry out playback experiments with target species (European robins, *Erithacus rubecula*; blue tits, *Cyanistes caeruleus*; and great tits, *Parus major*) manipulating song features and noise levels to measure territorial behaviour.

Dr Francis Wamonje

(National Institute of Agricultural Botany, East Malling)

Brown marmorated stink bug (BMSB,



Halymorpha halys) is an invasive pest established in many European countries, causing significant crop damage and urban nuisance impacts. The insect is originally from Asia, but its global range has expanded considerably within the last three decades. Reports of UK interceptions at ports date back to 2010, but since 2018 adults have been observed free in the environment within England. Climate-based niche models indicate that conditions in some regions of the UK are suited to establishment, with areas of Greater London likely to support at least one generation per year based on historic climate data. However, with predicted climate change, more extensive areas of South East and Eastern England may become colonised by 2050. Based on the increased numbers of BMSB sightings in 2021, we will continue with this surveillance targeting sites where previous records of BMSB pheromone trap catches have been confirmed and other sites where the CLIMAX model predicts establishment – e.g. Norfolk. CUBG previously hosted one of the traps and we request to place another one for the year.

Daniele Certini

(University of Edinburgh)

The research on *Asclepias syriaca* L. is focused on exploring the seed dynamics and gust response. A study on the morphology of *Asclepias syriaca* L. will be followed by drop tests, mechanical tests to understand the deformation of the filaments during different flight conditions, and mathematical modelling of the behaviour of *Asclepias syriaca* L. during its flight.

Dr Maarten Christenhusz

(Royal Botanic Gardens, Kew)

The purpose of this study is to place the genus *Piper* in a phylogenetic and phylogeographic context. We also aim to discover the origin of the cultigen *Piper nigrum*. To do this we will apply radseq to elucidate on the biogeography and phylogeny of the genus. We required material of *Verhuelia*, because we need all genera of *Piperaceae* to be represented and *Verhuelia* was still missing from our sampling.

Dr Mike Beale

(Rothamsted Research)

At Rothamsted, as part of a BBSRC Strategic Programme, we are conducting an extensive screen of phenolic glycoside containing plant biomass (mainly in the *Salicaceae*). Recently we have become interested in a compound called idesolide, that according to the phytochemical literature is present in the fruits of *Idesia polycarpa*. We have some questions regarding the true chemical structure of this molecule, based on experience with this type of compound in *Salix*, so we required berries from *Idesia* so that we can re-isolate this compound to answer these questions.

Professor Andrew Smith

(University of Oxford)

We have taken some very small, 1mg samples for carbon-isotope analysis from succulent plants in the *Aizoaceae* and *Apocynaceae* families.

External Researchers – International

Joao Filipe da Silva Martins

(Universidade de Coimbra, Portugal)

Breeding of *Arbutus unedo*: use of conventional and biotechnological tools to obtain tolerant genotypes to abiotic stress. This project aims to select tolerant genotypes to abiotic stress, in particular drought, and characterize the tolerance mechanism, through a physiological and metabolomic analysis of the plants. Because we aim to test the influence of genotype and plant provenance on resistance to water restrictions, the use of plants from provenances with different climatic conditions is essential.

Pawel Gornas

(Institute of Horticulture, Latvia)

The knowledge about tocotrienols, tocotrienols, tocotrienols, and other rare tocotrienol-related compounds is still very limited due to several challenges faced in analytical chemistry such as separation resolution, co-eluting, the price/absence of

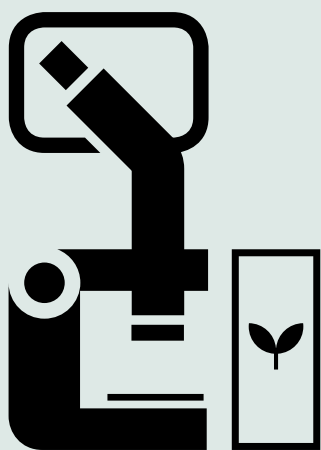
standards and low analyte concentration in plant material. Another issue is that there exists almost no knowledge about free and bound tocotrienols in plant material and their unknown biological function which might be of scientific, agriculture and medicine great importance. The last two decades of research on tocotrienols show their promising potential against cancer. However, to make the next giant step in cancer therapy by application of tocotrienols their efficient delivery systems, higher bioavailability, alternative natural sources rich in tocotrienols and lower costs of their extraction/isolation are required. It seems that the taxonomic approach and dicotyledonous plant families can offer an alternative solution as tocotrienol natural resources. Also, the desirability of “green” (environmentally friendlier) techniques are of increased global concern, to reduce the environmental and health impacts of scientific and manufacturing industries inclusive of extraction and testing procedures. Therefore, the aim of the project is: to propose the alternative sources of tocotrienols in dicotyledonous plant families applying a taxonomic approach and using green techniques, starting from extraction and ending on identification.

Michael Pirie

(University of Bergen, Norway)

Systematics, evolution, and conservation of *Erica* (*Ericaceae*). We are currently experiencing a human mediated mass extinction event, with habitat destruction and degradation extirpating species, dramatically reducing numbers and genetic diversity of populations, and impacting the viability of their complex interdependencies with other organisms. Estimates of the numbers of plant species currently under threat of extinction are shockingly high, however, such assessments themselves are qualified by the grave limitations of our basic knowledge. Successful targeting and implementation of conservation efforts, both in-situ and ex-situ, require improved understanding of e.g. species boundaries, genetic diversity, and ecology. The global, multidisciplinary, nature of this task requires an international

Research supported and facilitated



collaborative network. In this proposal we aim to bring together just such a network of researchers and horticulturalists specialised in different aspects of evolution, ecology, and conservation of species of the flowering plant family Ericaceae.

Shen Huang

(Zhejiang Chinese Medical University, China)

We are collecting the fresh leaves and resin of *Liquidambar orientalis*, *L. styraciflua*, *L. formosana* and *L. acalycina* from different countries and regions and carrying out molecular identification of them. The traditional Chinese medicine identification is carried out on the commodity storax and its similar products, which provides a more comprehensive scientific basis for the identification of storax and its allied drugs.

Johanna Gratzner

(Design Academy Eindhoven, The Netherlands)

Graduation Project, BA Design Research, Design Academy Eindhoven, NL. I am attempting to digitize specimens of *Lysimachia minoricensis*, obtaining reliable information about physical size through the process of photogrammetry. This process includes photograph capturing on site and a preserved cutting of the shoot system provided for image capturing at the research facility Design Academy Eindhoven, NL.

Mariam Gamal El-Din

(Ain Shams University, Egypt)

Phytochemical analysis, isolation and identification of secondary metabolites of different plant extracts from plant material collected at CUBG. Biological investigations of different extracts according to reported ethnopharmacology. Comparative investigations of different organs and different species.

Plant material supplied to other Institutions

CUBG supplied 335 accessions of plant material in diverse forms to 24 institutions. Of these, 71 accessions of 70 taxa were distributed to 10 Gardens:

Botanischer Garten der Universität Leipzig, Germany
 Hortus Botanicus Universitatis Jagellonicae, Krakow, Poland
 Jardin botanique alpin, Meyrin, Switzerland
 Ökologisch-Botanischer Garten, Universität Bayreuth, Germany
 Botanischer Garten der Johannes-Gutenberg-Universität, Mainz, Germany
 Botanischer Garten der Universität Bern, Switzerland
 Jardin Botanique de La Gacilly, France
 Botanischer Garten Chemnitz, Germany
 Botanic Garden of the University of Latvia, Riga, Latvia
 Botanical Garden of the University of Zagreb, Croatia.

Plant material accessioned

During the period 1st October 2021 to 30th September 2022 the Garden accessioned 364 plants, of which 157 were of direct wild origin. In addition, we accessioned 261 seed lots.

Publications by Staff

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MA Sinnott-Armstrong, R Middleton, Y Ogawa, G Jacucci, E Moyroud, BJ Glover, PJ Rudall, S Vignolini, MJ Donoghue 2022 Multiple origins of lipid-based structural colors contribute to a gradient of fruit colors in *Viburnum* (Adoxaceae). *New Phytologist*. <https://doi.org/10.1111/nph.18538>

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B Wilson, GA Lazkov, KT Shalpykov, SF Brockington 2022 *Tulipa toktogulica* (Liliaceae), a cryptic, endangered new species from the western Tien-Shan, Kyrgyzstan. *Phytotaxa* 566 (1), 1-12.

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CA Airoidi, CA Lugo, R Wightman, BJ Glover, S Robinson 2021 Mechanical buckling can pattern the light-diffracting cuticle of *Hibiscus trionum*. *Cell Reports* 36 (11) 109715. DOI: <https://doi.org/10.1016/j.celrep.2021.109715>

R Middleton, E Moyroud, PJ Rudall, CJ Prychid, M Conejero, BJ Glover, S Vignolini 2021 Using structural colour to track length scale of cell-wall layers in developing *Pollia japonica* fruits. *New Phytologist* PMID: 33720398 DOI: [10.1111/nph.17346](https://doi.org/10.1111/nph.17346)

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A Timoneda, T Yunusov, C Quan, A Gavrin, SF Brockington, S Schornack 2021 MycoRed: Betalain pigments enable in vivo real-time visualisation of arbuscular mycorrhizal colonisation. *PLOS Biology* DOI: <https://doi.org/10.1371/journal.pbio.3001326>

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B Wilson, A Dolotbakov, BJ Burgess, C Clubbe, G Lazkov, K Shalpykov, M Ganybaeva, O Sultangaziev, SF Brockington 2021 Central Asian wild tulip conservation requires a regional approach, especially in the face of climate change. *Biodiversity and Conservation* 30, 1705–1730. DOI: <https://doi.org/10.1007/s10531-021-02165-z>

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Y Chang, R Middleton, Y Ogawa, T Gregory, L M. Steiner, A Kovalev, R. H. N. Karanja, P J. Rudall, BJ Glover, S N. Gorb, S Vignolini 2021 Cell wall composition determines handedness reversal in helicoidal cellulose architectures of *Pollia condensata* fruits. *PNAS*. DOI: <https://doi.org/10.1073/pnas.2111723118>

MJ Marca-Zevallos, GM Moullet, TR Sousa, J Schietti, LS Coelho, ...A Cano et al. 2022 Local hydrological conditions influence tree diversity and composition across the Amazon basin. *Ecography* e06125, 2

Á Cano, FW Stauffer, T Andermann, IM Liberal, A Zizka, CD Bacon, ... 2022 Recent and local diversification of Central American understory palms. *Global Ecology and Biogeography* 1

MFT Jiménez, E Prata, A Zizka, M Cohn-Haft, A VG de Oliveira, T Emilio, N Chazot, T LP Couvreur, SM Kamga, B Sonké, Á Cano, RG Collevatti, BG Kuhnhäuser, WJ Baker, A Antonelli, CD Bacon 2021 Phylogenomics of the palm tribe *Lepidocarpaceae* (Calamoideae: *Arecaceae*) and description of a new species of *Mauritiella*. *Systematic Botany* 46 (3), 863–874

Weather

Katie Sarll
Nursery & Experimental
Horticulturalist

This winter continued to be mild. The spring was warm and dry, experiencing nearly half the amount of rain compared to the previous year, with 348.8mm for this year's annual total. There were extreme dry spells in April and July. Every month from March until September was well below the average rainfall, with July being the lowest at 1.8mm. This October had only half the rainfall compared to last October. The summer had some very high temperatures, of 39.9°C on the 19th July, shattering our record of 38.7°C in July 2019. There were 13 days when the temperature exceeded 30°C. June had one day, July experienced six days, followed by six consecutive days in August.

October was mild with an average of 16.5°C. The warmest temperature was 20°C on the 8th. Two notable showers occurred on the 19th and 20th with thunder, these resulted in over half the month's rainfall with 16 and 16.6mm consecutively.

November and **December** continued to be mild, 16.2°C on the 10th, a few night-time air frosts; the coldest on the 22nd at -2.9°C.

January was a cold and dry month with 15 night time air frosts, the lowest -2.8°C on the 20th.

February was notably milder than last year, lowest temperature at -1.6°C on the 10th, with a high rainfall of 42mm for the month.

March was a mild month throughout, with the warmest being 22.5°C on the 30th, with rain in bursts, though little throughout with a total of 32.5mm.

April was cold to start, with three night time air frosts, resulting in the only snow flurries of the year on the 1st. It gradually warmed up as the month continued, followed by mild temperatures throughout, 21.7°C on the 16th, with an average maximum temperature of 14.8°C.

May experienced low rainfall for the month, with a total of 18.1mm.

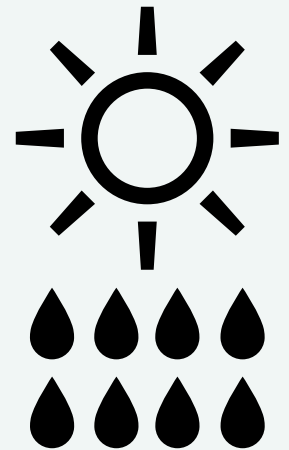
June saw only sporadic falls of rain, with the most falling on the 4th at 12.3mm. A very mild month throughout, with 32.2°C on the 17th.

In **July** we had the hottest temperature on record for the Garden at 39.9°C on the 19th, Coningsby reached 40.3°C (taking our British record from 2019), with 23 days of no rain.

August some rainfall returned with 17mm on the 24th. The month was very hot with the highest temperature of 34.4°C on the 14th.

September was a dry and warm month, with 10.6mm of rain on the 5th. Temperatures gradually petered out, with 25.9°C the highest on the 4th.



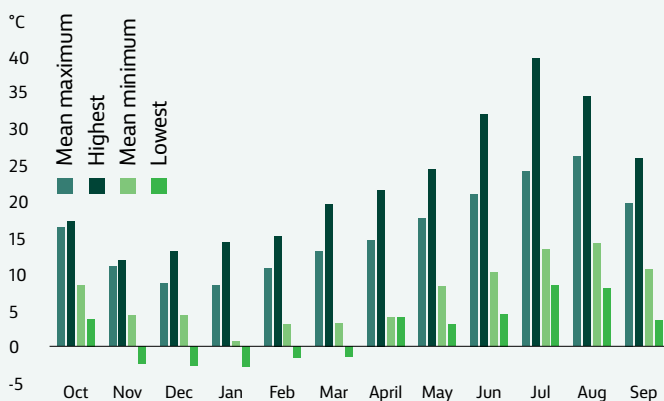


Katie Sarll, horticultural assistant and weather reader at Cambridge University Botanic Garden, records the temperature for Monday, July 18, 2022.

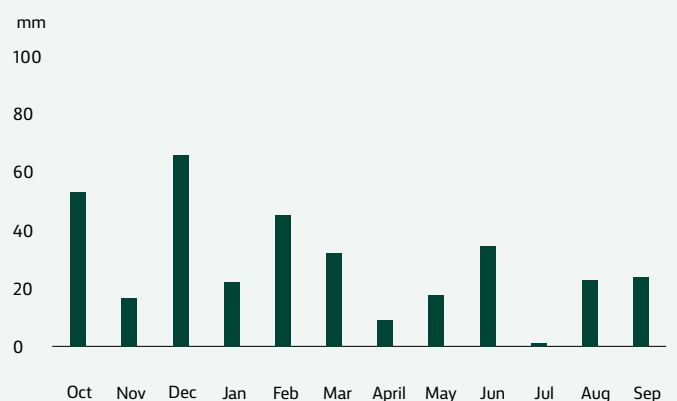


Keith Hepsall / Cambridge Independent

Monthly temperature (°C) 2021-22



Monthly rainfall (mm) 2021-22



Funding

It has been a positive year, enabling us to return to 'almost' normal operations, reintroduce much loved events such as the 'Sounds Green' summer music series, and warmly welcome an increasing number of Visitors, Friends and Corporate Friends to the Garden.

Rachel Agnew
Finance Manager

Income

		2021–22	2020–21
<i>Funding Source</i>	<i>Details</i>	£ k	£ k
University Support	Pay and Non Pay	1,037.1	1,010.8
Trust Funds	The Cory Fund	722.9	682.4
	Other Trust Funds	21.8	20.7
Admissions Income	Gate takings (including tours, guidebooks etc)	1,026.1	747.2
Earmarked Funds	Friends (including income for events and activities)	356.0	277.3
	Other Specific Donations and Trade	816.7	418.1
Project Grants/ Funding – see breakdown below		57.8	102.2
Education Courses, Donations & Events		49.7	50.2
Donations – General		7.4	8.1
Other		0.0	15.7
Total Income		4,095.5	3,332.7

Breakdown of Income (Project Grants/Funding)

	£ k	£ k
Heritage Lottery Fund – Culture Recovery Grant	8.5	76.6
Grant towards Trainee Programme – Stanley Smith Horticultural Trust	12.5	0.0
Audience and Learning / Strategic Audience Engagement Grant (UCM)	13.0	4.8
Strategic Research Initiative – Collections Connections Communities	8.4	0.0
BGCI Sustainability Project – Garfield Weston Foundation	8.0	0.0
PlaMatSu Exhibition and Workshops (Marie Curie Innovative Training Network)	0.0	18.9
Cambridge Water – Sponsorship of the Dry Garden – Annual Support to 2025	1.5	0.0
Impact (BBSRC/NERC)	5.0	1.9
Sainsbury Laboratory – Support towards Plant Science Masterclass	0.9	0.0
Total	57.8	102.2

Expenditure

	2021-22	2020-21
<i>Funding Source</i>	£ k	£ k
University Support	1,036.3	1,014.3
Trust Funds	562.4	614.6
Admission and Tours	527.2	321.1
Earmarked Funds: Friends	219.9	167.7
Earmarked Funds: Other	331.2	341.7
Specific Project Grants / Funding – see breakdown below	54.2	104.7
Education Courses, Donations and Events	71.7	31.0
Donations – General	2.3	2.8
Other	-0.8	4.6
Total Expenditure	2,804.4	2,602.4*
Total Income less Total Expenditure	1,291.1	730.3
Less: Earmarked funds held for future planned expenditure	-1,285.2**	-714.0**
Funds remaining for discretionary use	5.9	16.3
Breakdown of Expenditure (Specific Project Grants/Funding)		
	£ k	£ k
Heritage Lottery Fund – Culture Recovery Grant	13.6	71.5
Grant towards Trainee Programme – Stanley Smith Horticultural Trust	12.5	0.0
Audience and Learning / Strategic Audience Engagement Grant (UCM)	14.2	14.9
Strategic Research Initiative – Collections Connections Communities	3.1	0.0
BGCI Sustainability Project – Garfield Weston Foundation	9.7	0.0
PlaMatSu Exhibition and Workshops (Marie Curie Innovative Training Network)	0.0	15.0
Interpretation (HEIF5/Donation)	0.1	2.6
Cambridge Water – Sponsorship of the Dry Garden – Annual Support to 2025	0.8	0.0
Impact (BBSRC)	0.1	0.7
Total	54.2	104.7*

Notes:

* Calculations include minor rounding differences.

** Includes specifically funded activity and commitment of funds towards the Garden's Capital Campaign (<https://www.botanic.cam.ac.uk/the-garden/development-of-the-garden/current-projects/>).

Income figures include interest where funding has been held on deposit.

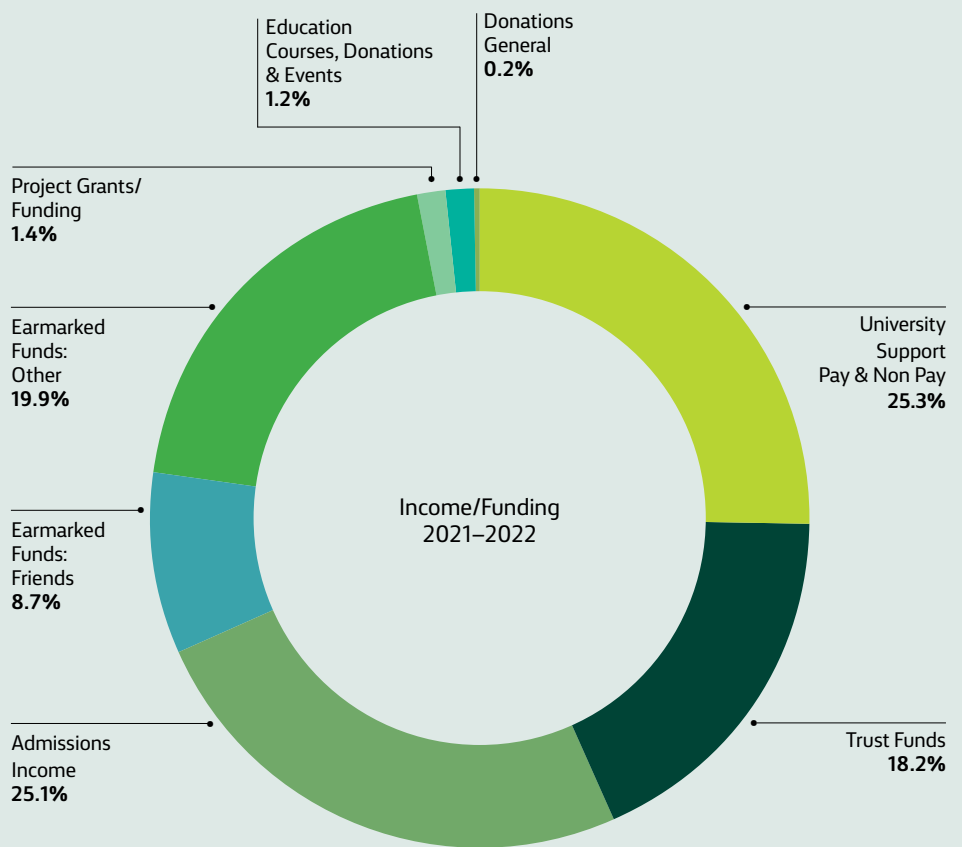
Funding (cont'd)

With a rise in events and activity, trading revenues in particular improved encouragingly (the highest level recorded), aided once again by a reduced rate of VAT payable on Admission and Friends income, the positive impacts of the Culture Recovery (HLF) funded marketing campaign in 2021, coupled with an uptick in media coverage.

Trust funds continued to perform well and donations, including an increasing number supporting specific activity such as the Station Road Bulb Planting Project, were most gratefully received. Accompanying Gift Aid donations were also at their highest level (thank you), contributing towards planned projects and activity within the year and beyond.

Grants were received to support new projects to include a collaboration with Botanic Gardens Conservation International (BGCI) to produce educational resources in support of sustainable gardening and a Phenology project funded by a University of Cambridge Strategic Research Initiative <https://www.cam.ac.uk/research/research-at-cambridge/strategic-research-initiatives-networks>. Funding was committed to activities to entertain, engage and encourage visitors, to include various visitor trails, monthly family activities and a 'Twilight at the Museums' event. The International Garden Photographer of the Year exhibition also returned for a 7th year.

Operational expenditure overall however was far lower than anticipated, where reduced levels of staffing impacted our ability to progress planned aims and goals within the period. Activities are set to resume with gusto in 2022-23.



Donations

Celebration and Commemorative Bench Scheme

Alistair and Paula Flutter in memory of a friend
Helen Judson in memory of her husband
David Judson
David and Rosalind Morgan in memory of Betty Morgan.

Sponsor a Tree Scheme

Frances Allcock in memory of David Charles Gardiner
Julie Grover in memory of her husband
Al Montasser Osman in memory of Aida Farhat
Corporate sponsorship in celebration of an Associate
Nick and Mary Faiers
Rosalyn Gregory in memory of David Gregory
Mike Jakeways in memory of Nicky Gilmour
Elizabeth Rendell in memory of Alan Rendell.

Individual Gifts and Donations

Anonymous £100
Anonymous – a donation towards the Bulb Planting Project and to sponsor a Horticultural Trainee £26,000
Gift of Shares from Jon Drori £12,580
Colin and Janet Gilbraith donation of appreciation £1,000
Elizabeth Mumford and Mrs P L Dobbie Holman £1,000
John Davenport £125
We are hugely grateful for the numerous donations received online or in our donation boxes, thank you, as always, for your generous support.

Grants, Trusts and Societies

Baldock Horticultural Society £65
BGCI 1st Instalment Sustainability Project £8,000
Collections Connections Communities, Strategic Research Initiative, Participatory Research Funding for Flower Power Phenology Project £8,417
BBSRC grant towards a CUBG Circadian Trail £5,000
Stanley Smith Horticultural Trust sponsorship in support of a Horticultural Trainee £12,500.

Corporate and other support

Birketts LLP sponsorship of Sounds Green 2022 music series £5,000
Cambridge Water PLC sponsorship of the CUBG 'Dry Garden' over 5 years £6,000
DWG Landscape Architects £103
Gatsby Plant Science Education Programme grant awarded for the support of Plant Science Delivery of Masterclasses 2021 £885
JBS Executive Education Ltd £500
John Innes Centre donation relating to MSc Student Visit £140
Sainsbury Laboratory contribution towards Festival of Plants 2022 £1,000
University of Cambridge Museums – Strategic Audience Engagement Grant (1 April 2022 – 31 March 2023) £3,000
University of Cambridge Museums – Audience & Learning Strategic Partnership Grant (1 April 2022 – 31 March 2023) £10,000
University of Cambridge Museums – Support for Twilight 2022 £6,000.

Fundraising Capital Campaign

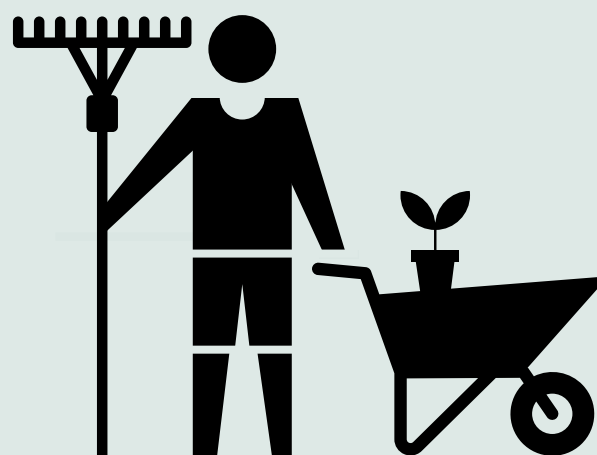
Many thanks to all those who have donated to the Garden's Capital Campaign.

Thanks also goes to the Henslow Circle, Friends and Corporate Friends for their generous and unwavering support, and to those who continue to make significant gifts over and above the annual renewal subscription.

...and lastly special thanks to those who have chosen to Gift Aid admissions, subscriptions, and donations helping to support the continuing work of the Garden.

Syndicate & Cory Managers

Botanic Garden staff



Four meetings of the Botanic Garden Four meetings of the Botanic Garden Syndicate were held during the year under the Chairmanship of Dame Fiona Reynolds.

Syndicate members were:

Professor David Coomes

Professor Jon Drori (external)

Dr Laurie Friday

Dr Ian Furner

Mr Donald Hearn

Professor Christopher Howe (from February 2021)

Professor Henrik Jönsson

Professor Rebecca Kilner

Professor Kamal Munir (from November 2021)

Ms Barbara Neto-Bradley (student member for one year)

Professor Alison Smith

Dr Rosy Thornton

Professor Bhaskar Vira (left summer 2021)

The Secretary was the Garden's Director,

Professor Beverley Glover

The Cory Managers met four times during the year under the Chairmanship of Professor Alison Smith (Head of the Department of Plant Sciences). Managers for the year were:

Mr Michael Allen

Professor David Cebon

Professor Howard Griffiths

Dr Kate Maxwell

with Mr David Sizer as the representative of the Director of Finance (from February 2022)

Director

Professor Beverley Glover

PA to Director: Jane Adams

Assistant Director (Audiences & Enterprise)

Paul Pomfret

Administration

Departmental Administrator: Wendy Godfrey

Assistant Administrators: Richenda Whitehead and Caty Cooke

Learning Administrator: Lucy Watts

Friends Administrator: Sacha Watson

Curation

Curator: Sam Brockington

Assistant Curator: Ángela Cano

Plant Records Officer: Pete Atkinson

Collections Co-ordinator: Margeaux Apple (from April)

Curation Assistant: Mar Millan

Development

Head of Development and Publicity: Anna Patterson Lee

Marketing and Communications Co-ordinator:

Helen Needham

Estates

Head of Estates and Operations Manager:

Carl Tatterton

Estates Manager: Phil Starling

Finance

Finance Manager: Rachel Agnew

Finance Coordinator: Tracey Brock

Finance Administrators: Elaine Dalton and Rebecca Chapman (from May)

Horticulture

Head of Horticulture: Sally Petitt

Horticultural Displays

Team Leader - Paul Aston;

Senior Horticulturist Western Display – Rut Gallmeier (from January),

Assistants - Pete Wrapson, Alice Riches (from March), Ciaran Bradshaw (from August);

Senior Horticulturist Eastern Display – Andrea Topalovic Arthan (from February), Assistant – John Kapor

Garden Landscapes

Team Leader: Mark Crouch

Senior Horticulturist Landscape and Machinery:

Adrian Holmes

Assistant: Matthew Murawski (to November)

Ross Gildea (from February) Assistant Trees

and Shrubs: Alistair Godfrey (to November)

Richard Denham (from February)

Glasshouses:

Team Leader Glasshouses and Nursery: Luigi

Leoni (from March)

Senior Horticulturist Nursery & Experimental:

Simon Wallis

Assistant: Katie Sarll

Glasshouses Senior Horticulturist: Kathryn

Bray (from February)

Assistant: Barbara Griffiths

Weekend Horticultural Assistant: Alice Riches

(to March), Melina Yakas (from June)

Trainee Horticultural Technicians

September 2021 – September 2022

Rosamund Crowhurst, Matthew Weston,

John Houston, James Moon, Luke Ford

Learning

Head of Learning: Hayley McCulloch

Learning Officer: Sally Lee

Schools Learning Officer: Bronwen Richards,

Hannah Elkington (from June)

Community Learning Co-ordinator: Louise

Campbell (from August)

Visitor Services

Head of Visitor Services: Nicci Steele-Williams

Deputy Head of Visitor Services & Team Leader

(Tuesday-Thursday): Laura Welford

Team Leader (Friday-Monday): David Evans

Deputy Team Leader: Mark Fielding

(May – September seasonal position)

Visitor Services Assistants: Amanda Wilkins,

Lucinda Fudge, Sue Baker, Vikas Shinde

(to June), Alicia Lloyd, Kristine Cimals (to

November), Alexandra Pond (to April), Betsy

Brown, Saphia Kaikati (from August), Eilidh

Bodfish (from August), Tom Austin (from

August), Chris McFarlane (from September),

Ismay Wells (April to August), Lorna Ashcroft-

Nowick (to January)

Visitor Services Receptionist: Heloise Toop

Botanic Garden staff activities

Obituary

We were saddened this year to learn of the death of **Dr Donald Pigott** (7 April 1928 – 11 September 2022), Director of CUBG from 1984 to 1995. Donald Pigott specialised in the lime trees, of which the Botanic Garden has such a magnificent collection, and was the author of an important monograph of the genus *Tilia*. As a young researcher in Cambridge he helped to establish the Ecology Mound in the British Wild Plants area of the Garden. As Director, he oversaw the review of the Botanic Garden that led to its reshaping to enhance public access and to strengthen its research value within the University.

The following members of staff have contributed to external organisations and groups in connection with their posts:

Professor Beverley Glover: Fellow of Queens' College; trustee of the Royal Botanic Garden Edinburgh; Chair of the Science Advisory Committee of the Royal Botanic Garden Edinburgh; member of the Council of the European Society for Evolutionary Developmental Biology; Chair of the Council of Scientists of the Human Frontier Science Programme; member of the Botanical Society of America; member of the British Society for Developmental Biology; Fellow of the Linnean Society; patron of the Cambridgeshire Gardens Trust; vice president of the Cambridgeshire Beekeepers' Association; member of the Advisory Board of New Phytologist; Strategic Advisor to 'Plants, People, Planet'; member of the Editorial Board of *Current Opinion in Plant Biology*; member of the Natural Environment Research Council's Peer Review College; gave a keynote lecture at the 26th International Congress on Sexual Plant Reproduction, Prague and a keynote lecture at a symposium on Celebrating Botanic Gardens: past, present and future; gave an invited lecture at the University of Connecticut.

Associate Professor Sam Brockington: is a fellow of the Linnean Society; member of the High Value Biorenewables Network; member of the Botanical Society of America; member of the Darwin Tree of Life Plant Steering Group; Academic Lead for the Cambridge University Herbarium; trustee and council member for the Bedfordshire, Cambridgeshire, and Northamptonshire Wildlife Trust; member of the Great Fen Steering Group; trustee for Thrive (Social and Therapeutic Horticulture)

Paul Pomfret served as a trustee for Middleton Hall Trust.

Carl Tatterton continued as a trustee of the Hobson's Conduit Trust.

Helen Needham continued as a member of the Great Days Out In & Around Cambridge committee.

Sally Petitt continued as chair of the Merlin Trust (which provides travel awards to young horticulturalists) and as a member of the Borde Hill Garden Council. She continues to serve on the RHS Education Committee, and joined the RHS Joint Rock Garden Committee.

Dan Jenkins: Elected Fellow of the Royal Society of Biology, elected as a member of the Royal Society of Biology Curriculum Committee; continued as a member of the Plant Science Group, Biology Education Research Group and the Education Policy Advisory Group at the Royal Society of Biology.

Claire Pennyquick: member of the Careers Committee of the Royal Society of Biology.

Alex Jenkin continued as a member of the Outreach and Engagement Working Group of the Royal Society of Biology.

Corporate Friends

Our Corporate Friends programme continues to grow, we now have 114 Oak and 13 Redwood Friends. We are most grateful to these companies who choose to support the Garden, while enabling their employees to enjoy our green spaces.

Redwood Friends Apple AstraZeneca Cambridge Design Partnership Ltd Cantab Asset Management Costello Medical Domino UK Limited GMSL Microsoft Research Mills & Reeve LLP MRC Toxicology Unit RealVNC Limited Secondmind AI Ltd Softwire Technology Limited St Catharine's College

Oak Friends Abcam PLC AKT II Ltd Amazon Arcadis UK Arcus Foundation Arcus Global Ltd ARM Ltd AstraZeneca Investor Relations BIOS Health Ltd Birketts LLP Brookgate Development Management Ltd Cambridge Bid Ltd Cambridge City 4 PCN Ltd Cambridge Commonwealth, European & International Trust Cambridge Consultants Ltd Cambridge Econometrics Cambridge Education Group Cambridge Flow Solutions Cambridge Innovation Capital Cambridge Institute for Sustainability Leadership Cambridge Intelligence Ltd Cambridge Investment Management Ltd Cambridge Judge Business School Cambridge Mechatronics Ltd Cambridge Quantum Computing Limited Cambridge Research Office Cambridge University Development & Alumni Relations Cambridge University Press & Assessment Cambridgeshire Police Federation Cambustion Limited Carter Jonas CCDC Churchill College Clare Hall Cogentia Healthcare Consulting Ltd Deloitte Department of Biochemistry Wellness, Equality and Diversity Committee Department of Pharmacology Department of Engineering Department of Genetics Department of Geography Department of Material Science and Metallurgy Department of Psychology Department of Zoology Department of Pathology Department of Physiology Development & Neuroscience Downing College EMBL-EBI Staff Association Emmanuel College Entrust Eversheds-Sutherland Faculty of Architecture & History of Art Faculty of Education Federation of European Biochemical Societies Five AI Functional Gut Clinic Gam Systematic LLP Geant Gilead Sciences Graphcore Gurdon Institute Harrison Clark Rickerbys Healx Limited Hills Road Sixth Form College Hoare Lea LLP HP UK Development Ltd Institute of Astronomy University of Cambridge Institute of Criminology Intrasonics Ltd Isaac Newton Institute for Mathematical Sciences John Lewis & Partners Cambridge Kennedys lowRISC CIC Lynfield Management Mander Portman Woodward (MPW) Cambridge Marks & Clerk Marshall Sports and Social Club Mott MacDonald Ltd MRC-Cognition and Brain Sciences Unit MTK Wireless Ltd Nash Matthews LLP Natural England NIAB Nu Quantum Ltd PEM Pembroke College Penningtons Manches Cooper LLP Qualcomm Sports & Social Club Ramboll Raspberry Pi Foundation Reg Genome Royal Albert Homes Sagentia Innovation Samsung Cambridge Solution Centre Samsung R&D Institute UK Saunders Boston Limited Savills (UK) Ltd Scott Polar Research Institute Siemens Industry Software Ltd Simmons Wavelength Limited South Staffs Water St Andrews Tutorial Services Ltd St Faith's School St Mary's School Staff Counselling Service Stantec Stephen Perse Foundation Stephen Perse Sixth Form Stone King LLP Studio 24 Taylor Wessing The Biodiversity Consultancy Ltd The Leys School The Positive Internet Company Ltd The Tuesday Project Ltd THIS Institute (The Health improvement Studies Institute) Thomson Webb & Corfield University of Cambridge Information Services University of Cambridge School of Clinical Medicine Vine FX VNC Automotive Limited WeWork WSP Wyton on the Hill Parish Council Yusuf Hamied Department of Chemistry.



**Cambridge University
Botanic Garden
1 Brookside
Cambridge CB2 1JE**

**Tel: +44 (0)1223 336265
www.botanic.cam.ac.uk**

**f CUBotanicGarden
@ cubotanicgarden
t CUBotanicGarden**

