Cambridge University
Botanic Garden

University Botanic Garden
Annual Report 2016–2017

UNIVERSITY OF CAMBRIDGE

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.

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

Nigel Luckhurst

Director's Report

This year the Botanic Garden maintained a renewed focus on the collections, beginning to reap the rewards of newly implemented processes and strategies that ensure the collections are well curated and accessible to all. While our role in supporting research and education around the world continues to grow, several papers from our own research programmes were in the spotlight this year, catching the attention of the global plant science community. At the same time our project to dredge the Garden's Lake, for the first time in 170 years, caught the attention of thousands of local visitors.

One of the most enjoyable aspects of running the Botanic Garden is the astonishing diversity of topics I have the opportunity to engage with, often all in the same day. Although I thought I was used to an exciting mix of activities, I certainly didn't expect my career in academia to include the dredging of an historic lake holding rare and endangered species in a heritage listed landscape!

The issue of silt build up in the Botanic Garden's Lake, one of its original features dating back to Henslow's 1846 design, had been causing concern for some years when I took up post. The Lake is an important part of our ability to maintain a wide diversity of species, providing freshwater, bog and lake margin habitats for many plants, including some of our most iconic trees (such as the swamp cypress, *Taxodium distichum).* It is also an important part of our wildlife provision, acting as a temporary or permanent home for fish, freshwater mussels and other aquatic invertebrates, and of course to a large population of birds including our resident heron and the visiting egrets and kingfishers. The Lake is also of significant importance to many of our visitors, with the younger ones particularly enjoying the stepping stones and the opportunity to feed the ducks. However, 170 years of hard water and the deposits from those ducks had taken their toll in terms of silt build-up. Water levels were getting very low, the aquatic life was beginning to suffer and some of the plants were showing signs of being crowded out by the shallow water-loving reeds and sedges.

With support from the University's Estate Management department we decided on a full dredge, and the winter of 2016/2017 was a very muddy one at the Garden, with diggers based on the bed of the drained Lake and a compactor processing the waste into large drainage bags, where it dewetted over a period of several weeks, before removal to the University farm. Although the mud and upheaval was unpleasant for staff, our visitors seemed to enjoy the novel experience and there was considerable excitement about what we might find in the silt. Surprisingly, nothing more interesting than 170 years of pine needles and branches was uncovered – not even the inevitable Cambridge bicycle. The project was very successful, and it is a real pleasure to enjoy, again, the iconic views that were planned in 1846 and to see the diverse plant collections, and the animals they support, flourishing in the new environment.

Some of our other activities of this last year might be more obviously connected to our primary roles in research and teaching. Our Curator, Sam Brockington, took the plunge with a new database, BGIris, and all our data has been successfully migrated to this new system. BGIris has many new capabilities and the Garden staff are enjoying the opportunity to analyse the collection in different ways. Sam himself was able to use his experience of our collection, and a collaboration with Botanic Gardens Conservation International, to explore the patterns of species diversity held by botanic gardens worldwide. His analyses, which pointed to biases of temperate over tropical diversity and an almost wholesale failure to consider the earliest diverging extant plant groups, the mosses, liverworts and hornworts, were reported in a high profile paper in Nature Plants, as we explain in more detail on page 17. Following on from this research, Sam and I are working on a collections strategy which will define the accession priorities for CUBG over the next decades. Our focus, as always, will be on those species most likely to be of use to plant science researchers around the world, but we are also keen to ensure good representation of plants whose stories make engaging learning opportunities, as well as a mixture of species of different conservation status. An exciting development on this front occurred in the summer of 2017, when our second *Amorphophallus titanum* corm threw up a flowering shoot – only 2 years after its companion had done the same. We stayed open late into the night for 2 nights, to allow visitors to experience the thermogenic spadix and its smell of rotting flesh. Over 6000 visitors witnessed the flowering over 48 hours, but even more spectacular was to come. Our Glasshouse Supervisor, Alex Summers, sourced pollen from recent flowerings at the Eden Project and the Royal Botanic Gardens Edinburgh, and pollinated the female flowers. It is enormously exciting to be able to report that the pollination was successful, and that we are now in possession of several hundred seeds of this vulnerable native of Sumatra. We will share these with the global botanic garden community over the next year, both to help support conservation efforts for this species and to ensure that many more thousands of people can experience its majesty first hand.

The Botanic Garden is at its best when it is able to combine scientific research with visitor engagement in this way, and we have continued to work over the last year to expand the range of opportunities for visitors to connect with the science we support. Our Science on Sundays series of drop-in talks was more popular than ever this year, and we have developed interpretation for our Scented Garden, our Autumn Colour Area and our Perennial Meadow that connect the horticultural experience to the science underpinning what is seen. These efforts seem to be paying off, as we again set a new record for total visitor numbers, with over 290,000 visitors passing through our gates in addition to over 11,000 schoolchildren on arranged education visits and the many other course, tour and community groups that we welcome separately. Visitors often leave comments, either directly with the Visitor Services team, by email, or on the review website, TripAdvisor. This feedback is very valuable in helping us to meet our visitors' expectations, and we make a regular effort to share highlights with all staff across the Garden. Particular favourites in the visitor feedback this year have included the excitement around the flowering of the Titan Arum, very positive comments on the Sounds Green series of summer music evenings, and some kind comments from visitors who we managed to reunite with lost children. It is a real joy to know that the Garden is appreciated by such a wide community of visitors. We look forward to welcoming many more visitors in coming years as we continue to develop our collection and its role as an internationally focused research and teaching resource.

Professor Beverley Glover – Director

The year in pictures...

Alex Summers

Glasshouse Supervisor, Alex Summers, embarks on a 3-week collaborative Botanic Garden plant collecting expedition to Vietnam – October/Nov 2016

Howard Rice

Mud, mud glorious mud! The Lake is dredged for the first time in the Garden's history – November

Howard Rice

Orchids 2017: Another India opens at the Garden – February

The Oceanic Islands House reopens after redevelopment – May

2,181 visitors enjoy the annual Festival of Plants – May

Silver linings – new research reveals the science behind the Saxifrage's silver-white crust – June

A weekly celebration of summer and music, Sounds Green is part of the Cambridge Summer Music programme of events – July

Be a Bee and reap the rewards! Launch of our new Flower Power Family Trail plus other summer activities at the Garden – July

Goodbye to iconic tree and old friend – felling of the black walnut – August

Matt Davey

Science on Sundays series is launched by Dr Matt Davey talking about his research into snow algae growing in the Antarctic – March

New signs and blackboard made by Rowan Humberstone installed in the Schools Garden – March

The Garden Lake is refilled – March

LEFT: Return of the Titan and a titanic success: Titus flowers and 3,500 visitors come to experience its stench including BBC Gardeners' World who filmed pollination in the early hours of the morning – June 17

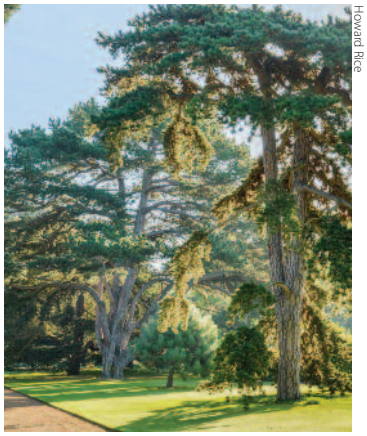
RIGHT: Titus is presented to visitors

Gardeners' Question Time co-chair, Peter Gibbs, visits to record in the Scented Garden with Demonstration and Display Supervisor, Peter Kerley – July

chadwick dyer clarke

LEFT: The Rising Path is the keystone of the three-year Understanding Plant Diversity project at the Garden (funded by the Monument Trust). Heavy machinery lends a helping hand on the Systematic Beds

RIGHT: Artist's impression of the Rising Path



Howard Rice

BGCI

A study by Cambridge University Botanic Garden's curator, Dr Sam Brockington, and Botanic Gardens Conservation International (BGCI) finds an "astonishing array" of plant diversity in the global botanic garden network – September. LEFT: Henslow Walk, CUBG. RIGHT: Singapore Gardens by the Bay.

Horticulture

Each of the seven sections of the horticultural team work to ensure that essential seasonal tasks and maintenance are delivered. The completion of basic tasks such as weeding, edging, mowing, hedge cutting, cutting down, leaf clearance, mulching, propagation, planting out, re-potting, pruning, and updating plant records allows us in turn, to enhance and develop the landscape, displays and collections.

Replanting the Limestone Rock Garden and Woodland Garden

Last year we began a rolling programme of work to clear, re-soil and re-plant the entire Limestone Rock Garden over the coming years, beginning with a segment of the North American plantings. This year the Alpine and Woodland Section moved on to the second phase, in which we cleared a range of predominantly Mediterranean species from the banked area beside the clump of *Taxus* species which forms the backdrop to the Rock Garden. Again we dug out the old, impoverished compost and introduced a bespoke mix, designed specifically for growing alpines in Cambridge conditions. Once the compost had settled we were able to plant out a selection of European alpines ranging from the shade-loving *Hepatica nobilis,* to the sun-lovers *Dianthus waldsteinii, Iris lutescens* and *Leontopodium alpinum.*

In the Woodland Garden we have been progressively working to develop a geographical theme within the herbaceous elements of the plantings. The focus for this year's plantings was Asian perennials, and here a range of herbaceous and bulbous species were selected to intermingle beneath the woody canopy, where they will thrive in the humus-rich shade of this area. Plants introduced here include *Disporopsis pernyi, Tricyrtis formosana* and *Rodgersia pinnata,* and these will grow to provide a green woodland carpet.

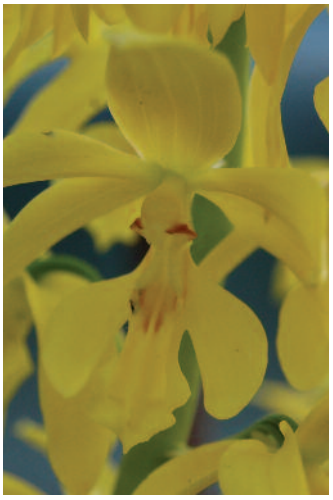
Developing our alpine displays

The prolific displays in our Mountains House rely heavily on material grown in our behind-the-scenes alpine nursery, and a programme of redevelopment here over the last ten years has seen facilities for the cultivation of a wide range of display material improve considerably. A further extension of these improvements took the form of a raised, covered plunge frame, which has enabled us to increase our capacity to raise and grow-on alpine plants destined for the Rock Garden. This has freed up valuable protected nursery space, and enabled us to extend the range of species included within our alpine collections and to cultivate a wider range of demanding high alpine genera such as *Dionysia, Draba* and *Androsace.*

Orchids from India

Our Orchid Display has become a permanent fixture in the Botanic Garden calendar. This year our theme was India, which tied in with the University of Cambridge Museums and Botanic Garden (UCM) 'Another India' programme. This provided opportunity for us to work in collaboration with partner collections, and particularly with the Museum of Archaeology and Anthropology. During February and March the Glasshouse Range was transformed to provide a colourful and florific display of plants. Species included cool climate orchids displayed in the Mountains House, such as *Calanthe sieboldii* and *Pleione grandiflora,* along with the Himalayan *Coelogyne cristata.*

These were shown beneath a swag of prayer flags which conveyed an essence of far-flung, mountainous lands. In the Tropical Houses species including the vulnerable *Pholidota chinensis* were displayed alongside a pithora mural which was evocative of the western Indian state of Gujarat. The orchid display extended into the Glasshouse Corridors and Tropical Wetlands House where mass displays of *Cymbidium* and *Dendrobium* brought further colour and interest, while interpretation throughout highlighted the diversity and cultural value of the family Orchidaceae. The Orchid Display was timed to coincide with our offering for the UCM Twilight event, and we offered intrepid visitors the rare opportunity to visit the Glasshouses at night to marvel at the spectacle of our orchids highlighted with special effects lighting.



Calanthe sieboldii

Coelogyne cristata

Developments in the Glasshouses

The Glasshouse Section was successful in flowering our third Titan Arum *(Amorphophallus titanum).* This Sumatran species is categorised as vulnerable in the wild, and while it is held in collections throughout the world, few flowerings occur in cultivation. It produces one of the largest single flowering structures in the world, along with a powerful smell of rotting flesh, which gives rise to the name 'corpse flower.' The flower is at its peak for 2–3 days when the flower structure is fully open, and the pungent aroma is at its most intense. Once the Glasshouse team confirmed that flowering would occur, the inflorescence was measured daily to give an indication of exact flowering time. This enabled staff Garden-wide to promote, publicise and manage visitors at the critical time of flowering. During a two-day period in June, when the Garden was open until 10pm, we had an influx of evening visitors, all eager to witness this rare flowering and to experience the extraordinary scent of the Titan. On the first evening a window was carefully cut into the base of the spadix to reveal the female flowers. This also provided access for successful pollination, using fresh pollen donated by The Eden Project and frozen pollen from the Royal Botanic Gardens Edinburgh (RBGE). Pollen produced by our Titan was also distributed to RBGE and Paignton Zoo, and we have also frozen pollen for future use. We anticipate that, once ripe, seed will be sown here at the Garden both for our use, and also for distribution to other botanic gardens.

During the year we redeveloped the Oceanic Islands House to present a more authentic landscape to our visitors. Approximately 20 tonnes of basalt rock were manoeuvred into place to create an evocative, rocky backdrop to new plantings. These included the crevice loving *Aeonium tabuliforme,* along with *Musschia aurea, Sonchus hierrensis* and *Azorina vidalii.*

Oceanic Islands House redevelopment

Azorina vidalii

Propagation of Vietnamese material

Much of the newly introduced planting was acquired from the Jardin Botanico Vieja y Clavijo, Gran Canaria, which sourced the material from the wild. The addition of wild sourced material for cultivation greatly enhances the curatorial, conservation, research and horticultural value of our collections. Alex Summers, Glasshouse Supervisor, participated in a collecting trip to Vietnam for three weeks from 16 October 2016. These trips provide horticulturists with the opportunity to observe and study plants in their natural habitat, and to understand the environments in which species naturally grow, thus enhancing our ability to cultivate plants within our collections. The expedition was run collaboratively with Royal Botanic Garden Kew, RBGE Logan, and Glasgow Botanic Gardens. The Hoang Lien mountain range in northwest Vietnam was the destination for the trip, with temperate and sub-tropical species providing the main focus for collecting. In excess of 500 seed collections were made. Material collected has been sown at CUBG, and at the other participatory gardens. Here we have already had successful germination of a range of species, including *Magnolia sapaensis, Acer flabellatum* and *A. breviceps.* We will continue to nurture these and look forward to incorporating many in our plantings in the future.

Horticultural underpinnings of the Understanding Plant Diversity project

The Systematics Section began work on the initial horticultural phases of the Understanding Plant Diversity project. This initially required the establishment of a decant area at Brooklands Lodge, and this took the form of several raised plunge beds and the installation of irrigation. Into these beds we transplanted material identified for retention from the Monochlamydae (southern) and Thalamiflorae (western) sections of the beds. Material retained has included *Euphorbia amygdaloides* ssp. *robbiae, Oxyria digyna* and *Rheum x cultorum*. Additional material will be sourced from other botanic gardens and collections, and Kew's Millennium Seed Bank. Once the beds were cleared in these sections we were able to rotavate, stone bury and level the site to allow soil to settle over winter. Both areas were turfed in spring under the direction of the Landscape and Machinery Section, and with the input of all horticultural teams.

Systematic Beds returfing

The new bed designs were cut out in the Monochlamydae section in late summer. Work will continue on the Thalamiflorae section, and we will also repeat the same process on the third section, Corolliflorae, on the eastern side of the Systematic Beds. Throughout the process we will retain the integrity of Murray's original design, while updating plantings to demonstrate current classification as recognised by the Angiosperm Phylogeny Group.

Keeping the lawns and paths in good condition

In addition to the extensive turfing of the two Systematics sections, further turf maintenance was carried out in other areas by the Landscape and Machinery team. We continue to suffer widespread damage to our lawns by badgers and birds foraging for chafer grubs, which reside directly beneath the turf and eat the roots of the grass.

Rectification works to the Main Lawn, Brookside Lawn and Systematics following chafer-related damage were undertaken, while biological nematodes were also applied to these areas to control populations of chafer grubs. In our efforts to treat these pests we also introduced chafer beetle traps to enable us to monitor population levels, and enable targeted treatments. The dredging of the Lake caused damage to grass areas and also paths, and these were reinstated by the Landscape and Machinery team. The lawn at the lakeside was lifted, rotavated, levelled and re-layed. Grass reparations were also required through the New Pinetum, where silt-removal lorries tracked through the area. Here damaged areas were rotavated, levelled and re-seeded. Additional rectification works to the Main and West Walks were also carried out. Here heavily rutted paths were turned over, re-laid, compacted and top dressed to permit ease of access to our ever-increasing number of visitors.

Chafer damage to Main Lawn

Badger damage to Systematic Beds

Discovery Area development

Progress with the Discovery Area

Staff on our Trees and Shrubs section began work clearing through our boundary plantings, and this remains very much work in progress, having started with the Discovery Area last year. This year in the Discovery Area we worked on sculpting the landscape, introducing undulations and hollows to the site, and also removing low branches from within the canopy thicket on the boundary to allow young visitors to explore the canopy. The area was also contained by a newly installed cleft oak fence and entrance sentinels which will define the area. Shrubby plantings will further define spaces, and we anticipate opening this to the public in May 2018.

Special care for our trees

Our tree stock requires constant monitoring and input to maintain healthy specimens. Regular in-house checks of woody material are undertaken, particularly after storms, and of mature specimens. This year these inspections were supplemented by our second full tree survey. This was done by a specialist external contractor, who observed every tree within the Garden, whether it be an original or a new planting. The survey takes into account tree health, obvious faults, decay, location, and accessibility, and advises on interventions based on safety factors. Many of the recommendations highlight minor issues, including tight tree labels, encroaching ivy, deadwooding, and felling of small trees. Much of this work can be dealt with in-house by our Trees and Shrubs team. A small percentage of larger works, such as the felling of mature, large plantings, require the input of a team of qualified arborists. While the tree survey highlights a small number of removals, much of the work is remedial, and all ensures that the Garden remains a safe environment for staff and visitors alike. Our on-going in-house tree surveys also determine our tree works programme, and work will continue to deliver the recommendations advised by the survey and also based on our own observations. In the summer of 2016 our highly revered *Juglans nigra* (black walnut) near the Brookside entrance defoliated suddenly, giving rise to speculation as to the cause of this uncharacteristic leaf-drop. At the time observations suggested that this was either caused by an anthracnose infection, which causes sudden leaf loss, or honey fungus *(Armillaria mellea)*. Given that the cause was at this stage unknown we continued to monitor the tree, and review in spring, by which stage if the cause were anthracnose it would have produced a new, healthy canopy. This was sadly not the case, and we resigned ourselves to the loss of this impressive tree to honey fungus, which can result in the death of weak or ageing specimens. In summer the tree was felled, and while there was great reluctance to do so, we have another black walnut alongside the *Pterocarya fraxinifolia* which can grow to reach the same stature as this much-loved specimen. During the year we also removed specimens of *Populus alba* and *P. nigra* ssp. *betulifolia*. Both trees grew in the Autumn Colour Area, and lost limbs during high winds in late summer. Given the brittle nature of this genus, and their location in a prominent, high access area, we decided that we should remove both for safety reasons. While our own observations and recommendations from the external tree survey determine our tree management policy, significant works are only undertaken with the City Council's approval, following submission of a tree works application, and with our own consideration of replacement plantings.

Juglans nigra May 2017

Training the next generation

As an established garden with a long history of training staff we are conscious of the value of offering training and developmental opportunities to others wishing to pursue horticultural careers. Our accredited Cambridge Certificate in Practical Horticulture and Plantsmanship continues to provide a year-long training scheme for horticultural students. We are also committed to promoting horticultural careers and offering experiences to others interested in furthering their understanding of the horticulture industry. This year we again hosted three local school pupils for a two-week work experience placement in conjunction with the Employability Partnership. We also recognise the role we can provide in furthering skills and knowledge of those already embedded in horticulture. This year the Glasshouse Section hosted two placements from Chelsea Physic Garden and Myddelton House, both of whom were keen to develop their glasshouse skills. During the year we hosted a PlantNetwork Glasshouse Forum which focused on sharing resources and knowledge, to which we welcomed 20 botanical horticulturists from across the country. In addition we held a training session for 30 Cambridge College, National Trust, English Heritage and City Council gardeners focusing on chafer grub issues and treatments for this ever-burgeoning problem. Both were successful, with attendees sharing experiences and knowledge. While highlighting the value of such collaborations, these also served to remind us of the knowledge, expertise and experience of our own horticultural team.

Sally Petitt – Head of Horticulture

Education

Highlights

No. of Courses = 65

Course participants = 595

No. of new course participants = 251(42% of total)

School children = 11, 014 (up 24% on previous year)

No. of school visits = 428 (up 28%)

Pavement chalk art at Hanover & Princess Court

Lifelong learning at the Garden

During the last year we have been reviewing the way our team works and how the areas of the programme we have developed support the overall goals of the Garden. Through a review of our work and time spent thinking about how our priorities might change over the next five years or so we developed a strategy which focused on the development of our schools programme and on support for Further Education and Higher Education students – with our new facilities in place in the Schools' Garden this is the perfect time to do this. Over the next year the addition of HE & Research Impact Coordinator and Horticultural Learning Coordinator posts, funded by HEFCE, will add further support to our offer to both FE students and those moving on to HE. We expect these posts to be filled in early 2018. We have also taken the opportunity to rename our function as the Learning Team – on paper this might seem a trivial change, but it reflects the wide range of formal and informal teaching and outreach that we do. It also ties with similar department descriptions at other gardens and museums across the UK which we think will aid navigation on our new website when it arrives in 2018.

Courses, talks and events for adults

Our adult courses programme delivered 65 courses over the reporting period, which saw 595 adults taking part in our diverse range of short courses in plant science, gardening, plant identification, botanical illustration, garden history, photography and creative arts. Around 40% of those taking our courses during this period had not previously taken a course at the Garden, confirming that this programme continues to attract new attendees year on year.

During 2017 we themed a selection of courses to focus on India, to support India Unboxed, a season of activities developed across the University Museums to support the UK-India Year of Culture. These included a garden history course on Himalayan plant hunters led by Christine Bartram of the University Herbarium, a linocut printing course inspired by Indian woodblocks, a session on the history and use of Saffron, and an illustration course that focused on insects from the region – with insect specimens supplied by the Zoology Museum. The Garden's annual Orchid Display in the Glasshouse Range also linked to this theme – informing our interpretation and choice of displays by creating links with the Another India exhibition at the Museum of Archaeology and Anthropology as part of the India Unboxed season.

In February we took advantage of the Glasshouse Range being lit up for Twilight at the Museums to host a Cam Late event aimed at adults. Our Botanic Nights cocktail event quickly sold out and 100 people attended the event. Visitors wandered the Range exploring the plants that featured in three different cocktails, sampling edible insects and discussing the future of food and drink in a changing climate with volunteers from the Departments of Plant Sciences and Zoology.

The third season of our Science on Sundays talks opened at the University's Science Festival in March and these continued monthly until August, with six talks on current plant science by researchers from the Department of Plant Sciences and the Sainsbury Laboratory. Through the year 265 visitors attended these free drop-in talks at the Garden and we are planning a further series for 2018.

Botanic Nights cocktail

Joe Higham

Sixth form student passes scheme

Further work to support our adult visitors has included the revamp of plant lists for the Bee Border, Winter Garden, and Dry Meadow. These are now available to pick up free at the gates or can be downloaded from the website. Lists for the Scented Garden and the Cory Lodge Lawn borders will follow over the next year. Alongside this we have developed a design format for new adult trails which we hope to roll out in 2018, alongside the beginnings of plans for a series of podcasts for download from the new website, once it is up and running.

School visits and outreach

Over the last year we have welcomed 11,014 school children to the Garden through a total of 428 school visits. This is up 24% (+2080) and 28% (+95) respectively on the previous year. In April the hours of our Schools Learning Officer, Bronwen Richards, were extended to full time, to support the growth in our school visit numbers, trial new schools resources and pilot new models of school visit, increase our offer to both early years and secondary students and to enhance our ability to provide outreach and support to local schools and individual students.

A sixth form student passes scheme, started in 2012, now gives almost 400 students from local sixth form colleges the opportunity to regularly visit the Garden to support their studies in Biology, Applied Science, Geography, Art, Photography and Graphic Design.

Towards the end of this reporting period we began work on developing a set of Natural Forms GCSE and A level art resource boxes, which will be trialled by a small group of local secondary schools. This pilot project was undertaken by Hannah Elkington, who was able to stay on working with the Learning team for a short contract to support the schools programme, after her post covering adoption leave for our Community Learning Officer came to an end.

We have continued to support schools in the region through outreach. We delivered a Crime Scene Investigation forensic biology session for RHS Hyde Hall's Careers Day for year 9 and 10 students from secondary schools in Essex. Our Schools Learning Officer, Bronwen Richards, joined the Sainsbury Laboratory running activities at the Big Biology Day hosted by Hills Road Sixth Form College, and attended a biodiversity conference at Flag Fen for A level students – leading a session on the role of botanic gardens. The Garden also hosted an RHS Campaign for School Gardening teacher CPD session with a focus on growing food and cooking, to support the primary curriculum.

Our collaboration and work with the Gatsby Plant Science Education Programme (GPSEP; a grant funded project based jointly in the Garden and the Sainsbury Laboratory) has also continued throughout this period, aided by our Schools Officer, Bronwen Richards, being embedded in their team until she joined us full time in April. The time that Bronwen has spent working jointly for our team and GPSEP has strengthened our links with this programme and provided excellent opportunities for joint working. As part of the student engagement programme a series of Masterclasses for A level students was delivered at the Sainsbury Laboratory in 2017, and we plan to deliver another set in 2018. We also continued to support a DNA barcoding project with the University Technical College (UTC), GPSEP, and the Sanger Institute. Students from UTC were introduced to the role of botanic gardens in identifying and conserving endangered species, and to the importance of CITES. They sampled selected endangered species within the Glasshouse range, supported by garden staff, extracted and submitted their own plant DNA barcodes to the European Nucleotide Archive (ENA) database – making a genuine contribution to scientific knowledge and conservation. The students taking part also produced posters, which were displayed in the Glasshouse Range during our Festival of Plants.

Schools' Garden

The Schools' Garden continues to provide us with lots of opportunities to use hands-on gardening to inspire and encourage exploration of plants by children and teachers. Our after-school Gardening Club, run with children from St Paul's, our nearest primary school, has had a successful growing season with fruit, vegetables, herbs and cut flowers filling the beds. We have been able to use the polytunnel more this year to start crops off and our staff volunteers, Alan Langley and Alistair Cochrane, have done a sterling job growing produce and keeping the garden up to scratch.

A new sign for the Schools' Garden was made by the woodwork team at the social enterprise charity, Rowan Humberstone. The beautiful handmade wooden structure features blackboards, an insect hotel and a green roof – it has quickly become a focus for the garden. Visitors use the chalk to leave us messages and draw pictures and we are able to point out plants and features of interest – like the fantastic pumpkins Alan and Alistair grew for us.

Alice the Camera

Schools' Garden sign by Rowan Humberstone

This year we have also added some 'mini worlds' to the Schools' Garden – to showcase and develop outdoor learning and play initiatives for early years children. Designed by Yasmeen Farooqui, one of our volunteers, these dinky gardens, built in two square raised beds, are now home to dinosaurs, dragons, and little people of all shapes and sizes. They were designed to provide a focus for younger children, but have become surprisingly popular with our adult visitors too.

Science Interpretation

In March 2017 we said goodbye to our Interpretation Associate, Dr Alison Murray, as a 2-year contract, funded by HEIF5 to develop science interpretation at the Garden, came to an end. As a legacy of this post we now have a series of new displays in the Garden and new interpretation for existing displays. These include The Winter Garden, The Perennial Meadow outside Cory Lodge, The Autumn Garden, Newton's Apple Tree and the Chronological Bed. More interpretation from this project will go out in the Garden in 2018 as the spring season begins. We now have a new house style and a number of our staff have been trained to use the graphic design software, Indesign, so that temporary interpretation can be created in this new housestyle and updates made as required when our displays change and develop.

Events and Festivals at the Garden

At Apple Day in 2016 we ran mini apple tasting sessions for children and made Apple Hedgehog bird feeders with families who visited us in the Garden Room. We were also joined by volunteers from Cambridge Sustainable Food who ran pumpkin-themed activities for our visitors.

For the University's Festival of Ideas we delivered a family event called 'Move it, Shake it' which explored seed dispersal through a range of drop-in activities including fantasy seed making and seed dispersal demonstrations. For adults the garden historian, Laura Mayer, delivered a talk on Capability Brown to support the nationwide celebration of the bicentenary of his death. During the University's Science Festival our Head of Horticulture, Sally Petitt, gave a tour entitled 'What's in a name? Hidden tales of botanical nomenclature' which delved into the stories behind the names of some of the Garden's most iconic plants. We also launched a new trail, 'Family Trees', which challenged children to search for trees and discover their secret tree family mottos.

At the Festival of Plants in May we drew again on the India theme, creating a spice bar for visitors to discover the uses, folklore, smells and tastes of spices from the country. We also used spices to flavour a huge pot of chai for visitors to taste and children created mini fabric flags printed with Indian woodblocks. We were joined by colleagues from the Museum of Archaeology and Anthropology, who ran craft activities to create Naga head-dress inspired badges and artwork painted with stick brushes. Alongside these activities, the science communicator, John Hinton, enthralled our visitors with his quirky songs about science 'Now That's What I call a Lot of Songs about Science' and a series of quotations from films popped up on plant labels in the Glasshouse Range through 'Call of the Wild', an art installation by Judith Weik.

The Learning team have also supported two other major public engagement activities in Cambridge this year. We ran a stall on using sustainable growing media at The Earth Optimism Solutions Fair at the David Attenborough Building on World Earth Day in April – joining over 30 local, national and international conservation organisations to showcase a variety of practical ways that people can make a real difference for the planet through their everyday lives. In July at the City Council's Big Weekend we joined other science outreach teams in the University's Fun Lab – delivering a flowers and pollinators activity for families.

Families at the Garden

On the first Saturday of every month we deliver a free family event and this year we also chose to add India themed sessions to this part of the programme. We made paper flower garlands inspired by traditional Indian flower garlands, tie dyed fabrics, and made paints with Indian spices. Following the decision last year to make these sessions free for children, they have continued to attract high numbers of attendees. Over the reporting period 825 children attended these sessions and our family trails and backpacks have continued to gain high praise from visiting families. Twilight at the Museums again ran across the University Museums in February and, as it coincided with our annual orchid display we used the Another India theme of the display to create mini mandalas with the 1300 visitors who explored our Glasshouse Range after dark.

Gardening in the community

Community carrot harvest

In the summer of 2017 we launched another new family trail called 'Flower Power' which led the children around the Garden to discover flowers and the creatures that pollinate them. This kicked off an exceptionally busy summer season of family events with a focus on flowers and pollination. These included the drop-in event 'Be-a-bee' which allowed you to enter the world of the bee, by crawling into a giant flower, making bee headbands, exploring UV patterns on flowers and looking at bees under a microscope. 'Bee Adventure' led by the Vital Spark Theatre created an imaginary garden adventure for young children though song and drama. Jenny Kirkham, our Library Manager, led 'Once upon a time in the Garden', a morning of plant-themed storytelling for the under 5s. In July we used the shadows of plants to make some abstract artworks with families and in August we led a 'Dusk Patrol' – a rare night time walk for families around the Garden to discover the wildlife that comes out when the sun goes down. We rounded off the summer with 'Sensational Scents' – making and mixing pot-pourri using flowers from the Garden.

Outreach and Community

Our Community Learning Officer, Sally Lee, was on adoption leave during this period and we welcomed Hannah Elkington to our team to cover the post and lead our community outreach.

The Gardening Club at Hanover and Princess Court this year has been challenging, full of highs and lows. During the last year two of our regular community garden club members died unexpectedly, leaving other residents and members of the club upset and in need of support. We hope our weekly sessions have helped to give a focus to them, through planting up plants in memory of our friends. Highs including winning prizes in the City Council's residents' gardening competition, and for many residents harvesting their first ever homegrown crops.

Alongside our regular weekly club helping residents to grow vegetables, herbs and flowers, we began a small-scale project to focus on the trees at Hanover Court, as some were being vandalised and damaged. We began by clearing the areas around the bases of the trees and added tree labels giving common and Latin names as well as country of origin. Our gardening club members have enjoyed finding out where the trees are from and we hope to extend this project to other community gardens in the city next year, in consultation with Cambridge City Council's tree team. In May we ran a morning session with residents to plant up hanging baskets and planters to fill the neighbourhood with colour. In the afternoon we 'Drew a Botanic Garden' with a session run by artist, Rachel McGivern, creating pavement chalk art.

Our monthly walks with adults from the Thursday Group at the St Paul's Centre continue to attract a good crowd and we are grateful to Jenny Egbe and Yasmeen Farooqui for supporting this session throughout the year. We have also been piloting a series of guided walks through Cambridge City Council's exercise referral scheme and supporting adults visiting the Garden with the charity, Wintercomfort. Our seasonal visits to St George's Care Home have also continued, with themed activities to highlight plants at different times of the year.

With our community projects now firmly established we want to work on ways to evaluate this area of our programme more in the next year and hope to create some digital diaries with our groups.

Staff and Conferences

We are grateful to Hannah Elkington for all her work while covering adoption leave for our family and Community Learning Officer, Sally Lee – who returned to her post in September 2017. Flis Plent continued to support the board of BGEN as a Director, this year taking over responsibility for running the Network's training programme. We hosted two BGEN training days at the Garden, one on Evaluation and another on working with Early Years Audiences. Our Schools Learning Officer, Bronwen Richards, delivered sessions on the GPSEP Masterclass programme at the BGEN annual conference at the Alnwick Garden, and at BGCI's Congress in Geneva.

Volunteers

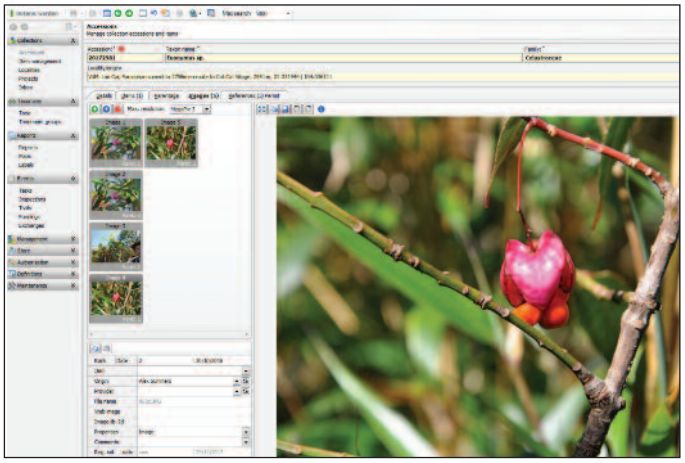
Over the last couple of years we have relied hugely on our dedicated volunteers, and with some moving away from the area and others retiring we realised it was time to begin to add a few more to the corps. We advertised and received a great response and we are now in the process of training our new volunteers and introducing them to our existing group. As ever we thank all our volunteers for their dedication and time in supporting all our learning programmes.

Flis Plent – Head of Learning

Curation

Updating the database

One of the main challenges in collection management within a botanic garden is tracking the accessioning, movement, and fate of thousands of plants in our landscape. Originally this was done as a book ledger, then as a card-index system, until we moved to a computerised system, BG-BASE, in 1998. In early 2017 we moved our collections data from BG-BASE to a new system, IrisBG, which offers a more secure environment for our data, a more modern intuitive interface for our staff, and enhanced capabilities in terms of online accessibility and mapping functions. The shift to a new system entailed a great deal of planning, garden-wide staff training, and the design and implementation of new processes over several months, under the watchful eye of our Plant Records Officer, Pete Atkinson. The value of the new system is immediately apparent, democratising access to the Garden database, and facilitating forward planning and collections analysis. In the coming year we look forward to opening up access to the database to the public.



Iris BG screen shot

Supporting research

Our Garden is positioned at the centre of one of the largest concentrations of plant scientists in the UK, and supporting third party research is central to our mission. Researchers request a range of support including the use of our landscape for zoological surveys and ecological experiments, consultation with our curatorial and horticultural staff, use of our experimental glasshouses and research plots, and material transfers from our documented living collections. About half of our requests are communicated directly to the Garden's staff, while the remaining half are communicated via 'PlantSearch', a facility operated by BGCI. 'PlantSearch' is particularly important in enabling us to facilitate research on a global scale, as most of our international requests come through this route. It is important to centrally monitor the research request process to ensure that we are: 1) dealing with research requests in a timely manner; 2) meeting our legal obligation to the various legislation controlling collections' use; 3) responding strategically to collection use, and 4) collecting data, information and narratives to communicate to our stakeholders and funders.

To deliver on these requests we have revamped how we handle research with all requests now forwarded to a central curation e-mail address. We immediately acknowledge the request, and all requests are entered on to our database regardless of whether we ultimately deliver on the request. This is vital because there are many valid reasons why we cannot fulfil a research request, yet it is important to record the interest in our collection, as testament to its perceived research value. If we can fulfil a request, we send a Research Description Form that asks the user to provide a description of their intended use. We do not facilitate research requests unless we receive this information in advance. Finally, although facilitating research requests requires good collaboration across the curation and horticulture teams, only the curation team can issue the formal Material Transfer Agreement, which ensures that we do not contravene any material or legal restrictions. It has been pleasing that over the past academic year we have tripled our delivery of research material compared to two years ago, a gain that is in no small part to the efforts of our Label Technician, Mar Milan, who now spends one day each week handling requests.

Auditing the living collection

It is perhaps surprising that about a quarter of research requests cannot be met because we are unable to find the plant in question, usually because the plant has died, been de-accessioned, or has moved location, but these events have gone unrecorded in our database. Such occurrences are common in highly transient living collections, but nonetheless, emphasise the need for regular and cyclical auditing of the collections to make sure we are up-to-date. Over the past year we have been focusing hard on catching-up on the huge back-log of auditing, which stretches back into the early 1990s. Here we have been working closely with the horticulture team, and have benefited from two fantastic curation volunteers, Cathie Sleigh and Penny Coggill, who have collectively managed to audit the tree collections, the Plant Heritage National Collections, and the Limestone Rock Garden. Garden-wide we have now reached the point that we have records for all accessions from at least 2007, and we aim next year to have all records accurate to within five years.

Relocating the Cory Library

Over the past year work has begun in earnest to relocate our Library to join the Herbarium Library in the basement of the Sainsbury Laboratory. New rolling stacks have been installed in the Sainsbury Lab basement, and Jenny Kirkham, our Library Manager, has diligently removed all duplicates between the two collections. She has completed the process of moving the Floras to their new location. In the new year the periodicals and special collections will be moved, and then the careful process of fully integrating the Cory and Herbarium libraries will continue.

All in all, Curation have had a busy year, continuing to put in place key processes and adjustments to how our collections are managed across the Garden. We have some exciting projects planned for the coming academic year, and very much look forward to the appointment of the new HEFCE-funded Assistant Curator. This appointment will mark a new transition for the curation team, enhancing our taxonomic provision, and looking to more creative aspects of collection management, with the addition of new and exciting plant material from across the world.

Dr Sam Brockington – Curator

Friends

Juliet Day

Friends' gathering

It has been another successful year for the Friends of Cambridge University Botanic Garden. At the end of the reporting year we had 6,816 Friends, the majority of which were renewals, and 93 Corporate Friends.

This year saw the reintroduction of Early Bird Tours, which were extremely popular and sold out within 15 minutes of going on sale. Friends were invited to observe the birds in the Garden with Dr Mackenzie and Dr Mowles from Anglia Ruskin University before the Garden opened to the general public, followed by breakfast. The College Garden tours continued to be popular – this year the Friends enjoyed tours of both Clare and King's College Gardens.

Spring and summer coach outings were organised by Elizabeth Rushden and Gail Jenner and in May, an international Friends' trip was organised to the Gardens of Ireland by Margaret Goddin, all of whom are volunteer Garden Guides and to whom we are extremely grateful.

Other Friends' events included two very popular Christmas wreath-making workshops, Herbarium and Sainsbury Laboratory tours and a talk explaining the dredging work happening in the Lake. In the spring, Plant Records Officer, Pete Atkinson, gave the Friends a talk about the history of plant records and labelling in the Garden up to the present day.

Our annual Friends' evening highlights tour took place on a June evening and was well attended, with guides and Friends enjoying a glass of wine afterwards in the Temperate House. Toby Buckland (Gardeners' World, and a former trainee of CUBG) presented the Friends' Annual Lecture.

The Friends' e-news circulation has increased over the past year and we have redesigned the Friends' application forms and membership cards. We are in the process of making it possible to purchase Friends' memberships online – this will become available by the end of 2017. We believe that this will provide an accessible renewal and joining method for many people.

An online Friends' survey will finish in December 2017. It is hoped that this will provide useful data to inform decisions relating to future events, the planned Patrons scheme and other Friends' related matters.

We would like to thank all of our Friends for their continued support.

Anna Patterson-Lee – Head of Development and Publicity

Communications

The flowering of the Titan Arum was the main event of an extremely busy year for the Communications team. We have enjoyed excellent coverage for our core events such as Apple Day and the Festival of Plants, but also articles and stories on everything from the high profile to the more niche, including good local and national press coverage for research based at the Garden. We were delighted to feature in the BBC flagship gardening programmes, Gardeners' World and Gardeners' Question Time, as well as in local television and radio, national and local press, online and social media.


1

Rare blooming kicks up a stink

Summary of News Coverage, 1 October 2016 – 30 September 2017

Type of news cover	Number of appearances
National Magazine	8
National Press	7
Local Magazines	10
Local Press	25
BBC Radio	13
National TV	4
BBC Gardeners' Question Time	1
BBC Gardeners' World	1
Countryfile website	1
Local TV	2
Worldwide online press/journals	17
Press tweets	6
Local radio	4

During this period, our Facebook page 'Likes' increased from 4,964 to 5,783 (an increase of 16%) and our Twitter followers rose from 7,706 to 9,430 (an increase of 22%). We only started tracking our Instagram followers from 1st January 2017, but in the period from then until 30 September 2017, our followers rose from 532 to 1,312 (an increase of 146%).

Twitter impressions (interactions of any sort with a tweet – views, likes, replies etc.) peaked in June with the Titan impact at 471,000 and we had 21,500 profile visits that month. Profile visits (recorded on a per month basis) rose from 2,891 in October 2016 to 5,771 in October 2017.

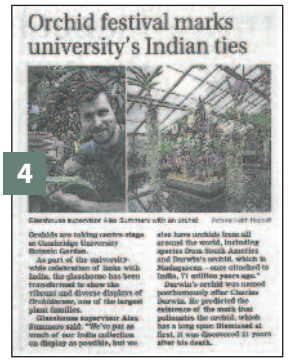
1
Cambridge News
28 June 2017

2&4
Cambridge Independent
1–7 March 2017

3
Twitter
3 February 2017

5
Cambridge Edition
May 2017

6
BBC News website
28 September 2017



Lake dredge

Silt removal

Dried silt is prepared for removal from site

On 24 November 2016 Miles Water Engineering started our long awaited Lake dredging project. Constructed in 1857–58 (with water diverted from Hobson's Conduit into a clay-lined disused gravel pit), the Lake had received little maintenance and was heavily silted. This had reduced water depth to 0.3 metres in areas (clearance could lead to an average of 1.6 metres depth), the Lake's biodiversity and ecology were suffering due to silt depth and oxygen depletion and the Lake's condition would never naturally improve without intervention. The decision was taken to make amends and set the Lake condition right for the future. It was to be a large task in a small window of opportunity before other Garden developments made interventions on this scale much more difficult.

While setting out the site and allowing the Lake to drain naturally, all the aquatic life was harvested and removed from site. The silt was excavated from the Lake (in excess of 2 metres deep in areas, clogged with Garden detritus, predominately pine cones), fed through a sieve and pumped into geotextile sacks to drain and solidify for twelve weeks. The solid matter was then transported to and used on the University farm. During desilting, areas of reed bed and shallows were left to introduce a variety of habitat for future planting and wildlife, the reeds also providing a natural silt trap for incoming water to the Lake.

Once the silt had been removed from the Lake (and was draining in bags along the Main Walk), the base of the Lake could be sculpted to seal any gaps, the banks could be repaired and oak edging replaced.

The geotextile bags "sweated" the moisture out from within to leave a semi-solidified silt. Over the twelve week wait, the bags did visibly reduce in size as the inner mass lost water content. This left a solid that was viable enough to be moved by plant machinery across site, and more importantly, in a condition to be moved on public roads to the University farm.

The lakeside worksite was reinstated and reseeded during silt drying time and the opportunity was taken to replace the existing patios with larger variants, presenting a better view over the Lake and creating areas for new planting schemes. With new edging in place, the Lake could once again be filled in stages, to

The Garden Lake is refilled

determine its water holding capabilities. The natural wildlife eagerly took this opportunity to start moving back to the Lake and explore their new surroundings. At this stage, with the immediate worksite free of site fencing and machinery and open for business, an element of normality returned and the "new" Lake started to clarify, take on its own character and become part of our visitor experience once again. After a long wait, the enormous task of removing the solidified silt could commence. This had more impact Garden-wide than the Lake dredge itself, with hundreds of tonnes of silt to be transported through the Garden and off site. Impeded by poor weather, on paths unsuitable for heavy earth moving machinery, slowly but surely the silt was removed. Many paths were hit hard but thankfully the Main Walk was left relatively unharmed by the process.

"Lake dredge done", the task of Garden remediation took hold and the horticultural staff worked wonders in bringing the Garden back up to standard, in particular the New Pinetum where the materials were stored and removed from site, and the access route in-between.

Remarkably during the whole process, nothing of historical interest emerged from the Lake, not even a bicycle after 100 years in Cambridge! The whole process went much more smoothly than anticipated and provided an additional attraction to our visitors – many a small child was seen observing the process from the safety of the central mound, fascinated by the diggers in the Lake!

Looking at the Lake today, the difference is immeasurable. The water is clean, with an average depth in excess of 1.6 metres, perfect for horticultural development. Natural wildlife has returned with small fish, water snails and fresh water mussels emerging, and a full complement of avian life. The growth-impeding silt has gone, leaving a lake with a sheen and depth of reflection visibly demonstrating its health and vitality. The future looks positive without planned maintenance for at least … perhaps 50 years or more.

Carl Tatterton – Head of Estates and Operations Manager

Estates

Classroom Access Ramp

The Botanic Garden courses programme has grown from strength to strength, and we had become increasingly conscious of the needs of our less mobile students. This year the installation of a ramp suitable for wheelchair use was deemed a necessity to improve accessibility between Brookside and the Classroom courtyard. Plans were made to enhance this area with a larger gateway, ramp and handrails to enable wheelchair access. Estate Management worked with local architects to produce a plan suitable for this Grade Two listed area, ensuring that the Garden's aspirations were suitable for the historic nature of the buildings. The construction phase was completed in good time with only minor impact to the ongoing course schedule, albeit extremely noisy and dusty when the York Stone was being cut to size to accommodate the ramp's slope and curve.

Classroom courtyard ramp

The new ramp *en route* to Brookside

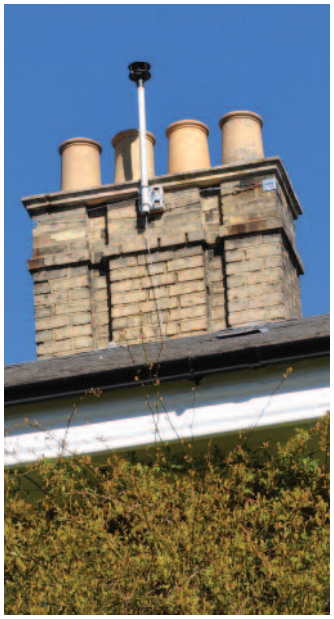
The completed ramp detracts little from the original space for use in the courtyard as it fits perfectly into an otherwise unused corner. This now enables wheelchair users on courses to move freely between the Classroom, Brookside and the general Garden. The new wider gateway and ramp is generally more accessible for all visitors and has the added benefit of assisting in transportation of heavy items to and from the courtyard. In addition, the ramp has smartened up and revitalised the courtyard, permitting more light in and enhancing the views out to the wider Garden.

Anemometer Installation

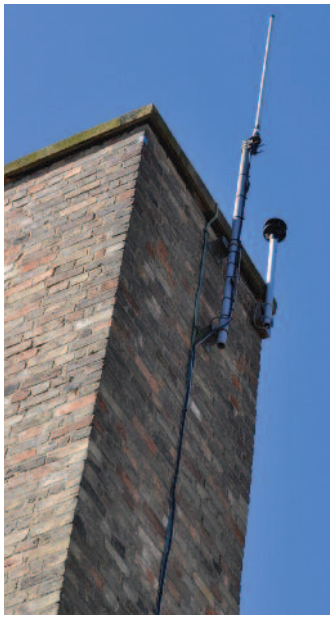
One of the major risks to staff and visitor safety at the Garden comes from high wind, which may cause glass to fall in our Glasshouse Range or one of the many mature trees to lose a limb. When high winds occur, the decision to close the Garden for safety purposes is always a difficult one – after all, we do not want to close our Garden unless we really have to. Reliance upon other University department wind speed measuring equipment was proving increasingly unreliable, as their need for information did not always match ours and we needed accurate, reliable and geographically relevant information. So the decision was made this year to investigate the installation of our own wind speed monitoring equipment to enhance our safety portfolio.

Following a lengthy process of equipment selection, planning processes and approvals, permission was granted by the City Council for the Garden to install three anemometers on prominent buildings to the Garden's west, east and central locations. The anemometer affixed to our Glasshouse chimney now serves to provide audible alarms in our Glasshouse range at a pre-determined wind speed, to enable evacuation of that area for staff and visitor safety. In addition, as a Garden central location, this anemometer provides an accurate measure of wind speed to our Main Lawn and Walk area which are both tree dense and heavily utilised by the public. In addition, all staff can view the actual wind speed from our Brookside anemometer with the added advantage of having available live graphs and data displaying the current, low, average and maximum wind speed, with historic information reading back for up to 10 days in 10 minute intervals. This anemometer is at our western edge from where the majority of our prevailing winds arrive. Sadly, the anemometers will not stop the strong wind impacting upon the Garden, but they do provide a greater degree of confidence when determining weather conditions and contingency planning. Internet connectivity adds the advantage of all Garden staff being able to view current conditions regardless of location, enabling key personnel to remain able to inform decisions when out of the Garden.

Carl Tatterton – Head of Estates and Operations Manager



The Brookside anemometer



The Glasshouse anemometer

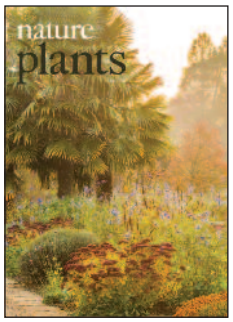
Research

The diversity of roles the Garden plays in Research, both across the University and more widely, always amazes our visitors and Friends. Pages 19–22 of this Annual Report provide a summary of Research conducted in 2016–2017. 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, Chemical Engineering, Chemistry, Geography, Physics and Zoology. We welcome requests for material and resources from colleagues from all academic and research organisations, and are delighted to be able to support such a diversity of projects.

Looking inward to develop a stronger outward-facing profile

Each year in this Annual Report we select a subset of our supported research to discuss in more detail. This year's focus may seem rather inward-looking, as we describe a pair of home-grown articles published by our own research teams. However, these articles all stem from the work we have been doing over the last few years to understand the richness of our living collection, its strengths and weaknesses, and its role in the global community of plant collections. These analyses are part of our determination to develop a collection strategy for CUBG that will ensure we maintain and strengthen our provision of living plant material for research and teaching purposes.

Thinking global, acting local



Devising a collection strategy for the Garden requires consideration of both intrinsic factors (for example our university research needs or local climatic conditions) and extrinsic factors (for example the varied activities and foci of our sister institutions), which collectively influence the balance of the material we grow in our Garden. Extrinsic factors can be challenging to understand, and are valuable and interesting research avenues in their own right, especially our synergistic role in the context of a global network of 3,500 botanic gardens. Consequently, scientists in the Curator's research group have spent the past two years analysing global datasets compiled by Botanic Gardens Conservation International, comprising some 1.3 million records from about 1,116 institutions. By cross-referencing these data against the working list of known plant species, currently sitting at 350,699, we have been able to provide the first comprehensive global assessment of how much plant diversity is cultivated in *ex-situ* botanic garden collections.

The study, published in the journal Nature Plants[1], found that the global network of botanic gardens conserves living plants representing over 60% of plant genera and over 90% of plant families. Furthermore, the world's botanic gardens contain at least 30% of all known plant species, including 41% of all those classed as 'threatened'. However, the study revealed notable gaps in world-wide collecting efforts, most notably a significant imbalance between temperate and tropical regions. About 93% of all plant species grown *ex-situ* are held in the northern hemisphere, and while 60% of temperate plant species were represented in botanic gardens only 25% of tropical species are similarly conserved, despite the fact that the majority of plant species are tropical in origin.

Plants not currently grown in botanic gardens are often more interesting than those that are already in cultivation. So while the study found that over half of all flowering plant genera are housed in the world's botanical collections, as well as almost all the cone-bearing seed plant genera, such as conifers, species from the most ancient plant lineages, termed 'non-vascular' plants, are currently almost undocumented in botanic gardens, with as few as 5% of all species stored in the global network. Non-vascular plants include species such as the liverworts and mosses, and are the living representatives of the first plants to colonise the land. Within these plants are captured key moments in the early evolutionary history of life on Earth, and they are essential for understanding the evolution of plants. Even within the more commonly cultivated vascular plants, fascinating and unusual plants are often not held in collections, for example *Hydrostachys polymorpha,* an African aquatic plant that only grows in fast flowing streams and waterfalls, or the tiny parasitic plant *Pilostyles thurberi,* only a few millimetres long, which lives completely within the stem tissue of desert shrubs.

Of special interest in our study is the global response of botanic gardens to the on-going extinction crisis. While gardens hold close to half all threatened species, just 10% of overall storage capacity is dedicated to such plants. Our research supports the concept promoted by BGCI, that botanic gardens have a critical role to play in plant conservation initiatives and represent our best hope for saving some of the world's most endangered plants. Moreover internationally coordinated efforts are needed to house even more species at risk of extinction. Currently, an estimated 20% of plant diversity is under threat, yet there is no technical reason why any plant species should become extinct. Botanic gardens protect an astonishing amount of plant diversity in cultivation, but need to respond directly to the extinction crisis. Our study is important because it will enable us to target our efforts much more effectively to support research and conservation, and to work together to ensure that plant species do not needlessly become extinct.

[1]Mounce RM, Smith P, Brockington SF (2017) *Ex-situ Conservation of Plant Diversity in the World's Botanic Gardens,* Nature Plants 3, 795–802

Meeting global grand challenges

Understanding the pattern and processes that influence what we collect is one of the steps to designing a strategy for future collections. But hand in hand with this information we also need to consider what the purpose or purposes of our Botanic Garden's collection should be – in particular, what role it can play not only in the traditional research disciplines of taxonomy, systematics, comparative biology and evolutionary biology, but also in addressing global concerns such as supporting the needs of a growing human population in a sustainable way. Our thinking about these issues led us to write an article together this year on "Botanic Gardens and Solutions to Global Challenges". The article was published in a new Cambridge University Press book, "Plant Conservation Science and Practice: The Role of Botanic Gardens"[2]. The volume is devoted to an exploration of the roles that botanic gardens play in 21st century plant conservation, edited by Sara Oldfield (former director of Botanic Gardens Conservation International) and Stephen Blackmore (Emeritus Regius Keeper of the Royal Botanic Gardens Edinburgh). The chapter that we co-wrote focused on the exploration of the roles for botanic gardens in tackling two particularly pressing global challenges – feeding the world and supporting the world's energy requirements. The impetus for the thinking came from John

Beddington's warnings of a "perfect storm" resulting from shortages of food, water and energy, all driven by human population growth. The human population reached 6 billion in 2000, 7 billion in 2015, and is predicted to hit 8 billion by 2025 and 9-9.5 billion by 2050, after which population growth is expected to level off to some extent. Extra people will clearly need extra food, but they may demand more food than simple numbers suggest because, as populations grow in wealth, consumption of meat increases, creating additional inefficiencies in global food supply. Since conversion of plant calories to animal calories has a maximum efficiency of 10%, increased demand for meat creates at least a 10-fold increased demand for crop production. The scientific community is often focused on agronomic research stations and technology-driven solutions to these problems, but we explore how living collections held by botanic gardens worldwide are contributing to research that aims to avert this storm. For example, research into crop wild relatives is an important part of understanding the genetic diversity in responses to pathogens, pests and abiotic stresses that may be available for introgression into domesticated species, but such research relies on access to properly curated examples of wild collected species. There are some striking examples of botanic gardens holding globally significant collections of appropriate germplasm, often sourced and held locally to the point of origin. For example, the Botanic Garden at Almaty, in Khazakhstan, holds over 200 wild apple accessions, collected locally in the area in which the domesticated apple is thought to have originated. These accessions provide the opportunity for functional research into useful agronomic traits combined with genomic research, to develop strategies to expand the ranges of habitats in which such crops can be grown. Similarly, we examined case-studies in the collection of biofuel crop accessions and their relatives in botanic gardens, and describe ways in which the horticultural expertise of botanic gardens can be used to explore the potential of a diversity of species to support human fuel demands. Here, we took the opportunity to showcase the example of our own Algal Innovation Centre, built in the Cambridge University Botanic Garden to provide a pipeline to translate lab scale research on microalgae as fuel providers into a semi-industrial scale process.

Thinking about these issues over the last year has put us in a strong position to continue to develop our own collections strategy document for the Cambridge University Botanic Garden. Of course, this strategy will also have to reflect our local environment, climatic conditions, and the diverse uses of our Garden by a wide range of visitors and stakeholders. It may be that the best role we can play on the global stage will be one of supporting a highly diverse collection focused on anticipated research needs of the broader plant science community, as well as concentrating on a particular set of taxa relevant to particular aspects of our own research progammes. But it is clear that our commitment to supporting plant science research, and our determination to do so in a strategic way, has only been strengthened by engaging intellectually with these exciting research questions. We now look to the challenge of implementing our academic insights, to sustain and enrich the living collections over the next few years.

[2]Brockington SF and Glover BJ (2017) *Botanic Gardens and Solutions to Global Challenges in Plant Conservation Science and Practice: The Role of Botanic Gardens* (eds Oldfied S and Blackmore S) Cambridge University Press, 7:166-191.

Professor Beverley Glover, Director and
Dr Sam Brockington, Curator

Ginkgo biloba tree

Foliage of critically endangered Dawn Redwood

Research supported and facilitated

The Botanic Garden maintains and makes accessible the living plant collection of the University of Cambridge. Research and teaching is supported through the plant collections of over 8,000 species, the Experimental Section which provides supported glasshouse and open ground research plots, and through use of the 40-acre landscape. In addition to home-grown research the Garden supports a wide range of projects throughout the University of Cambridge and collaborates with a great many external partners.

Cambridge University Botanic Garden
Staff publications (Director, Curator and others) are listed separately in the "Publications by Botanic Garden staff" section.

Professor Beverley Glover, Director:
Research programme focused 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 Herchel Smith Foundation. Material maintained at CUBG, analysed in the experimental plots, or accessed from the living collections, for projects including:

- Stamen evolution in *Solanum,* with Dr Sandy Knapp (The Natural History Museum) and Gwen Davis (PhD student).
- The relationship of floral morphology to pollination success in *Vicia faba,* with Dr Jane Thomas (National Institute of Agricultural Botany) and Emily Bailes (PhD student).
- Molecular evolution of key developmental pathways in plants, with Dr Sam Brockington (Curator, CUBG) and Dr Chiara Airoldi (post-doc).
- Development and evolution of insect-mimicking petal spots in *Gorteria diffusa,* with Dr Paula Rudall (RBG Kew), Dr Allan Ellis (Stellenbosch University), Roisin Fattorini and Greg Mellers (PhD students).
- 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), Dr Silvia Vignolini (Department of Chemistry, University of Cambridge) and Dr Edwige Moyroud (post-doc).
- The effect of plant viral infection on pollinator attraction, with Dr John Carr (Department of Plant Sciences, University of Cambridge), Dr Alex Murphy (post-doc), Netsai Mhlanga and Sanjie Jiang (PhD students).
- Evolution and development of nectar spurs in *Linaria*, with Dr Mario Fernandez-Mazuecos (post-doc) and Erin Cullen (PhD student).
- Conservation of *Potentilla porphyrantha* in Armenia with Lydian International, Dr Peter Carey, Dr Jo Treweek and Chris Davis (PhD student).
- Interactions between petal surface and pollinator claw morphology, with Dr Walter Federle (Department of Zoology, University of Cambridge) and Jonathan Pattrick (PhD student).
- Petal epidermal cell morphology and the association with insect pollinators in *Nicotiana,* with Gabriela Doria (PhD student).
- Corona development and evolution in Apocynaceae, with Dr Lize Joubert (visiting scientist).
- Provision of liverworts, mosses, ferns, lycophytes and cycads for undergraduate teaching.

Dr Sam Brockington, Curator:
Research programme focused on the evolutionary genomics of the order Caryophyllales, funded by NERC, the NSF and the Isaac Newton Trust, and using material grown in the experimental glasshouses, and across the living collections:

- Sequencing transcriptomes in Caryophyllales in collaboration with Stephen Smith (University of Michigan) and Michael Moore (Oberlin College, Ohio).
- Reconstituting the betalain pathway in heterologous host systems with Alfonso Timoneda (MSc student) and Hester Sheehan (post-doc).
- Understanding how Caryophyllales switch from betalain pigments to anthocyanins with Tao Feng (visiting Scientist, Wuhan Botanic Gardens).
- Sampling material for genomic sequencing projects in Caryophyllales including *Simmondsia chinensis* and *Delosperma napiforme.*

Department of Plant Sciences, 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. Also growing *Zea* mays for analysis of inheritance of key traits.

Dr John Carr (Plant Virology Group)
We have been using a bay of the glasshouse to investigate the effects of virus infection of the interactions of tomato and bean *(Phaseolus vulgaris)* with bumblebees *(Bombus terrestris).* The work has been going on for several years and in 2016 was featured in the Economist and other publications. The work suggests that virus-infected plants are more attractive to pollinators than healthy or resistant plants and findings may be useful for improving pollinator service in gardens and for understanding how plants, pathogens and pollinators coevolve in the wild.

Professor David Coomes
(Forest Ecology and Conservation Group)
Measuring silica content of rice leaves taken from the Tropical Wetlands House and comparing them with spectral readings from a field spectrometer to develop a simple non-destructive method for testing responses of plants to herbivory and other stressors.

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.

Dr David Hanke (Plant Growth Substances Group)
Wheat plants were grown for Farhat Nazir (industrially funded post-doc) for a study of the control of seed dormancy by hormones in relation to pre-harvest sprouting.

Dr Ian Henderson
(Genetic and Epigenetic Inheritance in Plants Group)
Growing wheat plants for a range of projects exploring plant sexual reproduction and the processes that generate variation between generations. Specifically, projects focus on the meiotic cell division where gametes are generated with half the number of chromosomes of parent cells.

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.

Dr Uta Paszkowski (Cereal Symbiosis Group)
The mutually beneficial arbuscular mycorrhizal (AM) symbiosis is the most widespread plant-fungal association between roots of terrestrial plants and fungi of the Glomeromycota, in which the fungus receives photosynthates from the plant and enhances its mineral, particularly phosphate, nutrition. This research focuses on the identification and characterisation of molecular mechanisms underlying the development and functioning of AM symbioses in the crop plants maize and rice. Maize and rice lines are grown in the Botanic Garden's research glasshouses and experimental plots for genetic characterisation and seed amplification.

Professor Alison Smith and Dr Matt Davey
(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.

Dr Edmund Tanner (Tropical Ecology Group)
Growing tree seedlings under shade for studies of forest dynamics. Exploring competition between weed and crop seedlings for root allocation in different soil types.

University of Cambridge

Dr Siobhan Braybrook and Rozi Vofely (Sainsbury Laboratory)
Use of 44 accessions from the living collections. Leaf epidermal pavement cells exhibit a wide range of shapes ranging from mundane to quite exotic ones. The aim of this project is to study the strength of the correlation between the cell shape and various other factors: in particular to evaluate the extent to which phylogenetic relations are reflected in cell shape diversity. Assessing these relationships requires a broad range of samples from different plant families.

Dr Sebastian Schornack (Sainsbury Laboratory)
Plants engage with fungi to improve access to nutrients such as phosphate. We sample liverwort species from the Botanic Garden *(Lunularia cruciata* and *Pellia endiviifolia)* and stain them to detect fungal structures. We found that *Pellia endiviifolia* harbours 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.

Dr Raymond Wightman (Sainsbury Laboratory)
CUBG Alpine and Woodland Section is working with Dr Raymond Wightman (Sainsbury Lab) using the Alpine Department's *Saxifraga* collection to study hydathode development using cryoSEM microscopy and to analyse their secretion products with Raman microscopy.

Yassin Rafahi (Sainsbury Laboratory)
Exploration of developmental mechanisms classically relies on analysis of pattern regularities. Whether disorders induced by biological noise may carry information on building principles of developmental systems is an important question. Here, the goal is to address this question using phyllotaxis, the geometric arrangement of plant aerial organs, as a model system. We have developed a stochastic model of primordia initiation at the shoot apex, integrating locality and stochasticity in the patterning system. This stochastic model recapitulates phyllotactic patterns, both regular and irregular, and makes quantitative predictions on the nature of disorders arising from noise. We are looking for the observed disorders in accessions from CUBG and investigating the predictions of the model in other species.

Professor Paul Dupree (Department of Biochemistry)
Use of the greenhouses to grow thermotolerant plants for biochemical analysis. Provision of willow and poplar for phloem cell wall studies. Provision of a range of grass species for comparative cell wall analysis.

Professor Peter Leggo (Department of Earth Sciences)
My research in the Garden has been for over seventeen years. In the period October 2016–September 2017 I carried out experiments using digested food waste pelletised with finely ground zeolitic tuff. This is ongoing at this time to find the mixture giving maximum plant nutrients.

Jack McMinn (Emmanuel College) and Liam Pattullo (Selwyn College) with Professor Nick Davies (Department of Zoology)
Prey species often have to consider predation risk when choosing where to forage. We tested this by establishing two experimental sites, fitted with two peanut feeders each – one relatively exposed and the other more associated with 'natural cover'. As predicted, blue and great tits generally preferred the 'covered' feeders, especially after the presentation of taxidermic mounts of sparrowhawks.

Jack Clough (King's College)
Analysis of 10 accessions of grasses using a Near-infrared (NIR) spectrometer and colorimetric assays using a molybdenum blue reaction for silica content. Silica content will subsequently be compared to the spectra for a given plant allowing calibration of the NIR spectrometer and enabling a non-destructive method for assaying plant Silica.

Mat Dalton (Department of Archaeology)
My overall project aim is to understand why some herbivorous domestic animals kept in ancient Sudan produced calcitic faecal spherulites in their gut and others of the same species did not. These features are minute (5-15µm), spheres of calcium carbonate crystallized within the intestine of some herbivorous and omnivorous animals. They may survive for long periods of time, and so are important indicators of animal dung in archaeological contexts. The hypothesis to be tested is that only animals consuming sufficiently calcium-rich plant diets will produce these features. Six accessions of species known to have been fed to herbivorous animals in ancient Sudan (on the basis of macrobotanical and phytolith investigations) were analysed using ICP-AES to quantify calcium content of leaves and various different plant parts.

Dr Ana Prohaska, (Department of Zoology)
We aim to develop a new method for reconstructing ancient plant population sizes that will be applicable to thousands of plant species worldwide. We intend to do this through an innovative fusion of two established paleoproxies, fossil pollen and ancient DNA. The method will employ state of the art single cell sequencing technologies to pioneer high throughput DNA based identification and counting fossil pollen grains, delivering population size estimates for many species simultaneously. Development of the method requires the use of both fresh and herbarium pollen samples.

Professor Ulf Buentgen and Alma Piermattei (Department of Geography)
Supply of Titan Arum growth data for 2004, 2015, 2017 and weather data for the same periods for analysis of growth rates of the inflorescence in relation to ambient temperature.

External collaborations

Dr Julia Mackenzie
(Department of Life Sciences, Anglia Ruskin University)
Blue tits and great tits breeding in the Cambridge University Botanic Garden have been studied for over 14 years. The project involves monitoring breeding birds and colour ringing of adults to identify breeding pairs. This year two undergraduate students supervised by Dr Sophie Mowles and Dr Sarah Hart and supported by Dr Julia Mackenzie (field work) collected nests to study the effects of nest parasites on breeding success. One of the students in addition collected data on feather mites found on breeding adults and nestlings.

Elizabeth Godfrey and Jenny Hastings
(Department of Life Sciences, Anglia Ruskin University)
Investigating the effects of anthropogenic noise on the ability to respond to alarm calls. Using playback of alarm stimuli at different times of the day (in/out of rush hour) to determine whether anthropogenic noise impacts the ability of birds to respond to threat cues.

Dr Thomas Ings, Stephanie Maher, Christina Martin-Hernandez and Victoria Backham (Anglia Ruskin University)
For the second year, the nesting aggregations of solitary bees were surveyed at CUBG. This study focused on three species: *Andrena fulva, Andrena cineraria* and *Colletes hederae*. Both *Andrena* sp were recorded as nesting in the Garden in 2016 and re-established in similar locations this year. The principal *A. fulva* nest site has expanded since last season, although the number of *A. cineraria* nests seems to have diminished slightly. *Colletes hederae* was recorded nesting in the garden for the first time this year. This is a non-native species that is establishing itself further north in the UK every year. It is active in autumn and primarily forages on flowering ivy.

Dr Tim Pankhurst (Plantlife)
The Fen Orchid, *Liparis loeselii,* is the principal focus of a collaboration between Plantlife and CUBG, also involving RBG Kew, Norfolk Wildlife Trust, Suffolk Wildlife Trust, Butterfly Conservatrion and Natural England. We have been trying to understand better the reproductive strategy of this European protected species. This has involved a programme of seed-baiting to a) locate and identify the symbiotic fungus that it relies upon for germination, b) assess the suitability of potential reintroduction sites, and c) develop an *ex-situ* population, both for study and as stock for reintroduction. The conservation strategy for this plant is now in its 10th year. The *ex-situ* stock is now growing creditably, demonstrating our capacity to propagate and cultivate the plant in artificial conditions, and we approach the time when we will have sufficient plants to initiate a programme of experimentation.

Dr Peter Stroh (Botanical Society of the British Isles)
I am a Scientific Officer for the BSBI, based at Cory Lodge. In 2017 I co-authored *'Threatened Plants in Britain and Ireland'* (Walker *et al.,* 2017), interpreting data collected for the BSBI's Threatened Plants Project. This was the most extensive sample-based survey of threatened plants ever undertaken in the British Isles, and focused on 50 of our least studied threatened plant species. The main aims of the project were to quantify the extent of recent losses, why they had taken place and gather information on their local abundance, habitats and ecological and management requirements.

Publications;

- Stroh, P.A., Pescott, O.L & Mountford, J.O. 2017. Long-term changes in lowland calcareous grassland plots using *Tephroseris integrifolia subsp. integrifolia* as an indicator species. *Plant Ecology* 218:1269–1281.
- Stroh, P.A. & Scott, W. 2017. *Angelica archangelica* subsp. littoralis (Apiaceae) – a new native taxon for Britain. *New Journal of Botany* 7: 57-58.
- Walker, K.J., Stroh, P.A. & Ellis, R.W. 2017. Threatened Plants in Britain & Ireland. Botanical Society of Britain and Ireland (BSBI), Bristol.

Jonathan Shanklin (Cambridge Natural History Society)
The Cambridge Natural History Society continued its annual series of visits to the Garden to record the fungal population. The 2016 visit took place during a dry autumn and fungal numbers were the second lowest during the series of visits. A description of the conclusions from visits made since 2000 was published in Nature in Cambridgeshire (Shanklin & Tribe, 2017) and a one page checklist of the more common species prepared for the use of visitors. Shanklin, J. & Tribe H. (2017) Fungi in the Cambridge University Botanic Garden. *Nature in Cambridgeshire* 59, 3-5.

Tommy Root (British Plant Galls Society)
Survey of plant galls in CUBG.

Rosie Earwaker
(Cambridgeshire County Recorder, bees, wasps and ants)
Analysing hymenoptera populations and working on a small book on the bees of the Botanic Garden.

Kevin Hand (National Bat Monitoring Project)
The Garden was included in 2 surveys as part of the National Bat Monitoring Project. I found good numbers of the 2 target species, pipistrelle and noctule, as in past years. Very few are found in the surrounding streets, so the Garden is important for feeding bats.

Yurij Tynkevich (National University of Chernivtsi, Ukraine)
Genetically determined features define such parameters of eukaryotic organisms as productivity, resistance to diseases and adaptability to stress factors. The genetic variability in populations of species representing monocotyledonous and dicotyledonous plants as well as invertebrate animals is being studied using a combination of molecular, morphological and physiological methods. Potentially this data could provide an insight into a further understanding of the genetic variability of economically important traits.

Rachel Fosberry (Oxford Archaeology East)
Seed of 21 accessions supplied to create a botanic reference collection for archaeological research.

Professor Anne Osbourn (John Innes Centre, Norwich)
The goal of our research with the accessions supplied is to elucidate the understanding of limonoid tripterpene biosynthesis. The triterpenes are one of the most numerous and diverse groups of plant natural products. They are complex molecules that are, for the most part, beyond the reach of chemical synthesis. Simple and conjugated triterpenes determine important crop traits, including protection against pest and pathogen attack. These compounds also have a wide range of applications in food, health and industrial biotechnology sectors.

Dr Sarah O'Connor (John Innes Centre, Norwich)
The goal of our research using this material is to assess the location of all quinine and other alkaloid metabolites in leaf and stem. We will then identify genes that may be involved in alkaloid biosynthesis. We will then characterise these genes by biochemical assay and perform mechanistic enzymology on them.

Dr Bruno Nevado (University of Oxford)
Using transcriptome data from plant genera that experienced rapid diversification in the recent past, we will investigate to what extent rapid diversification is accompanied by increased adaptive evolution of gene sequences and their expression levels. The 51 species supplied by CUBG will strengthen our project and expand its reach.

Barry Warrington (National Agromyzidae Recorder)
Identification of Agromyzidae (leaf miner) – supply of leaf with leaf miner damage.

Yannick Woudstra
(Royal Botanic Gardens, Kew & Queen Mary University London)
Four accessions supplied for a project studying the processes that shaped the variation in floral morphology in Papaveraceae by linking a detailed dataset of floral morphological characters (through dissections) to genome size (through flow cytometry) and mapping this onto recent phylogenies.

Matthew Jeffery (Royal Botanic Gardens, Kew)
The genus *Saxifraga* has a startlingly diverse range of leaf forms, and this research involves collecting and measuring leaves in order to determine how evolutionary changes in leaf form and function allows plants to colonise new habitats. Leaves from 12 CUBG species will be used for morphological measurement and DNA analysis.

Karl Fischer (University of Bradford)
Development of an analytical method for the simultaneous analysis of the poisons aconitine, atropine, coniine, digitoxin, ouabain, paclitaxel, and ricin using high performance liquid chromatography and mass spectrometry.

Dr Tim Upson (RHS Wisley)
Ongoing research into the systematics of the genus *Lavandula*.

Yanxia Sun (Wuhan Botanic Gardens, China)
To investigate the phylogenetic relationships among genera within Berberidaceae, and to compare the size, structure, and gene content of plastomes among different Berberidaceae genera, we intend to collect materials of representative species from 16 Berberidaceae genera for complete plastome sequencing.

Professor Andrew Hudson (University of Edinburgh)
To investigate the basis of the low frequency of stinging hairs in *Urtica dioica* ssp. *galeopsifolia* by crossing it with the stinging *Urtica dioica* and following inheritance of stinging hair density in subsequent generation. If genetically tractable, the aim would be to identify the underlying causative genetics.

Anders Backlund (Uppsala University)
The goal is to study a set of chemical compounds with a limited distribution in the family Lauraceae, using material to confirm metabolic predictions based on a phylogenetic framework.

Martin Slater (Private Researcher)
Tree growth data for Dawn Redwood for comparison with other trees for use in estimating their age. Specifically, the comparison of height and diameter at breast height of three known-age Dawn Redwoods to estimate the age of three age-unknown redwoods in Norfolk and Suffolk.

Miranda Sinnott-Armstrong and Professor Michael Donoghue (Yale University, USA)
Analysis of mature and developing fruit in the Garden's extensive collection of *Viburnum* species. The goal of this project is to understand the repeated evolution of structural colour effects in this genus, and to explore whether independent evolutionary origins use the same nanoscale mechanisms.

Publications by Botanic Garden staff
(highlighted in bold)

- Moyroud, E. & **Glover, B.J.** (2017). The evolution of diverse floral morphologies. *Current Biology* 27, R941-R951.
- Fernandez-Mazuecos, M., Mellers, G., Vigalondo, B., Saez, L., Vargas, P. & **Glover, B.J.** (2017) Resolving recent plant radiations: power and robustness of genotyping by sequencing. *Systematic Biology* 10.1093/sysbio/syx062
- Fernandez-Mazuecos, M. & **Glover, B.J.** (2017) The evo-devo of plant speciation. *Nature Ecology and Evolution* 1, 0110.
- Pattrick, J., Block, W. & **Glover, B.J.** (2017) The effect of the bee gym grooming device on Varroa destructor mite fall from honeybee *(Apis mellifera)* colonies. *Journal of Apicultural Research* 56, 63-70.
- Moyroud, E. & **Glover, B.J.** (2017) The physics of pollinator attraction. *New Phytologist* DOI: 10.1111/nph.14312.
- De Jager, M., Willis-Jones, E., Critchley, S. & **Glover, B.J.** (2017) The impact of floral spot and ring markings on pollinator foraging dynamics. *Evolutionary Ecology* DOI:10.1007/s10682-016-9852-5.
- Vignolini, S., Gregory, T., Kolle, M., Lethbridge, A., Moyroud, E., Steiner, U., **Glover, B.J.**, Vukusic, P. & Rudall, P. (2016) Structural colour from helicoidal cell wall architecture in fruits of *Margaritaria nobilis. Journal of the Royal Society Interface* DOI: 10.1098/rsif.2016.0645.
- Groen, S., 14 others, **Glover, B.J.** & Carr, J.P. (2016) Virus Infection of Plants Alters Pollinator Preference: A Payback for Susceptible Hosts? *PLoS Pathogens* 12 (8), e1005790.
- Whitney, H., Reed, A., Rands, S., Chittka, L. & **Glover, B.J.** (2016) Flower iridescence increases object detection in the insect visual system without compromising object identity. *Current Biology* 26, 802-808.
- Walker, R., Rudall, P. & **Glover, B.J.** (2016) Utilizing next generation sequencing for evo-devo study of plant traits. *Next Generation Systematics.*
- **Glover, B.J.**, Airoldi, C.A. & Moyroud, E. (2016) Epidermis: Outer Cell Layer of the Plant. In: eLS. *John Wiley & Sons, Ltd: Chichester.* DOI: 10.1002/9780470015902.a0002072.pub3
- **Brockington, S.F.** and **Glover, B.J.** (2017) Botanic Gardens and Solutions to Global Challenges in Plant Conservation Science and Practice: The Role of Botanic Gardens (eds Oldfield S and Blackmore S) *Cambridge University Press,* 7:166-191.
- Walker, J., Yang, Y., Moore, M., Mikenas, J., Timoneda, A., **Brockington, S.** & Smith, S. (2017) Widespread paleopolyploidy, gene tree conflict, and recalcitrant relationships among the carnivorous Caryophyllales. *American Journal of Botany* 104:6
- Smith, S., Brown, J., Yang, Y.,Bruenn, R., Drummond, C., **Brockington, S.**, Walker, J., Last, N., Douglas, N. & Moore, M. (2017) Disparity, diversity, and duplications in the Caryophyllales. *New Phytologist* DOI: 10.1111/nph.14772.
- Mounce, R., Smith, P. & **Brockington, S.** (2017) *Ex situ* conservation of plant diversity in the world's botanic gardens. *Nature Plants* 3: 795.
- Yang, Y., Moore, M., **Brockington, S.**, Timoneda, A., Feng, A., Marx, H., Walker, J. & Smith, S (2016). An efficient field and laboratory workflow for plant phylotranscriptomic projects. *Applications in Plant Sciences* 5: 1600128
- **Petitt, S.** (April 2017). *Aethionema grandiflora. Curtis's Botanical Magazine:* 34 1.
- **Petitt, S.** (June 2017). *Bomarea x cantabrigiensis. Curtis's Botanical Magazine:* 34, 2.
- Wightman, R., **Wallis, S.** & **Aston, P.** (2017) Hydathode development in the alpine plant *Saxifraga cochlearis. Flora* 233: 99.

Plant material provided to other Gardens

King's College, Cambridge
Ten plant accessions supplied

St John's College, Cambridge
One plant accession supplied

Clare Hall, Cambridge
One plant accession supplied

Madingley Hall, Cambridge
One plant accession supplied

Wolfson College, Cambridge
Two plant accessions supplied

Missouri Botanical Garden
Seed of one accession supplied

Geneva Botanic Garden
Seed of one accession supplied

Meise Botanic Garden
Seed of two accessions supplied

Royal Botanic Gardens, Edinburgh
Pollen from one accession supplied

Paignton Zoo and Garden
Pollen from one accession supplied

National Botanic Gardens of Ireland
Three accessions supplied

Plant material accessioned

During the period 1st October 2016 to 30th September 2017 the Garden accessioned 754 plants, of which 178 were of wild origin. In addition, we accessioned 68 seed lots and databased 1173 herbarium specimens.

Syndicate and Cory Managers

Four meetings of the Botanic Garden Syndicate were held during the year under the chairmanship of Dame Fiona Reynolds. Syndicate members were Professor Sir David Baulcombe, Professor Paul Brakefield, Professor David Coomes, Professor Nick Davies, Dr Laurie Friday, Dr Ian Furner, Mr Donald Hearn, Professor Nick Jardine, Professor Ottoline Leyser and Dr Mike Rands. The Secretary was the Garden's Director, Professor Beverley Glover. The Syndicate were pleased for the opportunity to meet the Botanic Garden staff following their July meeting.

The Cory Managers met four times during the year under the chairmanship of Professor Sir David Baulcombe (Head of the Department of Plant Sciences). Managers for the year were Mr Michael Allen, Professor Howard Griffiths and Dr Alan Munro with Mr Jonathan Appleton as the representative of the Director of Finance.

Botanic Garden Staff – October 2016 to September 2017

Director
- Professor Beverley Glover

Administration
- Administrator: Wendy Godfrey
- Finance Officer: Rachel Agnew
- Deputy Finance Officer: Anouska Arthur
- Finance Administrator: Elaine Dalton
- Assistant Administrators: Richenda Whitehead and Caty Cooke
- Education Administrator: Emma Daintrey
- Friends Administrator: Sacha Watson
- PA to Director: Jane Adams

Curation
- Curator: Sam Brockington
- Plant Records Officer: Pete Atkinson
- Plant Records Assistant: Mar Millan
- Cory Library Manager: Jenny Kirkham

Development
- Head of Development and Publicity: Anna Patterson Lee (from January 2017)
- Marketing and Communications Co-ordinator: Helen Needham
- Monument Trust Project Manager: Juliet Day

Education
- Head of Education: Flis Plent
- Education Officer: Sally Lee
- Education Officer: Hannah Elkington (Adoption leave cover from September 2016)
- Schools Education Officer: Bronwen Richards
- Interpretation Associate: Alison Murray (to March 2017)

Estates
- Head of Estates and Operations Manager: Carl Tatterton
- Estates Manager: Phil Starling

Horticulture
- Head of Horticulture: Sally Petitt
- Alpine & Woodland Section: Supervisor – Paul Aston; Assistant – Simon Wallis
- Demonstration & Display: Supervisor – Pete Kerley; Assistant – David Austrin
- Experimental Area: Supervisor – Pete Michna; Assistant – Sally Hughes (to December 2016), Katie Martyr (from March 2017)
- Glasshouse Section: Supervisor – Alex Summers; Assistant – Alan Langley
- Landscape & Machinery: Supervisor – Adrian Holmes; Assistant – Alistair Cochrane
- Systematics Section: Supervisor – John Kapor; Assistants – Julie Clos, Pete Wrapson (from March 2017)
- Trees & Shrubs Section: Supervisor – Mark Crouch; Assistant – Ian Barker (to April 2017)
- Trainee Horticultural Technicians: from September 2016 to September 2017: Graham Hale, Robyn Young, Barbara Griffith, Toby Warren, Bryony Langley, Will Greenfield, Robert Bradshaw. From September 2017: Rosalyn Anderson, Penny Brice, Rut Gallmeier, Luigi Leoni, Andy Clarke, Jenny Allwood-Booker, Russell Beeton

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
- Visitor Services Assistants: Andy Bryant, Amanda Wilkins, Lucinda Fudge, Hannah Winter (to January 2017), Sue Baker, Alice Watkins (to March 2017), James Oliver, Kathryn Villanueva, Anca Cojocaru (from November 2016), John Neville (from June 2017), Vikas Shinde (from May 2017).
- Receptionist: Heloise Toop (from September 2017)

Botanic Garden staff activities

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 Gardens Edinburgh; member of the Science Advisory Committee of the Royal Botanic Gardens Edinburgh; member of the Council of the European Society for Evolutionary Developmental Biology; member of the Botanical Society of America; member of the British Society for Developmental Biology; fellow of the Linnean Society; member of the Linnean Society's Education Committee; member of the Systematics Association Council; external Examiner for Botany at Trinity College Dublin; patron of the Cambridgeshire Gardens Trust; vice-president of the Cambridgeshire Beekeepers' Association; member of the Advisory Board of New Phytologist; member of the Editorial Board of Current Opinion in Plant Biology; member of the Natural Environment Research Committee's Peer Review College; serves on the Royal Society's Small Grants Panel and the Royal Society's 150K grants panel; gave invited lectures at the University of Oxford, the University of Potsdam, University College London and the University of Sussex, and to the Cambridge Society for the Application of Research, the Friends of Sheffield Botanic Garden and to the International Dendrologists' Society; gave a keynote talk at the New Phytologist Next Generation Scientists meeting in Norwich.
- Dr Sam Brockington: member of the European Society for Evolutionary Developmental Biology; member of the Botanical Society of America; fellow of the Linnean Society; trustee of the Bedfordshire, Cambridgeshire, Northamptonshire Wildlife Trust; co-organised Nagoya Biosecurity meeting; co-organised Biosecurity and Biocontrol DEFRA/Plant Network Meeting; gave lectures to Plant Heritage Eastern Conference, Plant Network Annual Conference, the International Dendrologists' Society, the Cambridge Society for the Application of Research, and at the 6th Global Botanical Congress, Geneva.; gave an invited lecture to the Botanical Society of Scotland.
- Dan Jenkins was elected as a committee member of the UK Plant Sciences Federation (July 2017) and continued as a member of the UK Biology Education Research Group and the Royal Society of Biology's Education Policy Advisory Group.
- Flis Plent is director on the board of BGEN, with responsibility for their training programme.
- Juliet Day continued as a member of the Executive Board of PlantNetwork.
- 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 was appointed chair of the Merlin Trust, which provides travel awards to young horticulturalists; continued on the Advisory Committee of the Chelsea Physic Garden and as a member of the Borde Hill Garden Council.
- Alex Summers continued as a member of the RHS Tender Ornamental Plant Committee.
- Simon Wallis continued as a member of the RHS Joint Rock Garden Plant Committee.

Funding

The Botanic Garden has had a very busy year, and our income streams reflect both an increasing number of visitors and Friends, and specific new projects such as the Monument Trust funded redesign of the Systematic Beds.

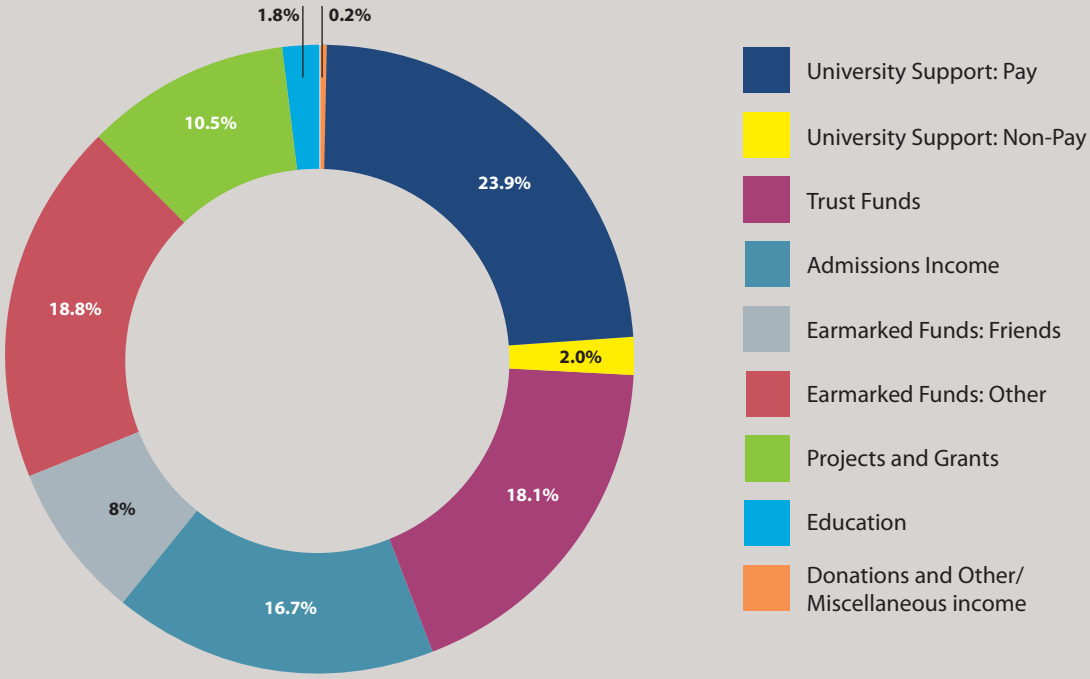
We were delighted this year to be the first botanic garden to be awarded funding through the HEFCE Higher Education Museums, Collections and Galleries fund, which will create three new posts to further support research and HE learning at the Garden.

The Garden was grateful to receive various donations and legacies, which, coupled with an increase in the uptake of Gift Aid, helped to fund the redesign of the Oceanic Islands area in the Glasshouse Range, support the essential databasing of the Herbarium and much more. Funding was also committed for projects due to start in 2017-18. Further investment was made in the Research Fund, the distribution of which supports science and research at the Garden.

Perennial, the Gardeners' Royal Benevolent Society, generously funded the salary of a seventh Trainee participating in the Garden's one year horticultural trainee scheme.

Our Volunteers once again shared with us their knowledge and expertise, playing an active and vital role at the Garden, assisting with educational activities, giving guided tours to adults and children, in the Library, stewarding and assisting the Horticultural, Friends and Estate teams. During the year, 4102 volunteer hours were worked, for which we offer our grateful thanks.

Income 2016-17



Income

		£k	£k
Funding Source	**Details**	**2016-17**	**2015-16**
University Support	Pay	744.3	696.3
	Non Pay	60.8	90.1
Trust Funds	The Cory Fund	545.8	515.6
	Other Trust Funds	16.4	15.5
Admissions Income	Gate takings (including tours, guidebooks etc)	521.4	421.8
Earmarked Funds	Friends (including events and activities)	249.9 see breakdown	209.8
	Other Specific Donations and Trading	586.4	296.3
Project Grants/Funding		326.8 see breakdown	371.0
Education Running Costs, Courses, Donations and Events		56.0	53.3
Donations – General		4.9	38.7
Other/Miscellaneous income		0.3	4.7
Total Income		**3,113.1***	**2,713.2***

Breakdown of Income (Friends: Earmarked Funds)

Friends of the Botanic Garden – Subscriptions	241.1	200.6
Friends of the Botanic Garden – Outreach programme	6.5	7.0
Friends General Donations and 25 Fund	1.2	1.4
Other	1.1	0.8
Total	**249.9**	**209.8**

Breakdown of Income (Project Grants/Funding)

Monument Trust	301.0	300.8
Audience Engagement Strategic Enablement Grant (University of Cambridge Museums)	5.0	5.0
Interpretation (HEIF5 Funded)	0.1	40.5
Perennial – Funding towards Trainee Programme	20.8	20.0
New Zealand Rock Garden (Donation)	0.0	4.7
Total	**326.8***	**371.0**

Expenditure

		£k	£k
Expenditure Type	**Funding Source**	**2016-17**	**2015-16**
Pay	University Support	705.8	685.4
	Trust Funds	473.5	450.7
	Admission and Tours	364.3	354.8
	Earmarked Funds: Friends (including events and activities)	80.5	74.2
	Earmarked Funds: Other	92.8	64.3
	Specific Project Grants/Funding	60.7 see breakdown	55.1
	Education Running Costs, Courses, Donations and Events	17.5	18.4
		1,795.1	1,702.8*
Non Pay	University Support	99.4	99.0
	Trust Funds	88.2	31.7
	Admission and Tours	26.8	60.4
	Earmarked Funds: Friends (including events and activities)	132.2	86.2
	Earmarked Funds: Other	135.6	60.4
	Specific Project Grants/Funding	288.9 see breakdown	29.4
	Education Running Costs, Courses, Donations and Events	50.4	36.7
	Donations – General	1.2	27.6
		822.8*	431.5*
Total Expenditure		**2,617.8***	**2,134.3**

Breakdown of Expenditure (Specific Project Grants/Funding)

Monument Trust	330.4	19.1
Connecting Collections – University of Cambridge Museums	3.2	4.5
Interpretation (HEIF5 Funded)	23.7	29.0
The Geoffrey and Eileen Adams Garden Room – Schools Room	-29.7 see Note 1	11.9
Perennial – Funding towards Trainee Programme	21.9	18.6
New Zealand Rock Garden (funded from a specific in memory donation)	0.0	1.4
Total	**349.6***	**84.5**
Total Net Income:	**495.2**	**578.8**
Less: Earmarked funds held for future planned expenditure	-489.9	-564.1
Funds reinvested by Cory and Trust Fund Managers	-0.5	-41.0
Committed reserve funds temporarily invested in the 'Research Fund'	-191.8 see Note 2	-808.2
Funds remaining for discretionary use	**-187.1***	**-834.5**

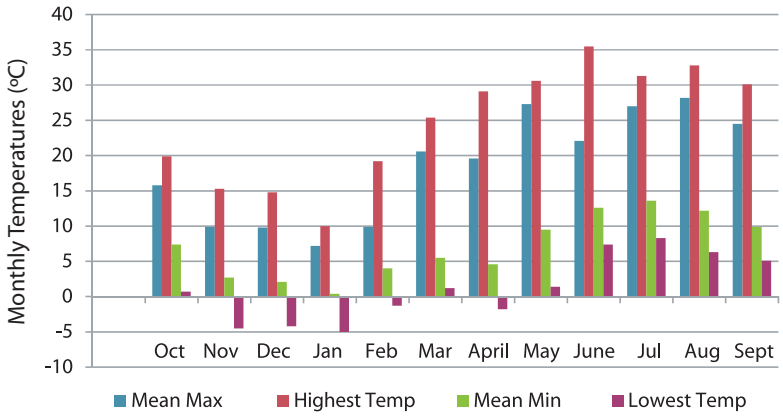
Notes:

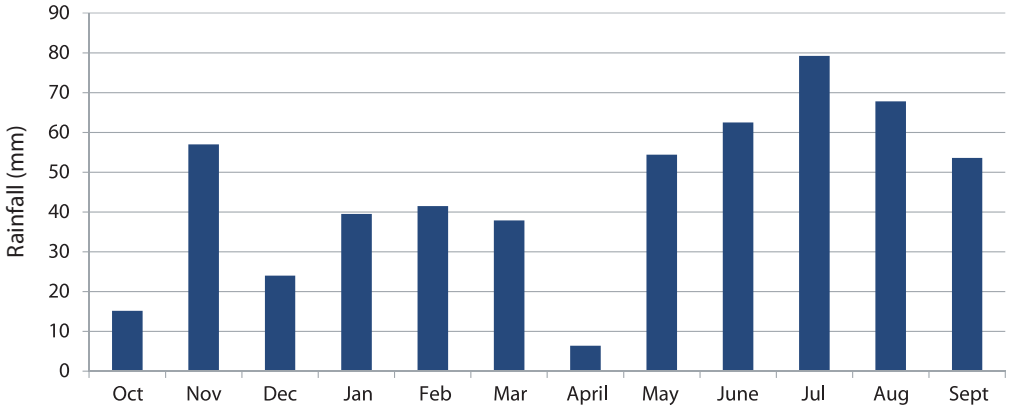
1 Includes internal transfers.

2 Legacies and other reserves not required within a 3-5 year period, are temporarily invested in the University Endowment Fund for the 'Research Fund', the annual distribution of which is used to further science and research at the Botanic Garden in the short term.*Calculations include minor differences.

Weather

This academic year was consistently warm, especially during October 2016. This trend continued with hot days in summer and early autumn. In addition there were unseasonably high amounts of rainfall from May to September.





October 3rd 2016 had the first ground frost of the autumn. The month was rather dry with a total of only 15.2mm rain, the lowest for the year. November was wetter, with a maximum of 10.4mm rain in a single day. The first air frost of the winter occurred on the morning of November 2nd. These temperatures were not sufficient to bring the leaves down, so we continued to enjoy an autumn leaf spectacle into the following month. December enjoyed milder daily temperatures than average but the nights were slightly cooler. It was a fairly dry month except for 18.3mm of rain recorded on the 10th.

January 2017 had 15 air frosts during the month with the sharpest on the 22nd and -5ºC being the coldest for the year. There were large amounts of rainfall during the first half of the month. On the 2nd 7.5mm rain was recorded, but as the month went on the frequency of rainfall decreased. February was a wet and windy month, the Garden closed for high winds all day on the 23rd. The highest temperature was similar to January at 9.9ºC. On average it rained every other day, with a heavy downpour on the 23rd of 21.9mm! There was a surprisingly mild night on the 22nd when the temperature only fell to 10.4ºC. There was very little noteworthy snow fall with just a handful of traces during the winter. As the ground rarely froze, the snow did not settle for long. March was consistently warm throughout, the highest temperature being 25.4ºC on the 31st. It was quite a dry month, with a maximum daily rainfall of 7.4mm on the 20th.

April was the driest month of the year, the maximum temperature was generally cooler than March. The highest daily rainfall in April was 1.9mm on the 27th, and the month's total was only 6.4mm.

There were a couple of cold nights at the end of the month, with -1.8ºC in the air and -6ºC on the ground. This caused damage to several of the Garden's herbaceous plants. May experienced a maximum temperature of 29.1ºC. The last ground frosts of the year occurred on the 1st and 11th of May. The month on the whole was quite dry with the exception of a few days, one producing 16.6mm of rain on the 18th. June was consistently pleasant with a few hot days, the highest temperature recorded was 35.5ºC. A higher amount of rainfall fell, and this was boosted on the 27th with 42.7mm in a single day.

July started promisingly at 31.3ºC at the beginning of the month. However, there was frequent rain in the second half with 19.6mm on the 29th. Overall July was the wettest month of the year, with a total of 79.2mm of rainfall. August was a cooler month and much more unsettled after the 11th, with 24.6mm of rain falling on the 9th, making it the second wettest 24 hours for the year. September went back to an average rainfall, with the majority falling in the first half of the month. The heaviest rain was on the 27th, when 9.1mm fell. The month started with a high temperature of 30.1ºC then gradually became cooler.

With thanks to John Kapor for helping to provide historical data and information for the year.

Katie Martyr – Experimental Assistant

Thank You

Gifts, donations and support received in Annual Report period 1 October 2016 – 30 September 2017

Legacy Giving

- Monica Beck residue legacy payment of £36
- Joan Preston legacy of £10,000
- Silvia Norton final legacy payment £145,868

Individual Gifts and Donations

- We would like to thank all those Friends of Cambridge University Botanic Garden who continue to make significant gifts over and above the annual renewal subscriptions. We would also like to thank all visitors who choose to make donations, however small, to support the work of the Garden.
- Special thanks also goes to those who have chosen to Gift Aid Admissions, Subscriptions and Donations – it really does make a huge difference and allows us to do so much more.

Grants Trust and Societies

- Monument Trust. Funding for the Systematic Beds project – £300,000
- Perennial, the Gardeners' Royal Benevolent Society, for the employment of an additional horticultural trainee – £20,767

Corporate and other support

- Bircham Dyson Bell for the Sounds Green Music Festival – £5,000
- CambPlants Hub for the Festival of Plants – £1,000
- Sainsbury Laboratory Cambridge University for the Festival of Plants – £1,000
- University of Cambridge Museums Support for CamLates Programme – £1,000
- University of Cambridge Museums Strategic Enablement Grant – £5,000
- University of Cambridge Museums Training grant – £500

Donors to the Cory Library

- Janet Bayliss
- Roy Lancaster
- Richard Wade

Corporate Friends

Abbey College
Amazon EVI
Apple Europe Ltd
Arcadis
Arcus Foundation
ARM Ltd
Astra Zeneca
Bellerbys College
Bircham Dyson Bell
Birketts LLP
Blackdot Solutions Ltd
Bloomhall Ltd
Bromium UK Ltd
Brookgate Development Management Ltd
Cambridge Assessment
Cambridge Centre for Sixth Form Studies
Cambridge Crystallographic Data Centre
Cambridge Education Group
Cambridge Institute for Sustainability Leadership
Cambridge Intelligence
Cambridge Judge Business School
Cambridge University Department of Chemistry
Cambridge University Department of Chemical Engineering & Biotechnology
Cambridge University Department of Geography
Cambridge University Department of Pathology
Cambridge University Department of Pharmacology
Cambridge University Investment Office
Cambridge University Press
Cambustion Limited
Cantab Asset Management
Cantab Capital Partners
Carter Jonas
Churchill College
Clare Hall, University of Cambridge
Collabora Ltd
Connected Home
Costello Medical Consulting Ltd
Deloitte LLP
Docker UK Ltd
Dow Agrosciences Ltd
Electric IMP Limited
eLife Sciences Publications Ltd
Eversheds LLP
Faculty of Education, University of Cambridge
GÉANT
Granta Design
Hills Road Sixth Form College
Historic England + English Heritage
Inivata Ltd
International Workplace
Intrasonic Limited
Irwin Mitchell
John Lewis Cambridge
KPMG
Lynfields Management Ltd
Marks and Clerk LLP
Marshall Sports & Social Club
MedImmune
Microsoft Research Ltd
Mills and Reeve LLP
Momo Group Ltd
Mott MacDonald Ltd
MPW
MRC Cognition & Brain Sciences Unit
Nash Matthews LLP
Natural England
NetNames Brand Protection Ltd
Netronome Systems Ltd
NHS Cambridgeshire and Peterborough CCG
NIAB
Peters Elsworthy and Moore
PROWLER.io
Qualcomm Technology International Ltd
Ramboll UK Ltd
Raspberry Pi Foundation
Real VNC Ltd
Cambridge Royal Albert Homes
Samsung Cambridge
Saunders Boston Limited
Savills (UK) Ltd
Siemens Industry Software Ltd
Slater & Gordon (UK) LLP
Sony Computer Entertainment
St Faith's School
St George's Court Care Centre
St Mary's School
Stone King LLP
Strutt & Parker
Taylor Wessing LLP
Thales e-Security Ltd
The Biodiversity Consultancy Ltd
The Leys School
The New School of English
The Open University
Thomson Webb & Corfield
Transversal Corporation Limited
Trustonic
Tucker Gardner
Undo Ltd
Woodfines LLP
WSP

… and thank you to everyone who visited the Garden

Visitor numbers through ticket offices (including Friends, groups and paying visitors) 290,802. Adult Education course participants 595. Educational visit participants 11,014

Front cover image by Sally Petitt
Back cover image by Juliet Day

The paper used in this publication has been sourced from sustainable sources.

www.botanic.cam.ac.uk