



ROYAL
BOTANIC
GARDEN
EDINBURGH

ANNUAL REPORT
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ROYAL BOTANIC GARDEN EDINBURGH

Our mission is exploring and explaining the world of plants for a better future

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Cover photo: Tropical Palm House at Edinburgh (courtesy of Helen Pugh).
Photo, this page: *Iris sibirica* 'Blue King'.



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CHAIRMAN'S FOREWORD

Sir George Mathewson



Photos, clockwise from top left:
 Students botanising in Belize; the John Hope Gateway takes shape at the West Gate; schools education in the Glasshouses at Edinburgh; tackling practical work on a botany course; horticulture students in the potting shed; autumn colours at Dawyck Botanic Garden; the new visitor centre at Dawyck; Chairman Sir George Mathewson.



In October 2007 it was my great pleasure to take the role of Chairman of the Board of Trustees at the Royal Botanic Garden Edinburgh (RBGE), a great Scottish institution respected around the world and embodying over 330 years of excellence in botany and horticulture.

Throughout its distinguished history, the Garden has evolved and adapted in order to meet the needs of society. This continuous process of renewal is essential to maintaining relevance and vigour. Having been established as a physic garden involved in the teaching and practice of medicine, RBGE has gone on to build up living and preserved plant collections from every region of the world. Alongside the development of these national collections, the Garden has gained an enviable reputation for its research on the evolution, classification and conservation of plants. It has expanded its educational programmes into a broad portfolio that supports the school curriculum and the formal professional training of horticulturists and plant scientists. In recent years, it has increased its emphasis on community outreach in order to meet the needs of a wider cross-section of society.

The Royal Botanic Garden Edinburgh is an institution I came to understand well through serving as the Chair of the Campaign Board set up to help secure the resources needed to construct the John Hope Gateway. With the generous support of individual donors, the Heritage Lottery Fund, other trusts and foundations and the Scottish Government, this outstanding new facility is now taking shape at the West Gate.

When it opens its doors in 2009 it will provide visitors with the quality and range of facilities they expect to find at a world famous botanic garden. Like the smaller visitor centre opened recently at Dawyck Botanic Garden (see page 40), it will include exhibition spaces and communications facilities, so greatly increasing RBGE's ability to reach out and influence its many audiences.

This elevated scale of investment allows this historic institution to move forward and redefine itself in the 21st century. In a time of unprecedented change in the global environment, RBGE is positioning itself as a place where people can come to understand these rapid changes and learn how they can contribute to a better future for all of us. The John Hope Gateway, in particular, will provide a platform for RBGE and its many partners across Scotland to reach new audiences and to help to shape the future.

Finally, I would like to pay tribute to the many achievements made at the Garden under the chairmanship of my predecessor Dr Paul Nicholson. Sadly he died in 2007 following a long illness during which David Nicolson stepped in very ably as Acting Chairman. I am grateful to them both and to the staff of the Royal Botanic Garden Edinburgh for their dedication and commitment. ■

A handwritten signature in black ink, which appears to read 'G Mathewson'.

Sir George Mathewson, Chairman



REGIUS KEEPER'S INTRODUCTION

Professor Stephen Blackmore



Welcome to this review of another highly successful year at the Royal Botanic Garden Edinburgh (RBGE). This has been one in which the Garden continued its efforts to capitalise on the distinctive opportunities that arise from its unique status in Scotland as a world-renowned research institute that is also a popular visitor attraction. Where else can people walk so freely into a place that carries out scientific research?

The most significant development of the last 12 months was undoubtedly the decision by Richard Lochhead MSP, Cabinet Secretary for Rural Affairs and the Environment, which gave the green light for construction of the £15.7 million John Hope Gateway. When it opens next year, the Gateway will make a highly significant contribution to connecting our visitors with the major scientific challenges of our time. Our strategies for success in the future require us to maintain the correct balance between continued investment in our traditional strengths in botany, horticulture, conservation and education on the one hand whilst working hard to improve our visitor offer on the other.

These two different aspects of our institution are increasingly interconnected as we place ever greater emphasis on increasing the opportunities for public engagement in science. We are acutely conscious that, in addition to undertaking practical science that delivers biodiversity objectives, plant conservation and sustainable use, we can develop our outreach, interpretation and education to be a powerful force for social change.

Because of the threats to humanity posed by global environmental change and by climate change in particular, it is urgent that we make our best endeavours to help mobilise people from all walks of life in response to these challenges. During the year, we revised our mission statement to reflect this commitment to influence and change. It is now: *exploring and explaining the world of plants for a better future*.

The John Hope Gateway will provide a superb platform for communication and engagement, both for RBGE and for a wide range of partners across Scotland, including research institutes, universities and non-governmental organisations. In anticipation of its opening, we are in the process of developing a new Ranger Service of skilled staff who will help visitors to learn more during their visits to the Garden.

We know that the majority of visitors come to our four Gardens simply to relax and enjoy outstandingly beautiful

We can develop our outreach, interpretation and education to be a powerful force for social change.



landscapes and plant collections, and that by pursuing the highest standards of display we can help to satisfy their innate human need for contact with nature. The benefits to health and well-being that arise from interacting with nature are increasingly understood to be much greater than was thought in the past. Having skilled staff – including our Rangers, Science Communicators and Education team – working alongside scientists and horticulturists will maximise the benefits gained from a visit to the Garden.

During this year, the UN Convention on Biological

Diversity undertook a formal review of the Global Strategy for Plant Conservation (GSPC) and concluded that, although much more remains to be done, progress has been made towards the goal of halting the decline in plant biodiversity.

I was personally involved in the series of workshops that gave rise first to the Gran Canaria Declaration and subsequently to the GSPC itself, and as a member of the Global Partnership for Plant Conservation, I have chaired meetings to maintain the momentum behind the GSPC and contributed to the recent review.

Perhaps the clearest conclusion of the review process was that the botanic gardens of the world all share an unparalleled opportunity for public engagement. Through the coordinating efforts of Botanic Gardens Conservation International (BGCI), the world's botanic gardens are better placed than ever to help guide their global total of 200 million visitors per annum towards a more sustainable relationship with our planet. At the Royal Botanic Garden Edinburgh, we have made this our most ambitious task for the future. ■

Professor Stephen Blackmore FRSE, Regius Keeper

Photos, facing page, clockwise from top left: Artist's impression of the John Hope Gateway as seen from inside the Garden (illustration by Richard Carman); the scanning electron microscope suite; Richard Lochhead MSP announces funding for the John Hope Gateway; secondary schools education at RBGE; Dr Tony Miller in Soqotra; a Garden Ranger in action during the Signs of Spring event.

Photo, this page: Regius Keeper Professor Stephen Blackmore in the Queen Mother's Memorial Garden.

Photos, clockwise from this page:
Hot springs at Air Panas, Gunung Leuser
National Park, Sumatra; Lilian Snelling's
botanical drawing of *Primula rupicola*;
RBGE horticulture staff training
Omani botanists.





GLOBAL PARTNERSHIPS

The challenge to secure the future of the planet's plantlife is a truly global one, and around the world experts in plant taxonomy, conservation, horticulture and education are joining forces and sharing knowledge as never before. International collaboration in scientific research has always been a cornerstone of RBGE's approach, but now it is expanding its activities in capacity building for horticulture, interpretation and education with urgency, supporting fledgeling botanic gardens in countries such as Oman.

In the 21st century, the power of the internet is being harnessed fully to share valuable data with peers. The comprehensive database of the world's biological collections being developed at RBGE will allow scientists anywhere to track down the artefacts they require for their studies. Similarly, a new database of Sapotaceae brings together data about this economically important plant family. The creation of such essential databases requires strong collaboration and a sense of joint purpose, drawing on both new and long-established relationships.



Unravelling Sapotaceae, a joint effort

Peter Wilkie, Tropical Botanist





The taxonomically complex family Sapotaceae is a key research focus of the Garden's Tropical Diversity section. The family contains over 50 genera and 1,000 species and is composed of mainly large tropical trees. It is distributed throughout the tropics and is an ecologically important component of lowland tropical forests.

The family is also economically valuable, with many genera producing high-quality timber (*Palaquium*, *Madhuca*, *Baillonella* and *Manilkara*), white latex (*Palaquium gutta*, gutta percha, and *Manilkara zapota*, chicle) and widely cultivated edible fruit (*Manilkara zapota*, the sapodilla plum, and *Chrysophyllum cainito*, the star apple).

Within the family, species are relatively well defined but the genera are not. Estimations of the number of genera vary greatly from 53 to 122 and many of these genera have no modern monographic treatment. A key focus of the Sapotaceae research group at RBGE is to clarify generic relationships and circumscriptions and to deliver taxonomic treatments. Fieldwork and close collaboration with other researchers around the world are vital to this work.

This year Dr Vanessa Plana, working with Dr Laurent Gautier of the Geneva City Conservatory and Botanical Gardens, submitted her revision of the Madagascan species of the genus *Manilkara*, while Kate Armstrong continued her research of the Asian members of this genus as part of her PhD studies. Dr Barbara Mackinder has just started a revision of the African *Chrysophyllum* and Dr Peter Wilkie has been collating information for a monograph of the species-rich genus *Palaquium* and an account of the Sapotaceae for the *Flora of Peninsular Malaysia*.

Fieldwork is essential to these studies, particularly in areas from which very few botanical collections have been made. This year, Kate Armstrong has been collecting in West Papua and Sulawesi and Dr Peter Wilkie in Sumatra. Both have been working closely with fellow Sapotaceae researcher Dr Teguh Triono of Herbarium Bogoriense,

Indonesia. In addition, Dr James Richardson has been collecting in Cameroon together with Dr Elspeth Haston and colleagues from the National Herbarium of the Netherlands. All have made valuable new collections of Sapotaceae.

These new collections are particularly important for molecular phylogenetic studies – they contribute to the data that will help us solve the problems of generic delimitation. As part of this research theme, Dr James Richardson has visited the Sapotaceae research group in Stockholm and Dr Ulf Swenson of the Swedish Museum of Natural History has visited Edinburgh to collaborate on large-scale phylogenetic publications of the family.

Together with the Swedish group, Dr James Richardson has also been developing dated molecular phylogenetic trees, which will allow estimates of when diversification in particular lineages occurred to be made. This will help determine how geological and climatic changes have affected current patterns of diversity and distribution of Sapotaceae.

A major focus of the research group over the past year has been the development of the Sapotaceae Resource Centre website with Dr Martin Pullan. The site will permit access to our database of 50,000 herbarium specimens from around the world and also has information about other research groups, floras, monographs, phylogenetic analyses and future conferences. The development of this resource has been made possible by the collaboration of a wide range of institutes from around the world, and is helping place RBGE at the centre of world Sapotaceae research. ■

Photos, clockwise from facing page, top left: Dr Peter Wilkie returning from Gunung Kimiri in Gunung Leuser National Park, Sumatra (photo courtesy of Alex Sumadijaya); *Chrysophyllum cainito* at Bogor Botanic Garden, Indonesia; *Palaquium formosanum* at Pulau Ubin, Singapore; collecting *Manilkara* in West Papua, Indonesia; collecting with Indonesian co-researchers at Air Panas, Gunung Leuser National Park, Sumatra; Gunung Leuser National Park from Gunung Kimiri, Sumatra; Dr James Richardson collecting *Manilkara* at Campo, South Province, Cameroon (photo courtesy of Lars Chatrou).



Indexing the world's biological collections

Mary Gibby, Director of Science



In December 2007, RBGE embarked on a new project to help develop a Biological Collection Index – an internet-based database of information on the world's biological collections of plants and animals – in partnership with the Global Biodiversity Information Facility acting on behalf of Biodiversity Information Standards (TDWG).

All biodiversity research ultimately relies on artefacts in collections. These artefacts may be dead or living specimens, illustrations, fossils, seeds or other materials. The Convention on Biological Diversity (CBD) obliges governments to conserve their biodiversity and to do this, researchers need to find and utilise these artefacts.

These are widely distributed between collections and a large proportion is not stored in the countries of origin. Researchers have to rely on historical knowledge, specimens cited in extant publications and word of mouth to find research materials. They cannot know if they are missing anything significant, while governments cannot know what assets are available to help them understand and conserve their biodiversity.

The Biological Collection Index (BCI) is being established to hold data about collections and to cover all taxonomic groups, with the ultimate aim of providing a single point of access for researchers and governments seeking biodiversity materials. The project has support

from other organisations and projects such as the Natural History Museum, London (NHM), Smithsonian National Museum of Natural History, Biodiversity Heritage Library (BHL) and Index Herbariorum.

At RBGE, Dr Roger Hyam is leading the project, working closely with Dr Martin Pullan, and is currently developing the website and contacting curators and collections managers in museums, botanic gardens and other institutes to start gathering information.

We estimate there are about 20,000 real, physical collections – such as herbaria – in the world. Each collection will be given its own individual record that can be edited by any registered member of the community. These 20,000 collections are the core things BCI will track. We hope curators will use the BCI website to make sure they and their collections are visible to the world. The ultimate success of the project depends on the support and active involvement of the international taxonomic community. ■

Photos, this page, clockwise from top left: Plant specimen in the Garden's Herbarium; Director of Science Prof. Mary Gibby and (left to right) Dr Roger Hyam of the Taxonomic Databases Working Group sign the BCI agreement in December 2007, with RBGE's Head of Bioinformatics Dr Martin Pullan and Major Floras Co-ordinator Dr Mark Watson looking on; botanical illustration of *Primula rupicola* by Lilian Snelling.



Creating Oman Botanic Garden

Ian Edwards, Head of Interpretation and Exhibitions

The new Oman Botanic Garden being created in the desert near Muscat has the personal support of the Sultan of Oman himself. Once complete in 2011, it will represent the most significant collection of indigenous plant species in the Middle East.

The garden will also be a major tourist attraction for Oman, attracting both local residents and foreign tourists. Since March 2006, RBGE has been providing consultancy to the Sultan's office, giving advice on botanical and horticultural matters, from nursery management to the selection of plant species and habitats for inclusion in the extensive collections.

A particular challenge for RBGE's Oman team has been to recreate the unique environment of the monsoon woodlands of the southern Dhofar region within a huge artificial biome. People from all over Arabia visit Dhofar in the monsoon to experience the mists that roll in from the sea and cause the trees to drip with cool water. Oman Botanic Garden hopes to offer the same experience, amid a variety of authentic flowering plants, 12 months of the year.

The fascinating ethnobotany of the region, first showcased in 1988 with the landmark publication *Plants of*

The fascinating ethnobotany of the region will be reflected in a craft village where demonstrations of traditional uses of plants will take place.

Dhofar by Dr Tony Miller and Dr Miranda Morris, will be reflected in a craft village where demonstrations of traditional uses of plants will take place. Visitors will also be able to walk through glasshouses containing plants from the highest mountains of Oman and experience the juniper woodland of the summit areas.

In addition to botanical and horticultural expertise from RBGE Science and Horticulture Divisions, the Garden's exhibitions and events team is providing consultancy on the interpretation aspects of the project. In partnership with Bright 3D (also acting as interpretation consultant on the John Hope Gateway), we have provided detailed designs for eight new visitor interpretation centres, as well as the outdoor habitats, glasshouses and craft village. We have also given practical and technical support to Oman Botanic Garden's emerging education programme. ■

Photos, this page, clockwise from top left: Visualisation of the site of Oman Botanic Garden by architects Alatec, Madrid; Leigh Morris, Head of Education at RBGE, training local Omani botanists as part of capacity building for the Oman Botanic Garden project.

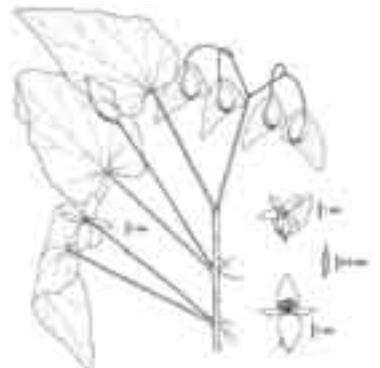
Photos, clockwise from this page: Interference contrast image of ocelli (Latin 'eyes') at the corners of valves of the marine diatom *Triceratium*. The ocelli are where polysaccharide is secreted from the cell to attach it to rocks or seaweeds; bamboo is the subject of a climate change study in which RBGE scientists are participating; recording bryophytes as part of the Scottish Snowbed Monitoring Project, another initiative to monitor the impact of climate change.



THE SCIENCE OF BIODIVERSITY

Climate change is among the most pressing issues on the 21st-century global agenda. Biologists around the world, working across a range of disciplines, are investigating the potential impacts of climate change on the planet's flora and fauna, and projecting the scale of these impacts. From Scotland's own lichen flora to the food of the iconic panda, the Royal Botanic Garden Edinburgh is engaged in this international effort, working alongside partners and collaborators at home and abroad to provide baseline scientific information necessary to assess climate change impact.

Alongside climate change, habitat destruction and deforestation by humans pose the greatest threats to global biodiversity. Yet the full extent of plant diversity, especially in the tropics, is yet to be fully understood. Genetic studies are advancing our knowledge of the evolutionary relationships within key genera, as our multifaceted work on *Begonia* shows. DNA studies are also helping to reveal the diversity of ubiquitous yet enigmatic microscopic organisms, the diatoms. From Australian duck ponds to humid Asian jungles, RBGE's expertise – in both traditional taxonomy and sophisticated genetic techniques – is helping the effort to document and understand plant biodiversity in the face of global loss.



Begonia research sheds light on tropical diversity

Catherine Kidner, Lecturer in Plant Evolutionary Biology



Begonia is one of the core taxonomic groups being researched by RBGE's Tropical Diversity group. Found throughout the tropics, it is one of the ten largest angiosperm genera and provides an ideal model for understanding speciation and diversification.

Initial work focused on producing a broad-scale phylogenetic tree (evolutionary family tree) to understand the evolution and biogeography of the genus. Population genetic studies have also been carried out to shed light on the influence of population behaviour on the generation of biodiversity.

Recent work at the Garden includes a checklist of the *Begonia* of South East Asia produced by Dr Mark Hughes (<http://elmer.rbge.org.uk/Begonia>), covering 520 species from Burma to Fiji. This provides images of herbarium specimens, including type specimens, together with publication and distribution data.

Dr Hughes has also been working on a monograph of *Begonia* in Sumatra, where only around 50% of the diversity in the genus has been described. And for his PhD, funded by the M.L. MacIntyre Trust, Daniel Thomas is working on an inventory and phylogeny reconstruction of the *Begonia* of Sulawesi, an island rich in endemic species. This work will aid our understanding of the biogeography of the areas surrounding Wallace's Line, and provide conservation assessments of species in an area undergoing rapid deforestation.

In the laboratory, Dr Catherine Kidner and colleagues are using *Begonia* to find the genes responsible for differences in shape and behaviour between species. *Begonia* is ideal as it is a large and diverse group, has many cases of convergent evolution (where the same trait has evolved in different lineages) and many species produce fertile hybrids, allowing us to use genetics.

Initially, we are focusing on section *Gireoudia* from Central America and Mexico. This section contains 66 species in habitats ranging from wet rainforest to dry scrub land. With the help of Glasgow Botanic Gardens and Dr Rekha Morris of the American Begonia Society, we have collected living material of 24 species – raw material for our studies.

This year, RBGE's *Begonia* evo-devo (evolutionary development) work became fully established with a grant of £440,000 from the Biotechnology and Biological Sciences Research Council (BBSRC) to make a genetic map of *Begonia* and clone and characterise several key developmental genes.

In the coming year, the grant will fund Dr Keith Gardner, who will use the map to do Quantitative Trait Locus (QTL)

This work will help us understand the process of speciation in the tropics and how the great diversity of this biome evolves.



analysis, a technique that shows how different genes affect a trait such as leaf size or flower shape. This will allow us to determine how many genes are responsible for variations between species.

We have also been fortunate to attract several PhD students for the coming year. Saima Umbreen Imran and Mobina Shaukat Ali, both funded by the Higher Education Commission (HEC), Pakistan; and Nicola Burton

Harrison and Alex Twyford, both funded by BBSRC, will all work on various aspects of our genetic and molecular investigations of tropical *Begonia*.

Future plans include travel to Mexico and Costa Rica to collect more accessions in the wild, increasing the number of species for examination, and to start

analysing population genetics and hybridisation. Together, this work will help us understand the process of speciation in the tropics and how the great diversity of this biome evolves. ■

Photos, facing page from top left: *Begonia* F1 hybrids being grown for study in RBGE's research glasshouses; Daniel Thomas climbing to collect *Begonia* at Gunung Katopas, Sulawesi, Indonesia; *Begonia macintyreana*; leaf from F1 hybrid of *B. multinervia* x *B. carolineifolia*; illustration of *Begonia kaniensis* for Dr Mark Hughes' monograph (courtesy of A Dorward).

Photo, this page: Daniel Thomas and porters on expedition collecting *Begonia* at Gunung Katopas, Sulawesi, Indonesia.



Investigating the effects of climate change

*Chris Ellis, Conservation Officer:
Lichens and Bryophytes*

The Garden's work relating to climate change is wide-ranging, both in terms of the botanical groups examined and the types of study pursued.

Our ongoing phenology project monitors the growth and flowering times of selected plants in the living collection at Edinburgh. Undertaken by a group of dedicated volunteers, this monitoring provides information on plant responses of interest to both climate change scientists and horticulturists. The results of this work appear in our horticultural journal *Sibbaldia*.

Recent work on Scottish biodiversity has completed a series of climate change projections, which are used to assess the likely response of species to scenarios envisaged by the Intergovernmental Panel on Climate Change (IPCC). Reflecting the importance of cryptogams in British biodiversity, this work has focused on lichen species.

Our results have demonstrated the strong potential for shifts in biodiversity patterns, though also reveal a critical link between climate change and habitat management. Studies examining the climatic response of lichen indicator species have shown that habitat quality strongly influences species' sensitivity to climate change. These models have been used for the first time to assess the way in which habitat may be managed to offset the potentially negative impact of climate change.



Photo: ©iStockphoto.com/Jonathan Larsen



Our results have demonstrated the strong potential for shifts in biodiversity patterns, though also reveal a critical link between climate change and habitat management.

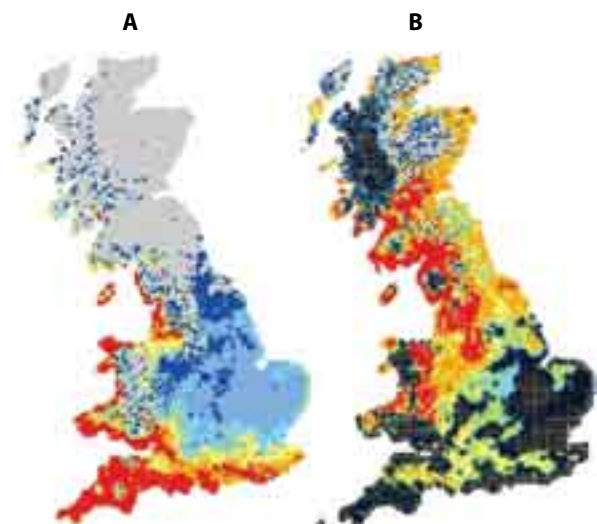
This climate modelling is now supported by a number of targeted monitoring studies. New monitoring programmes have been established for snowbed bryophytes and montane-heath lichens. These groups are sensitive components of iconic Scottish habitats, and particularly threatened by climate warming. The results of this long-term monitoring will be used to assess the rate and magnitude of climate warming impacts, and aim to provide information potentially useful in mitigating associated effects.

Internationally, RBGE is working with collaborators at the University of York, Kunming Institute of Botany and the Foreign and Commonwealth Office, China, in a study to examine the climatic response of bamboo, and consequences for the giant panda. This ambitious project aims to assess levels of climate change threat in an extremely mountainous and complex landscape, and over a much larger scale than the Scottish work to date.

To provide detailed data on the distribution of bamboo species, and their climatic limits, RBGE scientists have sampled across a series of transects in the remote regions of Sichuan. This sampling provides additional data to complement bamboo distribution maps drawn up from herbarium records. The project will assess projected change in the distribution of bamboo, and compare these shifts with the ability of the panda to migrate to suitable feeding grounds. ■

Photos, clockwise from facing page, top left: Bryologist Gordon Rothero records bryophytes in quadrats on a snowbed on Ben Macdui as part of the Snowbed Monitoring Project; the giant panda depends on bamboo; bamboo in Edinburgh's Glasshouses; a snowbed landscape on the slopes of Ben Macdui in the Cairngorms; MSc student Dafydd Crabtree sets up a snowbed monitoring site in the Cairngorms to examine climate change impact on montane lichens.

Maps, below: The modelled distribution of 'southern' lichen species for two time periods: A. using present-day climatic variables, and B. using climatic variables projected forward to the 2050s. Red shows areas of highest bioclimatic suitability, through blue to grey (species absent). The stippled areas in B. show key areas of uncertainty, i.e. where the 2050s climate scenario lies outside the range of the present-day climate experienced by the species.





Great strides in diatom research

Katharine Evans, NERC Fellow and David Mann, Senior Principal Research Scientist

In the last few years, diatom research has advanced rapidly as people realise the vital role of these tiny organisms in controlling levels of carbon dioxide. Their amazing ability to transform dissolved silicates into intricately patterned glossy silica inspires chemists to develop new methods of synthesis. And diatoms are increasingly used for assessing water quality. Yet the number of people engaged in understanding their diversity has declined and many key questions remain unanswered.

Three years ago, Dr Katharine Evans was awarded a Natural Environment Research Council (NERC) Fellowship to work with RBGE's Prof. David Mann – one of the first such Fellowships awarded outside the university sector.

We set out to answer two key questions relating to the use of diatoms for monitoring environmental change: firstly, can we improve the way we identify and discover diatoms by using DNA-based methods, and secondly, are species widely distributed? Determining biogeographies is critical to monitoring, because if species have highly restricted distributions then methods developed for assessing water quality in Britain are unlikely to work in Eastern Europe, let alone temperate South America.

We set out to answer two key questions relating to the use of diatoms for monitoring environmental change.

Our first target was to develop reliable methods of identification. In the 1980s and 1990s, David showed that microscopical research significantly underestimates diversity: 'morphological' species often contain multiple entities that cannot interbreed and that should be recognised as independent species. So we have developed DNA barcoding for identification.

The idea is simple: choose a short stretch of DNA sufficiently variable to distinguish between species yet sufficiently invariable within species, and amenable to straightforward comparison.

Following tests, we chose the mitochondrial gene *cox1*, which is also the gene of choice for barcoding animals, but is inappropriate for use

in higher plants. We now routinely use *cox1* to confirm identifications and to discover hitherto unknown *Sellaphora* species.

For example, using microscopy we recently identified diatoms from Kew Billabong in Australia as *Sellaphora auldreekie*, which is common in Scotland. But subsequent barcoding showed there were in fact two new *auldreekie*-like species in Kew Billabong. Mating experiments by



Dr Pieter Vanormelingen (SYNTHESYS-funded) confirmed that the two new species (currently called 'southern *auldreekie*' and 'novel *auldreekie*') are incapable of mating with each other or with *S. auldreekie*.

A few years ago, Prof. Bland Finlay suggested that all microbes are dispersed so effectively that the same species will occur all over the world, wherever ecological conditions are suitable. This is known as the 'ubiquitous dispersal hypothesis' (UDH) and stands in sharp contrast to flowering plants and animals, where species are often restricted to particular regions. If Finlay is correct, then sampling similar ponds in, say, Europe and Australia should give similar diatom floras; it will also be reasonable to use the same monitoring methods across wide geographical areas.

We have investigated the UDH in two ways – by direct documentation of distributions aided by DNA barcoding and indirectly, by using molecular methods to examine whether gene flow and hence dispersal of diatoms is limited. The results are complex.

Some species are indeed widespread: we have found *Sellaphora capitata*, *S. auldreekie* and a species provisionally called 'urban elliptical' in European and Australian duck ponds. But others like 'australis' and 'southern capitata' seem restricted to Australian ponds and *S. blackfordensis*

and 'pseudocapitata' to European ponds. We now have to establish why some species appear better dispersed than others. One possibility is that widespread species were introduced by human activities. We are investigating this idea using sediment cores provided by Australian colleagues.

Using microsatellite markers, we examined the degree of gene flow occurring between populations of *Sellaphora capitata* in Scotland, England, Belgium and Australia. We found that all populations were genetically distinct, indicating that diatoms do not move around as rapidly as predicted in the UDH. Now we are moving on to investigate the scale at which ubiquitous dispersal can occur by examining gene flow between diatoms living on opposite sides of a single pond. ■

Photos, clockwise from facing page, top left: Prof. David Mann harvests diatoms from mud using lens tissue traps; Lake Purrumbete, Victoria, Australia; collecting in sticky mud in Lake Tooliorook, Victoria, Australia; boiling diatoms in nitric acid to produce clear cell walls for microscopy; a dividing *Sellaphora* cell; DNA showing up blue in stained diatom cells.



Photos, clockwise from this page:
Illustration of pumpkin (*Cucurbita moschata*) by Rungiah, circa 1830;
tree ferns (*Dicksonia antarctica*) at
Logan Botanic Garden; new plant
labels for the living collections.



CARING FOR THE COLLECTIONS

The Royal Botanic Garden Edinburgh's collections – its living collections of 14,000-plus plant species growing at the four Gardens, its world-renowned Herbarium of three million or so preserved specimens, and its extensive Library and Archives – provide the fundamental resources for all the Garden's activities. Scientific research, education and training, visitor amenity and public engagement all make use of these collections. RBGE is internationally renowned for the depth and scope of its collections and they are valuable tools for researchers from around the world.

Therefore, curating the collections to the highest standards is a top priority for the Garden. When it comes to our living and preserved specimens, this also means keeping pace with advances in classification. This reporting year, RBGE led the way in reorganising its living collections in accordance with the definitive APGII system following the reorganisation of the Herbarium last year.

Providing greater access to our collections is another key priority. The wealth of materials in our Archives and the rich history behind them continue to surprise and delight. This year, a new trilogy of books reveals a remarkable set of drawings in glorious full colour, published for all to enjoy.



New system of classification for the collections

Colin Pendry, *Flora of Nepal*,
Floristic Researcher



Plant classification has seen many changes during RBGE's 338-year history, but 2008 will be remembered for the implementation of major changes in the management of our collections. This spring, we completed a two-year project to reorganise all our living and preserved collections according to APGII, the definitive system of classification which uses DNA evidence to precisely show the evolutionary relationships among plants.

When the Garden was founded as a physic garden in 1670, plant species then being grown were believed to be immutable, divinely-created entities. The huge number of previously unknown species brought back to Europe by the 17th- and 18th-century voyages of discovery needed to be catalogued, and the pre-eminent figure in this process was Linnaeus. His 1735 sexual system offered a simple, practical way to make sense of this newly found diversity.

However, Linnaeus's system depended on very few characters and often separated plants which were clearly closely related. In subsequent centuries, the quest for a more 'natural' classification system occupied many great botanical minds, but they were always hampered by the limited number of characters which could be studied in plants, and their classifications were based on personal opinions about the relative importance of these characters.

In recent years, molecular biology has revolutionised classification and comparisons of DNA sequences clearly show how closely related different species are. Now classification can accurately reflect evolution. In 2003, the Angiosperm Phylogeny Group (APG) of 29 systematists headed by Prof. Mark Chase at Kew, published a new classification – known as APGII – based on molecular research. APGII explicitly reflects the history of plants, grouping them in 'clades' reflecting shared descent.

It is remarkable how closely many family concepts from earlier classifications agree with the DNA evidence, but it was also found that some large families like the Euphorbiaceae and Scrophulariaceae, long considered to be dumping grounds for species of uncertain affinities, did not meet the strict criteria of shared descent and would have to be restructured.

APGII has been the focus of debate and its principles are now firmly accepted by systematists worldwide. Any future changes are likely to be limited to the few remaining species whose placement is still uncertain, so we can be confident that we are now using the definitive system.

In 2006, RBGE became the first institute of its size to reorganise its herbarium in accordance with APGII. Also in that year, the Garden's plant records database, *BG-BASE™*, was brought into line, allowing the re-labelling of living plants to begin – a two-year task successfully completed in spring 2008.

Eagle-eyed visitors would have noticed subtle changes to the plant labels for certain angiosperm species in the Gardens. Meanwhile, large institutions including Kew, the Natural History Museum, London, Missouri Botanical Garden and the Paris Herbarium are keeping a close eye on developments here as they consider the adoption of APGII for their own collections. ■

In the last year, Logan Botanic Garden has seen plenty of new and exciting developments, many of which lay a platform for the year ahead. Phase two planting of the new Tasmanian Creek was completed in 2007 as part of the RBGE Diploma students' practical experience.

The diversity of flora from Tasmania is represented by many species of *Eucalyptus*, *Leptospermum*, *Melaleuca* and over 200 plants of *Dicksonia antarctica*. A winding bark path was also constructed, allowing visitors to appreciate the tree ferns from both below and above.

Logan now boasts the largest outdoor planting in the UK of *Blechnum cycadifolium* from the Juan Fernandez Islands. Over 60 specimens have been planted on the banking at the lower side of the Chilean area. The fern collection in the Woodland Garden has been further developed in recent months, with several species never before grown outdoors in Scotland.

The area surrounding the pond has been further enhanced with a new avenue of jelly palms.

The formal pond in the Walled Garden had a complete overhaul during the winter and has now been replanted. The area surrounding the pond has been further enhanced with a new avenue of jelly palms, *Butia capitata*, from Mexico. Unfortunately, the koi carp that had occupied the pond for over 30 years were stolen in late February.

The winter of 2007 was the Garden's mildest since records began in the 1960s and it is proposed that our new plantings should consider the effect of climate change to take advantage of new opportunities.

In spring 2008, the student accommodation was refurbished and this has been well received by the occupants. In recent months, the Garden has attracted a large number of interns, from college lecturers to school leavers, and from countries including Kenya, Denmark, Sweden and Austria. They have been a great asset to the Garden and helped forge new partnerships.

We have been building closer links with local primary and secondary schools to ensure that the collection is utilised to its maximum potential. In spring, seven teachers from schools throughout Dumfries and Galloway participated in a two-day 'Schools into Industry' event, the first of its kind for horticulture in Scotland. Over 50 children attended an event celebrating spring in the Garden, held on Easter Sunday. ■

Photos, facing page: New plant labels with the plant family name in the top right corner reflecting APGII classification; pages from *Species Plantarum* by Linnaeus (courtesy of the Linnean Society of London); Horticulturist Janette Latta installs the new labels.

Photos, this page: New plantings of *Butia eriopatha* beside the refurbished formal pond at Logan; a new avenue of *Trachycarpus fortunei* at the entrance to Logan; young plants of *Dicksonia antarctica* and *Eucalyptus* in the Tasmanian Creek.



New plantings at Logan

Richard Baines, Curator,
Logan Botanic Garden





Wight trilogy published, Hope's notebook acquired
Henry Noltie, Researcher, Historic Collections



Wight trilogy published

The publication of *Robert Wight and the Botanical Drawings of Rungiah & Govindoo* on 1 May 2007 represented the culmination of a five-year project by Dr Henry Noltie – studying the herbarium and illustrations made by Robert Wight in South India between 1821 and 1853 and now housed at RBGE.

The end result is a lavishly illustrated trilogy of books, beautifully designed by Robert Dalrymple. The first volume is a biography of Wight, setting the scientific work of this prolific collector, commissioner and publisher of illustrations, and passionate advocate of the natural method, in an historical context.

In the second are reproduced 200 of the stunning drawings made for Wight by the artists Rungiah and Govindoo. The final volume is a travelogue, describing the adventures of the author in search of Wight, both in the field and in herbaria in Britain and India.

In his review of the trilogy for *World of Interiors*, acclaimed writer and historian William Dalrymple wrote: "These three volumes form the most magnificent study now available of the natural-history painting of the [East India] Company, and contribute hugely to the history of British botany in India."

Photos, this page, clockwise from top left: *Strychnos cinnamomifolia* var. *wightii* by Rungiah; Dr Henry Noltie with his books; floral details of *Hibiscus lunariifolius* by Rungiah; Robert Wight by Daniel Macnee (courtesy of Royal Botanic Gardens, Kew).



Bound in marbled paper and written in his own hand, it contains Hope's original scheme for a natural classification of flowering plants.



Hope's notebook comes home

The Library's most exciting acquisition of the year was undoubtedly a small notebook of John Hope, RBGE's great 18th-century Regius Keeper. Bound in marbled paper and written in his own hand, it contains Hope's original scheme for a natural classification of flowering plants.

This classification was previously known only from two very partial sources. The first was the charts with hand-written summaries of the scheme that Hope used during his botanical lectures. The second source was in the form of notes taken down from Hope's lectures by several undergraduates – though slightly fuller, these betray the varying degrees of interest and attention span of the sort to be expected from young medical students.

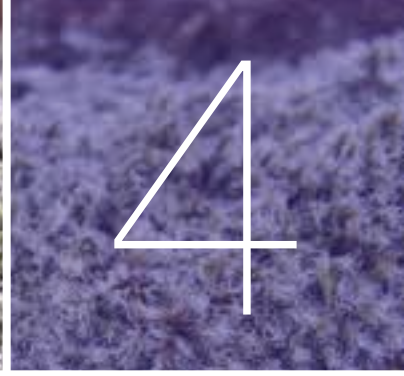
Now, for the first time, we know the names of the genera that Hope placed in his 'natural orders' – many of which could not have been guessed from their sometimes obscure names. The notebook turned up in a house clearance sale in Edinburgh and was drawn to our attention by bookseller Alex Fotheringham. We are grateful to him and to the Friends of the National Libraries, who gave a £2,000 grant (two-thirds of purchase price) towards its acquisition. ■

Photos, this page clockwise from top: Main image shows Hope's notebook at top left and notes taken from Hope's lectures by Francis Buchanan in 1780 below it, with a teaching diagram showing Hope's natural classification scheme; Hope's bookplate; details of classification scheme from Hope's notebook; etching of John Hope (left) and his gardener John Williamson by John Kay.





Photos, clockwise from this page: Autumnal forest floor with puff ball fungus in Heron Wood Reserve, Dawyck Botanic Garden; Nezahat Gökyiğit Botanik Bahçesi (NGBB) in Istanbul, Turkey; woolly fringe-moss (*Racomitrium lanuginosum*); RBGE's Scottish Plants Officer Dr Heather McHaffie out in the field; Iris in bulb frames against the urban backdrop of NGBB in Istanbul; the northern haircap moss (*Polytrichum sexangulare*).



CONSERVATION IN POLICY AND PRACTICE



As the relentless march of habitat loss through human activities shows no signs of slowing down, the world's plantlife is in crisis. International initiatives such as the Convention on Biological Diversity and the Global Strategy for Plant Conservation recognise this, and demand practical and integrated action underpinned by sound science. Botanic gardens are shifting their focus and redefining their priorities to rise to this challenge.

The Royal Botanic Garden Edinburgh is working on several levels, both initiating and supporting a range of practical conservation programmes at home and abroad. Essential for the success of such programmes is the transfer of skills and knowledge to those on the ground, or where a shortage of skills exists. Therefore, capacity building through practical education and training is at the heart of our involvement in projects at home in Scotland and in countries such as Turkey.



Training Natural Talent Apprentices

*David Long, Bryologist and
Stephan Helber, Mycologist*



In 2006, the National Lottery Good Causes awarded a £677,500 grant to the BTCV in Scotland to implement the Natural Talent Apprenticeship Scheme. This is a new specialist training programme designed to overcome a shortage of skills in certain aspects of Scottish ecology such as beetles, lichens, fungi, grassland and freshwater conservation.

Two of the first six Natural Talent Apprentices, Maren Flagmeier and Neville Kilkenny, were based at RBGE for much of their training in the past year. They learned fieldwork and laboratory-based techniques alongside the Garden's experts in cryptogamic plants.

The innovative training scheme has attracted media attention – Maren and Neville recently featured on the BBC Scotland television programme *Landward* – and is proving popular and successful. Applications are flooding in for the next round of apprenticeships, which are currently being advertised. In 2009, RBGE will again play a leading role in the training of the next generation of experts when it welcomes two more Bryophyte and Mycology Apprentices.



Bryophyte Apprentice

Scotland has one of the richest bryophyte floras in the world, with many rare and interesting species important for conservation. Scotland's bogs, oceanic rainforests and mountains are dominated by bryophytes, yet they remain poorly known.

One reason for this is a shortage of experts who can identify them and conduct surveys for conservation agencies such as Scottish Natural Heritage (SNH) so that adequate protection can be given to the important species and their special habitats.

Maren Flagmeier will soon complete her 18-month training programme as a Bryophyte Apprentice under the mentorship of Dr David Long, and with expert teaching from other leading Scottish bryologists Dr David Chamberlain, Dr Liz Kungu and Gordon Rothero.

Maren was based at RBGE for the first six months of her apprenticeship. She made regular field excursions around Edinburgh and spent the remaining days looking down the microscope, aided by our Herbarium and Library, as well as receiving expert tuition.

From these excursions, she compiled site lists and several reports. She was also able to join specialist training courses and field meetings of the British Bryological Society. During her second six-month placement, with the National Trust for Scotland at Mar Lodge near Braemar, she ambitiously undertook a successful survey of the bryophyte 'hotspots' of the estate.

This survey included the Cairngorms, where she joined Gordon Rothero and David Long to contribute to the ongoing Scottish Snowbed Survey. In her fieldwork she has also made significant contributions to other ongoing research, including recording for the new *Bryophyte Atlas* and collecting liverwort samples for an RBGE research project, DNA-barcoding of British Liverworts.

Her final placement has been divided between SNH headquarters in Inverness, where she has collaborated with the SNH Lower Plant Officer Dr David Genney to look at bryophyte data available for Scotland's suite of Sites of Special Scientific Interest (SSSIs), and the Forestry Commission, where she has undertaken survey and advisory work in Glen Affric as part of a large project to restore native woodland.

Originally from Germany, she has been able to develop her expertise in Scottish bryophytes to such an extent that she has won a PhD scholarship at the University of Aberdeen to begin a new research project on one of Scotland's flagship bryophyte habitats, the so-called liverwort heath. This habitat is found only on the highest and wettest

RBGE will again play a leading role in the training of the next generation of experts.

Photos, facing page, clockwise from top left: Apprentice Maren Flagmeier studies bryophytes on boulders by Lochain Uaine, Mar Lodge Estate; the moss *Sphagnum capillifolium*; the fungus *Geastrum triplex*; searching for bryophytes in arable fields; Mycology Apprentice Neville Kilkenny at work in the lab.

mountains of north-west Scotland and appears to be suffering decline, possibly due in part to climate change.

The Apprenticeship has been instrumental in setting up this important study. Scottish bryologists are delighted to welcome a new expert to their community and RBGE is pleased to have played a leading part in this.

Mycology Apprentice

The development of skills in identifying macrofungi requires experience in fieldwork and laboratory-based investigations involving microscopy and other techniques. For some time

it had been apparent that mycology, the science of mushrooms and other fungi, would benefit from the Natural Talent scheme.

So, in October 2007, Neville Kilkenny joined RBGE as a Mycology Apprentice. His mentor is Prof. Roy Watling, RBGE Research Associate and mycologist extraordinaire. Though Neville spends much of his time at the Garden, his training includes periods at Mar Lodge with freelance mycologist Liz Holden and at SNH with David Genney.

After a short induction, Neville accompanied Roy and Dr Stephan Helfer on fieldwork in the Lothians and Borders in autumn 2007. He also conducted a survey of an ancient woodland reserve in the west of the country on his own. These field activities were complemented by weekly training sessions with Roy, systematically studying the family characters, genus by genus, of Scotland's most common fungi. Smaller projects involving difficult species are tackled as they present themselves.

Neville has proved to be an asset to the Garden. Not only has he made great strides in his identification skills, but during an outing with the South East Scotland Fungus Group in March this year, he discovered a new fungus for Scotland at both species and genus level. The nearest known localities for *Mycenastrum corium* had been Denmark to the east and Spain to the south.

He is now the official recorder for this group of fungus enthusiasts, and in April 2008 he contributed information on threatened fungi to the East Lothian Local Biodiversity Action Plan public consultation exercise. Neville is also being trained in fungal records databases, eventually leading to publications and the basis for conservation policy. Several plans for future projects are already on the table. ■



A solid start for Turkey's new botanic garden

David Rae, Director of Horticulture

This year saw the conclusion of the three-year Darwin Initiative project at Nezahat Gökyiğit Botanik Bahçesi (NGBB) in Istanbul, Turkey. NGBB is possibly one of the world's most remarkable and innovative new botanic gardens. It is located in the intersection of two major motorways in eastern Istanbul where it occupies a total of about 30 ha.

The garden started as a memorial park in 1995. It was the brainchild of Nehat Gökyiğit, a wealthy engineer turned philanthropist and conservationist who secured permission from the authorities to create a memorial park for his late wife Nezahat on the motorway sides and adjacent spaces. He eventually sought the help and advice of Prof. Adil Güner, one of Turkey's leading botanists.

Spurred on by encouragement from others, Gökyiğit and Güner decided to turn the memorial park into a botanic garden, and so in 2003 it was re-designated as Nezahat Gökyiğit Botanik Bahçesi (NGBB) or Nezahat Gökyiğit Botanic Garden. Following a workshop attended by RBGE's Dr David Rae and Ian Hedge, RBGE sought a Darwin Initiative grant to help develop the garden.

Groups of staff from NGBB were able to learn about field collecting and all the record-keeping and seed cleaning techniques involved.

The purpose of the project was to develop the horticultural and educational potential of NGBB so that it could eventually contribute to the objectives of the Convention on Biological Diversity (CBD) and the Global Strategy for Plant Conservation (GSPC). The project would equip staff with the training and knowledge needed to

conserve Turkey's plant species through horticultural techniques and educational programmes.

Capacity building and technology transfer would be delivered through a series of workshops, staff exchanges, hands-on practical work and field trips.

The project started with a demonstration field trip led by RBGE's Martin Gardner and Sabina Knees in September and October 2005. On this trip, successive groups of staff from NGBB were able to learn about field collecting and all the record-keeping and seed cleaning techniques involved. This was followed by two exchanges of horticultural staff for training and work experience: Tony Garn and Helen Thomson travelled to Istanbul and then two NGBB staff came to Edinburgh.



Two workshops took place later in the year, one on propagation techniques led by RBGE Garden Supervisors Peter Brownless and Colin Belton and the other on plant records, involving Fiona Inches and Janette Latta. This followed the installation of *BG-BASE™*, the plant records database used at RBGE, by Dr Kerry Walter.

In year two, again two staff from NGBB came to RBGE for horticultural training and work experience and two of our staff, Graham Stewart and Phil Ashby, travelled to Istanbul to lead horticultural training workshops. Next, Dr David Rae, Prof. Mary Gibby and Dr Tony Miller took part in a conservation and networking workshop which was attended by many staff from NGBB and other botanic gardens and university departments.

Finally, two education workshops followed – one on formal and children's education, taken by Leigh Morris and Cath Evans, and the other on teaching biology in botanic gardens and on art in education, taken by Susie Kelpie and Jacqui Pestell.

The third year followed the established pattern of two staff exchanges (involving Simon Crutchley and John Dunn from RBGE) and was followed by an interpretation workshop, leading to the production of an Interpretation Master Plan by Visitor Services staff Dr Max Coleman and Vlasta Jamnický. David Rae and

Mary Gibby then took part in a conference on the links between NGBB and the Convention on Biological Diversity, which NGBB staff, other botanic gardens, universities and government officials attended.

Apart from the tangible benefits to NGBB, the most pleasing aspects of the project have been friendships fostered between staff of the two gardens, and the development of spin-offs. These include the nurturing of talent in three young Turkish botanical artists, the delivery of Certificate-level horticultural training from RBGE's Education Department (see page 50), additional visits between staff of both gardens funded by other trusts and grant-giving bodies and the signing of a new agreement between the two gardens aimed at developing new partnerships in the coming years. ■

Photos, clockwise from facing page, top left: *Iris furcata* in the wild in Turkey; the surprising urban setting of Nezahat Gökyiğit Botanik Bahçesi (NGBB) in Istanbul; RBGE horticulture staff leading a workshop for staff of NGBB; *Fritillaria minuta* in the wild; RBGE staff train NGBB horticulturists in Turkey; newly planted raised beds at NGBB; *Fritillaria caucasica* in the wild in Turkey; Prof. Adil Güner at work at NGBB.



Five years of the Scottish Plants Project

Heather McHaffie, Conservation Officer,
Vascular Plants



The Scottish Plants Project kicked off in 2003 and concluded in 2008. During its five years, there has been *in-situ* conservation action on 11 species of conservation concern and *ex-situ* conservation of over 50 species for education and restoration.

What's more, Scottish plant conservation has been taught to over 300 people through formal courses at MSc, BSc, and HND levels; 182 people have attended specialist workshops and courses, while over 800 people have heard about the work of the project through talks to local societies. There has also been engagement with the general public through Edinburgh Science Festival events.

In-situ work has involved monitoring a range of species in their natural habitats. The original Rare Plants Project provided good datasets enabling comparisons over a 12- to 15-year period. For example, the Norwegian mugwort (*Artemisia norvegica*), found on three mountain tops in the north of Scotland, might potentially be badly affected by climate change, but monitoring showed that healthy populations are still present. By contrast, the alpine lady-fern (*Athyrium distentifolium*) is already showing signs of damage due to lack of overwinter snow protection. Monitoring will continue for this species at a site near the Rannoch Moor.



On lower ground, plants that grow in arable fields have greatly declined due to intensified agriculture. The purple ramping-fumitory (*Fumaria purpurea*) is an endemic species that has probably suffered habitat loss but is not well recorded due to identification problems.

This was addressed by holding eight practical workshops in Easter Ross, Inverness, near Aberdeen, Fife and Edinburgh. Participants on these and other workshops included retired botany lecturers, MSc and HND students, RBGE staff and volunteers, botanical survey workers, vice-county recorders and members of various botanical societies, as well as staff from the Scottish Agricultural College, Scottish Crop Research Institute and Scottish Natural Heritage.

Woodsia ilvensis, probably Britain's rarest fern, is the focus of a major ongoing project started in 1995. As Lead Partner for this UK Biodiversity Action Plan species, RBGE has coordinated UK-wide monitoring. The successful propagation of an *ex-situ* conservation collection provided plants for re-introductions, and several former sites were planted with good survival rates after up to eight years. This is another species probably affected by

The purple ramping-fumitory is an endemic species that has probably suffered habitat loss.

climate change, but due to this intervention programme, the increased number of plants has improved the chance of survival.

Target 8 of the Global Strategy for Plant Conservation (GSPC) specifies the cultivation of vulnerable or endangered plants in *ex-situ* conservation collections.

RBGE's own Target 8 Project has involved working closely with horticultural staff, who also took part in field visits to collect plants and seed. These plants also have an educational purpose at the four Gardens. Because all plants monitored by the Scottish Plants Project are Target 8 species, the two projects are inter-related. An additional dimension has been the involvement of students in cultivation, distribution and genetic studies.

The dedicated Scottish Plants Project website is at <http://rbg-web2.rbge.org.uk/scotplant/> ■

Photos, clockwise from facing page, top left: Monitoring oblong woodsia (*Woodsia ilvensis*); Norwegian mugwort (*Artemisia norvegica*); alpine lady-ferns (*Athyrium distentifolium*) growing in a corrie near Bridge of Orchy in 1995; the same corrie appears bare in 2005 after the ferns were killed by lack of snow cover; alpine lady-fern at Ben Alder; Fay McKenzie monitoring one-flowered wintergreen (*Moneses uniflora*); purple ramping-fumitory (*Fumaria purpurea*).

Photos, clockwise from this page: *Spirit – a Chinese Spring Lantern Festival* lights up the Temperate Palm House; the sunshine monitor on top of the Temperate Palm House; image from *Herbarium Amoris* by Edvard Koinberg; an exhibit in *Classify*; the new Dawyck Visitor Centre; volunteer and participants in the Children's Garden Project.





5



ENGAGING THE PUBLIC



The Royal Botanic Garden Edinburgh and its three Regional Gardens – Benmore, Dawyck and Logan – are popular visitor attractions and also valued amenities to local residents as places for contemplation and tranquillity. We are continually striving to enhance and improve the visitor experience, and to this end we now have a new visitor centre at Dawyck and a revamped Garden Ranger service at Edinburgh.

The Gardens are unrivalled settings for one of our most pressing and multifaceted tasks – to communicate the importance of plants to a broad public audience. Through an ever-growing programme of events and exhibitions, we aim to draw in new audiences and encourage visitors to reflect on the relationship between humanity, art and culture and the natural world. Our expanding range of volunteer opportunities give interested individuals a chance to roll up their sleeves and help out behind the scenes, while we remain grateful for the financial support of, and interest shown by, our Members and Patrons.



Exhibitions and events celebrate links past and present

Ian Edwards, Head of Interpretation and Exhibitions

Carl Linnaeus tercentenary

During 2007, institutes throughout the world marked the tercentenary of the great Swede, Carl Linnaeus, who is regarded as the 'father of classification' and arguably made a greater contribution to the science of classification than any other individual.

The Garden's own tribute to Carl Linnaeus included talks from several well-respected speakers, guided tours and a special 'birthday party'. On 23 May, the Garden remained open late and people were encouraged to celebrate in a way Linnaeus himself would surely have approved of with food, wine and lively period music from a Swedish ensemble.

RBGE collaborated with the Swedish Embassy to present a stunning exhibition of photographs, *Herbarium Amoris*, by Swedish photographer Edvard Koinberg. This consisted of very large images of flowers accompanied by Linnaeus's own descriptions of floral plants based on analogies with human sexual relationships.

The main focus of our Linnaeus celebrations was the summer exhibition in the Exhibition Hall, *Classify*. This included a reconstruction of Linnaeus's study, complete with homemade wallpaper composed of botanical prints. There were also some important examples of books from our Library connected to Linnaeus.



The rest of the exhibition was devoted to the science of classification, with exhibits that demonstrated the use of tools and techniques, such as identification keys, microscopes, DNA sequencing and the use of herbarium collections, by taxonomists. Plant drawings and photographs illustrated 300 years of botanical illustration. However, the most popular exhibit was one in which visitors could create their own classification systems by arranging jars of botanical and zoological specimens on a 'classification wall'. In 2008, *Classify* was presented at the Courtyard Gallery at Benmore Botanic Garden.

China Now

China Now in Scotland is a festival of cultural, business and scientific events celebrating the links between Scotland and China. The festival provided an excellent opportunity for RBGE to celebrate 100 years of working in China, and to promote our connection with Chinese people in Scotland and China.

The Scottish Government recognised the importance of this unique relationship by choosing to open China Now with a spectacular evening at the Garden. As guest of honour, First Minister Alex Salmond was able to witness the enthusiasm and goodwill that has

been the cornerstone of our strong and successful relationship with China.

The highlight of RBGE's China Now programme was *Spirit – a Chinese Spring Lantern Festival* in February and March 2008. Staged in the Glasshouses at night, it combined an artistic interpretation of RBGE's involvement in China with a celebration of the traditional Chinese winter lantern festival. The local Chinese community had contributed support and ideas which were added to the creative mix overseen by leading Scottish-based arts company NVA.

Plants in the Glasshouses were lit in a beautiful and spectacular fashion, creating a special ambience that transformed the space into a magical arena. Music was composed especially for *Spirit* by Kimho Ip, while other elements included lanterns created by the community, chrysanthemum tea to drink and floating origami flowers in the pond. RBGE's programme of China Now events continues until October 2008. ■

Photos, clockwise from facing page, top left: *Spirit – a Chinese Spring Lantern Festival* lights up the Temperate Palm House; reconstruction of Linnaeus's study in the exhibition *Classify*; hands-on discovery at *Classify*; atmospheric lighting on bamboo in *Spirit*; portrait of Carl Linnaeus (courtesy of the Linnean Society of London); First Minister Alex Salmond at the opening of *Spirit*; image from *Herbarium Amoris* courtesy of Edvard Koinberg.



Firsts and new works at Inverleith House

Paul Nesbitt, Curator, Inverleith House



This year, Inverleith House again presented a world-class programme of exhibitions, which included drawings and material from the Garden's Archives and Herbarium as well as contemporary art of international significance by artists based in Scotland and abroad.

The gallery won a grant from the Scottish Arts Council (SAC) towards the year's programme: at £75,000, it was the highest to date. Inverleith House was also designated a Flexible Funding client organisation as the SAC's transition to Creative Scotland was instigated.

The year began with the first-ever exhibition of work by Lilian Snelling (1879-1972), considered by many to be the finest botanical illustrator in colour of the 20th century. The collection of illustrations depicting mainly rhododendrons and primulas was part of our spring opening programme.

It was accompanied by *Plum Tree Blossom*, a film by Jeremy Millar made in the garden of the East Gate Lodge at the Botanic, and *No Fixed Points – Drawings by John Cage and Merce Cunningham*. John Cage (1912-1992) is considered one of the most influential composers of the 20th century.

A day of Cage's music, written to be performed using plants, was held in the Temperate Palm House, along with workshops and a film series at Edinburgh's Filmhouse. The events were designed to widen access and increase audiences and they were supported by additional funding, obtained from the SAC's Music Department for the first time.

Our summer exhibitions programme featured the world premiere of new work by one of the most influential colour photographers, William Eggleston. Taken in Memphis in 1973-74, these large-format images of people and places had only recently been printed for the first time, and the exhibition was widely hailed as a highlight of the Edinburgh Festival. Its opening coincided with the artist's 68th birthday and it was made possible by financial support from Cheim & Read Gallery in New York and Victoria Miro in London. The exhibition was accompanied by the first Scottish screening of Eggleston's film *Stranded in Canton* in the Wash-House.

In the lower ground floor gallery, Rosita McKenzie presented the second in a series of six innovative exhibitions designed to improve access to the Garden's collections for blind and visually impaired audiences. *Two Voices II – Science behind the Scenes* was widely praised.

Over the years, Inverleith House has provided the opportunity for artists to make exhibitions for its rooms which could be shown nowhere else. The installation of wooden beams throughout six of its seven rooms by the Glasgow-based artists Smith/Stewart was just such an exhibition.

The three final exhibitions of the year – Nick Evans, Tony Swain (who represented Scotland in the 2007 Venice Biennale) and Neville Rae – also featured entirely new work. Invitation cards for these exhibitions were sponsored by Tullis Russell Papermakers, whose continued support saw sponsorship-in-kind reach record levels. ■

“I write my music to heal the world,” said Bob Dylan. Lost in the Sahara desert in 1969, environmental photographer Mark Edwards was rescued by a Tuareg nomad and taken back to an encampment. Recovering around a fire under the stars and a moon that had just received man’s first footprints, he hears the strains of Dylan’s ‘A hard rain’s a-gonna fall’ from a bootleg tape.

In this surreal setting, as Dylan’s lyric piles image upon image, Edwards contemplates how these words reflect the many ways in which mankind is wreaking havoc upon the planet and so many of its people. He decided to travel the world in search of an iconic image that would illustrate each line of the song.

Over 30 years and 150 countries later, the exhibition *Hard Rain* was born, comprising a 50m banner juxtaposing each line of the lyrics with an image, and accompanied by a book of potent essays including the reactions of leaders and thinkers around the world. *Hard Rain* was launched at the Eden Project in 2006 and in summer 2007, RBGE became the first major botanic garden to stage this heart-rending exhibition.

RBGE became the first major botanic garden to stage this heart-rending exhibition.

The Visitor Services team, with the help of horticultural staff, developed an innovative low-profile scaffold for the banners. Set out around the Fossil Courtyard under the Palm House, this stunning exhibition was seen by over 150,000 visitors over its six-month showing from July 2007 to January 2008 – many of whom were moved to add their personal message to the Tree of Hope Garden staff had erected.

During the Edinburgh Festival, *Hard Rain* provided an apt backdrop for performances by the Zawose family, Tanzanian musicians and dancers whose people live with many of the torments depicted in Edwards’ evocative pictures.

In August, it also made an ideal setting for the announcement by Richard Lochhead, Cabinet Secretary for Rural Affairs and the Environment, of the Government’s funding package for development of the John Hope Gateway (see page 58). ■

Photos, facing page, top to bottom: Taking down William Eggleston’s exhibition *Portraits 1974; Two Voices II – Science behind the Scenes* by Rosita McKenzie; *Lizard on a Leaf* by Merce Cunningham from the exhibition *No Fixed Points* (image courtesy of Merce Cunningham/Aperture Foundation).

Photos, this page: Tanzanian music troupe the Zawose family perform during the Edinburgh Festival (photo courtesy of Chris Watt); visitors’ personal messages flutter like prayer flags on the Tree of Hope; an aerial view of the *Hard Rain* installation on the Fossil Lawn at the Botanics; photo in *Hard Rain* showing Suri Amazonian children watching a bulldozer’s destruction (image courtesy of Mark Edwards/Still Pictures).



Hard Rain hits the Botanics

Alan Bennell, Head of Visitor Services





New visitor centre for Dawyck

*David Knott, Curator,
Dawyck Botanic Garden*

The official opening of the new visitor centre at Dawyck Botanic Garden on 14 May 2008 marks the latest chapter in the long history of Dawyck.

Dawyck, located in the Scottish Borders and with a sustained planting history of over 300 years, boasts some of the oldest plants in RBGE's living collections: *Abies alba* planted 1680 and *Larix decidua* planted 1725.

After becoming RBGE's third Regional Garden in 1979, Dawyck started attracting ever increasing numbers of visitors, so the small visitor facilities constructed in the early 1990s had become increasingly inadequate.

After a number of feasibility studies and consultation with adjoining landowners earlier this decade, it was decided to build new visitor facilities on the footprint of existing buildings, with new garden workshops adjacent. After funding was secured – £1.4 million from the Scottish Government, £70,000 from Scottish Enterprise Borders and £130,000 from RBGE's own reserve fund – the build programme was completed in less than a year. It began in early June 2007 and the anticipated handover date of mid-April 2008 has been met on target.

The light, airy building boasts floor-to-ceiling glass in the shop/reception area enhanced by internal oak columns, frames and beams.

The building was designed by Simpson and Brown and Border Construction was the main building contractor. The visitor centre comprises a shop and reception area, café with internal seating for 50 and external seating for 40, studio with exhibition space and introductory films, and offices.

The light, airy building boasts floor-to-ceiling glass in the shop/reception area and café, enhanced by internal oak columns, frames and beams. The remainder of the building exterior is clad in copper and wood panelling.

Both interior and exterior flooring have been finished in heat-retaining blue limestone, while energy-efficient under-floor

heating is powered by a biomass boiler fuelled with locally sourced wood chips. All this makes for an extremely warm welcome for visitors. ■

Photos, this page: European silver fir (*Abies alba*) planted in 1680 at Dawyck; the attractive new visitor centre at Dawyck; guests at the opening reception enjoy the warmth of its oakwood interior features.

Photos, facing page: RBGE's revamped website offers a user-friendly online visitor experience; the easy-to-search events calendar on the website; ox-eye daisies brought summer colour to the home page.



Photo: © iStockphoto.com/Stefan Klein



Revamped RBGE website goes live

*Hamish Adamson, Publications Manager
and Ida Maspero, Web Project Co-ordinator*

November 2007 saw the launch of a new website for the Royal Botanic Garden Edinburgh at www.rbge.org.uk. The Garden's diverse online audiences, including local and foreign visitors, students, fellow scientists and horticulturists and the media, can now enjoy a user-friendly and visually attractive site with many features.

The process of redeveloping the website had kicked off in 2006 with an external review and a web visitor survey. Both found that users had difficulty navigating the existing site and finding the information they required, and browser incompatibility meant that some pages were inaccessible to many users. Meanwhile, staff feedback had indicated that RBGE's group of web editors found the content management system cumbersome and complicated to use, with some understanding of HTML coding required when uploading content.

So, between January and March of 2007, internal and external stakeholders were consulted and a set of requirements for a new website were drawn up. Five web development companies were invited to tender and the successful contender, Edinburgh-based Net Resources, began building the new website in April that year, deploying an open-source content management system (CMS) called MODx and customising it to meet our needs.

The new, cutting-edge CMS allows the site to grow with the organisation – new sections and pages are easily added by RBGE staff. It delivers a website that is fully compliant with W3C web standards and disability discrimination legislation. What's more, it also offers robust access permissions so that web content editors around the organisation can be easily managed. These editors are able to create and update their web pages through an easy-to-use, browser-based interface that requires no knowledge of HTML.

Useful new features for visitors to the website include intuitive site navigation, a comprehensive and easy-to-search calendar of events and stunning image galleries of the four Gardens. Content has also been expanded to include extensive information about features and highlights at the Gardens, as well as RBGE's diverse research projects and education courses.

Since its launch at the end of November 2007, the site has been receiving around 35,000 unique visitors a month, and has proved invaluable in delivering the Garden's communications. Alongside the new site, the web project team also launched a proactive marketing initiative in the shape of a monthly e-newsletter. This is now being sent to over 2,000 recipients.

In the second half of 2008, we plan to add an online shopping facility, allowing visitors to purchase RBGE merchandise, as well as secure log-in areas for students, volunteers, Members and Guild members. ■





Photos, this page: Garden Rangers raising the profile of RBGE at the Edinburgh Treefest; the new Garden Rangers team.

Photos, facing page: The ruined Victorian Fernery at Benmore is the subject of the latest Members' Appeal; Members' outing to the Festival of Orchids at Scone Palace; the Garden's Development Team, proud winner of the Institute of Fundraising 'UK Fundraising Team of the Year' award.

Growing the Garden Rangers

Alan Bennell, Head of Visitor Services



For much of the 20th century, visitors to the Botanic were welcomed by Royal Park Constables. Since the 1980s, this team has undergone several changes to retain the vital security role for premises and people combined with a more versatile personal welcome for visitors. They metamorphosed via a unified Stewards force in the Corporate Services Division to Garden Stewards in the Horticulture Division.

In the course of 2007, the ambition of creating a team of Garden Rangers was realised, operating in a similar way to the Countryside Rangers found in nature reserves, National Trust properties and other outdoor sites. In doing so, we are laying the foundations for the standards of visitor welcome, information provision and visitor management that will be delivered with the opening of the John Hope Gateway in 2009.

The development of the team has been led by Alan Bennell, Head of Visitor Services, in collaboration with Gary Love, Head of Human Resources, and key colleagues in the Horticulture Division. It has involved planning, targeted recruitment, staff training and sensitive negotiations with the trade unions, as well as the cooperation of the existing Garden Stewards and their managers.

The process began in May 2007 with the transfer of these Stewards to the Visitor Services Department, coinciding with the appointment of a new Head Ranger, Giles Kempself, who arrived with a sound background as a

Countryside Ranger. His experience and determination to encourage change has been integral to progress.

New recruits arrived over the summer, bringing work experience of wildlife trusts and country parks. Plans were made to rationalise staff grading and working conditions, to instigate targeted skills training and to empower individuals in engaging with visitors across a range of activities.

By early 2008, the Garden Ranger service was launched. With union support, the Rangers migrated to new rotas that eliminated long days and stabilised levels of cover. The strength of the team is the balance between new blood and the group of long-serving staff, who have a valuable understanding of the special circumstances in a botanic garden.

Now, the Garden Rangers are integrating their outreach, delivering such diverse services as issuing visitor satisfaction surveys, supervising commercial film shoots, selling guidebooks and events tickets, collaborating in community outreach events and horticultural therapy sessions and supervising special needs provision.

And, since the arrival of Senior Ranger Clare Bury in March 2008, they have started their own programme of free, family-friendly activities to engage visitors more closely with plants and their importance. We foresee steady growth for our new Garden Ranger service and, eventually, implementation of the model at Benmore, Dawyck and Logan Botanic Gardens. ■



Membership and fundraising going strong

Sally McNaught, Membership Manager and Jackie Whalen, Development Manager

Membership numbers passed the 6,000 mark for the first time this year, making it another successful year of growth for the Membership Programme. Events arranged by Members' Committees have expanded in number and diversity across all four Gardens, attracting new audiences and continuing to encourage more people to consider supporting the work of the Garden by joining as a Member.

Gross Membership income for the year was approximately £168,000; this includes almost £30,000 raised by the Committees' events, creating a record fund for the Small Projects Disbursements, which support a wide range of projects at all four Gardens.

The latest Members' Appeal, launched in February 2008, focuses on the restoration of Benmore's Victorian Fernery. Thanks to the generosity of our Members and Patrons, almost £23,000 has been raised so far, helping to secure the future of this unique, Grade B listed feature, built by James Duncan in the 1870s. And this year, an additional £3,223 was received towards the previous Members' Appeal – for the Biodiversity Garden – bringing the total there to almost £26,000.

Due to staff changes, the latter stages of this year have been focused on retention and stewardship of the Membership Programme. However, we hope to turn our

attention to promoting the Programme again over the coming year and gaining even more support for the work of the Garden.

The competition to name the new Gateway at Edinburgh closed early in 2008 and attracted nearly 300 entrants from individuals and interested societies. Many of the names suggested reflected core areas of RBGE's work and history. The winning entry, the John Hope Gateway, was proposed by Dr Ian Rolfe and commemorates John Hope, Regius Keeper from 1761 to 1786, who established the Garden at Leith Walk in 1763.

Project fundraising highlights for the year include obtaining full funding for core works to restore the Benmore Fernery, securing support for the China Now programme, including *Spirit* and the launch event (see page 37), continued support for Jade Dragon Field Station & Lijiang Alpine Botanic Garden and quadrupling the number of legacy pledges for RBGE's work from the previous year.

In July 2007, RBGE's Development Team (responsible for fundraising and Membership) was crowned winner of the Institute of Fundraising 'UK Fundraising Team of the Year' award. This peer-reviewed award recognises excellence across all sectors of professional fundraising and is a tribute to the team's achievements of recent years. ■



Volunteers boost the Garden's work

Contributions from Catherine Siddall, Susie Kelpie, Tony Garn, Sally Rae, Jane Corrie, Geoffrey Harper, Lynsey Muir and Sally McNaught



Storytelling

Storytelling in the Garden by our volunteer group the Talking Trees played an integral and magical part in the family events programme this year. The Trees have continued to delight with their popular monthly Sunday afternoon sessions as well as special events throughout the year.

In September, visitors made their way to our very own corner of the Highlands, the Heath Garden, for *Tales in the Gloaming*, an enthralling and atmospheric event held as part of Highland 2007 Year of Culture. Our storytellers once again took part in National Tell A Story Day during October's Scottish International Storytelling Festival.

In December, the Trees worked overtime, offering sessions every Sunday during our Green Christmas Festival and even borrowing Santa's Grotto on two occasions for special seasonal stories for older children. During the Science Festival in April, the themes of climate change and environmental responsibility ran through the Trees' specially created sessions, bringing a new perspective on these topical issues.

Photos, this page, clockwise from top left: The Talking Trees Storytellers in their usual base, the Forest Room; Children's Garden volunteers with a few of the young gardeners; work placement student Ellen Hortemo; planting hanging baskets with the help of a Children's Garden volunteer.

Education

Over the past year, our band of stalwart volunteers has helped ensure the smooth running of the Education Department. Their support has included lab technician work, setting up practical experiments, help with practical children's art classes and assisting the Education Officer with secondary schools sessions.

Our dedicated volunteers have become expert at putting up and taking down a variety of yurts and tents and the general maintenance of the department, as well as sneakily setting up exciting teddy bear picnics without the children noticing.

The Children's Garden volunteer team has enabled the successful continuation of the project. Volunteers work on a one-to-one basis with a small group of primary-aged children through a full growing season, tending their own produce from seed to harvest and culminating in a family barbeque party to eat what's been grown!

For three months this year, we enjoyed administrative support by an overseas work placement student, Ellen Hortemo from the Norwegian horticultural college Gjennestad Gartnerskole.



Horticulture and Garden Guides

A well-developed volunteer programme supports the Outdoor and Indoor Departments of the Horticulture Division. Though many of our volunteers are settled, a turn-over allows fresh faces to join and experience the regular various horticultural activities involved in developing and maintaining the living collection.

A summer training programme has been implemented to help expand the knowledge base of our volunteers. This helps to make horticulture volunteers, who are often a first point of contact for the visiting public, an increasingly valuable resource to RBGE.

This year's special project was preparation for the Rhododendron Conference in May 2008. The renovation of the Herbaceous Border also gained momentum with the seasonal help of volunteers.

Our group of Garden Guides have a diverse and expanding knowledge of the Garden and of Scotland in general. They continue to lead daily walks and a range of specialist and booked tours outdoors and in the Glasshouses.

Photos, this page, clockwise from top left: Garden Guide Dawn Smith leads a tour of the Glasshouses; Herbarium volunteer Audrey Watson at work in the mounting room; Herbarium volunteer Moira Peters; horticulture volunteers plant up a floral Saltire in the Demonstration Garden.

Herbarium

This year, the Herbarium volunteers have kept busy preparing the specimens acquired from Glasgow University Herbarium in December 2005. The 67,000 specimens include bryophytes, ferns, algae, lichens and flowering plants from all over the world.

Volunteers continue to help with the mounting of specimens collected by RBGE staff, and specimens gifted from other herbaria. They also repair and remount the Glasgow specimens where necessary. Our volunteers have also helped make new labels for the herbarium cabinets and cupboards since reorganisation to the APGII system (see page 22).

David Braidwood has databased 600 Erich Werdermann herbarium specimens collected in Chile early in the 20th century. This dataset is now around 98% complete, with a total of 11,000 specimens databased. In the meantime, Kim Harding has been working tirelessly on labelling and cataloguing herbarium specimens for the British collection under the supervision of Douglas McKean.

James Stewart has helped sort and select good-quality herbarium specimens from 10,000 or so collected from plots in Central Kalimantan as part of the Indonesia Tropical Forest Management Programme. Alison Bacon has been helping to lay away the bryophyte collection gifted to RBGE by her father.



Library

This year, Library volunteers have worked on annotating the first of three fascinating scrapbooks compiled by James McNab. James succeeded his father William as RBGE's Principal Gardener in 1849. His scrapbook is a careful compilation of documents from many different sources and includes letters, newspaper articles, photographs and paintings.

The scrapbook covers his father's supervision of the transfer of the Garden from Leith Walk to Inverleith (1821-23) and gives wonderful details about later developments such as the building of the Temperate Palm House (1856-57) and the opening of a (now vanished) Museum of Economic Botany in the Garden (1851). Articles on public access to gardens and gardeners' wages show James McNab to have been something of a radical in his sympathies.

The pages of the scrapbook have now been numbered and brief notes about its contents are available on request from Library staff. The book itself is in a fragile state of repair and in need of restoration.

Photos, this page, clockwise from top left: The scrapbooks of James McNab; the sunshine monitor mounted on top of the Temperate Palm House; Rhododendron Phenology Project volunteers doing their rounds; portrait of William McNab; an illustration from the scrapbook.

Phenology

The Daily, Weekly and Rhododendron Projects are gathering momentum. The phenology volunteers now monitor not only first-flowering dates but also other stages in a plant's life cycle. Budburst and leaf fall are particularly important for climate change studies as carbon sequestration occurs only when leaves are present. Therefore, we now measure these events in the Daily and Rhododendron Projects.

Fortunately, we have a cloned population of 20 poplar trees next to the Chinese Hillside. These genetically identical plants show that our methods are reliable and that differences in leafing dates of only a few days between one year and the next are statistically significant.

One drawback of phenology is that we must collect data for many years before we have enough for serious scientific analysis. However, selected results are published each year in RBGE's horticultural journal, *Sibbaldia*, along with discussion of observation methods and our plans for a phenological classification of plants.



Photography

This year, Alex Wilson and Brenda White again supported RBGE's photographer, Lynsey Muir. Brenda continued her long-term project to scan the vast slide collection of plant portraits and close-ups held in the photography studio. There are thought to be around 5,000 images in this collection and already nearly 1,500 slides have been scanned.

Once the images are scanned, Brenda will add them to the image database, Fotostation. This will give RBGE staff wider access to RBGE's image collection. Brenda has also photographed a number of Adult Education courses and the images are being used to promote RBGE's Education programme.

In 2007, the Photography Department welcomed a new volunteer, Peter Clarke, a student currently completing his HND in photography at Stevenson College. He is particularly interested in wildlife photography and has taken a number of stunning wildlife images in the four Gardens for use in RBGE's publications.

Photos, this page, clockwise from top left: Photo of the Redwood Grove at Edinburgh by photography volunteer Alex Wilson; a Membership volunteer helping out at the annual Plant Sale; photo of *Gerbera nepalensis* by photography volunteer Brenda White; photo of a blue tit at Dawyck by photography volunteer Peter Clarke.

Development and Membership

The Development and Membership programmes benefit from the committed support of a number of volunteers. This year has seen many staff changes and our office volunteers – Joan Wilcox, Maida Fotheringham, Janette Dobson and Jean Doyle – have provided assistance in administrative tasks, ensuring that the Membership programme has continued to run smoothly.

The programme is supported by regional committees and a national board, comprising teams of volunteers who run dedicated Members' events. These events contribute significantly to the success of the programme, providing enjoyable ways for individuals to learn more about the Garden's work as well as generating vital funds that directly support a range of work via the Small Projects Fund (see page 43). A grand total of nearly £106,000 has been raised in this way over the last five years.

This year also saw the final meeting of another dedicated board of volunteers, the RBGE Campaign Board, chaired by Sir George Mathewson, after successfully completing the fundraising campaign for The Gateway. Our grateful thanks to the Campaign Board members for helping to make this pioneering project a reality. ■



Photos, clockwise from this page: Like trowels, basic propagation and cultivation skills are essential tools for budding horticulturists (photo courtesy of Eamonn McGoldrick); Certificate in Field Botany student Sheena Wurthmann; *Cycas revoluta*; at work during a Garden Design class; Dr Greg Kenicer and Field Botany students on a field trip in Scotland; students on a field trip in Belize.



EDUCATION FOR THE FUTURE



The Royal Botanic Garden Edinburgh has a long history in education. Supervising and supporting PhD candidates, delivering an MSc in plant taxonomy alongside the University of Edinburgh and providing inspiring schools and adult education courses are all testament to the Garden's commitment to teaching and learning.

As the focus of RBGE's scientific work shifts ever more towards supporting conservation efforts around the world, our educational activities have seen an increase in capacity building – passing on knowledge and practical skills in places where they have been in short supply. Along with colleagues in all areas of the Garden, the Education team this year introduced two Practical Certificates. Not only have these course programmes been welcomed by students here in the UK, but they are also being deployed in capacity building initiatives in such countries as Oman and Turkey.



RBGE introduces Practical Certificates

*Leigh Morris, Head of Education,
Greg Kenicer, Lecturer and
Heather McHaffie, Conservation Officer,
Vascular Plants*



RBGE has delivered botany and horticulture training worldwide for many years. In 2006, we decided to formalise our practical training, and we developed RBGE Practical Certificates in Field Botany and Horticulture. The broad aim is to provide simple, standardised, practical-based, RBGE-certificated qualifications that can be delivered by a range of staff in various countries and locations.

The Certificate in Practical Horticulture (CPH) addresses a major gap in the UK and international horticultural training markets. This new qualification covers areas such as plant identification, propagation and maintenance, and it can be delivered using plants and horticultural approaches specific to different students, countries and gardening styles. Its sister qualification, the Certificate in Practical Field Botany (CPF), allows students to gain all the basic skills required for botanical and ecological fieldwork. Topics include keys and identification, data and specimen gathering, survey techniques and equipment, as well as preparation for expeditions.

The courses are predominantly practical, with additional support from a written syllabus and visual aids. The two certificates each contain eight modules that can be taught as individual one-day courses. The time to complete a certificate is flexible: two weeks as an intensive programme or over a two- to three-year project.

The formal assessments for the certificates, to be credible, are also kept as practical as possible. Students on both courses are required to keep a notebook for the course. They must then complete a series of practical tasks, either during the course (e.g. as part of the botany fieldwork) or as a practical examination at the end.

Since we launched the Practical Certificates in September 2006, the response has been excellent and, as a result, we are now expanding the groups to which they are offered. Our own HND/BSc Horticulture students now complete the

CPH in the first year of their full-time programme, and our MSc students gain the CPF during their field trip to Belize. In the UK, the CPF is one of several RBGE education initiatives supported by Scottish Natural Heritage.

Both certificates are also in high demand in our Adult Education programme. From 2009, students will have the opportunity to take the CPF either as an intensive one-week course in Scotland (based at Kindrogan Field

Studies Centre) or as a two-week tropical course (based at Las Cuevas Research Station in the Chiquibul forest, Belize).

The CPH has already been used in some of RBGE's international capacity building projects.

Because the fundamental skills involved in propagation and plant

care are the same the world over, this qualification can be tailored and taken wherever RBGE is working.

We have delivered the training to staff at Oman Botanic Garden in Muscat, and four Yemenis from embryonic botanic gardens in Ta'izz and Soqatra came to RBGE in summer 2007 to complete the programme. As part of our Darwin Initiative project in Turkey (see page 30), a group of Turkish garden staff completed the CPH as a two-week programme delivered by RBGE in Istanbul this year. Their aim is to offer this programme at their garden in the future.

The initial success of our Practical Certificates has been impressive. Other countries have shown interest in receiving the training and, importantly, gaining an RBGE certificate. Our vision is for our programmes to become a delivered outcome in many of our future development projects.

The response from other UK organisations has also been good. The Eden Project in Cornwall, supported by RBGE, is now offering our CPH to adults as a weekend course. We hope that this partnership will develop further, and that other leading organisations will adopt our courses for use in their own capacity building projects. As others take up our programmes, as is already happening at Eden and in Istanbul, staff within each organisation can be trained to deliver the programmes, with RBGE acting as the verification and awarding body for the certificates.

Surprisingly, there are no similar qualifications available in the UK, and there is clear potential for them to contribute significantly to income generation at RBGE. After further development, the potential of the Practical Certificates to become badges of practical training quality at botanic gardens throughout the world is certainly a realistic aim. ■

Our vision is for our Practical Certificate programmes to become a delivered outcome in many of our future development projects.



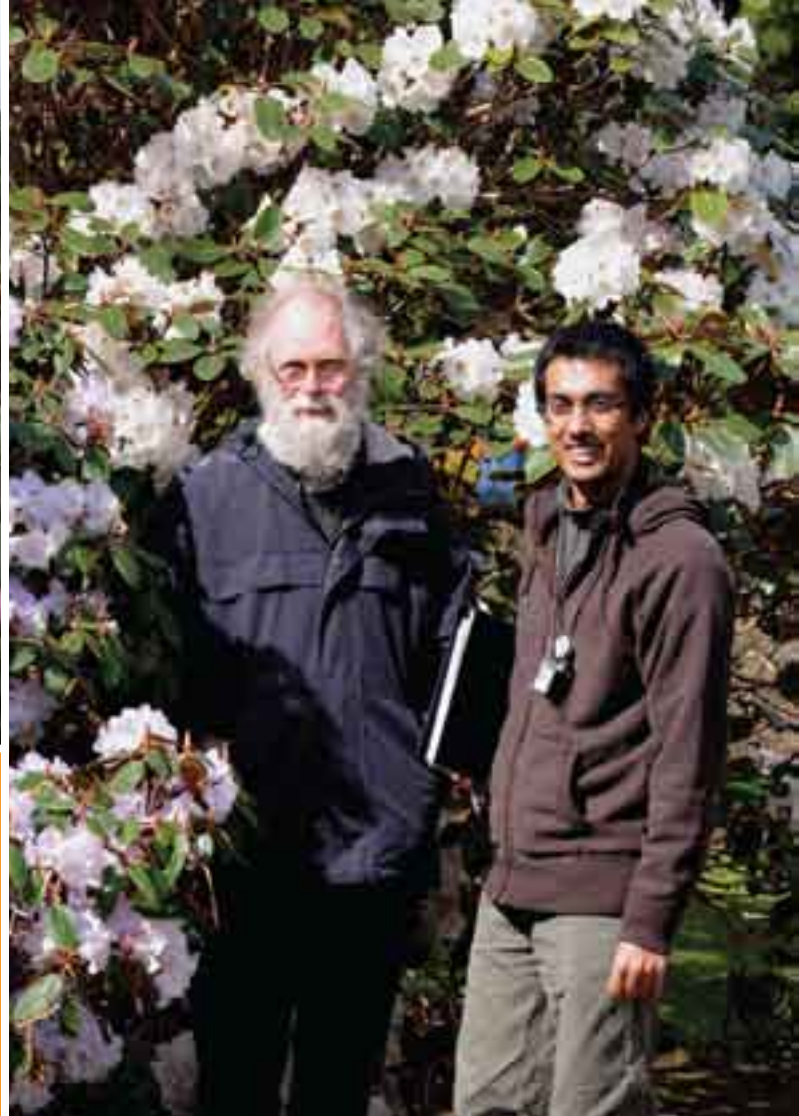
Photos, facing page, clockwise from top left: RBGE staff delivering practical training to horticulturists in Turkey; student on a field trip in Scotland; hands-on work for CPH students in RBGE's Nursery; Yemeni botanic garden staff busy in the Nursery during CPH training in Edinburgh; a CPH student gets her hands dirty at the Eden Project; CPF students press specimens during a field trip to Belize.

Photo, this page: RBGE staff training NGBB horticulturists in Turkey.



Nepalese botanist gains Darwin Initiative Fellowship

Mark Watson, Co-ordinator of the Major Floras Programme



In September 2007, Ram Chandra Poudel travelled from the mid-hills of Nepal to join the other international students starting the MSc in Biodiversity and Taxonomy of Plants, run jointly by Edinburgh University and RBGE.

Ram was one of the top Darwin Scholars on our recent three-year project 'Building Capacity for Plant Biodiversity, Inventory and Conservation in Nepal', funded by the Darwin Initiative. As a result of his achievements, he was awarded a prestigious Darwin Initiative Fellowship to continue his studies by working with us and attending our MSc.

During his year in Edinburgh, Ram has joined up with Bhaskar Adhikari, an RBGE PhD student from Nepal and classmate from Tribhuvan University. For both Ram and Bhaskar, receiving further academic training in the UK will make a huge difference to their research capabilities back in Nepal, and future students of Tribhuvan University will benefit from their teaching.

These activities are part of the Garden's long-term involvement in the Flora of Nepal project, and are making a big difference to the country's capacity for biodiversity

research. For his research project, Ram chose to investigate three rhododendron species from Nepal which are often confused in the wild (and RBGE's rhododendron expert Dr David Chamberlain believes an unknown fourth species may also be involved).

For Ram and Bhaskar, receiving further academic training in the UK will make a huge difference to their research capabilities back in Nepal.

The Garden's living collections contain over 40 accessions of *Rhododendron campanulatum*, *R. wallichii* and *R. aeruginosum* from the Himalayan region, which have been vital for DNA sampling and in understanding variations in morphology. Ram has also been able to draw on David's extensive experience – as well as that of other staff and students – as he uses molecular

tools, scanning electron microscopy and morphometrics of living and herbarium specimens to try to unravel the problematic taxonomy of this group. ■

Photos, this page: *Rhododendron wallichii* in the wild at Solu Khumbu (Everest region) in Nepal; Ram Chandra Poudel of Nepal with RBGE's rhododendron expert Dr David Chamberlain.



New Diploma in Garden Design

*Leigh Morris, Head of Education and
Diane Pyper, Course Director*



Two years after its creation, RBGE's Diploma in Garden Design is proving a success and is already turning out very competent garden designers. Plans are now afoot to add a second year to the programme.

For a number of years, RBGE had offered garden design courses at introductory and intermediate level and in 2005, we decided to launch our own professional-level Diploma in Garden Design.

We benchmarked our standards against requirements for registered membership of the Society of Garden Designers and appointed Diane Pyper as Course Director. Diane had been teaching most of the garden design courses, but importantly she had also been delivering a Diploma-level programme elsewhere.

RBGE's Diploma has a strong emphasis on design, but also includes hard landscaping, plant use and horticultural practices. The first course started in September 2006, with design elements taught mainly by Diane Pyper and Douglas Coltart, and horticultural and plant identification training provided by RBGE horticulturists. We also secured the services of renowned garden designer and TV personality Chris Beardshaw to

The use of guest lecturers is key to the success of this Diploma.

act as external moderator and critique the students' final presentations.

Although the first year was a success, a number of improvements were made for this year. The horticultural element was formalised with a series of workshops tailored to meet design students' needs. We also increased the input from Chris Beardshaw, who has been well-received by students – this year he has made one visit per term to run critiques and workshops and we are hoping to increase his involvement even more. The use of guest lecturers is key to the success of this Diploma – they introduce our students to a range of creative approaches and specialisations.

We aim to raise the standard even further by adding a second year to the programme in which students will develop their design portfolios independently, with the support of occasional tutorials at RBGE. ■

Photos, this page, clockwise from top left: Garden Design student hard at work in class; Course Director Diane Pyper and student in a Garden Design class; getting to grips with essential draughtsmanship skills.



Photos, clockwise from top left: Greg Kenicer, now a lecturer at RBGE, introduces youngsters to the wonders of ferns (photo courtesy of Helen Pugh); Raffaella Mantegazza; Jin-Hyub Paik pressing specimens during an expedition to the Gaoligong Shan; Abdul Wali Al-Khulaidi; Estelle Gill investigating native scurvy-grass (*Cochlearia* species); Barbara Mackinder with *Berlinia rabiensis*; Daniela Schill preparing liverwort specimens for molecular work in Minnesota; H el ene Citerne in the Glasshouses.



PhD students – where are they now?

Catherine Kidner, PhD Co-ordinator



PhDs at the Royal Botanic Garden Edinburgh cover a range of topics, from classic taxonomy through evolutionary developmental genetics, phylogenetics, population genetics and conservation. Most of our recent students have gone on to further work in plant science.

Many foreign students have returned to lectureships or research positions in their own countries. Nazre Saleh, who graduated in 2006, has returned to Malaysia where he works in the Faculty of Forestry, University Putra Malaysia, not far from Kuala Lumpur. Haja Maideem Kader Maideem (2008) has also returned to a lectureship in Malaysia. Pranee Palee took up a lectureship in Thailand after finishing her PhD in 2006 and Abdul Wali Al-Khulaidi (also 2006) has returned to the Agricultural Extension and Research Authority in Yemen.

Four recent graduates have joined RBGE staff. Peter Wilkie (2006) did his PhD part-time whilst on staff. Barbara Mackinder (also 2006) was employed part-time at Kew while working on her PhD and has now taken on work at RBGE too – she divides her time between working on Sapotaceae as Research Associate and being a Leguminosae Researcher for Flora of Arabia (as a staff member), whilst remaining on staff at Kew.

Greg Kenicer graduated in 2007 and has joined RBGE's Education Department as a lecturer in botany, though he retains an interest in legume phylogenetics. Sophie Neale (2005) has worked on the BioCASE/SYNTHESYS biodiversity database and is now working with Dr Tony Miller and Sabina Knees on the Oman Botanic Garden (see page 11) and other Flora of Arabia projects.

Chris Kettle (2006), Daniela Schill (2007) and Jin-Hyub Paik (2008) have all moved on to post-doctoral positions at RBGE in collaboration with their supervisors. Chris is an NERC post-doc working on a joint project with the University of Aberdeen, while Daniela is Sibbald Fellow working with bryologist Dr David Long. Jin-Hyub Paik undertakes short Sibbald-funded projects on Gesneriaceae with Dr Kwiton Jong and Dr Michael Möller.

Hélène Citerne (2004) has stayed in the field of floral evo-devo and taken up a post-doctoral position in France, while Will Goodall-Copestake (2006) is working on krill at the British Antarctic Survey in Cambridge.

Alan Forrest (2006) worked for a time with sex specification in plants at the University of Edinburgh and is now a post-doc in Spain studying the evolution of floral form in *Antirrhinum* species. Kanae Nishi (2007) is continuing to work on *Streptocarpus* but has moved to the lab of another ex-RBGE PhD student, Chun-Neng [Bruce] Wang (2003), in Taiwan.

Finally, Estelle Gill is still working with British native plants as a conservation officer based at the Macaulay Institute in Aberdeen, while Raffaella Mantegazza (2007) works in quality control for a commercial company. ■

Photo, this page: *Dahlia* 'Moonfire'.



Also
this year ...



1

1 RBGE's horticulture team provided the show-stopping centrepiece for the great Floral Hall at **Gardening Scotland**, held in early June 2007 at Ingliston. The ambitious, large-scale display, dubbed 'Gardening the Earth', reflected the international flavour of the Garden's living collections and conservation work with rare and exotic plants from around the world. It featured a raised viewing platform overlooking beds representing different geographical areas and endangered ecosystems, such as mangrove swamps and coral reefs, as well as elements from Benmore, Dawyck and Logan Botanic Gardens. RBGE horticultural staff and scientists were on hand to chat to show-goers.



2

2 **First Minister Alex Salmond** visited RBGE's display at Gardening Scotland on the first day of the show – he is pictured here examining a replica Wardian case containing the very rare *Rhododendron tuhanensis* and flanked by RBGE Indoor Curator David Mitchell and Director of Horticulture Dr David Rae.



3

3 In August 2007, RBGE hosted the **Sixth Biennial Conference of the Systematics Association** against the backdrop of tercentenary celebrations of Carl Linnaeus (see page 36). The Garden welcomed some 200 delegates from around the world to discuss issues including modern approaches to documenting the planet's biodiversity, assessing the mechanisms by which new species evolve, and funding opportunities from UK research councils. The meeting featured several lectures by RBGE staff and students, and provided a vibrant forum for biodiversity researchers.

4 The Garden's **Herbarium and Library** joined over 60 buildings around Edinburgh in opening their doors to the public as part of Edinburgh Doors Open Day on 29 September 2007. Over 200 people came along to enjoy a free guided tour of the building – first opened in 1964 and extended in 2005-06 – and its world-class facilities.



5 Plans to restore the ruined Victorian **Fernery at Benmore Botanic Garden** in Argyll received a boost on 30 November 2007, when the Heritage Lottery Fund awarded £236,500 to RBGE for the restoration. Once restored, Benmore's Fernery will open to the public as a hub for education and awareness about the conservation of ferns.



6 Work to construct The Gateway, RBGE's new state-of-the-art visitor facility, began in autumn 2007. In September, the West Gate closed to the public so that clearing of the site could begin. A temporary main entrance was opened at the North Gate on Inverleith Place and the Botanic Shop continued trading from a temporary site at the East Gate. This photo shows progress of the building work as at February 2008. Spring 2008 saw the adoption of a new name for the building – the **John Hope Gateway** – following a naming competition that attracted nearly 300 entries. The winning entry, from Dr Ian Rolfe, commemorates RBGE's Regius Keeper from 1761-86 (see page 25 for more about Hope).



7 The commencement of work to the John Hope Gateway was preceded in August 2007 by an announcement by **Richard Lochhead**, Scottish Government Cabinet Secretary for Rural Affairs and the Environment, of the final funding package of £10 million for the project. The Minister is pictured here planting a tree to mark the occasion, along with Sarah Bronsdon of the Heritage Lottery Fund (left), and RBGE Trustees and management.



8 **Professor Douglas Henderson**, RBGE Regius Keeper from 1970 to 1987, died in November 2007. He was the Queen's Botanist in Scotland from 1987 until his death. During his time as Regius Keeper, he presided over several major developments, including the installation of two new glasshouses, the first opening of Inverleith House as an exhibition venue and the incorporation of Dawyck into RBGE's care.



9 Following the death of Dr Paul Nicholson, **Sir George Mathewson** was appointed the new Chairman of RBGE's Board of Trustees in November 2007. Sir George, formerly Chairman of The Royal Bank of Scotland, previously headed RBGE's Campaign Board in its successful Gateway fundraising drive.





10



11



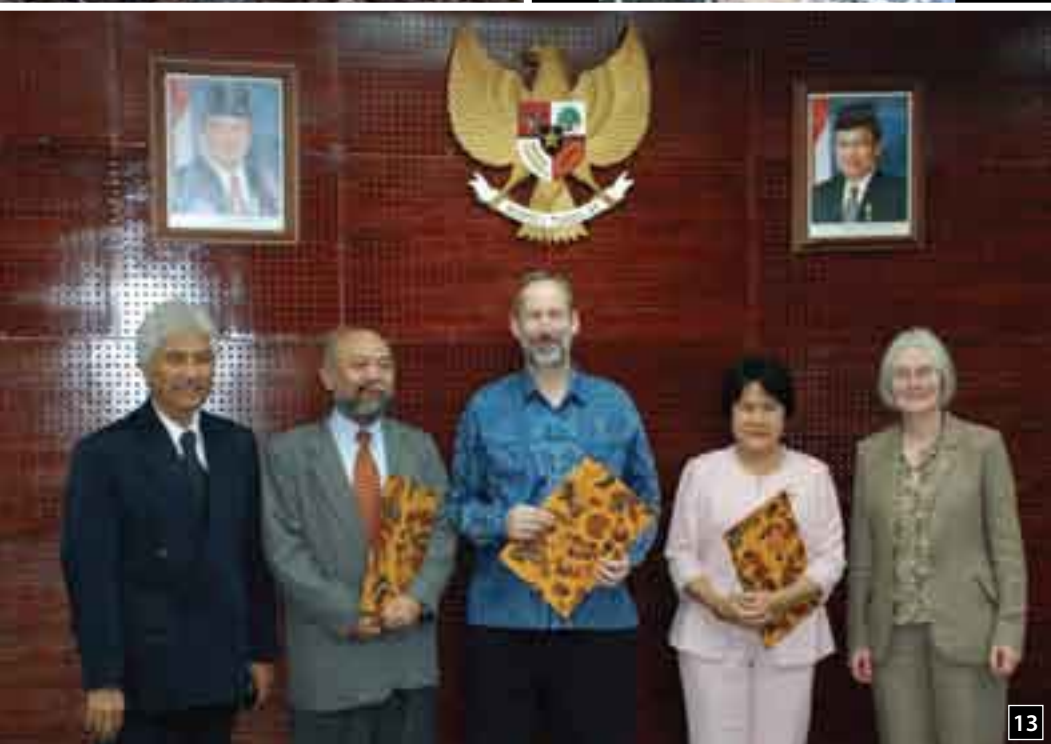
12

10 Prof. Mustafa İşiloğlu of Mugla University in Turkey came to RBGE for nearly six months, from November 2007 to June 2008, to work on Turkish collections of larger fungi under the guidance of the Garden's mycologists Prof. Roy Watling and Dr Stephan Helfer. Three papers – on a new species of *Marasmius*, the first Turkish record of *Lepiota rubella* and a report of a fatal mushroom poisoning of a young girl in southern Turkey – are awaiting publication. Further papers are being readied for presentation to journal editors. This image shows *Inocybe rimosa*, the fungus responsible for the fatal poisoning investigated by Prof. İşiloğlu.

11 In early 2007, Logan Botanic Garden in Dumfries and Galloway welcomed a new Curator after the retirement of Barry Unwin. **Richard Baines** was formerly Head of Horticulture at Barony College near Dumfries.

12 An all-new **guide book for the Botanics in Edinburgh** was published in July 2007. The 48-page, full-colour booklet offers visitors a detailed glimpse behind the scenes at RBGE, an insight into its extensive living collections and a round-up of the Garden's must-see features.

13 RBGE's Regius Keeper Prof. Stephen Blackmore and Director of Science Prof. Mary Gibby visited Indonesia in February 2008 to sign a **research collaboration agreement** between RBGE and the Centre for Plant Conservation, Bogor Botanical Gardens, and Indonesia's Research Centre for Biology. Pictured from left to right: Prof. Dr Endang Sukra, Deputy Chairman for Life Science, Indonesian Institute of Sciences; Dr Dedy Darnaedi, Director, Research Centre for Biology; RBGE's Prof. Stephen Blackmore; Dr Irawati, Director, Centre for Plant Conservation at Bogor Botanical Gardens; RBGE's Prof. Mary Gibby.



13

14 **China's Ambassador to the UK**, H.E. Madam Fu Ying, dined with RBGE's Senior Management during her official visit to Scotland in November 2007. She is pictured here with the Director and Deputy Director of Horticulture, Dr David Rae and David Paterson.

15 In June 2007, RBGE welcomed the **new Chinese Consul General** in Edinburgh, Madam Tan, to her post with a visit to the Herbarium. Here, Major Floras Co-ordinator Dr Mark Watson shows her herbarium collections made by George Forrest in China over 100 years ago, with Director of Science Prof. Mary Gibby and Regius Keeper Prof. Stephen Blackmore looking on.



15



14



Summary of accounts

During the year, the Garden received grant in aid of £13,370,000. Other grants, gifts and donations of £955,000 were received; £1,220,000 was generated from admissions to the Regional Gardens, education courses, rents, concessions, Membership income and other activities; trading and commercial activity contributed £496,000. Staff costs amounted to £7,284,000 and £3,748,000 was spent on other operating costs excluding depreciation. Capital expenditure of £5,077,000 was incurred of which £1,429,000 was for the construction of the Dawyck Visitor Centre and £2,861,000 for The Gateway building at Edinburgh.

The consolidated accounts for the year show a deficit of £8,397,000. This is because grant in aid for revenue purposes is credited directly to the General Fund rather than being shown as income on the face of the Income and Expenditure Account. Once this is allowed for, the remaining deficit on the General Fund is £118,000. Of this, £95,000 is a loss on the disposal of assets caused by the Gateway development. There is a surplus of £41,000 on the Board Reserve Fund. This is made up of a surplus of £28,000 on the Ferguson Bequest, a surplus of £35,000 on non-grant-in-aid activities and a loss of £22,000 from the Botanic Trading Company, which faced difficult trading conditions as a result of the relocation of the shop at the West Gate as part of the Gateway development.

The full RBGE accounts are laid before Parliament and are available to view in the RBGE Library or online at www.rbge.org.uk/about-us/corporate-information/annual-report-and-accounts.

Photo, this page: *Veratrum album*.

Consolidated Income and Expenditure Account

Year ended 31 March 2008

	2007/08 £000	2006/07 £000
INCOME		
Voluntary income	955	977
Gain on sale of investments	9	28
Incoming resources from charitable activities	1,220	879
Income from fund generating activities	496	716
	2,680	2,600

	2007/08 £000	2006/07 £000
EXPENDITURE		
Staff costs	7,284	6,870
Depreciation	1,558	1,437
Less release of deferred grant	(1,277)	(1,188)
Other operating costs	3,748	3,444
	11,313	10,563

	2007/08 £000	2006/07 £000
OPERATING DEFICIT		
Operating Deficit	(8,633)	(7,963)
Dividends and interest receivable	103	78
Notional cost of capital	(856)	(750)
Deficit for the financial year (after notional costs)	(9,386)	(8,635)
Reversal of notional cost of capital	856	750
Excess of depreciation based on revalued amounts over equivalent amortisation of deferred grant	279	244
Adjustment for Movement on Project Funds	(146)	62
Deficit for the financial year	(8,397)	(7,579)
Transferred to:		
General Fund	(8,438)	(7,702)
Board Reserve Fund:		
Trustee Funds	13	76
Ferguson Bequest	28	47
Deficit for the financial year	(8,397)	(7,579)

Consolidated Balance Sheet

As at 31 March 2008

	2007/08 £000	2006/07 £000
FIXED ASSETS		
Collections	0	0
Other tangible assets	26,718	23,391
Intangible assets	56	0
Investments	692	755
	27,466	24,146

	2007/08 £000	2006/07 £000
NET CURRENT ASSETS/(LIABILITIES)		
Stock	187	191
Debtors	594	486
Current asset investments	683	643
Cash at bank and in hand	1,532	1,045
Creditors: amount falling due within one year	(1,805)	(1,498)
Net Current Assets	1,191	867
Total Assets less Current Liabilities	28,657	25,013

	2007/08 £000	2006/07 £000
TOTAL ASSETS LESS LIABILITIES		
Creditors: Amounts falling due after more than one year	0	(14)
Total Assets less Liabilities	28,657	24,999

	2007/08 £000	2006/07 £000
CAPITAL AND RESERVES		
Unrestricted Funds		
Accumulated Deficit on the General Fund	(120)	(2)
Board Reserve Fund: Trustee Funds	637	653
Total Unrestricted Funds	517	651
Restricted Funds		
Board Reserve Fund: Ferguson Bequest	787	827
Capital Revaluation Reserve	8,764	9,059
Deferred Capital Grants	17,591	13,608
Donated Asset Reserve	755	755
Project deferred income	323	223
Project deferred expenditure	(80)	(124)
Total Restricted Funds	28,140	24,348
	28,657	24,999



Professor Stephen Blackmore, Accountable Officer
2 July 2008

Photo, this page: Ox-eye daisy, *Leucanthemum vulgare*.

Facts and figures

INCOME	2007/08 £000	2006/07 £000
Revenue Grant in Aid from RERAD	8,319	7,688
Capital Grant in Aid from RERAD	5,051	2,941
Other capital grants	179	262
Research grants	755	800
Income from Botanic Foundation	87	30
Donations	113	90
Admissions	245	240
Catering contracts	90	95
Education charges	390	299
Rents receivable	27	29
Membership income	114	125
Events, venue hire, licensing and commercial publishing	72	118
Botanics Trading Company sales	424	598
Botanics Trading Company Gift Aid	0	57
Dividends and interest receivable	103	78
Other income	354	91
	16,323	13,541

MEMBERSHIP NUMBERS	2007/08	2006/07	2005/06
Number of Members	6,056	5,874	4,945
Percentage increase	3%	18%	15%

VISITOR NUMBERS	2007/08	2006/07	2005/06
Edinburgh	611,293	623,312	579,328
The Glasshouses	42,002	37,716	39,724
Benmore	56,320	58,560	36,634
Dawyck	22,018	22,139	18,054
Logan	26,209	26,675	25,388

LIBRARY STATISTICS	2007/08	2006/07	2005/06
Books purchased	608	562	702
Books & reprints donated	177	131	184
Non-book orders	172	5	12

Principal items catalogued including retrospective cataloguing:

Books	2,110	2,445	5,176
Serials	35	25	4
Reprints	144	91	127
Journal articles	2,885	1,888	1,613
Grand Total	5,174	4,449	6,920
Current journals held	1,406	1,402	1,402
Lapsed journals held	2,941	2,908	2,879
Total journals held	4,347	4,310	4,281

Binding:

Books	40	29	61
Journals	478	538	482
Total	518	567	543

Visitors	1,000	1,000	1,200
Enquiries (estimated)	2,500	2,800	4,000

HERBARIUM STATISTICS	2007/08	2006/07	2005/06
Incoming loans	127	100	88
Specimens borrowed by RBGE	6,336	6,925	5,818
Outgoing loans	121	133	108
Specimens lent by RBGE	6,583	6,812	4,515
Specimens received as gifts or exchanges	31,773	3,260	8,012
Specimens mounted	15,951	11,000	3,479
Backlog of unmounted specimens	54,379	46,112	41,689
Specimens barcoded and data entered	27,251	30,615	15,344
Plant specimens identified from the general public	212	186	246
Plant specimens identified from the living collection	851	497	461
Specialist visitor days	464	256	364
Public visitor days	103	185	230

LIVING COLLECTION	2007/08	2006/07	2005/06
Families	345	344	333
Genera	2,725	2,728	2,722
Species	13,406	13,407	13,505
Taxa	17,599	17,650	17,761
Accessions	34,401	34,353	33,517
Plant records	66,758	66,044	53,706
New accessions	1,955	1,976	2,266
% Wild origin	56%	59%	55%
% Verified	32%	31%	31%

FUNDRAISING

In addition to the Grant in Aid received from RERAD, the Garden raised £1,830,000 for general purposes and £1,123,000 for specific projects in this reporting year.

General highlights include:

- Gross Membership income, including Gift Aid and events, of £168,000
- Members' appeals raised £25,679 for The Gateway Biodiversity Garden and £23,000 for the Benmore Fernery project.

Highlights in fundraising for The Gateway include:

- A Biffaward flagship grant of £459,000 – a 'first' for this organisation in supporting a project of this size and scale in Scotland
- £250,000 donation from The Wolfson Foundation
- A further donation from The Gannochy Trust, bringing their total support to £125,000
- The Russell Trust made an additional donation, bringing their total to almost £20,000
- Support of £125,490 from Scottish Natural Heritage.

RETAIL – BOTANICS TRADING COMPANY

The Botanics Trading Company made a loss of £21,856 in the year compared with a profit of £55,614 in 2006-07. The relocation of the Botanics Shop from the West Gate during the construction of The Gateway contributed to difficult trading conditions.

Photo, this page: *Veratrum album*.

Environmental report

Introduction

Welcome to the Royal Botanic Garden Edinburgh's (RBGE) first annual environmental report, which summarises our progress in reducing the environmental impact of our operations. The highlights of this year's annual environmental report are included here. For the complete version, please see our website www.rbge.org.uk

The environment is not a new strategic topic for RBGE, since we have been developing an environmental management system (EMS) and actively running an environment working group since 2006. More recently we have made concerted efforts at an organisational level to improve environmental performance through various initiatives. We are also taking seriously the growing demand being placed on non-departmental government bodies by the Scottish Government and its 'Greening Government' strategy.

We have taken action over the last three years to become more systematic in the way we address the environmental impacts of our activities by adopting an environmental management systems approach modelled on the international standard ISO14001. This means that we have developed a comprehensive, high level environmental policy for the whole organisation, have identified our significant environmental impacts and have set objectives and targets to reduce these and demonstrate continual improvement. Our Environmental Policy can be found on our website www.rbge.org.uk

In this report we chart our progress for 2007-08 in pursuing targets set in 2006-07.

Royal Botanic Garden Edinburgh's environmental impacts

As part of the process of adopting a more systematic approach to environmental management, we knew that the first step would be to identify all the ways we as an organisation impact on the environment (referred to as 'environmental aspects' in the ISO14001 standard). It was necessary to set these out in a 'register of aspects' and then undertake a risk assessment of each aspect in order to establish the effects we have on the environment and rank them in order of significance. These would then become the focus of our objectives and targets. RBGE's key environmental aspects include:

- Use of natural resources
- Emissions to the atmosphere
- The generation of waste
- Use of water and emissions to water
- Conserving biodiversity

Environmental management system and responsibilities

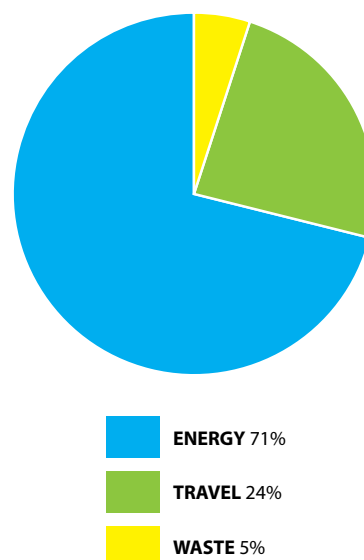
RBGE's senior management team are responsible for ensuring that our Environmental Policy is implemented and that we take action to reduce our environmental impacts. We have set up an environmental working group that includes our Environmental Co-ordinator together with key staff who will lead the environmental management groups (EMGs) – for utilities, transport, biodiversity, recycling and procurement – to deliver our objectives and targets.

Each group is expected to meet as regularly as required to formulate policy for their area, set targets and monitor progress. For each of the areas of the organisation (e.g. Nursery, Glasshouses) there is an Area Champion. Area Champions may be asked by EMGs to help introduce new environmental policies or procedures into specific areas.

Every member of RBGE's staff is expected to commit to the principles within our environmental policy and make an active contribution towards delivering the objectives and targets.

Carbon footprinting is a useful tool with which to compile an inventory of the greenhouse gas emissions associated with RBGE's activities. For this initial carbon footprinting exercise, we have concentrated on the botanic garden in Edinburgh. The 'operational boundary' for the carbon footprint includes emissions that can be broadly categorised as either 'direct' or 'indirect', and these are summarised in the table on page 66. The total annual carbon footprint for 2007 is 4,356 tonnes of carbon dioxide equivalent (tCO₂e). The approximate relative contributions from each of the components of the footprint are shown in the pie chart below.

Components of RBGE's Carbon Footprint



Direct	Indirect
Emissions from the combustion of fuel in boilers	Use of electricity (generated at a power station)
Emission from business travel in vehicles owned by the business	Business travel in non-company-owned vehicles (trains, buses, planes, hire cars, etc.)
	Incineration of waste or decomposition in landfill.

The footprint does not include a consideration at this stage of:

- (i) the greenhouse gas emissions associated with staff travel to and from work in private cars, or the travel of visitors to and from the Garden;
- (ii) the greenhouse gas emissions and distribution miles for RBGE's purchase;
- (iii) the greenhouse gas emissions that relate to RBGE as a 'corporate citizen' (e.g. services provided by the local authority).

Utilities Environmental Management Group

Target (2006/07)	Progress to date
Establish the group	Achieved
Establish baseline figures for quantities of utilities used	This was carried out for the Edinburgh site as part of the carbon footprinting exercise undertaken in early 2008 – see table below. Need to establish baseline figures for other sites too
Develop policy for reducing usage and increasing efficiency of use	All new design and equipment is installed with energy efficiency as the highest priority.

Energy Consumption in Edinburgh Botanic Garden

Utility	Units (2007)	Amount per annum (2007)	Tonnes of carbon dioxide equivalent (tCO ₂ e) per annum	Proportion of RBGE's carbon footprint
Electricity	Kilowatt hours (KWh)	1,806,906	777	18%
Gas	KWh	11,227,290	2,133	49%
Fuel oil	Litres (L)	61,500	178	4%
Total energy	–	–	3,087	71%

Recycling Environmental Management Group

Target (2006/7)	Progress to date
Introduce recycling into the public areas of the Garden	Achieved
Recycling metal, plant material, glass, paper and cardboard from non-public areas	Achieved

The generation of non-hazardous waste is recognised as a significant environmental aspect for RBGE. Increasing the amount of waste we segregate, recover, re-use and recycle is critical so that we can reduce the amount we are responsible for that currently goes to landfill.

Transportation Environmental Management Group

Target (2006/07)	Progress to date
Establish the group	Achieved
Establish baseline information on transport use	Baseline information was gathered for business travel within the RBGE during the carbon footprinting exercise. Current recording methods probably do not fully capture this component of the footprint. Procedures have been put in place in order to ensure that information on all business travel is recorded in a readily useable format
Develop policy for reducing the amount of transport and making more efficient use of existing modes of transport	A 'decision tree' is being devised to help staff make low carbon travel choices, particularly within Britain.

Travel by staff on RBGE business contributes a significant portion of the organisation's carbon footprint (24%). Many of RBGE's functions require long distance travel. However, where opportunities exist for more sustainable travel, RBGE is keen to promote these.

Procurement Environmental Management Group

Target (2006/07)	Progress to date
Establish the group	Achieved
Develop listings of all aspects to be considered	All paper from the RBGE shop and restaurant is now recycled
Develop policies for use of more ethical, green or locally sourced products	Costings are being done to ascertain the feasibility of providing staff with clothing made from fairly traded organic cotton.

The Indoor Department (Glasshouses) has increased its use of biological cultural controls to reduce pest populations as part of an Integrated Pest Management System (IPM).

The staff canteen at RBGE is now stocked with Fairtrade products where possible.

Biodiversity Environmental Management Group

Target (2006/07)	Progress to date
Establish the group	Achieved
Establish a system to survey biodiversity – one group per year	During a recent survey commissioned by the biodiversity group, Bob Saville from Lothian Wildlife Information Centre (LWIC) found a bark louse new to Scotland on several conifers near the North Gate
Develop policies for increasing biodiversity in and around the Garden	Information from the annual surveys will be used to advise Garden staff and inform work programmes.

The Nature Conservation (Scotland) Act 2004 imposes a duty on all public bodies to further the conservation of biodiversity in the delivery of their statutory functions. Since biodiversity is core to the functions of RBGE, it is considered that this is an area in which we can excel at delivering our statutory duty to educate, support and network with regard to biodiversity.

Certification of Annual Environmental Report

We have assisted RBGE in compiling this, its first environmental report and we are satisfied that all the information supplied and calculations made accurately reflect its current environmental performance. We believe that RBGE can build on this encouraging start and are keen to encourage RBGE to set challenging but achievable targets in further reducing its carbon footprint and tackling the complex issue of conserving and enhancing biodiversity. It has a clear role to play in communicating the issues to the general public and thus encouraging them to 'raise their game' and in furthering the leadership role that the Scottish Government expects of it and other public bodies. *Dr Phil Say, Natural Capital, April 2008.*

Photo, this page: Butterfly on *Echinacea* species (photo courtesy of Alex Wilson).

Publications by staff and associates

1 April 2007 - 31 March 2008



Authors associated with RBGE are noted in upper case.

The medium of publication is noted as a symbol after each reference:

- A** Publications in peer reviewed journals
- B** Books, book chapters, edited books
- C** Reports, commissioned work, abstracts
- D** Book reviews
- E** Unpublished thesis

ADAMSON, H. (2007). On course for new knowledge. *The Botanics*, 29: 10. **C**

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AKERS, R. (2007). A preliminary checklist of the vascular plants of the Cockscomb Basin Wildlife Sanctuary, Belize. M.Sc. University of Edinburgh/RBGE. **E**

Amato, A., Kooistra, W.H.C.F., Levaldi Ghiron, J.H., MANN, D.G., Pröschold, T., Montresor, M. (2007). Reproductive isolation among sympatric cryptic species in marine diatoms. *Protist*, 158: 193-207. **A**

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