What to grow? Revaluating the public glasshouse collections at Cambridge University Botanic Garden

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Abstract

Deciding what we grow in Botanic Gardens and the messages our plantings can convey is key to ensuring that our collections remain relevant and useful. Restoration of the public glasshouse range at Cambridge University Botanic Garden (CUBG) has provided an opportunity to address this question. This paper discusses the process and philosophy behind the review of our collections and the overarching theme that has emerged, intended to provide a more logical and exciting experience for visitors. Utilising the varied glasshouse environments enables us to showcase some of the key environments from around the World and their plants, 'the drama of diversity'. The collections must be relevant in a multitude of different ways, exotic flowers to excite visitors and showcase glasshouse horticulture, an education resource and to highlight issues of conservation and sustainability, themes in common with many other gardens. But we also wish to give a unique perspective to our collections. As a University Botanic Garden working closely with plant scientists, we plan to show the importance and relevance of plant sciences in 'understanding plant diversity', a theme running throughout the glasshouse range and in time extending to other collections.

Introduction

The glasshouse range at Cambridge University Botanic Garden (CUBG) is one of our best known landmarks and attractions, providing the growing conditions to cultivate nearly 2000 tender plants from around the World. It is of a unique design with a corridor of nearly 90 metres in length from which a succession of eight separate glasshouses open off along the southern edge. The current range was constructed from Burmese teak in 1933 and 1934, a direct replacement for a previous structure of a similar design and layout built from pine in 1888. Much of the original teak structure has survived although some houses have since been replaced with aluminium and the central palm house was rebuilt in steel during the late 1980's. However, the teak houses still form a major part of the range and are, we believe, the only surviving teak range in the UK and hence of great historic value and interest.

Figure 1. The Glasshouse range viewed from across the Main Lawn

In 2000 a five-year plan was developed by the Glasshouse Supervisor and Curator that aimed to develop some of the houses. Lack of resources and maintenance issues hindered the implementation of these changes. In 2005 support from the University Estate Management Service enabled a restoration programme to begin so to secure the future of the remaining teak elements of the glasshouse range. The final phase is scheduled to finish in the summer 2007. The durability of the teak has been remarkable considering it has been exposed to all elements for over 70 years with only sporadic maintenance. Most of the major structural pieces are perfectly sound and with repair have been retained. The glazing bars, which had deteriorated at each end, have all been replaced utilising teak salvaged from the demolition trade around the UK.

The restoration programme has been the catalyst that has enabled us to take a far more fundamental review of the collections and planting themes throughout the glasshouse range. It has also opened up access to funding so new landscapes and plantings could be created and interpreted. This paper discusses the process and outcome of the revaluation of our glasshouse collections.

Figure 2. - The original timbers of the Temperate House roof restored to their former glory pictured during reglazing. The corridor leading to the Palm House, rebuilt in steel and opened in 1989, is shown beyond.

Current highlights and problems

The current glasshouse plantings represent a mix of contemporary and historic plantings arranged according to their environmental requirements. Educational and interpretive themes focus on sustainability, adaptation, conservation and horticulture and the plantings of economic plants are used extensively by the Education Department, particularly for school groups. It is one of the Gardens major visitor attractions and particularly important during adverse weather. Spectacular flowerings of plants such as *Agave sisalana*, the *Amorphophallus titanum* (Titan Arum) in 2004 and the yearly display given by the *Strongylodon macrobotrys* (Jade Vine) are highlights that attract many visitors and publicity.

Figure 3 - Strongylodon macrobotrys*, a favourite in many Botanic Gardens collections, the Cambridge plant flowers profusely each year. An iconic and exotic plant, it highlights their importance in engaging with visitors not usually inspired or interested in plants.*

Analysis of the collections and plantings revealed areas that could be improved and issues that needed to be addressed and are summarised below:

- Taxonomic content - certain plant groups and taxa were poorly represented. Whilst many unusual plant families and genera are grown, others such as the Proteaceae were simply missing or had been lost from the collection. Equally, certain highly diverse floras such as South Africa were poorly represented.

- Planting themes - Some of the plantings represented remnants from previous eras, appropriate to their time but less able to fulfil today's requirements. For example the cacti and succulents were housed as separate collections in different houses. Whilst individual plants in these collections provided opportunities for interpretation, the actual plantings where less successful in conveying a coherent story or theme.

- Green wallpaper - in some houses such as the Temperate House, a typical botanic garden collection of tender plants from around the World, visitors would walk in and through the display without stopping. Essentially the display provided no reason for them to stop and there was little engagement with the planting.

- Temporary displays – these were very successfully housed in the Conservatory and changed every 2--3 months. Popular with visitors and an opportunity to create interesting and educational displays they proved to be very high maintenance and with current resources a struggle to maintain.

- The visitor experience – a walk through the glasshouse range took you from one display to another. Whilst each glasshouse formed a display in its own right there was no cohesive theme or experience that linked each together.

The challenge of understanding our purpose and audiences

Key to developing any new scheme is to fully understand the purpose of the collections and the roles they need to fulfil. As declared in the Botanic Garden's Statement of Purpose:

'*The Botanic Garden holds the research and teaching collection of living plants for the University of Cambridge… Its fundamental purpose is to make these collections accessible for the current generation and to maintain them for future generations.'*

Within its 16 hectares the Botanic Garden grows and displays over 8,000 species, a representative collection of plant diversity. The protected and varied growing conditions provided by the glasshouse range dramatically expands the diversity we can cultivate to a global scale, albeit a minute selection. The varied collections and plantings represent a resource that is accessible and is utilised by the University for its research and teaching needs. In addition to these collections more specific research and teaching requirements are also met through our Experimental Section and its associated glasshouses. However, whilst fulfilling these core roles, the public glasshouses are most frequently accessed and used in other ways. They now fulfil a major public education role. Numerically, the primary users of the glasshouse range are our 130,000 visitors each year. The glasshouses are a popular attraction for these groups and offer a great opportunity to both inform and enthuse people about plants, their diversity and endless forms and wider environmental issues.

In essence this represents one of the challenges facing us as a University Botanic Garden. Our collections and plantings need to satisfy a number of different audiences and users. Developing the new glasshouses theme provided an opportunity to meet this challenge – the need to create a resource through our collections and plantings, that can be used in a multitude of different ways.

The opportunity and challenge - defining a theme and new plantings

The opportunity provided by the restoration meant we could tackle several issues. One of the key aims was to develop an overarching theme to provide our visitors with a more logical and exciting experience. As a series of individual but linked glasshouses the range lends itself well to displaying plants from different environments ranging from the wet tropics to arid lands, alpines to the subtropics. Moving from house to house visitors would experience a range of plant diversity from some of the key environments around the World. Each house would display different life forms and associated adaptations, demonstrate various ecologies and highlight conservation issues. In essence this may not be a revolutionary idea, more a reappraisal and reordering of the growing environments. What is significantly different is the philosophy driving this, linking the individual glasshouses and their collections into a coherent experience, which became known as the 'drama of diversity'. This change in philosophy is also reflected in the language used, we have started talking about displays rather than individual glasshouses. This will be reflected in the use of banners along the linking corridor that will introduce visitors to each display.

Current house name	New theme & display name	Rationale
Temperate House	Theme: **Unique Floras** Display name: **Continents Apart**	To show two of the richest floras in the World - South Africa and Australia. To explore their linked origins and the Mediterranean climatic zones of the World together with adjacent external plantings featuring plants from the Mediterranean Basin, California and Chile.
Conservatory	Theme: **Unique Floras** Display name: **Oceanic Islands**	To illustrate the unique diversity found on oceanic islands, including the Galapagos, representing the historic link in understanding evolution through Charles Darwin to his mentor and founder of CUBG John Steven Henslow, plants from the Canary Islands showing evolutionary processes (adaptive radiation) and St Helena illustrating the fragility of island ecosystems and the urgent need for Conservation.
Alpine House	Theme: **Alpine Diversity** Display name: **Mountains**	To illustrate the horticultural diversity of Alpines as a mixed and seasonal display including spring bulbs and to show plantings of 'true alpines' illustrating there major adaptations.
West Tropics, Palm House & East Tropics	Theme: **Tropical Diversity** Display name: **Rainforests**	Tropical Diversity – taxonomic, the range of life forms and ethnobotany. The plantings would be themed to reflect the Old and New World.
Succulent House	Theme: **Diversity of form and function** Display name: **Extreme Diversity**	Exploring plant diversity through form and function including carnivorous plants and Bromeliads.
Belize display and Cacti	Theme: **Arid land diversity** Display name: **Arid lands or Deserts**	To illustrate the diversity of arid land plants from Africa and the Americas. To show convergent evolution between succulent Euphorbiaceae and Cactaceae and the variety of other survival strategies including annuals and drought tolerant shrubs.
Fern House	Theme: **Lower plant diversity** Display name: **Before flowers**	To display examples of extant lower plants groups representing the key evolutionary steps in plant evolution.

Table 1 - Layout of the individual glasshouses showing the current house names and proposed themes, display names and the rationale behind each new planting

The recently planted Temperate House exemplifies the kind of ideas we wished to achieve. It was decided that the existing collection of tender plants certainly contained a diverse and interesting range of species but had limited landscape and visitor interest. Instead, we have focused on two of the most diverse floras in the World, those of the Cape Region of South Africa and Western Australia. Previously poorly represented in our collections, this has introduced a new range of families and genera. Both contain exotic and unusual plants, often of great ornamental value, enabling a visually interesting display to be created. This would appeal to those visitors who are keen gardeners wishing to see something unusual, whilst providing our own staff with the challenge of growing these plants and to display their horticultural skills. However, it is maybe the stories associated with these floras that can be told through the new displays that are of greatest interest. In this case the

key ones identified are: their shared origins as part of Gondwanaland exemplified through the family Proteaceae; and the fire dependence of the vegetation demonstrated as burnt areas of recovering vegetation in the displays. This later theme created great interest – the Botanic Garden burning its plants! This sparked great interest from the media including newspapers, radio and television and resulted in many additional visits. This immediately demonstrated the effectiveness of this new approach - we were successful by increasing the intellectual accessibility of our collections by creating interest and hence engagement with the plantings.

Figure 4 - Artist's impression of the restored and replanted Temperate House. A space has been created in the centre to show the wonderful architecture of the glasshouse. Equally importantly was to create a space for people, otherwise lacking in the glasshouse range. It could potentially provide a unique venue, a key asset when fundraising.

The next house also has the theme of unique floras, this time focusing on oceanic islands. Ideal as laboratories to study evolution, a planting of Galapagos plants will explore this and the historic link through John Stevens Henslow, founder of CUBG, mentor to Charles Darwin and the man who recommended Darwin for his famous voyage on the Beagle. The Canary Islands will take this theme by displaying the results of adaptive evolution through the visually exciting forms that have occurred in genera such as *Aeoniums* and *Lavandula*. Finally, conservation issues and the fragility of island ecosystems will be shown through some of the critical endangered plants from the South Atlantic Island of St Helena, including species such as *Trochetiopsis ebenus* (Ebony) only rediscovered in 1980 as two surviving plants on a steep cliff, and *Mellissia begoniifolia* (Boxwood) reduced to a single plant that was rediscovered in 1998.

In contrast the collections of cacti and succulents will be merged into a single house to create an arid land display. By forming a coherent display focusing on this key environment will allow a range of themes to be explored from the range of adaptations (a useful teaching resource for University students) and examples of convergent evolution, the classic example being the succulent *Euphoria's* of the Old World and the Cactaceae in the New World, illustrated by the juxtaposition of plantings. With arid lands likely to be at the forefront of climate change, a display of hardy cacti outside the glasshouse will, we hope, create an unusual and surprising horticultural display and a way to engage visitors in these wider and more serious issues.

A consequence of taking such a focused view of our displays is that some species we wish to cultivate will not fit a theme. Within the range we need some flexibility and this will be provided through the linking corridor. The corridor theme of tropical and subtropical ornamentals can be interpreted in a more flexible way and also provide areas for temporary displays. During the spring of 2007, the blank canvas provided by the recent

restoration has provided the backdrop for what has proved a very popular orchid display, one that will no doubt be continued in future years on a smaller scale.

Figure 5 - The restored eastern corridor offered a blank canvas for a major orchid display in the spring of 2007 before permanent planting takes place later in the year. The corridor will continue to provide an area for temporary displays in the future.

A unique perspective – Understanding Diversity

The Cambridge University Botanic Garden on its current site is the vision of its founder, John Stevens Henslow, Professor of Botany and mentor to Charles Darwin. He founded the Garden on scientific principles, a place for experimentation. Reflecting Henslow's vision a linking theme running through the plantings will be 'understanding plant diversity'. Using elements of the plantings or individual specimens the importance of plant sciences in understanding and utilising plant diversity will be illustrated. As a University Botanic Garden with a strong connection to a vibrant Plant Science Department we aim to create a unique perspective, a resource for teaching students and informing visitors. It offers the opportunity to explore everything from some of the greatest discoveries through to important current work relevant to today's issues such as climate change and conservation.

Display Name	Understanding Diversity and links to Cambridge based and other Plant Science research
Continents Apart	• Pollination biology and flower structure – illustrated through the beetle daisy, *Gorteria diffusa* reflecting current work on petal cell variation and their importance in pollination. • Useful plant chemicals – *Hoodia gordonii* and development of an appetite suppressant, work carried out by a locally based research companies. • Nutrient recycling and adaptations in poor soils, an area of research interest of Cambridge ecologists.
Oceanic Islands	• The importance of islands in understanding evolution – the historic link through Henslow and Darwin to illustrating adaptive radiation through genera such as *Lavandula*. • Conservation of the St Helena flora in which CUBG, through previous and existing staff have an interest.
Mountains	• Alpines at altitude – Surviving UV exposure at high altitudes and links to climate change. Pioneering research into plant responses to UV was carried out in Cambridge. • Arctic alpine elements in the British Flora as relicts of the ice age, a story first discovered through the Quaternary research in Cambridge.
Rainforests	• Rainforest structures and life forms reflecting the seminary work of Tim Whitmore in Cambridge. • Ethnobotany and its importance to indigenous people through links with the Department of Anthropology. • Regeneration in forests and the importance of sun flecks, a major area of current research in ecology.
Extreme Diversity	• Carnivorous plants – different solutions to living in nutrient poor environments. • Bromeliads – currently being investigated as indicators of climate change.
Arid land	• Succulence and Crassulacean Acid Metabolism, an example of an adaptation associated with arid environments and a major area of current research in the Department of Plant Sciences.

Table 2 – 'Understanding Diversity' – potential research examples and themes identified for each house.

Interpreting the drama of diversity

As important as the plantings themselves, provision of suitable interpretation is a key element to the success of the new plantings. With the help of a specialist the potential interpretation methods were assessed. This confirmed the need to carefully identify audiences and match the means of interpretation - essentially multiple delivery methods.

Our discussions identified permanent interpretation panels as an effective way to provide first line interpretation for our 130,000 visitors so they can understand at least the basic rationale and significance of each display. However, they will be kept to a minimum level in each house to achieve this and other methods utilized to tell the potentially numerous stories. This secondary level of information could be provided through means such as our website (the modern version of a leaflet) or even through laminated walkabout panels.

The very nature of plant displays means there will be times when we wish to interpret plants on a seasonal basis, often when they flower. In addition, repeat visitors form the largest proportion of our audience. Temporary changeable panels provide a way to meet seasonal demands and create continued interest.

However, we do see that guided tours are likely to be the most effective way of interpretation. How this will be organized is still open to discussion but could include special tours run by staff, alongside more regular tours with volunteer guides. Although resources limit our ability to utilise technological solutions it is hoped to explore such avenues in the future. They could certainly provide new and interesting opportunities for audiences such as University students who might be more likely to take advantage of the collections through audio tours linked to their lectures and downloaded to MP3 players.

Measuring up against the *Global Strategy for Plant Conservation* (GSPC)

The development of new plantings and themes has taken place within the context of the GSPC. In this case the major contribution is clearly through Target 14 – promoting education and public awareness. Creation of this new resource provides a powerful way to further raise the importance of plants to our visitors and maybe most significantly to the University students, who will be encouraged to further utilise the collections.

However, there are maybe other ways in which the glasshouse range and its collections can contribute in a smaller way. This includes:

- Target 3 – developing growing and propagation protocols for a wide of range plants.
- Target 8 – ex-situ conservation of island plants particularly those from St Helena by conserving key genetic clones.
- Target 11 – ensuring plants affected by international trade are appropriately sourced. For example, we propose to highlight that any new cacti used in the display are sourced from appropriate nursery sources.

Conclusion

The glasshouse restorations and new plantings at CUBG are taking us into an exciting time. The opportunity to undertake a fundamental revaluation has enabled us to revolutionise our plantings and collections within the glasshouse range, something that will no doubt be furthered in other areas. It highlights the often complex requirements that collections must fulfil and the need to create a resource that can be utilised in a multitude of different ways.

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