Congress Theme

Achieving the Global Strategy for Plant Conservation (GSPC) & Millennium Development Goals (MDGs) through education

The Holistic Experience at Ramat Hanadiv Park

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Rothschild Memorial Gardens and Nature Park, Ramat Hanadiv, Israel

Baron Edmond de Rothschild was known as the "Father of the Yishuv" (the pre-state Jewish community) and the "Well Known Benefactor". During the early days of Zionist settlement in Palestine, which began some 120 years ago, he supported the settlers, purchasing land and founding new rural communities. He continued to support these activities until his death in 1934. In April 1954, twenty years after his death, the Baron and his wife were reinterred in an official ceremony at Ramat Hanadiv. The Memorial Gardens were opened to the public on the same day.

Ramat Hanadiv Memorial Gardens occupy a seven-hectare site at the heart of a Nature Park that extends over some 450 hectares. It is located at the southern end of Mt. Carmel, approximately 140 metres above sea-level and a forty-minute drive to the north of Tel Aviv.

For thirty years Ramat Hanadiv lay dormant in the heart of the communities founded by Baron Edmond de Rothschild. The site was tranquil and seemingly untouched by the passage of time. Numerous visitors came to Ramat Hanadiv, but their visits were confined to the Memorial Gardens.

Subsequent years saw considerable change as the result of the increasing awareness of the importance of the Nature Park surrounding the Memorial Gardens. Research and educational activities developed during this period, as did the range of activities offered to the general public. The need to establish a building that could welcome the 300,000 visitors a year to Ramat Hanadiv and expose them to the themes and values of the site, increased. This development was accompanied by a process of self-definition, including the formulation of a vision and a mission statement. It was clear that Ramat Hanadiv was shaping a new identity that was more complex and developed than in the past.

> *"Ramat Hanadiv, a living monument to the memory of the Baron Edmond (Benjamin) de Rothschild, strives to create a balance between man and nature. It is carefully managed and tended for the benefit of the Israeli public as a whole and for generations to come, with awareness and sensitivity to its unique characteristics."*

With this vision in mind, the decision to utilize an area of the Nature Park in order to construct the Visitors Pavilion was not a simple one. The building plan underwent numerous revisions. An opportunity to provide the restaurant with a stunning view was abandoned in order to maintain the integrity of the Nature Park. The idea of establishing a museum was also rejected, reflecting the view that the aim of a visit to Ramat Hanadiv should be, above all, to experience the site. Architect Ada Karmi-Melamede showed great sensitivity to the beauty of the site. She chose to design a building covered with soil and vegetation. Over the years, the building will integrate in its surroundings and become part of the landscape.

In the 1990s, when the planning began, environmental awareness was almost non-existent. The Israeli standard for green building was introduced only in 2007, when construction work had already underway. Fortunately, the design concept chosen by the architect was consistent with a sustainable approach, and green-building principles could be integrated in the construction. The first of these focuses on planning a sustainable site. In keeping with this approach, trees felled in the construction area were ground for use as compost, while trees of unique value were preserved and construction work proceeded around them. Local rocks were quarried on the site for use in the construction process, and others were integrated in the landscaping as a design element. Another principle relates to water conservation and efficient consumption. This is reflected in the installation of an underground system for cooling the water used in the air-conditioners. The building also relies on natural light, which enters through an upper opening and is reflected off the internal walls. In order to limit the disturbance the building causes to its surroundings, night-time lighting has been kept to a minimum. These are just a few examples of the considerations that went into the

planning. The Ramat Hanadiv Visitors Pavilion eventually became the first public building in Israel to be granted 'Green Building' standard certification, and to be recognized as a certified LEED Building.

In the Theatre, a film entitled “Beyond the Gardens” presents the story of the Baron Edmond de Rothschild and Ramat Hanadiv. The Gallery hosts the exhibition “A Delicate Balance” which presents some of the main dilemmas that are encountered while managing the Nature Park and the Gardens. Classrooms enable teachers and students to take part in educational programs, most of which draw on the rich research activities at Ramat Hanadiv and are adapted to the Ministry of Education curriculum. The Lecture-Auditorium offers diverse possibilities for the visiting public. These facilities are complemented by a cafe-restaurant alongside a new playground.

Efforts are made to appeal to families who visit Ramat Hanadiv independently on weekends and during vacations. These visitors are offered organized activities such as bird ringing, concerts, or walking with the goats. Other families prefer to avoid peak visiting days and to come to Ramat Hanadiv during quiet periods. Ramat Hanadiv offers these visitors various types of activities that they can pursue on their own. The common aim of all the activities is to enrich the visiting experience and to expand the visitors' knowledge of sustainable development and the heritage of the site. As befits the legacy of Baron Edmond de Rothschild, all the activities are inspired by values of dignity and respect for nature and the environment.

Ramat Hanadiv operates as a non-profit institution. Entrance to the Gardens and the Visitors Pavilion is free of charge. The site closes at 4:00 pm, after which the Gardens and especially the Nature Park are left to their natural inhabitants. Establishing a cafe-restaurant at Ramat Hanadiv is a challenge, since the facility is closed for religious reasons on Saturdays (Sabbath) and on Jewish holy days. The need to ensure profitability of the cafe seems, at times to be at odds with principles of nature conservation and the reserved image of Ramat Hanadiv. The solution has been to change the daily functioning of the site. A marketing initiative was launched to invite groups of adults to come to Ramat Hanadiv during the week for enriching and engaging activities at the Nature Park and in the Gardens. The hope is that the participants will also visit the cafe and enable it to function without extending the visiting hours or using the facility as a banquet hall.

In conclusion, the construction of the Visitors Pavilion aims to meet needs that emerged naturally as the result of the growing number of visitors and their expanding fields of interest. At the same time, however, the building presents complex challenges for a site that seeks, on the one hand, to maintain balanced relations between nature and human activity and on the other, to enrich the visiting experience.

Partnerships and Conservation

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Abstract

Botanical gardens often sorely lack the financial means to ensure their functioning or to develop specific programmes. The Conservatoire botanique national de Brest (France) does not escape this rule, and for many years, it has been struggling to establish partnerships with private companies to fund its projects, particularly those dedicated to public awareness-raising.

This paper describes the partnership between the Conservatoire botanique and two private companies: a corporate foundation related to the fields of cosmetics and pharmacology (Institute Klorane) on the one hand, and an industrial group specialising in quarrying for the building sector (Lafarge Group) on the other.

First interested in funding projects that aimed to produce educational and communication tools, these two private groups then decided to also support *in situ* conservation programmes to preserve endangered plant species. The funds that they have allocated to our scientific programmes show that the preservation of natural resources can indeed be integrated into the corporate world. In financing communication tools, these partnerships have contributed to the wider dissemination of the Conservatoire botanique's goals regarding the preservation of endangered plants, and also to raising awareness about this issue among the staff of both companies.

Partnership and Conservation

The preservation of plant diversity is above all based on reliable information regarding threatened species and their distribution, as well as on implementing concrete *in situ* and *ex situ* conservation programmes managed by scientists and experts. However, actions carried out by scientists are fruitless if significant work is not concurrently carried out raise public awareness about the stakes of species' conservation.

Thanks to the efforts of their education services, botanic gardens are the best places to raise public awareness about conservation and biodiversity. Reaching out to a wide audience is a challenge for botanic gardens, if they want to be able to spread a message on the importance of plant diversity, which Target XIV of the GSPC (Global Strategy for Plant Conservation) is aiming at.

Nevertheless, creating education and information tools for the public involves a financial burden which botanic gardens often find difficult to bear, especially in terms of funding communication tools meant for an audience that actually does not come to visit the garden. As will be shown in the example of the Conservatoire botanique, partnerships with private companies could help fund educational tools and, at the same time, raise the awareness of a new public about the preservation of the plant heritage, especially the employees of the companies that fund our projects.

The Conservatoire botanique national de Brest

Founded in 1975, the Conservatoire botanique national de Brest was the first establishment worldwide to exclusively dedicate its work to the rescue of endangered plants. Since its beginning, the Conservatoire botanique has focused its activities on the rare plants of Brittany and the threatened endemic species of France, Europe and oceanic islands all over the world.

Based on our approach, the French ministry of environment decided to develop a network of national botanical conservatories (denominated by the acronym CBN) in 1988. Each botanical conservatory

accredited by the government contributes to the knowledge and protection of wild flora, the management and preservation of natural habitats in its accredited territory and provides information to the public about the stakes related to the conservation of plant diversity. There are eleven CBNs to date, covering almost the whole of metropolitan France. The CBN network is separate from the French botanical gardens network, and it is unparalleled in other parts of the world.

In addition to its official missions related to threatened plants of France, the CBN de Brest carries out its own international programmes on endangered endemic species.

After thirty years in being, CBN de Brest manages one of the largest collections in the world of threatened plants. It has carried out reintroduction programmes and leads partnerships with foreign botanical gardens to develop *in situ* conservation programmes. The collections established in Brest and the expertise gained in preserving species and raising public awareness are assets when setting up partnerships with private companies.

The Klorane Institute

The Pierre Fabre and Klorane laboratories use plants to make their pharmaceuticals and cosmetics, and Pierre Fabre, manager of these two companies, has always been concerned about the sustainable use of plant resources. In 1994, these two companies founded the Klorane Institute, a non-profit corporate foundation. Its aim is to promote the protection and good utilisation of the plant heritage by funding conservation and public education programmes about plants. To this end, the Institute publishes booklets on plants and fungi, which are widely distributed by pharmacies who have agreed to make them available to their customers. There are about 6000 of then throughout the country. The Institute also produces educational tools for schoolchildren and teachers about discovering the plant world.

From 1998, in order to make its commitment to schoolchildren more concrete, the Klorane Institute started to set up ‘Botanic Days Programmes’ (Fig.1) in partnership with the French botanical gardens and conservatories network, giving children the opportunity to discover a botanical garden.

Fig. 1 A Botanic Days Programme at CBN Brest

The partnership between the Klorane Institute and the CBN de Brest

The first contacts between our two organisations started in 1997, when the Institute funded the Conservatoire botanique in its attempt to reintroduce *Normania triphylla*, an endemic plant from Madera, extinct in the wild.

In 1988, the Institute asked us to collaborate on the Botanic Days. The aim of these programmes is to facilitate the discovery of botany by children, with the help of pharmacists who voluntarily start the children off in the construction of a herbarium during the school year. In the springtime, the Institute funds the travels of the children to go and discover a botanical garden and take part in one-day workshops on plants (on how to extract a substance from a plant, how to classify the different sorts of plants). The Conservatoire botanique was one of the first to participate in this programme, and since 1998, more than 3500 children from all over Brittany have come to Brest to visit our Garden and learn about our work on the conservation of threatened plants.

The Klorane Institute takes advantage of these special events in botanical gardens to promote its educational activities in the media about the sustainable use of plant resources. The botanical gardens that participate are not paid for this collaboration, but this voluntary commitment generates mutual links that give botanical gardens the opportunity to get support from the Klorane Institute.

In this way, in 2006, the Institute asked the Conservatoire botanique to produce a booklet on threatened plants (Fig. 2). The education service of the CBN de Brest and the CBN network prepared the text and produced the illustrations for a 48-page booklet. The Institute paid all the expenses of publishing 250,000 copies of this booklet. This document is distributed free of charge in pharmacies throughout France.

In 2008, the Institute continued its collaboration with the CBN de Brest to print 100,000 copies of a new booklet, entitled ‘Plants in danger, Emergency!’ (Fig. 3)”; this booklet has had a big impact on readers thanks to the short length of its text. This document is also distributed free of charge from pharmacies.

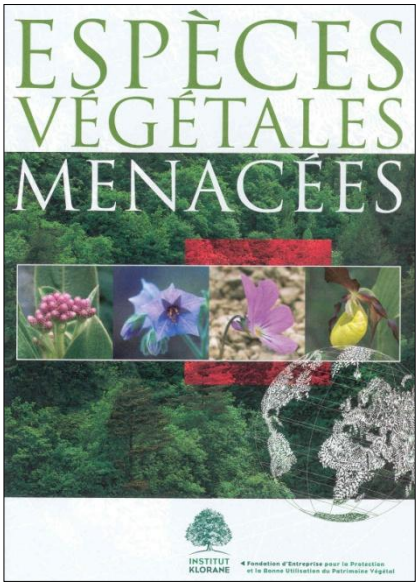

Fig. 2 The threatened plants booklet: Espèces vegetales menacées

Fig. 3 Plants in Danger booklet: Plantes en danger: Urgence!

In 2009, the Institute helped us to fund a new version of our greenhouse guidebook. (This document will be described in the later section dedicated to the partnership with the Lafarge company.)

Currently, the Conservatoire botanique is collaborating with the Klorane Institute on publishing a new document about invasive plant species for the general public.

To the Conservatoire Botanique, this partnership constitutes a very good opportunity to disseminate our ideas in favour of plant diversity conservation to a very wide public that does not visit botanical gardens and conservatories. We would never have otherwise been able to afford the completion of these documents and such a wide distribution throughout the country.

The booklets published with the CBN de Brest, just as all the documents produced by the Klorane Institute, are distributed to marketing representatives of the Pierre Fabre and Klorane laboratories, as well as to the media and visitors in commercial exhibitions where the medicinal and cosmetic products of these laboratories are displayed.

These good relationships with the education service of the CBN de Brest led the Institute to sign a convention with the CBN de Brest in 2007 to fund a three-year programme on the threatened plants of Madeira, and in particular to make a new attempt at reintroducing *Normania triphylla* in collaboration with the conservation organisations of the island. *Normania* has become something of an icon for the Institute, which uses this example to communicate its commitment to the preservation of plant diversity.

The Lafarge Group

Lafarge is a company founded in France in 1833, and is currently the world leader for construction materials (plaster, cement, concrete and aggregate). As part of its sustainable development policy, the Lafarge group as a priority funds actions in favour of the fight against global warming, the preservation of biodiversity, the protection of natural resources and innovations that favour the environment. In 2000, Lafarge was the first company to become a WWF Conservation Partner.

The partnership between Lafarge and the CBN de Brest

This partnership started following a guided tour (Fig. 5) of the Conservatoire botanique for a group of people working in the operation of quarries and the subsequent site restoration. After this visit, we asked the Lafarge employees whether their company could fund the actions of the CBN de Brest for the preservation of threatened plants.

Fig. 4 Normania triphylla

Fig. 5 Partnership guided tour

Quite rapidly, a partnership centred on three main points was formalised to fund:

- The completion of *in situ* conservation work on habitats and plants at local and international levels.
- The development of scientific and technical means of securing better *ex situ* conservation of the threatened plants cultivated at Brest.
- The improvement of our educational tools for making people aware of plant conservation.

This partnership started in 2007 and was renewed in 2009.

As part of our educational plans, we created an area in the greenhouses to grow carnivorous plants. We decided to show species cultivated in the nurseries but threatened or protected in their natural habitats. Moreover, with the support of Lafarge and the Klorane Institute, we have produced a new guide booklet to the greenhouses (Fig. 6). Richly illustrated and with bilingual text, this booklet is part of the greenhouses' interpretation trail and features some of the most endangered plants cultivated in Brest.

Also, support from the Lafarge group will allow us to launch a programme for conserving the threatened plants of Madagascar, creating garden-conservatories in the north and east of the island, which will be managed by the local villagers and the wildlife conservation organisations of Madagascar (Fig. 7).

Another international programme will soon focus on the reintroduction of the endangered plants of Mauritius, with the support of official organisations of the island, as well as Kew Royal Botanical Gardens. Conservation of threatened plants from Morocco and Greece is also projected.

Benefits of this partnership

Although the signing of the agreement between Lafarge and the CBN de Brest was reported in the press, Lafarge does not seek high-level publicity for its sponsorship work.

The end-benefits of this partnership are mainly aimed at Lafarge employees, by using the company's internal communication tools. They can thereby understand that they work for a company aware of its impact on the environment, but which has a genuine wish to reduce the negative effects of its activities as much as possible. In collaboration with Lafarge's regional managers, we are willing to provide free access to the greenhouses for all employees of the company.

Also, Lafarge has described this partnership in the specialised media that deal with the building and public works sectors. Through this partnership, we therefore indirectly raise the awareness of an audience that has no connection with the world of botanical gardens and biodiversity conservation.

Fig. 6 The new greenhouse guide booklet: description of an endangered Sarracenia *species*

Fig. 7 A Madagasarine garden-conservatory

Conclusion

A company that supports organisations that address societal issues, such as that of biodiversity conservation, gives a positive image to its employees. If the company's commitment is promoted through good internal communication, this prompts employees to take up this cause and to take an interest in the issue.

Thus setting up partnerships with private companies is a real opportunity for botanical gardens and conservatories to integrate their activities into those of society and thereby reach a new audience. In order for these partnerships between gardens and private companies to last and be effective over time, they must develop in a spirit of mutual trust and benefit.

Developing propagation protocols for conservation and education: project MGU

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Introduction

Biological diversity in this century is negatively impacted on by habitat loss as well as the eradication and exploitation of species. Remaining natural areas are affected by habitat fragmentation, changes in physical and chemical environment, exotic species invasions, and alterations in fire and hydrological regimes (White, 1996). In Africa, a rapidly expanding human population relies heavily on land and natural resources to meet their needs for food, medicine and grazing for animals.

Increased commercialisation of the traditional medicinal plants in South Africa has led to severe over-harvesting of natural populations, which has resulted in some species being driven to near extinction. This rise was stimulated by several factors, including a rapid increase in the urbanised black African population, of whom about 80% consult traditional healers (Cunningham, 1988). Traditional healers interviewed in the Lowveld region of Mpumalanga indicated that many species that were previously common are harder to find, while some have disappeared altogether. Maunder (1997) did a study which found that the estimated trade of medicinal plants in Mpumalanga is worth between R17 million and R26 million per year, with an estimated 20,000 tonnes traded annually in South Africa.

In recent years an understanding that communities need to be involved in the management of natural resources has lead to the development and establishment of numerous community-based conservation programmes. While community-based nurseries where medicinal plants are propagated has proven to be largely unsuccessful for various reasons, the cultivation of medicinal plants is still largely accepted as an alternative to harvesting plants from the wild. A project on cultivation of medicinal plant species was initiated in the Lowveld National Botanical Garden to support this practice.

Project MGU – the Useful Plants Project

The Useful Plants Project (UUP) started in June 2007 and was made possible by financial support from a philanthropist based in Spain. The UPP is managed by RGB Kew's Seed Conservation Department through the Millennium Seed Bank Partnership in Botswana, Kenya, Mali, Mexico and South Africa. The UPP aims to increase the capacity of local communities to store and propagate plant species that are most useful to their wellbeing, in order to be better equipped to face the challenges from climate change, over-exploitation, shortage of water, habitat loss and the invasion of exotic species.

The UPP focuses on the Lowveld region of the province of Mpumalanga in the South Africa. The main collaborator is the National Biodiversity Institute and the Project is based at the Lowveld National Botanical Garden. It is a three-year project which started in June 2007, with specific objectives set out for achievement in July 2010.

Aim

To enhance the conservation of medicinally-used plant species of the Lowveld area of Mpumalanga, through ex situ conservation (living collections and seed banking), capacity building and community training in plant propagation and seed storage.

Objectives and outcomes:

1. Develop the capacity of a community member to drive the Project.

A member of the local community was identified and appointed late in 2007 to manage the Project. The first months of 2008 were then spent on intensively training this person in seed collection methodology, seed storage and conservation techniques, and plant propagation principles.

2. Identify 120 priority medicinal plants species, in the following stages:

   - The Project focuses its activities on 120 medicinally used plant species of Mpumalanga, because a relative high number of useful plant species in the Lowveld of Mpumalanga are used for medicinal purposes. Therefore, to enhance the conservation impact of the Project, the species that were selected had to be of relevance to the local community as well as of conservation concern. The following criteria were used to determine which species to prioritize for the Project.

   - Although the Project on a global level focuses on useful plants, which could include edible plants, plants used for building materials or shelter, firewood, food and medicine, it was decided that the Project in South African will only focus on plants used for medicinal purposes.

   - There are three categories of threat according to the global IUCN classification – Critically Endangered, Endangered and Vulnerable. Any plants in the target area which are used medicinally and fall into one of these categories were automatically given a high priority.

   - Any medicinal plant species that are endemic, or near endemic to the province of Mpumalanga were also given a high priority.

   - Species that occur in the Lowveld of Mpumalanga, below 1500 metres above sea-level were prioritized. Although plants growing at higher altitudes are also widely used, attempts to grow these plants in the Lowveld are mostly unsuccessful due to climatic conditions.

   - Interviews (past and present) were conducted with traditional healers to find out which plant species they prefer to use, and to establish which species are becoming less common and harder to find.

   - The local 'muthi' markets in Nelspruit were visited to see which species are being traded. Many bulbous species are difficult to identify without any leaves or flowers, so some of these bulbs were bought and grown for identification.

   - Although some plants can be harvested in a sustainable way (by picking some leaves and small-scale debarking), other harvesting methods are completely destructive (bulbous plants are destroyed). Plants that are destroyed during harvesting were given a higher priority than those plants which are utilized more sustainably.

3. Seed collection for propagation and conservation.

   Seeds are collected for two purposes: Firstly, for ex situ conservation in the seed banks at the National Plant Genetic Resources Centre in Roodeplaat near Pretoria and at the Kew Millennium Seed Bank, as well as for living collections at the Lowveld National Botanical Garden. Secondly, for developing plant propagation protocols for each species to facilitate other conservation activities and training.

   Seed collections are made according to the guidelines provided by the Kew Millennium Seed Bank. In order to ensure that maximum genetic diversity is captured, a small amount of seed is collected from as many individual plants as possible. For each targeted species, herbarium voucher specimens are made to ensure scientifically correct identification, and to contribute to the distribution of information about the species.

4. Develop propagation protocols for the 120 selected species.

   The following types of protocol were tested during the propagation trials:

   - Pre-sowing seed treatments, which included scarifying, soaking in hot or cold water and smoke treatments.

- Determining the most suitable water regimes. All the targeted species are from the local areas and thus require a limited amount of water once established. Experiments were conducted to determine how the plants react during the dry winter times when they are only watered once a month.

- Different soil mediums and ratios of a combination of mediums were used to determine which medium or ratio is most suitable for each species. Although this aspect is scientifically important in developing propagation protocols, it was deemed of lesser importance to the Project because the communities will only have access to local soil and animal manure.

- Determining the most suitable propagation method. As the Project progressed, it was found that some species do not produce seed readily (*Haworthia limifolia* and *Warburgia salutaris*) and that some species are easier to propagate from cuttings (*Warburgia salutaris*, *Huernia hystrix*, *Duvalia polita* and *Tetradenia riparia*.) Alternative propagation methods were investigated for such species.

5. Transfer knowledge to the local community.

   Knowledge obtained from seed collecting and propagation protocols are transferred to the communities through workshops for:

   - Traditional healers.
   - School groups.
   - Community members.
   - Outreach horticulturists.
   - School groundsmen.

   Surplus plants that were propagated during the trials are made available to selected schools to establish a medicinal plant section. The groundsmen of the selected schools, as well as some of the children, are trained to propagate and maintain these plants.

   A medicinal plant section was established in the Lowveld National Botanical Garden for education and awareness purposes, designed to accommodate large school groups.

6. Disseminate and publish the information.

   All information produced for the Project is routinely documented. The relevant information is transferred to the local community and other Project stakeholders. Research results from propagation research will be published.

7. DNA profiling for 12 selected species.

   DNA samples are sent to the Leslie Hill Molecular Systematics Laboratory at the Kirstenbosch Research Centre in Cape Town for species profiling. The information obtained from this process is provided to conservation practitioners and researchers to assist in the identification of material found to be traded in the region.

References

Cunningham, A.B. (1988). *An investigation of the herbal medicine trade in Natal-Kwazulu*. Investigational Report No 29. Institute of Natural Resources, University of Natal, Pietermaritzburg, South Africa.

Maunder, M. (1997). Medicinal Plant marketing and strategies for sustaining the Plant supply in the Bushbuckridge Area and Mpumalanga Province. November 1997. DANCED – Community Forestry Project in the Bushbuckridge Area, South Africa. Dept. of Water Affairs and Forestry, South Africa.

White S.P. (1996). Spatial and biological scales in reintroduction. In: *Restoring diversity: strategies for reintroduction of endangered plants*, eds Falk D.A., Millar C.I., and Olwell, M. pp 49–83. Center for Plant Conservation. Missouri Botanical Garden, Island Press, Washington DC, USA.

Community-based plant conservation – a new approach for botanic gardens?

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Abstract

Plants are essential for all life on Earth and yet one-third of all plant species are threatened with extinction. Linking conservation to the provision of sustainable livelihoods is at the heart of BGCI's approach to securing plant diversity. Millions of people around the world rely on the harvesting and processing of wild plants for food and medicine, but these wild plant resources are rapidly diminishing and there is an urgent need for the implementation of effective sustainable harvesting methods. BGCI is working with botanic gardens and their local communities to undertake conservation assessments of wild plant species that support human livelihoods. The botanical skills available in botanic gardens are also brought to bear on developing propagation techniques for threatened species and developing community-based plant nurseries. In Vietnam for example, BGCI has supported the establishment of a permanent facility for the propagation of two endangered species, *Stephania dielsiana* and *Ardisia gigantifolia* in a home garden. Both these species are used for medicinal purposes and are threatened by over-exploitation. This paper provides further details of BGCI's experiences in developing community-based conservation programmes in Africa and Asia and makes recommendations for the successful implementation of such programmes.

Introduction

Plant diversity plays an important role in supporting human livelihoods. It is estimated that around 1.6 billion people rely on forest resources for their livelihoods (World Bank, 2001) and 22% of the world's population (46% of the global labour force) are employed in agriculture (Millennium Ecosystem Assessment, 2005). Furthermore, some 80% of people in developing countries rely on largely plant-based traditional medicine (WHO, 2003). However, many of the plant species on which people depend are under threat in the wild. Involving local communities is essential if we want to develop robust, sustainable conservation programmes for these essential resources.

BGCI is involved in a number of community-based conservation programmes in Africa and Asia. The experience gained from these varied projects is helping us to understand the challenges and identify potential solutions.

Pilot projects in Africa

BGCI has recently implemented two pilot projects in Africa. Based in Uganda and Madagascar, the pilot projects followed a similar format. The projects commenced with the identification of local botanic garden partners and the organisation of stakeholder meetings. During these meetings local community members identified the wild plants they use for medicinal, nutritional and income-generation purposes. The next stage in the process was to assess the conservation status of the species identified, and from this to develop a priority list of species requiring conservation interventions. The relevant interventions were then agreed upon in collaboration with local partners and community members. Such interventions could vary between developing nurseries and propagation methods for selected species, looking at sustainable levels of wild harvesting and reinforcing plant populations in the wild. Important outputs of these projects were:

- Synthesised overviews of currently known medicinal and nutritional plants;
- Identification of priority species for conservation;

- Contribution towards national plant Red Lists;
- Identification of 'important plant areas';
- Raised awareness of the potential to propagate and cultivate wild plants;
- Improved partnerships at various levels.

Conserving threatened trees in China

In China our focus has been on conserving threatened magnolias, with conservation priorities developed from the *Magnolia Red List*, published by Fauna and Flora International (FFI) and BGCI in 2007 (Cicuzza *et al*., 2007). The main threats to these species are over harvesting and habitat loss. BGCI, in partnership with the South China and Kunming Botanic Gardens has been supporting *ex situ* conservation and the development of propagation techniques for these species in order to reinforce wild populations. Local communities have been involved and actively participate in re-planting schemes, thus building their understanding of conservation issues and empowering them to take action to protect endangered species.

Community support in Cambodia

In Cambodia, BGCI is working with the Department of Nature Conservation and Protection on the sustainable management of natural resources in O Toch village. This village has been badly affected by the construction of a dam, with the loss of the natural stands of a number of species which had previously supported local livelihoods. These include bamboo and rattan, which are mainly used in basket making and *Aquilaria*, which is a source of extremely valuable agarwood. Working with the local community, success has been achieved in establishing a Community Protected Area (CPA) and developing nurseries for bamboo, rattan, *Aquilaria* and other native timber species. Re-planting of these species in the CPA is ongoing and harvesting levels are being controlled by the community.

Conserving medicinal plants in Vietnam and Indonesia

Making use of the botanical skills of the staff of local botanic gardens, BGCI has been working on the conservation of medicinal plants (*Cibotium barometz*, *Stephania dielsiana* and *Ardisia gigantifolia*) in Vietnam and Indonesia. In this instance, the focus has been on establishing propagation facilities located in home gardens, and working with traditional herbalists. The aim has been to produce seedlings which are used to reinforce wild populations and for growing plants for home-use.

Conclusions

The implementation of these community-based conservation programmes has highlighted a number of important points. These include:

- The importance of identifying and involving all stakeholders;
- The need to engage and work with local communities in order to build ownership of conservation initiatives;
- The importance of developing an understanding of the local situation and developing community-led solutions.

Furthermore, making linkages between botanic gardens and other conservation organisations and local communities helps to establish the clear linkages between *ex situ* and *in situ* conservation.

Finally, while poverty alleviation through the development of income generating activities based on the sustainable use of local plant resources might be the ultimate aim of conservation projects, such initiatives must always take into account the market situation and the ability of local communities to respond to the market.

References

Cicuzza, D., Newton, A. and Oldfield, S. (2007). *The Red List of Magnoliaceae*. Fauna and Flora International. Cambridge, UK.

Millennium Ecosystem Assessment (2005). *Living beyond our means: natural assets and human well-being* (Statement of the MA Board). Island Press, Washington D.C. USA.

WHO (2003). *Medicinal Plants*. Factsheet No. 134. WHO, Geneva, Switzerland.

World Bank (2001). *A revised forest strategy for the World Bank Group*. Draft 30 July 2001, World Bank, Washington D.C., USA.

Making children aware of the problem of invasive species: an educational approach in partnership with a natural history museum

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Introduction

Botanical gardens can adopt a multidisciplinary approach working with other organisations to improve their service and better educate the public about the problematic issues surrounding sustainable development and the loss of biodiversity.

The Montet Botanical Gardens in Nancy organises a multitude of activities for the citizens of tomorrow – our children. Learning weeks, for example, are organised during the school holidays on themes related to sustainable development. In an attempt to expand its public and develop partnerships, the Botanical Gardens joined forces with the Museum-Aquarium de Nancy (MAN) to organise a learning week on an issue that is pertinent for both establishments: invasive species. Such species are often introduced and propagated by man and are a good example of the impact our actions can have on biodiversity.

The project was organised around an exhibition entitled 'Les envahisseurs' ('The invaders'), designed collaboratively by the Botanical Gardens and the MAN. The aim was to observe both the animal and plant worlds to gain a global understanding of a serious ecological problem. The idea was also to expand our respective publics by creating exchanges with another establishment.

Context

The Les Envahisseurs Exhibition initiative came about as part of a more global cross-border project. The city of Nancy lies within a geographical zone called 'La Grande Région' which encompasses Lorraine (our own region is located in north east France) and neighbouring parts of Germany, Belgium and Luxemburg.

In 2007, Luxemburg was chosen by the EU to be the European Capital of Culture. The city therefore had numerous opportunities to promote its cultural sector through events, exhibitions and festivals throughout the year. It was not only the city that was chosen, but the entire Grande Région, a zone located in the heart of Europe, and the theme that was chosen was 'migrations'. Many of the Region's inhabitants regularly cross its national borders for work or to enjoy their European neighbours' cultural activities.

The subject of plant migration illustrated by invasive species therefore integrated perfectly into this theme. Furthermore the problem of these 'invaders', with similar problems in many other parts of the world, is unfortunately a very relevant issue in our region. Some 40 invasive plant species can be found in Lorraine. Among these are *Senecio inaequidens* (groundsel), originally from South Africa, and *Heracleum mantegazzianum* (giant hogweed). Giant hogweed, a species that escaped from the botanical gardens of the 19th century, gained fame in Nancy at turn of the 20th century. This was also the era of the artistic movement known as the 'Ecole de Nancy' (part of the Art Nouveau period) and giant hogweed inspired local artists and became fashionable in the city of Nancy. Despite being an invasive species and one that has severe adverse effects on health (it provokes phototoxic reactions and acute burns) it is still planted in public places today! We therefore still have plenty of work to do in terms of providing information about it to the public and to local authorities.

Invasive species exhibition: children near the invasive plant *Helianthus tuberosus* L.
© Nancy Botanical Garden

We should also mention other invasive plants such as *Fallopia japonica*, which causes extensive damage in the region, *Impatiens glandulifera*, very invasive in the Vosges Mountains, and *Helianthus tuberosus*, a root vegetable.

An original partnership with a natural history museum

In the context of Luxemburg 2007 - European Capital of Culture, an initiative entitled 'Best of Nature' was launched in La Grande Région. The initiative gave every museum or scientific cultural establishment dedicated to the natural world the opportunity to hold an exhibition to reveal the richness of the local environment in an area that is better known for its industrial than its natural heritage.

The Les Envahisseurs Exhibition was organised in Nancy in this framework. The Botanical Gardens tackled the problem of the region's invasive plants and the Natural History Museum covered invasive animals. This synergy between the two organizations provided the opportunity to explore an issue that is often little known to the public in any detail. The partnership with the MAN was straightforward because the Museum, together with the Botanical Gardens and the Iron History Museum, is one of the three scientific and technical cultural establishments of Greater Nancy (the urban zone encompassing Nancy and its neighbouring towns). The MAN, like the Botanical Gardens, is also co-managed by the University. It houses nearly 20,000 specimens as well as a tropical aquarium.

The programme

During the school holidays the Botanical Gardens organise learning courses for children called 'Green Workshops'. Over a week the children explore a theme related to the plant world and sustainable development. They spend two hours each morning at the Botanical Gardens covering a different activity each day to research the theme.

The Les Envahisseurs Exhibition acted as the basis for a joint workshop with the MAN on a theme that is complex for children.

Aim of the workshops

The objectives for the week were the following:

- educational goals:
  - to gain an awareness of the problem of invasive species: where do they come from? How did they get here? Why? What are the consequences of their introduction? What can be done?
  - to adopt a more global and ecological approach to a problems
  - to acquire a basic understanding of botany: the structure of a flower and of seed dispersal.
- to develop partnerships
- to expand our respective publics
- and for the children: to have fun!

Workshop activities

The children spent two days at the Museum followed by three days at the Botanical Gardens. They visited the two exhibitions that served as a basis for the different activities. Various educational approaches were therefore adopted.

At the Museum's exhibition the children discovered the invasive animal species that populate their close environment: the human body, the home, the garden, the city and the fields. They then used art to illustrate

Exhibition about invasive species: the Botanical Police desk

the means of transport used by these invasive animals to travel from their country of origin to the children's country. A documentary guide was prepared for this purpose by a visual artist.

At the Botanical Gardens the children were able to work their way around the exhibition, which was presented as a police investigation. By following the clues the children had to find a specific plant that is invading the region. The children adopted the role of the 'botanic police' to discover the well-known species (which was the giant hogweed). They had to learn how to use a determination key, name a plant, understand different plants' seed dispersal methods, understand the role of a herbarium and discover the consequences of the introduction of certain plant species into other regions.

They also used a publication written by the Botanical Gardens (a botanical thriller!), which summarised the theme of the exhibition and which also provided additional information, not only on the region's species but also on the different professions within the Botanical Gardens, particularly the work of the botanists who have to classify plants.

Conclusion

During the learning course the children were able to explore an ecological problem that concerns both the animal and the plant worlds. The complementary partnership between the two establishments was therefore successful in providing a better understanding of a complex subject. Beginning the week with the study of animal species was helpful for the work that followed on plants (more challenging for the children).

For the Gardens, working with an institutional partner was also a very positive experience, both in terms of sharing ideas and experiences about education. We are currently planning to develop our relationship with the Museum for further scientific and cultural projects.

Subsequently, another learning week was conducted, this time at the Botanical Gardens only, working for an entire week on plants only.

Strategy for the scientific training of teachers: the role of the Royal Botanic Garden, CSIC Madrid

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The Royal Botanic Garden, CSIC in Madrid is 254 years old and currently belongs to the National Spanish Research Council. The Education Team has been established for seven years. It works mainly with school children and the general public. Nowadays around 33500 school children attend to its activities each year. The education programme is based on scientific education and also education for sustainable development: its main aims are to:

- Increase scientific knowledge of society. This will make it able to understand everyday problems such as climate change or stem cells and to take part into social discussions about these problems.
- Make people aware of the importance of the plants and ecosystem conservation in order to achieve sustainable development.
- And finally, increase the number of scientific vocations among young people. Some European studies (Rocard *et al.*, 2007) and (Gago *et al.*, 2004), made by the High Level Group on Science Education of the European Commission's Directorate-General for Research, have drawn attention to the decreasing numbers of science students. This decease will result in the future in fewer numbers of scientists , inventions and new technology.

Addressing these targets, since 2007 we have set up a new line of projects, aimed at primary and secondary teachers. This project is divided into two areas:

- Training sessions (half-days) for teachers accompanied by their students in activities of the Botanical Garden.
- Training courses in botany addressed to teachers.

Last spring (2009) we have carried out the first course for teachers. We considered that this course was needed because:

- Teachers deal with children most of the time; they are one of the main participants inf their education. The more they know, the more they can teach. On the other hand, motivation is as least as important as knowledge; therefore, the more they are made aware of the importance of conservation and sustainability, the more they can motivate their pupils.
- Primary school teachers in Spain do not have an extensive training about plants or nature during their course years.

This first course had been aimed at primary school teachers. It includes theoretical and practical lessons. It was focus on biodiversity, classification and uses of plants and different ways to teach these contents to children by hands-on activities.

The course programme was:

- The Plant Kingdom – general features and classification
- Mosses and ferns
- Fungi and lichens

- Gymnosperms
- Angiosperms
- Traditional uses of plants
- Current research on plants
- A practical visit to the plant collections (Fig. 1)
- The Royal Botanic Garden, CSIC, as a learning resource for primary schools
- Hands-on activities (Fig. 2):
    - **"Be an explorer for a day".** Workshop about how nature explorers work. Children learn the importance of knowledge of biodiversity and how is the work of a botanist.
    - **"From roots to leaves".** Practical activities about how the plants work. Photosynthesis, food transport…
    - **"Fruits".** An approach to plants morphology, pollination and seeds spreading
    - **"Leaves: shapes and plant determination".** Using leaves shapes to determinate trees with a key
    - **"Step by step through the plant kingdom"** A global vision of plant classification and different groups of the plant kingdom. Microscopes and magnifying glasses are used to promote observation
    - **"Plants adaptations to extreme ambient".** The aim is observe and discover how plants survive in different conditions
    - **"Classify in green".** Activities to learn how classify plants. At the end, they build their own key to identify a group of plants.

The course was given over an eight-day period, from 17:30 to 20h, 2 days a week (teachers in Spain usually leave schools at 17h) and 20 alumni attended it.

Fig. 1 Practical visit to the garden and glasshouses (school teachers at a training course)

Fig. 2 Hands-on activity with plants (school teachers at a training course)

Theoretical lessons were given by scientists from the Garden or from the University; in each case they were specialists in the lesson's subject. Practical lessons were given by garden educators, as they have a huge experience in hands-on activities with children.

This programme has been incorporated into official teacher-training courses offered by the General Directorate for Quality Improvement of Teaching (Regional Government of Madrid), and other institutions belonging to local government in Madrid.

Various materials were also prepared for use in the classroom and in the Garden: written work, proposals for activities, etc., which complement the training. All those materials are available to teachers through our web-page www.rjb.csic.es

Evaluation of the first primary school teachers course

Evaluation was made through surveys. It included a section with questions about the course organization and other about the course contents (10 questions). Just 6 of 20 alumni answered the survey (Fig.3.)

Most of the alumni prefer a course running 2 days a week over four weeks, to one running continuously during almost two weeks. And they like 17:30-20h better than 16-18.30h.

Many of them consider the level of this course too high. As it was said before, the University degree courses for being a primary school teacher include just a few hours about plants, and this particular course lesson is given by specialist scientists. This lack of knowledge about plants can be due to the inability of scientists to communicate their subject, because they have little experience as communication skills are not (or very little) evaluated in their career (at least in Spain).

Teachers prefer practical lessons to theoretical lessons, they consider the latter too long and that they shorten the time available for practical work. They consider that it is more useful for the classroom to be trained in hands-on activities rather than having a high level of botanical knowledge.

Another question asked was about topics that they would add/remove/modify for the next edition of the course. Some of the relevant answers were:

- "I would add hands-on activities about uses of plants (perfumes, soaps…)"

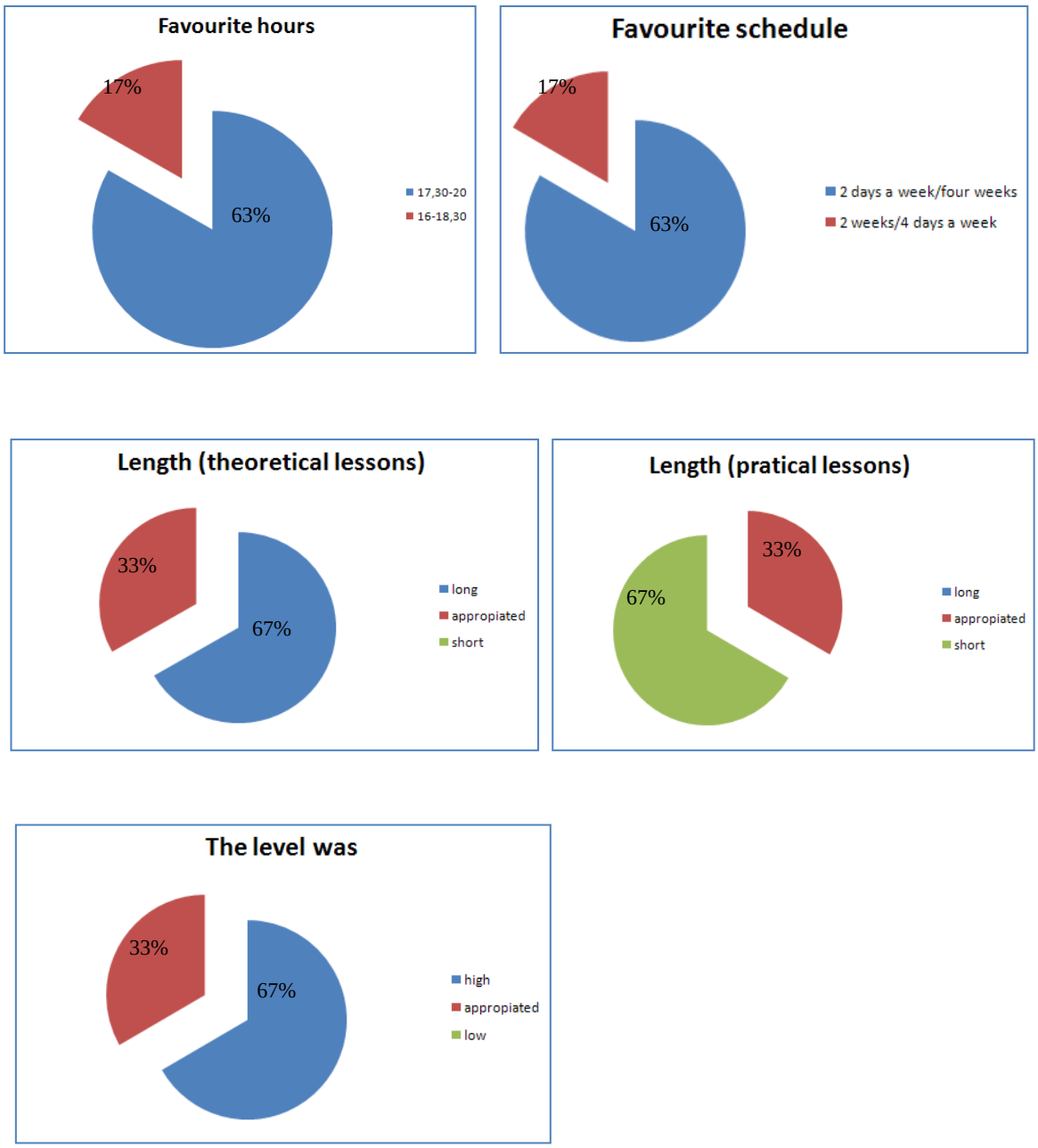

Fig. 3 Course statistics

- "I would add practical lessons about growing a vegetable garden in the school"
- "I would remove so many details about classification"
- "I would add more practical lessons".

In general, we can see again teachers' wishes about a practical training. School education in Spain is usually quite theoretical and there is a lack of practice, as there are few laboratories and groups can do little work out of the classroom.

The teachers were also asked about other courses titles of interest (in order to organize interesting new courses). These are some of the subject they sugested:

- palynology

- regional trees identification
- vascular systems of trees
- uses of plants.

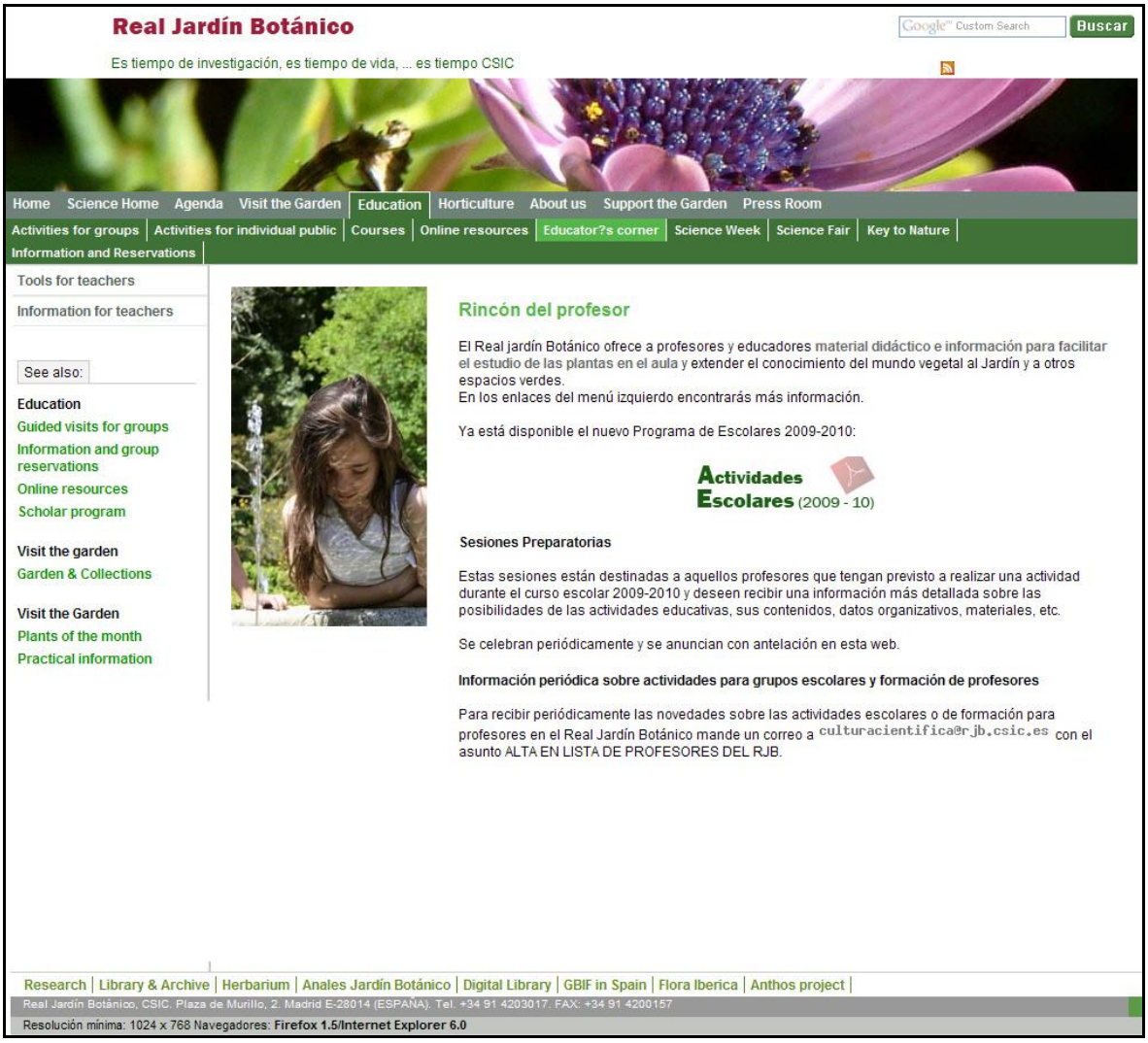

Fig. 4 Teachers' Corner in the Garden's website

Some general observations made were:

- "Some lessons were too long"
- "Very interesting and useful to teach botany at school. Very good teachers"
- "Very well organized".

The course appraisal had ten questions. The average mark was 8.1. We can consider the mark a little bit high, as it could be filled at home after the lessons, with plenty of information available.

Next year two courses for teachers will be provided:

- a second course for primary school teachers
- a first for secondary school teachers.

Besides all of this we have set up a page within the Royal Botanic gardens website called 'Teachers Corner' where we offer many resources for teachers and learning (Fig. 4).

References

Gago, J.M. *et al*. (2004). *Increasing human resources for science and technology in Europe: report of the High Level Group on Human Resources for Science and Technology*. European Commission. Brussels, Belgium.

Rocard, M. *et al*.(2007). *Science education now: a renewed pedagogy for the future of Europe*. European Commission. Brussels, Belgium.

The Botanical Gardens of the National Natural History Museum of Paris: an exceptional educational tool

Geneviève Beraud-Bridenne, Maïté Delmas & Yvette Delpopolo

National Natural History Museum, Paris, France

The National Natural History Museum (the Muséum) is the most visited science museum in France and has one of the world's largest collections, along with those of London and Washington. It comprises seven research departments and three departments of scientific communication. The living collections of the Muséum are spread out over 1000 hectares (2470 acres) and are all acquired, preserved and managed according to international strategies.

The Department of Botanical and Zoological Gardens (DJBZ) is one of the three departments for the communication of scientific knowledge. It is composed of five botanical gardens: the Jardin des Plantes of Paris (JDP), the Chevreloup Arboretum, the Menton Exotic Botanical Garden on the Riviera, the Samoens Alpine garden in the Alps and the Harmas de Fabre in the Rhône Valley.

The zoological gardens of the MNHN are also administered by the DJBZ with four entities: the Menagerie of the JDP, the Paris Zoological Park, la Haute Touche Animal Reserve and the Cleres Animal Reserve.

Whether zoological or botanical, the garden is the mediator that speaks through its living constituents which are the ambassadors of their *in situ* environment. The Jardin des Plantes of Paris is used in this paper as the example. Since its origin, it has been in constant evolution and is carrying out today major renovation projects.

Ever since its creation in 1626, from the King's garden for medicinal plants to today as a botanic garden, it has always been considered as a scientific garden. For over four centuries it has been a place where science has been in the making and where teaching has been a central mission with the creation of public lectures as early as the seventeenth century. Today its thematic gardens and plant collections continue this mission and participate in the diffusion of scientific knowledge and education on environmental preservation.

Established in the Quartier Latin in the vicinity of one of the main universities of Paris, it is also an intensely visited garden with public amenities; it receives 5 to 6 million visitors per year among which are 100 000 school children.

Biodiversity stakes and sustainable development are the educational goals for a 21st- century botanic garden

Today, the botanic garden fulfils two major goals by responding to a few current social preoccupations, biodiversity stakes and sustainable development, by reaching as many people as possible through the communication of scientific knowledge. In the presentations of our collections, we take great care in showing the interdependence of living nature and the necessity for human and animal re-adjustments, through a diversity of themed gardens, habitats or reconstituted ecosystems.

We target the messages to the 'value' of plants, the goods and environmental services rendered by biodiversity, the causes and consequences of biodiversity erosion, the presentation of conservation actions and sustainable management techniques.

Our second goal is to reach as many people as possible through the communication of scientific knowledge and education. We aim at reaching all types of recipients, which fall roughly into four categories: the general public, (families, amateurs…), scientists: (researchers, students), the educational world: (teachers and school children as well as children in need of integration) and finally, professionals. We also try to communicate to all age groups by offering a multitude of activities, workshops, conferences, guided tours and specific events.

Fig. 1 Plant association in the Ecology Garden

To accompany the 'free' visit, we have developed a series of self-guiding tools, regularly produced free documents and targeted brochures. Permanently available are themed leaflets (on historic trees, the Ecological Garden and the Alpine Garden…) and information bulletin boards. For families, we have created orientation games and, to match current scientific events, we develop activities (i.e. the Darwin Trail). To complete this agenda, an effective signage complements the careful and systematic labelling of our plant collections.

On top of the traditional and conventional communication tools of today, we are aiming at expanding existing, and developing new, interactive tools. Digital media tools are in the making. The Jardin des Plants website will be finished in 2010 to mark the International Year of Biodiversity.

By bringing the Garden to the internet surfer's fingertips, the new website will be an additional source of information for visitors, introducing the day-to-day and 'behind the scenes' activities and a diary of planned garden activities. It is planned to show the preservation of the plant heritage, scientific advancements and gardening and sustainable cultivation techniques and methods used in the Garden and offers links to the other great botanic gardens in the world.

Other digital media tools will be launched or are under study, such as customized visits (web-downloadable), i-phone guides (a new generation of audio-guides or interactive terminals in the Gardens and the use of flash code, video and audio podcasts, forums and blogs to provide information and advice to internet users.

The participation of the general public is encouraged through a series of projects initiated by the Muséum. Vigie-Nature is one of them, using well known species (common plants, butterflies, invasive plants) (http://www2.mnhn.fr/vigie-nature). Using specified methods, the public and nature lovers are invited to collaborate in gathering scientific data. So an outsider becomes an actor as the data are then analysed by the MNHN researchers.

Active public sponsoring

With the aim of encouraging the public towards the appropriation of a garden element, the Museum launched, in autumn 2009, a programme of tree or bench sponsoring, allowing the installation of a personalised name plate on one of the 225 new benches which have been installed in the JDP. The funds raised will be used to finance the Museum's signage.

The evolution of the Jardin des Plantes

In an area of 15 ha (37 acres), the Jardin des Plantes presents 6,100 taxa, including 600 taxa of decorative plants. (The DJBZ shows a total of 20.100 plant taxa in its five botanical gardens). Most of the collections presented outdoors come from the temperate regions of the world. Indoors in the four glasshouses are

presented the tropical and subtropical plant collections. A team of 50 is in charge of the everyday care of the living plants and the Garden is open all year round, free of charge.

No major public works had been carried out in the last 25 years in the JDP and all of a sudden the whole place is undergoing major restoration projects. This work started in 2004 with the renovation of the aged water-pipe system of the Garden. Following this, new projects have cropped up. As a general rule, the Department of Botanical and Zoological Gardens integrates in all its projects the interaction between animal and plant life. Eco-fauna gardens, a butterfly and a bird garden have been created; bird and entomological inventories are regularly carried out throughout the JDP.

A Plant Resource Garden has been established, illustrating the plant products derived from our biodiversity: medicinal, textile, dye and perfume-making plants. The natural habitats of the Paris Region can be discovered in the guided visits to the Jardin Ecologique; this is a garden managed using sustainable cultivation methods.

The Jardin Ecole de Botanique, an enclosed garden in the centre of the JDP, presents on 1 ha (2.5 acres), 3,200 plant taxa from the temperate and subtropical regions of the world which are able to thrive without protection in Paris. Plants are arranged in a systematic order. It is a living laboratory of the evolution of Botany and of scientific plant classifications. Started in 2009, it will offer the latest APG III (Angiosperm Phytogenic Group) classification based on the phylogenetic plant tree using DNA data. Three additional beds will present the convergence of shapes, plant adaptations and the diversification of plants. A new informative signage with three levels of reading has been developed for children (aged 8 to 11), for the general and for the scientifically inclined publics, making this scientific garden available for EVERYONE.

The Great Glasshouses

The 2 000 sq.m. of Great Glasshouses of the JDP are undergoing major renovation inside and out and will re-open in 2010 after five years of renovation.

A tour through the four houses will help the general public comprehend the world's plant diversity, understand its evolution and its capacity to adapt. In the Tropical Forest Glasshouse, the plantings and main educational exhibits will be presented around three themes: the plant resources, the plant adaptations to the ecological conditions of the tropical forest and finally plant–animal relationships. A selection of some tropical plants of the world will illustrate all the strata and plant types.

Two trails will lead the public to discover Man's Plant Resources and portray some well know well useful

Fig. 2 Free visit leaflets

Fig. 3 The New Caledonia Glasshouse at the Jatdin des Plantes

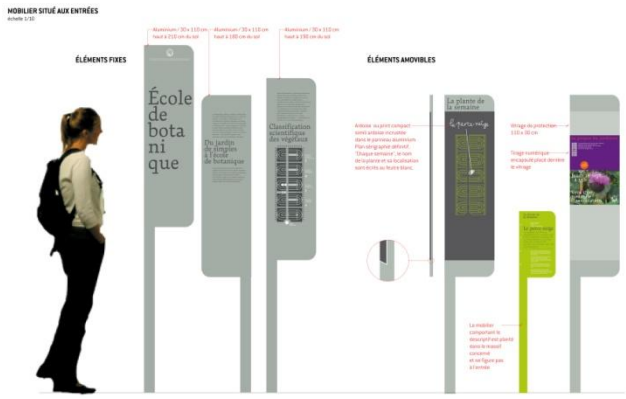

Fig. 4 Prototype information boards for Ecole botanique

Fig. 5 The pistachio tree behind this label was planted at the start of the 18th century, a living witness to the Garden's history

species such as coffee and vanilla.. A light-and-plant trail will guide the visitor though the main tropical forest features such as the undergrowth, climbers, the canopy, forest regeneration, and epiphytes. Different panels will present the history of the Museum's glasshouses, the richness and fragility of the Tropical Forest ecosystem, its composition and world distribution, the degradation of the forest and the conservation and preservation actions.

An Arid Zone glasshouse will show the main ways man, plants and animals adapt to dry spells in different regions of the world.

The New Caledonian Glasshouse presents this Pacific Ocean Island, a unique hotspot of biodiversity with 76 % of endemic taxa, third in rank after Hawaii and New Zealand. It has been arranged in the form of a walk through the island's ecosystems: the dry and the tropical forests, the savannah and the mine maquis (this is secondary plant growth following nickel mining).

The last building will become a Glasshouse on the History of Plants. An approach which presents, in seven plant scenes, the history and the evolution of plants from their original aquatic environment to their current land existence and the origin of flowering plants.

A major step for our renovation has been to enable access to all in the four renovated glasshouses. From now on, the needs of all types of handicapped visitors are met – whether physical, visual, auditory or mental. A new challenge for the team was to adapt the buildings classified as historical monuments.

A multi-sensory and innovative *mise en scène* is used with plant sculptures and giant screens to simulate plant growth. It was developed with a scientific team. The positioning of moveable elements: signs and interactive sensory devices will add interest throughout the trail. It will help the visitor discover the hidden sides of plants. An Intelligent Vine has been devised as an integrated conducting thread carrying, by way of its satellites, the scientific information to all publics. This innovative concept will be put into place in all four of the renovated glasshouses to ensure that the visit becomes a plant voyage for everyone.

Conclusion

The JDP is no longer a 'garden of collections' but has become in recent years a 'complete collection of biodiversity gardens' which aims to help the public grasp the idea of biodiversity and understand its essential role in everyday life. It is a steady path starting with environmental awareness and leading to effective action to preserve biodiversity 'Our Life-Insurance Policy'.

Developing and adapting tools to make the JDP available to all its visitors seeking specific means to understand the Institution's mission and its scientific messages has become a priority. The Museum is thus exploring new ways and approaches to communicate to the different target audiences and giving a choice to its visitors, the free, the guided tours, to those experiences requiring their active participation or finally, to virtual visits through the use of the new website.

Education through real conservation: the Writhlington School Orchid Project success story … and how it can be replicated

Lauren M. Gardiner

Royal Botanic Gardens, Kew, UK

"Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed it is the only thing that ever has."

Margaret Mead

The School

Writhlington School is a UK state-run secondary school with a business and enterprise specialism, catering for 1200 pupils, in a rural location in south west England. Over the last decade, the school has built its ethos around sustainability, enterprise and partnerships with other organisations and businesses. With the support of the Head Teacher, Marie Getheridge, activities such as the Writhlington School Orchid Project have been supported and encouraged, and the once poor exam results have dramatically improved, from 22% of students attaining five or more A*-C GCSE exams in 2000, to 98% in 2009. The school is now heavily oversubscribed, and it won £26million-worth of government funding to build a brand new school campus, which opened in Spring 2010, including £250,000-worth of state-of-the-art 200m^2 greenhouses and a brand new lab/growth room specially for the use of the Orchid Project.

Fig 1 New glasshouses under construction

Early beginnings of the Orchid Project

Led from the start by teacher Simon Pugh-Jones, the project grew out of an after-school Gardening Club (still a central part of the Project). The Writhlington School Orchid Project has involved hundreds of students over the more than twenty years that it has been running. Making use of a set of old greenhouses on the school property left from the days when the school offered rural studies as part of its vocational curriculum, and after a small collection of orchids was donated to the club, Simon was able to instill his students with his

own schooldays passion for this charismatic and diverse group of plants. After exhibiting and selling orchids at horticultural and local shows, and accumulating horticultural awards for their plants, around ten years ago the students took the next step in orchid propagation, to growing their own plants from seed, using sterile techniques to grow the seedlings on nutrient agar.

The Project and the school curriculum

Simon has successfully incorporated various aspects of the Orchid Project's horticultural work into the school curriculum. The aseptic techniques of seed sowing and seedling reflasking (plating the seedlings onto new media at frequent intervals to refresh the nutrient agar and give the plants more growing space) are now part of the science curriculum for every student at the school. He has also integrated the Project into the subjects of enterprise and manufacturing in which the school now offers Diploma courses. Science teachers at the school receive 'master classes' from Simon in the techniques used, which they then pass on to the students in their lessons. Students studying for GCSE and A-Level exams use the Project as the basis for their coursework assignments, satisfying the criteria for experimental design and statistical analysis with their experiments on altering the nutrient composition of the agar mix on which the orchids are grown *in vitro*. Because a single orchid seedpod can contain to up several million seeds, the generative potential of each orchid flower cared for by the students is enormous.

The Gardening Club

The after-school Gardening Club (nominally on Friday afternoons, but in reality taking place after the school bell rings most days), has spilled over into break and lunchtime sessions - either in the greenhouses taking care of the plants, or in the lab sowing fresh batches of seed (collected by the students from their own plants in the greenhouse, which they have hand pollinated themselves) or transferring seedlings onto fresh media. Tried and tested methods which are easily taught and replicated mean that the lab generates an unending supply of germinating seeds and that developing seedlings are available for projects and experiments in lessons, and for selling to generate the Project's main source of income.

Fig 2 Georgia and Sam pollinating Coelogyne cristata

Fig 3 The LabClub

Horticultural shows, sales and publicity

Another common activity for the Gardening Club students to be busy with outside of lessons is preparing for forthcoming sales and shows; this includes folding boxes and glueing on information labels ready t sell *in vitro* plantlets in a 'mini orchid kit' that the students developed and designed themselves through a Young Enterprise company some years ago. The students wholesale their *in vitro* plants and kits through botanic gardens and the Eden Project, and also sell them alongside adult '*ex vitro*' plants directly to the public at shows such as the Royal Horticultural Society London Orchid Show each March, talking about their work and plants with enthusiasm and knowledge.

Fig 4 Chelsea Flower Show medal

Fig 5 Luke Barnes in the Laboratory

Showing their orchids at horticultural and orchid shows around the UK, and occasionally abroad, the students generate a lot of publicity and have been featured several times on the BBC's Gardeners World programme, as well as on Teacher's TV (Japanese television), and in many newspaper and magazine articles around the world. The students have won numerous awards at shows (judged alongside botanical and horticultural organisations and professional companies) – so much so that they have a multi-colour wall of rosettes and certificates with a trophy cabinet to house them all. Many medals have been won at the annual Royal Horticultural Society London Orchid Show, and the Project has also won two gold medals at the Chelsea Flower Show at the two times that they have appeared there. The students have also won scientific prizes at the Royal Society in London, and the Young Scientist of Year award. In March 2010, 16 year-old student Luke Barnes won the Biology Prize, across all age groups, at the UK National Science and Engineering Competition with the research he carried out on orchids whilst on a trip to the Sikkim Himalayas with the Project in 2009.

Expeditions to see orchids in the wild around the world

Sales of plants generate sufficient funds to run the Project and its (nearly) annual field trips; these take small groups of students to visit orchid hotspots and see orchid conservation in action around the world. The Project has taken students to the Sikkim Himalayas, South Africa, Laos, Belize, Costa Rica, Guatemala, and Brazil – unforgettable experiences for those students who have given extraordinary amounts of time and commitment to the Project and who are rewarded with such trips. Visiting other orchid micropropagation labs in areas such as Brazil and Sikkim, visiting schools in Costa Rica, Sikkim, Durban and Cape Town in South Africa, and botanic gardens in Durban and Cape Town, Costa Rica, and Belize, has given the students insight into the lives and conservation issues facing their counterparts in other countries and other cultures. The inspirational value of going into the (usually) forests in these countries and seeing the orchids the students grow back in the greenhouses at Writhlington growing in the wild in all of these places, is incalculable.

At the same time, the students are not protected from some of the harsher realities facing conservationists and local people in these places, and on each trip they see evidence of threats such as deforestation, development, fires, and the illegal and overcollection of orchids. The students who have been on these trips come back and recount their experiences to their fellow students, informally and in school talks, to parents at open days and evenings, and in presentations given to local (and less local, depending on the age and confidence of the student) orchid and horticultural societies.

Two Writhlington students, Zoe Parfitt and Zoe Barnes, attended the 2009 BGCI Education in Botanic Gardens Congress in Durban and gave two wonderful practical laboratory workshops on the orchid micropropagation techniques which they use in the Orchid Project; they entertained and inspired participants throughout the Congress

Fig 6 Zoe Parfitt (13 yrs) teaching adults micropropagation at the Durban Congress

Student interaction and development

Interested students may choose to get more involved in the Project following on from their science lessons, but a lot of students will have joined much earlier on in their time at Writhlington. The Orchid Project engages some of the most disenfranchised students, as well as the most able, and often students will be pointed in the direction of the Gardening Club by teachers, parents, or friends, sometimes even before they have started at the school. Very shy students, those who have been bullied at other schools, those with behavioural problems with authority, maintaining attention, or with social interaction, rapidly learn to focus on a subject which they perceive as being 'less academic' than other school activities, alongside their counterparts and peers.

Students are assigned a 'mentor', usually of the same age, but someone who has been involved in the Project for a little longer, who guides them around the greenhouses, teaching them how to care for the plants, and learning leadership and teaching skills for themselves at the same time. Students are given a particular taxonomic or geographical group of orchids to be completely responsible for: the care of, watering, weeding and repotting are all done under the watchful eye and guidance of Simon and their peers around them. Within a couple of weeks, the students have absorbed an incredible amount of information from each other, and from Simon, and those with limited confidence are able to talk about 'their' species to visitors they have never met, with a remarkable degree of authority and knowledge. Some students with behavioural problems may take some time to settle down, but they are always treated equally with the other students, no matter what previous or outside problems at school. As with all of the students involved, they are expected to step up to the mark and live up to the high expectations Simon makes of them; it is recognised all round that the students and Simon are there because they want to be, rather than 'having to' be there. If students want to be involved, they *have* to take responsibility for part of the collection in the greenhouse, and the students take

great pride in looking after their charges and showing them off to visitors and at horticultural shows. Very rarely are plants neglected by their 'owners'. It is the high expectations that are made of the students, who are expected to make real decisions about how to look after their plants, which really seems to engage the them. They research their species to find out more about where and how they grow, and often go to the weekly lunchtime Orchid Science Club, where Simon teaches them about pollination, orchid anatomy, and evolution of different morphologies.

Why does the Project work so well with orchids?

A group of plants such as orchids presents an enormous array of teaching and learning opportunities. Collaboration with organisations such as the Royal Botanic Gardens, Kew, BGCI, the Royal Horticultural Society, the Eden Project, and orchid growers, conservationists, botanic gardens, and schools around the world, gradually built up over the years, give the students a view of the wider context in which the Project lies. They learn about the careers people make in horticulture, science, botany, conservation, business, policy even, and the value (in economic and biodiversity terms) of the species they grow.

Science can clearly be taught through using the plants, which provide a ready supply of demonstration materials and props for lessons. Different groups can be used to teach biodiversity and ecology – from pseudocopulation (what better way to engage the interest of teenagers when teaching botany?) to the mycorrhizal fungi which link all the trees and terrestrial orchids in a forest, the interactions and dependencies orchid species have with and on other organisms graphically illustrate 'webs of life'. Geography and climate change can be taught, along with evolution – why do species live where they do, and why they look so different? Conservation, habitat destruction and man's impact on natural populations of species – even 'what is a species?' and even 'why is a species orchid different from the orchids you can buy now in any supermarket?' are interesting and engaging subjects when taught with the aid of charismatic plants like these. What makes the questions infinitely more interesting, and the answers more memorable, is the fact that the students *know* the species they are responsible for keeping alive, and develop a far more holistic understanding of and appreciation for plants than they would if the same information was given to them in the form of school lessons alone.

What has made the Project work?

The Project has taken twenty years to get where it is today, but it is worth noting that it has developed gradually and organically to do so. Twenty years ago, the achievements which have been made, the countries to which students have travelled, and the turnover generated through sales of plants, would not have been dreamt of. Which is not to say that the Project lacked ambition at all: at each stage those involved set themselves challenges to meet (winning a gold medal at a particular show, entering students into different science competitions, propagating from seed for the first time), each leading on to new opportunities and developments which had not, perhaps could not have, been thought of before.

Committed teacher/member of staff and supportive head teacher

The value of a committed teacher or member of staff, in the form of Simon Pugh-Jones, to drive the Project forward and provide continuity has been key to the Project's success, along with the presence of a supportive head teacher in Marie Getheridge. Without them, as students leave the school at 16 or 18 years, as other involved adults (teachers, technicians, parents) move on for various reasons, the Project could easily have been put to one side and forgotten, but the continuity provided by Simon in particular has been an enormous asset.

Real techniques, real species

The work that the students do uses real techniques and real species, exactly as a botanic garden or commercial company propagating species would do. There is no sense of simplification and 'dumbing down' of the protocols, and the younger students are often surprised, and proud of the fact that, when they visit a

'real' lab that exactly the same procedures are being used and little 'translation' is required when teaching the students about real-life conservation projects.

Horticulture as a high-status activity

The Project has always held at its heart the ethos that horticulture is a high-status activity. Whereas in the past there was sometimes the perception that 'gardening' was what the not-so-bright kids could do instead of being academic, the students involved in the Project are a complete mixture of all abilities, and receive praise and awards for their work, on a par and often exceeding those of the more traditionally 'high status' school activities.

Decision-making, real responsibility, complexity and ambition

Students are given the skills and opportunities to make real decisions about the Project, how funds are spent, what species are grown and how plants are displayed for show judging. The role of each student in the Project can be significant, depending on how much time and effort they wish to invest, and the responsibility given to them can be large, for instance taking on all aspects of care for all of the plants in a number of related genera: from watering and feeding, to pollinating flowers and collecting seed, to repotting and treating any pests and diseases. Made to feel like equals, and respected for their own abilities, nearly all of the students step up to the mark and thrive with the sense of involvement and maturity assigned to them.

Enterprise

Because the Project generates its own funds, those involved are able to decide how those funds are spent. Equipment can be purchased when needed, foreign expeditions can be planned, trips to shows on the other side of the country can be booked – usually without the need to bid for additional funding, or having to be organised through third parties, and opportunities can be taken as they arise, rather than having to make proposals and business cases and wait for authorisation from others.

Curriculum links and real collaborations and partnerships outside school

Because the lab techniques used by the Project are integrated into the science curriculum for all students at Writhlington, every one of the 1200 students at some point comes into direct contact with the Project and has the opportunity to yet more involved if they want to. Students can and do self-elect to get involved at an earlier or later stage, but exposing all students to the Project during their secondary school career means that a number of students who would never normally attend such a club do get interested and join. The Project shows to all students at the school the relevance of the subjects they are studying and their real-life applications and career options, as they visit and receive visits from specialists at botanic gardens, such as the Royal Botanic Gardens, Kew, and The Eden Project. Real collaborations and partnerships with organisations in the UK and abroad, which some students have had the opportunity to visit and have their own experiences of, increase the relevance of the Project to the students, their peers and to the school community, and put their work in context.

Accessible for all

No matter what background a student comes from, model students through to students with serious behavioural issues, all students who join the Project are considered to be equal. Discipline transgressions may be punished with short bans from the greenhouses of a week or two, but there is no 'three strikes and you're out' rule, or formal punishment. The respect the students show each other and for their charges (fellow-students and plants) means that new joiners find they want to earn this respect for themselves, and they are able to do so, unencumbered by other members of the group holding preconceived ideas about them.

Future plans

Immediate future plans for the Writhlington School Orchid Project include concentrating over the next year on filling the brand new greenhouses with orchids grown in the lab and divided from existing plants in the collection as they grow. From $90m^2$ of greenhouse space to $200m^2$, there is a lot of growing to be done! Along with a number of other shows planned for the year ahead, the Project will be making its regular annual

appearance at the RHS London Orchid Show in March 2010, and possibly be attending the RHS Hampton Court Flower Show as well. It has also received an invitation to be part of the World Orchid Conference Show at the brand new Gardens by the Bay in Singapore in November 2011. In September 2010 the Project will be hosting the first-ever orchid show of its own – the Writhlington Autumn Orchid Festival, with orchid growers and societies from the neighbouring counties and the students displaying their plants, talks by the students about their travels, and tours of the new greenhouses.

Longer-term plans include continuing working with joint projects set up during expeditions to Sikkim, Laos, Belize, and South Africa. Over the last few years in particular, the Project has received many requests from organisations around the world that are interested in setting up similar schemes. Potentially working with BGCI and industrial partners, the Project is looking into the possibility of finding low-cost ways of getting the equipment and resources needed for such a project into schools in the UK and abroad, so that students and young people can propagate not just orchids, but carnivorous plants, medicinal plants, and other interesting, and potentially threatened in-the-wild plants which are difficult to grow using conventional means. Adapting the model of the Writhlington School Orchid Project to the needs and interests of each organisation (school, botanic garden, etc) will be a key factor in the success of these projects, which can pick and choose which parts of the model they wish to specialise in and which parts they are less interested in – from concentrating solely on generating seedlings to use in scientific investigations to support the curriculum, through to the enterprise aspects of selling artificially propagated plants grown from legally obtained seed to raise funds.

Acknowledgements

Enormous credit must go to Simon Pugh-Jones and all of the students involved in the Writhlington School Orchid Project, and especially to the students Zoe Parfitt and Zoe Barnes, who attended the BGCI Education in Botanic Gardens Congress in Durban in 2009, and gave two wonderful practical laboratory workshops on the orchid micropropagation techniques which they use in the Orchid Project, and entertained and inspired participants throughout the Congress. All those at the Durban Botanic Gardens and BGCI who made our visit possible and so fantastic – especially Margaret Appleton, Martin Clements and Chris Dalzell for DBG, and Julia Willison, Belinda Hawkins and Lauren Evans for BGCI. Funding for this trip was very kindly provided by the Royal Horticultural Society, the Somerset Gardens Trust, the Royal Botanic Gardens, Kew, Writhlington School, the Norton Radstock Rotary Club, and the Holmes Hines Memorial fund (EPSRC).

The Knowledge Café: Education and the Global Strategy for Plant Conservation – facing the future

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Welcome to the Knowledge Café workshop. The aim of this workshop is for us to share our views on education and the Global Strategy for Plant Conservation (GSPC) and to come up with new thinking and ideas for how botanic garden education can play a stronger role in implementing all targets of the GSPC.

Each table will focus on several targets of the GSPC. The targets below are the proposed new targets post-2010. To help guide the discussions, we have identified several questions. We also suggest that your table selects a chair and scribe.

Understanding and documenting plant diversity

Target 1 A widely accessible list of known plant species.

Target 2 An assessment of the conservation status of all known plant species to guide conservation action at national, regional, and international levels.

Target 3 Development and effective sharing of advice and guidance for plant conservation and sustainable use, based on research and practical experience.

Questions

- How does your education programme address the above targets?
- How can education departments influence other divisions within the garden to incorporate education, communication and public awareness within these targets?
- Has your garden developed any guidelines on teaching and learning about plant conservation and/or sustainability?
- How can botanic garden education programmes further contribute to these targets?

Conserving plant diversity

Target 4 Ecosystem services secured through effective management of at least 10% of major ecological regions

Target 5 Protection of at least 50% of the most important areas for plant diversity assured with effective management for conserving plant diversity in place

Target 10 Effective management plans in place to address biological invasions for 50% of important areas for plants that are invaded

Questions

- How does your education programme address the above targets?

- Which are the most important targets for botanic garden education programmes to address?
- How can education departments influence other divisions within the garden to incorporate education, communication and public awareness within these targets?
- How can botanic garden education programmes further contribute to these targets?

Conserving plant diversity

Target 7 At least 60% of threatened species conserved *in situ*

Target 8 At least 60% of threatened plant species in *ex situ* collections, and at least 10% in recovery and restoration programmes

Target 9 70 % of the genetic diversity of crops and other socio-economically valuable plant species conserved, and associated indigenous and local knowledge maintained

Questions

- How does your education programme address the above targets?
- Which are the most important targets for botanic garden education programmes to address?
- How can education departments influence other divisions within the garden to incorporate education, communication and public awareness within these targets?
- How can botanic garden education programmes further contribute to these targets?

Using plant diversity sustainably

Target 6 At least 30 % of production lands in each sector managed sustainably for plants and consistent with the conservation of plant diversity

Target 11 No species of wild flora endangered by international trade

Target 12 A continuous increase in the percentage of plant-based products derived from naturally occurring sources that are sustainably managed, based on progressive inventory and assessment

Target 13 The decline of plant resources, and associated indigenous and local knowledge innovations and practices, that support sustainable livelihoods, local food security and health care, halted

Questions

- How does your education programme address these targets?
- Which are the most important targets for botanic garden education programmes to address?
- How can education departments influence other divisions within the garden to incorporate education, communication and public awareness within these targets?
- How can botanic garden education programmes further contribute to these targets?

Promoting education and awareness and building capacity for the conservation of plant diversity

Target 14 The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes

Target 15 The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of the strategy

Target 16 Networks for plant conservation activities established or strengthened at national regional and international levels

Questions

- How effective are botanic gardens in delivering Target 14 (see terms and technical rationale below)?
- What can we do better?
- How does your education programme address Target 15 & Target 16?
- How can botanic garden educators work collectively to further address these targets?

Terms and technical rationale for Target 14

Communication, education and the raising of public awareness about the importance of plant diversity are crucial for the achievement of all targets of the strategy. This target is understood to refer to both informal and formal education at all levels, including primary, secondary and tertiary education. Key target audiences include not only children and other students, but also policy-makers and the public in general. Consideration should be given to developing specific indicators to monitor progress towards achievement of the overall target. It may be helpful to develop indicators for specific target audiences. Given the strategic importance of education about plant conservation, this issue should be included not only in environmental curricula, but should also be included in broader areas of mainstream education policy.

Key points raised

Most of the GSPC targets are related to the management of conservation – although educators are not responsible for management they are essential for raising awareness and knowledge of each of the GSPC targets.

- The role of educators in botanic gardens is to link science with public programmes and communications.
- There can be barriers or gaps in communication within gardens between science and education. It is the role of both sides to understand the issues and priorities facing each other in order to collaborate and communicate plant conservation issues effectively.
- Taxonomy and associated conservation assessments are often complicated and not easily understandable to a broad global audience with apparently weak international collaboration and communication.
- Networking and building relationships is vital to enable communication within and between botanic gardens to work towards commonalities, especially for smaller gardens with limited resources.
- It is important to engage the public in innovative ways. There is a need to de-jargonise the targets
- There is a sense of immediacy: instead of waiting for targets to be realigned, educators must act on the issues using appropriate language and innovative ways of engaging with their communities.
- There is considerable cross over with communication, public awareness and marketing. Botanic gardens are often not as adept as communicating with the general public as with schools and teachers.

- It is important to look outside the garden walls and think beyond what your own institution is doing, to successfully communicate important issues.
- Target 14 is a cross cutting target and should not be seen as stand-alone it should be embedded within all targets.
- Conservation, biodiversity, financial and education strategies should be integrated within botanic gardens
- Education and awareness should be embedded within all botanic garden departments to ensure collaboration. For example 'the advocacy of plants' could be built into the job description of every botanic garden staff member.
- The GSPC should fit in with other frameworks, e.g. Millennium Development Goals, and not be seen as separate or peripheral.