

Teaching for the 21st Century:

Botanic Garden

Proceedings of the

Education for a

Third International

New Millennium

Congress on Education

in Botanic Gardens



Teaching for the 21st Century: Botanic Garden Education for a New Millennium

Proceedings of the Third International Congress on Education in Botanic
Gardens

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Foreword

From 7-11 September 1996, the Brooklyn Botanic Garden in New York, USA, welcomed over 220 people from 43 countries for the third BGCI International Congress on Education in Botanic Gardens. The great diversity of nations, institutions and cultures represented at the Congress highlights the developing awareness of the importance of botanic gardens worldwide for environmental education. The Congress also provided an excellent and stimulating opportunity for global exchange of views and ideas.

During the five days, delegates presented a range of papers, workshops and posters, all of which reflected the four themes of the Congress: Education for Sustainability, Global Village, Urban Horticulture and Botanical Knowledge. From the meeting it was clear that botanic gardens, no matter what their size, have a pivotal role to play in raising public awareness of the need to develop new patterns of behaviour and attitudes towards the environment. Their involvement was seen as crucial in the implementation of international conventions such as the Convention on Biological Diversity and global initiatives such as Agenda 21.

Many of the delegates' presentations are contained within this book which, through sharing good practice and thinking, aims to increase the effectiveness and profile of botanic gardens in environmental education. These proceedings serve to illustrate the importance of communication and collaboration among botanic gardens at an international level. It is hoped they will encourage botanic gardens to develop new programmes and initiatives for environmental education.

Judith D. Zuk
President
Brooklyn Botanic Garden

Peter Wyse Jackson
Secretary General
BGCI

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- members of the Planning Committee who read through and commented on all the proposals submitted for the programme as well as moderating workshop sessions and facilitating network meeting groups
- many of the Friends of the Brooklyn Botanic Garden, who generously hosted delegates in their homes throughout the Congress and in some cases beyond
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This list is unable to mention everyone who ensured the smooth running and management of the Congress. Their work nevertheless, is greatly appreciated.

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Towards a Wider Perspective

From the good earth: lessons from the past, inspirations for the future

Michael Ableman

Fairview Gardens Farm and Education Center, Santa Barbara, California, USA

One day in the spring of 1883 in North Dakota as immigrant farmer John Christiansen plowed his fields, he looked up to find that he was being watched by an old solemn Sioux Indian. Silently the old Indian watched as the dark soil curled up and the prairie grass was turned under. Christiansen stopped, leaned against the plow handle, pushed his black stetson back on his head, and rolled a cigarette. He watched amusedly as the old Indian knelt, thrust his fingers into the plow furrow, measured its depth, fingered the sod and the buried grass. Then the old Indian straightened up and looked at the farmer. "Wrong side up" he said, and walked away. One hundred years later, and the words of the Sioux Indian are just beginning to ring true. 'Wrong side up' is more than a commentary on the plow's action on reversing the soil structure, 'wrong side up' is emblematic of our current food system, and of the conquering mindset that we inherited from those early American settlers. Their westward conquest, clearing the forests and plowing the land, reached the West Coast shores of the Pacific to what we now call California, and to the small farm I now work. But there were those who came to my land long before land ownership and agriculture existed as we know them.

My International 484 three-cylinder tractor requires full throttle these days. It is tired, and pulling the disc across the front field under the best of soil conditions is a chore. With a worn muffler it is loud too, very loud, so it was a small miracle I even heard the clink from somewhere behind me. I immediately stopped, throttled down, took the tractor out of gear and got off. There behind the disc was a stone pestle, perfectly preserved except for the marks left by the steel blades of the disc. It fitted comfortably in my palm, buffed smooth by Chumash Indian hands some 2000 years ago. The farm was soon to celebrate its 100th anniversary, and suddenly holding this ancient tool we were newcomers.

I have plowed this field a hundred times in fifteen years of farming here, but the trace of my native predecessors was inconspicuous. As hunter-gatherers they fed themselves off this land for generations, hardly disturbing it, leaving it virtually unaffected by their presence.

The farm is one of the last in a valley that once boasted some of the deepest and richest topsoil on the West Coast. We have survived, as fields of tract homes have replaced the walnut and citrus groves of the past. On our twelve acres we grow nearly one hundred different varieties of fruits and vegetables in a virtual year-round harvest, most of which is sold without ever leaving the farm gate. We have a store on the farm that supplies the local community with fruits, vegetables, eggs, honey and fresh-baked bread. We also work under a community-supported agricultural model with seventy families who are members. In a return to a form of social agriculture, community members throw in their lot with the farm by buying shares at the beginning of the season. Good year or bad, they are nourished by our labors but also share in our risks. We hold several farmers markets per week, as well as feeding the constant flow of visitors who come for events, tours, a yearly concert series, and various educational programs. Recently we formed a non-profit organization to oversee our educational programs, and raised the funds to put the land under a conservation easement. This will insure that it will always remain as an organic farm and education center. Twelve acres surrounded by suburban development feeds three to five hundred families and employs 15 people full-time. Current agricultural economics would say that's impossible. The farm has become a model for what can be done on a small acreage in an urban environment.

But perhaps what is more important is the way in which the farm has become a center for the community. It is in the area of community building that I think farms and gardens have a very critical role. Growing things slows us down, puts us in touch with the earth, and with each other.

Children respond to this more immediately than anyone. A big part of what we do involves children. Some of that is inevitable. Those growing up in the tract homes surrounding us have nowhere to go, the developers who designed and built those homes did not concern themselves with incorporating elements of nature, with space for gardens, with creating an environment where children have a sense of place. Those kids are magnetically drawn to the farm, to the open space, the hidden spots where they can put their forts, to the smells and the feel of soft ground under their feet. They know every nook and cranny, they play king of the mountain on the large compost piles, hide and go seek amongst the maze and tangle of our peach or avocado orchards. This is one place where they can be free, that they can feel connected to the earth. And while we discourage kids from picking foods without asking, we don't mind seeing the odd orange peel or carrot top left behind, that tells us that they are in fact touching base with real tastes from the earth.

But we also have had big success with more formal programs – children come through by the thousands each year for everything from two-hour tours to 5-day live-in programs. I always begin by having them gather around in a circle on the ground. I ask them to cup their hands and then I fill each set of hands with some rich topsoil. At first many of them respond with “Yuk” or scream when they encounter an earthworm, but I remind them that this is where their food comes from. I ask them to examine the soil closely and to close their eyes and smell deeply. I tell them that one pinch of living soil contains millions of forms of life.

I have found that if I can have even just a few hours with these kids I can open up that forgotten part of themselves that is connected to the earth. And when they stay longer they begin to let go of the world of shopping malls and video games. But the most important thing that we do is to go grazing. The harvesting and tasting of fresh foods from the fields is the most powerful tool that I use.

We had a group called Rites of Passage – they were 14 fatherless boys who were up from South Los Angeles. Many of these kids had never tasted real food, picked fresh. But when I let them harvest and eat a fresh cherry tomato or split a melon still warm from the sun, the response was incredible. These kids were tasting real food for the first time in their lives, nothing more needed to be said.

It is gratifying but it is also sad. It reminds me that we have become a culture of refugees from the land and that the environmental and social crisis we now face is a result of this alienation. After all, how can we be expected to take care of what we no longer understand if we no longer feel close to it?

I have had the privilege of living close to the land and to the source of food, but with that has come a great responsibility. I know that culture and food are entwined, that when we separated our families and our communities from the land we separated from much more than that. Returning to the garden, returning to food as the center, the gathering point for family and friends is so vital to our collective health and education.

This idea became so important to me that I went looking all over the world to make some sense of it: to understand how food, culture, land, and people fit together.

A couple of years ago I was sleeping in the old farmhouse where I live, when it started to roll like a ship, sending me flying out of bed. It was 4.30 in the morning and we had been hit by an earthquake. I plucked my son out of bed and headed out the back door, arriving just in time to see all of the electricity in southern California go off in a wave. It was a rare and beautiful experience to be able to gaze into the sky and experience the full array of brilliant stars in this urban environment where ambient light normally pollutes our night skies. Lost in that still beauty I forgot about the disaster that had just occurred.

When the sun came out that morning it was one of those perfectly still crystal clear days that often occurs after an earthquake. I thought I better investigate and see if the world around me still existed. What better way to feel the pulse of our suburban neighborhood than to visit Vons, the local supermarket. So I walked the few blocks from the farm to Vons. On the way cars were colliding in mid-intersection (the traffic lights were out), the gas stations had lines of cars (the electric pumps were not functional), and when I reached the door of Vons on this brilliantly clear sunny day and walked inside it was completely dark. The ice cream was melting in the freezers, the meats were going off on the shelves, and hoards of people were frantically filling their shopping carts using flashlights to navigate the aisles. When they reached the checkout counters there were signs that said ‘Sorry no change’ – the ATM machines were down. I looked around amidst this frenzy and it struck me how incredibly precarious and fragile our current food system really is.

My neighbors who shop in that supermarket are well paid, highly educated individuals who work at high-tech defense research companies. Yet if that supermarket had stayed closed they would have been hard pressed to know how to feed themselves. For all their money and education they are powerless when faced with taking care of the most basic human need.

By contrast I think of places like ‘The Garden Of Eatin’ at 25th. Street and ‘Dickinson’ in north Philadelphia where the average income is \$8000 per year, where infant mortality and violent-crime rates are some of the highest in the country. Yet there in that most vulnerable of places neighbors banded together to clear a lot of trash and rubble and were planting foods from their roots in the South. They were not only feeding themselves but were, in their own words: “Growing extra to feed the poor”. Marina La Pinia, also from Philadelphia, who although she is Filipino, grows peppers for her Puerto Rican neighbors and at the end of the season opens the garden to the neighborhood and serves a feast from her bounty. Abundance in the midst of poverty. We have to ask ourselves-who really are the poor?

It is in those places where opportunities and choices are few that real community often comes forth. And there is probably no greater basis for community than the gathering together to work with the earth. I saw this at fifteen

thousand feet in the Peruvian Andes, where hundreds of people gathered to prepare a field for potatoes for feeding single mothers and orphaned children. I have also seen it here in the heart of the Bronx where gardens bordering crack houses are cultural centers for the local neighborhood. A sense of self-reliance can come from the simple act of planting a seed; success on one's little plot can lead to success in other areas of life. Gardening is truly a pathway to community.

Now many believe the responsibility of feeding the world belongs wholly to farmers. But when the food system no longer fulfills the needs of the people, whether it is for economic or distribution reasons, or because of concerns about food safety, or because people want corn that tastes like corn, or potatoes that are more than a tasteless medium to convey salt and ketchup to their mouths, then people take that responsibility into their own hands. And so while many look to agriculture as the source of salvation, the truth is that the real revolution is happening in neighborhoods, communities, and towns. The revolution is taking place in small gardens, window boxes, in the most unlikely of places. And lest anyone dismiss gardens as units too small to have any impact or to indicate any trend at all, consider the United Nations study published this year that states that gardens and urban agriculture are providing food for a significant portion of the world's population. Gardens are also, as Gene Logsdon writes, "the incubators of the new farm ecology where seeds are saved, biological relationships are explored, and new methods of soil fertility and pest control practiced".

Botanic gardens have traditionally had the reputation of being exclusive enclaves where rare and exotic plants are protected and displayed. What we see today in the focus of this conference and amongst those gathered here is historic in turning that view around. The potential for these institutions to become the centers, the gathering places for local communities, places where local and traditional seeds and plants can be preserved and disseminated, where young people can regain an understanding and appreciation for the environment and those pieces of the natural world that are left around them. Botanic gardens may in some places represent the only living examples of that natural world. The challenge for these institutions will be to help growing urban populations to remember their roots, regain an understanding of the environment in which they live, feel identified with it enough to want to protect and restore it.

Our work is powerful, for no matter how complex, how stressful, or how difficult one's life has become – when one plants a seed and sees it grow, one cannot help but be renewed. Knowing that power is knowing one's personal power. Through the garden, poverty can become abundance, fear trust, and despair hope. The garden also feeds us in ways less tangible than the ripe tomatoes, the squash or the corn that we harvest from it. Ultimately this movement is about renewing our selves and our communities, through the simple act of planting that seed. It seems simplistic, but healing and renewal are accomplished in simple ways by increments – one spade full, one bucket of compost, one garden at a time.

You have the opportunity to become the front line of this revolution. Those centers that you nurture and steward are part of a much greater whole; one that holds promise for real change. I would like to end by sharing a quote from an old Hopi friend of mine who wears his wisdom so lightly.

"Sometimes I come to my field in the evening and stay all night because the porcupines were eating my corn. I'd sing all the way up and down the rows. My dad said this corn is like children and you have to sing to it and then it will be happy."

And each day as I observe my life and the world around me, racing about in its blind quest for more. I think of my 87-year-old Hopi friend, of a life lived with respect, and harmony in action and when I close my eyes I can see him as he slowly makes his way down the rows of corn, singing the songs of his ancestors, his every footstep like food for the soil, his voice echoing in the canyon. And then I remember, this is who we once were. And I ask myself, where are we going?

Stand up, stand up and be counted: education for sustainability and the journey of getting from here to there

John Fien

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The purpose of this paper is to reflect on the nature of sustainable development and education for sustainable living, especially in relation to the roles of those who work as environmental educators in botanic gardens. Thus my reflections focus on the challenges facing all of us who have a vision of a better, more just and ecologically sustainable world in which to live. Making such visions real is the challenge of 'how do we get from here to there'. How can we – as individuals, parents, teachers and communities – help effect the transition from present-day patterns of unsustainable development to ones which are based upon principles of social justice and democracy and which respect ecological laws and limits?

Only very few now dispute the need for such a transition. The rise of general public awareness of, and concern about, environmental problems means that the environmental debate no longer needs to focus on justifying the need for change. The consciousness-raising task set by the environmental predicament has been generally successfully over the last thirty or so years, despite the 'ups and downs' caused by economic recession and the recent resurgence of political conservatism in many parts of the world. Today, many of the world's business and industry leaders have recognised the need to change direction – as reflected in many books and training courses on industry, business and the environment. Today, the debate is not over whether we need sustainable development, but over the different meanings of 'sustainable development', and the nature, rate and details of the pathways towards it. This requires a renewal and refocussing of the consciousness-raising efforts we have been making in the past, and poses new challenges for environmental education.

We are today in response to the 1987 United Nations Commission on Environment and Development Report, called *Our Common Future*, which popularised the concept of sustainable development. The General Assembly of the United Nations established this Commission of academics, senior civil servants and politicians, more than half of whom come from developing countries, in 1983. The Commission which was chaired by the Prime Minister of Norway, Mrs Gro Harlem Brundtland, the only national political leader to have ever previously been a Minister for the Environment, had three objectives:

- to investigate global environmental and development issues and propose realistic solutions
- to recommend new forms of international co-operation appropriate to these solutions and
- to raise the awareness of the world's citizens, businesses, institutions and governments, and increase their readiness to adopt the proposed solutions.

The World Commission took the concept of sustainable development as the focus of its report and urged governments, industries and families to adopt a pattern of development "which meets the needs of present generations without compromising the ability of future generations to satisfy their needs" (World Commission on Environment and Development 1987, p.8). However, this relatively simple concept has been subject to a great variety of interpretations. The term was first used in the 1980 *World Conservation Strategy* published by IUCN, WWF, and UNEP. Lee Talbot, then Director of IUCN, describes how the term evolved. He described the first draft of the strategy as a:

wildlife conservation textbook, for at the time many conservationists regarded development as the enemy to be opposed and many developers regarded conservationists as at best something to be ignored, or at worst as an obstacle to progress. With each draft the two sides were brought closer and involved in a process of education. The final draft represents a consensus [*sic*] between practitioners of conservation and development.

(Yencken 1994, p.220).

Being the result of a consensus between parties who come from essentially quite distinctive paradigms or world views, sustainable development is not one of those terms that have a simple agreed meaning. Many conservationists argue that "ecological sustainability should be a goal in its own right, unshackled to development" (Yencken 1994, p.220). On the other hand, some argue that it is necessary to put economic sustainability ahead of ecological

sustainability, because following environmental regulations and conservation principles is expensive and businesses need to be profitable to be able to afford them.

Thus we can see that interpretations of sustainability are value-laden, but the extreme points of view miss the essential point: that the concept of sustainable development requires change and compromise from everyone. Sustainable development is, in the words of David Yencken, the President of the Australian Conservation Foundation, "an inspired way in which a bridge can be built between two conflicting paradigms, between the paradigm that has underlain past Western approaches to the environment and an emerging new environmental paradigm" (Yencken 1994, p.221).

It is possible, however, to find several hundred definitions of sustainable development in the literature. The important point to note, though, is that all definitions, whatever their source, serve particular social and economic interests and that they need to be critically assessed. However, while definitions of sustainability do vary, at the heart of sustainable development is the goal of reducing the impacts humans make on the earth – or as the Brundtland Commission defined it:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

(World Commission on Environment and Development 1987, p.43).

The Brundtland Commission made another important point about sustainable development. This is a point that has been made many times by countries from the South: environmental objectives are important in their cultures – far more important than they have been in the North – but the poverty and suffering of many of their peoples must also be addressed. According to the 1996 *Human Development Report* from the UN Development Program, poverty in the South is so widespread that the combined incomes of half the world's population is about the same as that of the 358 richest people in the world. Thus, many in the South say that environmental objectives which exclude development goals, and thereby limit their potential to raise their material standards to those of the North, are unacceptable.

What we need as environmental educators are some conceptual tools for analysing different propositions about sustainable development. Here are two ways to do that. This can be seen in the following four different versions of sustainable development:

- the environmental management view – which involves economic and environmental sustainability
- the limits-to-growth-view – which involves environmental and social sustainability
- the growth-with-equity view – which involves economic and social sustainability
- the sustainable-living view – which involves all three forms of sustainability: environmental, economic and social.

The sustainable-living view of sustainable development recognises the need to link ecological sustainability with a genuine concern for social justice. A focus on sustainable living sees sustainable development as a process that influences the manner and rate of resource use by one group of people, so that their consumption habits do not jeopardize the environment and well-being of people in other parts of the world, or destroy the capacities of future generations – in any part of the world – to satisfy their reasonable needs and wants. This requires a global perspective in environmental matters. This is what the environmental credo to "Think globally, Act locally" really means. What does this mean in terms of plants?

Firstly, it means that the energy crisis is not a crisis of oil, coal, gas or uranium. The real energy crisis is a firewood crisis. It is a crisis of trees and deforestation. Secondly, it means that the food crisis is not a crisis of sheep, goats, or cows. It is a crisis of rice and wheat and potatoes and peas and beans and tomatoes. It is a crisis of growing strawberries in West Africa for air-freighting to Paris, London and Berlin. It is a crisis brought about by growing sugar in Fiji for export instead of taro; of growing bananas in Honduras instead of beans; of growing tea on Sri Lankan plantations instead of rice; of clearfelling trees in the Solomon Islands, Papua New Guinea and Brazil to make newsprint; and of growing coffee instead of basic subsistence food crops in Brazil so that some people like most of us can sit at sidewalk cafes drinking cappuccinos. During the height of the Ethiopian famine in the mid-1980s, Ethiopia was a net exporter of agricultural products. Ethiopia was actually exporting farm products while millions in Eritrea and Tigray were starving. And you cannot blame the weather for that!

The food crisis is not a crisis of agriculture. It is a crisis of political priorities. It is a crisis brought on by a global development machine that puts profits before human needs and produces what is profitable rather than what is needed. The global environmental crisis is a crisis of people – not of resources or nature. It is a crisis of the blind leading the blind on the treadmill of economic growth, as the rich world aims for ever-higher levels of production, higher living standards, more wealth, and more of what we in our more optimistic moments call ‘progress’! The treadmill of inappropriate economic growth is really a descending spiral of inappropriate development, through which mal-development degrades the environment and undermines human well-being and health – and which, in turn, inhibits development and causes governments to want to crank up the treadmill even faster – which only rebounds on the environment and, instead of cranking up economic growth, only serves to make the descending spiral go even faster.

When IUCN, UNEP and WWF were planning the second World Conservation Strategy which was published under the title of *Caring for the Earth*, they coined the term ‘sustainable living’, and proposed that governments, industry and families needed to live by a new world ethic of sustainability. This ethic (described below) contains eight values which, at least for me, define a comprehensive set of criteria for sustainable development and also provide a central focus for environmental education. In summary form, these eight values fall into two groups – those related to our responsibility to care for nature (or ecological sustainability) and those related to our responsibility to care for each other (social justice). Four values may be identified in each group:

- people and nature: ecological sustainability:
 - *interdependence*: People are a part of nature and depend utterly on her. They should respect nature at all times, for nature is life. To respect nature means to approach nature with humility, care and compassion; to be frugal and efficient in resource use; to be guided by the best available knowledge, both traditional and scientific; and to help shape and support public policies that promote sustainability
 - *biodiversity*: Every life form warrants respect and preservation independently of its worth to people. People should preserve the complexity of ecosystems to ensure the survival of all species, and the safeguarding of their habitats
 - *living lightly on the earth*: All persons should take responsibility for their impact on nature. They should maintain ecological processes, the variety of life, renewable resources, and the ecosystems that support them. They should use natural resources and the environment carefully and sustainably, and restore degraded ecosystems
 - *interspecies equity*: People should treat all creatures decently, and protect them from cruelty and avoidable suffering
- people and people: social justice:
 - *basic human needs*: The needs of all individuals and societies should be met, within the constraints imposed by the biosphere; and all should have equal opportunity for improving their lot
 - *inter-generational equity*: Each generation should leave to the future a world that is at least as diverse and productive as the one it inherited. To this end, non-renewable resources should be used sparingly, renewable resources should be used sustainably, and waste should be minimized. The benefits of development should not be consumed now, while leaving the costs to the future
 - *human rights*: All persons should have the fundamental freedoms of conscience and religion, expression, peaceful assembly, and association
 - *participation*: All persons and communities should be empowered to exercise responsibility for their own lives and for life on Earth. Thus they must have full access to education, political enfranchisement and sustaining livelihoods; and they should be able to participate effectively in the decisions that most affect them

(Adapted from IUCN, UNEP and WWF 1990 p.22; Fien 1993)

A centrally important set of questions and issues arise when the implications for environmental education of the world-ethic of sustainability and the concept of sustainable living are considered. The Introduction to *Our Common Future* contains the following challenge to teachers written by the Commission Chair, Gro Harlem Brundtland: "first and foremost our message is directed towards people, whose well-being is the ultimate goal of all environment and development policies. In particular, the Commission is addressing the young. The world's teachers will have a crucial role to play in bringing this message to them" (World Commission on Environment and Development, 1987, p.xiv). Mrs Brundtland further outlined the nature of the transition required for sustainability, and the role envisaged for environmental education by the Commission, when she wrote:

The transition to sustainable development touches on core issues of our societies. It concerns basic values and moral codes for human behaviour, attitudes and consideration for fellow human beings and for nature itself. In order to reverse the present negative trends, there is an urgent need for commitment and action at all levels of society. Today, there is an increased awareness that solidarity and responsibilities must be extended to encompass the interests of future generations . . .

Teachers play a very important role in the transition between generations, in the transmission of knowledge from one generation to the next. Consciousness-raising is vital for change. Teachers can convey to children a sense of respect and responsibility for nature and for the global environment . . .

But respect for the environment alone will not be enough to save our common future. A sense of solidarity with the world's underprivileged will be equally important. There is no way we can win the battle to save the global environment unless we deal squarely with the issue of world poverty. We must teach the next generation that necessity of caring for the poor and the dispossessed, not only because it is morally right, but because it is in our common interest to do so.

(Brundtland 1991, pp.4-5a.)

I would like now to explore three implications of education for sustainability, with reference to our work as educators in botanic gardens:

- the need to expand the ecological foundations of environmental education to incorporate a social ecology perspective
- a review of the definition and purposes of environmental education and
- a review of the place of nature-study in environmental education.

A social ecology foundation for environmental education

Ecology has been described as the foundation discipline of environmental education; Hungerford, Peyton and Wilke (1990) write of the "ecological foundations of environmental education". However, an example of two approaches to teaching about biodiversity illustrate the limitations of such foundations.

Biodiversity is one of the central concepts of environmental education. It is also one of the values in the world-ethic of sustainability. Traditionally, this is what is usually taught about biodiversity in environmental education:

During the next 20 to 30 years, the world may lose many thousands or even hundreds of thousands of species of plants and animals – primarily because of environmental changes due to human activities. The list of lost, endangered and threatened species includes both plants and animals. About 10% of temperate region plant species and 11% of the world's 9000 bird species are at risk of extinction. In the tropics, the destruction of forests threatens thousands of species which live nowhere else.

Australia, for example, has lost 75% of its rainforests and 40% of its total forest cover since European settlement 208 years ago. Nearly 70% of all native vegetation has been removed or significantly modified, and the rate of clearance is accelerating, with as much land cleared during the last 50 years as in the previous 150. Native vegetation is still being cleared at the rate of over 600,000 hectares per year, which is almost half the rate of clearing in Brazilian rainforests in 1990-91.

A rate of extinction of this magnitude is alarming and poses a global problem which has kindled world-wide interest in "biological diversity" or "biodiversity". Biodiversity implies more than simply

the number of species that inhabit our planet. The ecological interactions among these diverse species and their physical environment make up the ecosystems upon which the human species depends for survival . . .

Biodiversity provides vital services such as renewing the earth's atmosphere, absorbing pollution and maintaining soil fertility. It provides ethical and spiritual inspiration for many societies. Biodiversity also provides the basic biological complement for the expression of coral reefs, forests and wetland ecosystems which help in fixing carbon from the atmosphere, an important and fundamental means of controlling greenhouse warming.

(Hillig 1997; Department of the Environment, Sport and Territories 1996)

There are fundamentally important concepts here, and much good work is being done in our botanic gardens to help visitors understand them. However, when guided by the concepts of sustainable living and social ecology, we need to expand what we tell people about biodiversity. For example, how important is it for us to ask our garden visitors to think about issues such as:

- many rich countries in the North are relatively poor in biodiversity because they used it up to buy their current high standards of living, and
- during colonial times, they raised their standard of living at the expense of the biodiversity of their colonies;
- many people today think that this process is continuing. Bio-piracy and the patenting of seeds from tropical gene pools is a threat to the development of the South
- who has the right to decide on the use of the genetic resources of a country?
- should the rainforest countries in the tropics which have not yet reduced their biological resources refrain from exploiting their forests because it might threaten global climate? Who is going to pay them for the oxygen their forests create?
- how can the poor people of a region exploit the biodiversity storehouses of their forests in ways that do not impair their longer-term economic development?
- how can the cost of preserving biodiversity for the globe be shared between the rich and the poor countries?

Visitors to botanic gardens need to address questions of this nature as well as strictly ecological ones. While biodiversity is basically an ecological topic, biodiversity problems and issues are connected to every fabric of our global society. Poverty, ill-health and environmental decline cannot be stopped merely by education about ecology.

Hillig, the former Director of the UNESCO Regional Office for Science and Technology in South East Asia (ROSTSEA), summarized the role of environmental educators in teaching about biodiversity when he stated:

Developed countries are relatively poorer in biodiversity because they have gained their current quality of life at the expense of their biodiversity and in most cases at the expense of the biodiversity of developing countries. Should those countries which have not yet reduced their biological resources stop development based on the direct exploitation of biodiversity store houses because it impairs their longer term economic development? How should the cost of preserving biodiversity for the globe be shared between the rich and the poor countries? Environmental education must address questions of this nature, as well as the biological components themselves.

While biodiversity is basically an ecological topic, biodiversity problems and issues are connected to every fabric of our global society . . .

Not everyone in the world can afford to value the environment and needs of future generations may vary highly. It will be difficult to develop positive attitudes and conserving behaviour towards the natural environment among many poverty-stricken citizens of developing nations. Without food for survival, there can be little thought given towards conservation of the environment for future generations . . .

The motivation provided by poverty, starvation and ill-health cannot be changed merely by education about environmental quality.

(Hillig 1997)

This means that development education, and the associated concepts of human rights, peace and democracy, must become a key element of environmental education – and an example of this expanded view of biodiversity education could be a workshop, or even a performance of the new WWF rock-musical called *Arabica*. This traces the 1000-year history of the coffee bean from its accidental discovery by an Ethiopian goatherd, through its growth in economic importance after being taken to South America, to today where the growers are in bitter enslavement to international cartels and bankers. It shows how a plant, which is so much a taken-for-granted part of our daily lives, affects the economy, society and ecology of many countries in the South (Thornber 1996).

The resultant focus on themes of development and human rights means that we need to see environmental education in a broader context, which even affects our definition of environment and environmental education.

Towards a definition of education for sustainable living

This redirection of the ecological foundations of environmental education towards social ecology provides the basis for a second way of exploring the implications of education for sustainable living for environmental education. This involves a broadening of the concept of environment and environmental education and their direct links with issues of development, human rights and peace – and, therefore, aligns environmental education as an integral partner with development education, human rights education and peace education in education for sustainable living. The World Conservation Union (IUCN) has described this new direction for environmental education as "education for sustainable living". They defined this as a process which:

. . . develops human capacity and creativity to participate in determining the future, encourages technical progress as well as fostering the cultural conditions favouring social and economic change to improve the quality of life and more equitable economic growth while living within the carrying capacity of supporting ecosystems to maintain life indefinitely

(IUCN Commission on Education and Communication 1993, p.6).

This is not an unproblematical definition. Questions may be asked about the meaning of 'technical progress' and ways in which 'carrying capacity' may be defined and measured. However, the definition does indicate that education for sustainable living has a future-looking orientation, and seeks to develop the creativity and action capacities of individuals and societies with a view to bringing about the social and economic changes that can foster equitable economic growth and ecological sustainability. In so doing, the definition avoids the ambiguity of many definitions of sustainable development that have concerned environmental educators (e.g. Jickling 1992), and the focus on individualism and behaviour modification that underlie unproblematical conceptions of environmental education (Hart & Robottom 1993).

The British Environment, Development, Education and Training Group's report, *Good Earth-Keeping: Education, Training and Awareness for a Sustainable Future*, also avoids these problems of ambiguity and individualism when it offers the following as a definition and set of objectives of 'education for sustainability':

We believe that education for sustainability is a process which is relevant to all people, and that, like sustainable development itself, it is a process rather than a fixed goal. It may precede – and it will always accompany – the building of relationships between individuals, groups and their environment. All people, we believe, are capable of being educators and learners in the pursuit of sustainability.

We argue here that education for sustainability is a process which:

- enables people to understand the interdependence of all life on this planet, and the repercussions that their actions and decisions may have both now and in the future on resources, on the global community as well as their local one, and on the total environment
- increases people's awareness of the economic, political, social, cultural, technological and environmental forces which foster or impede sustainable development

- develops people's awareness, competence, attitudes and values, enabling them to be effectively involved in sustainable development at local, national and international level, and helping them, to work towards a more equitable and sustainable future. In particular, it enables people to integrate environmental and economic decision making
- affirms the validity of the different approaches contributed by environmental education, and development education and the need for the further development and integration of the concepts of sustainability in these and other related cross disciplinary educational approaches, as well as in established disciplines

(Sterling, EDET Group 1992, p.2)

The place of nature-study in environmental education

The expanded conception of environmental education in education for sustainable living poses many questions and challenges for those of us who work out of doors and see nature study and experiences in nature as central to our work. I would like to focus on this point for a minute.

Nature-based work has given us many wonderful experiential teaching methods and has led to many innovations in environmental education teaching methods and materials, e.g. environmental interpretation, nature trails, sensory walks, Earth Education, Project Learning Tree, Project Wild, and so on. It has also led to the humanising of environmental education and helped us to provide learning experiences, especially in the outdoors, which give students self-confidence and esteem, and a sense of oneness with nature.

However, our new understanding of the scope of education for sustainable living alerts us to several dangers, if this is the *only* approach to environmental education that we provide. Firstly, it ignores the questions, issues and problems facing the student and her community. That is why I have been so pleased to learn about the community outreach programmes of the National Botanic Institute in South Africa, and the community-based conservation recycling and composting projects in so many other gardens. Focusing student attention on nature without also providing a focus on wider social and economic contexts can direct students to look inwards, rather than outwards to the links between the nature, the individual and society. Secondly, we must be careful that nature experiences do not become escapism. It is often argued that close contact with nature can help students to develop a strong personal bonding with the earth and, therefore, increase their desire to act for it. However, it is difficult to see how this romantic view of nature will automatically lead to this result without a degree of political conscientising as well.

The focus on personal development and nature experiences are characteristics of New Age thinking. However, this philosophy tends to over-emphasize the importance of personal transformation at the expense of seeing personal and broader social transformation as interdependent. It also tends to ignore the fact that the journey to sustainability requires both of these for sustained social change. Mary Mellor (1992) warns that the focus on the individual in this approach to environmentalism may prove to be less helpful than its advocates intend:

The problem in New Age thinking is the relationship between personal transformation and wider communal change . . . While I would not want to argue about the development of a spiritual dimension to our lives and a displacement of the emphasis on materialism, . . . it risks diverting us into an inappropriate self-obsession. While this may help us individually to develop a wider spiritual awareness and 'bring together' parts of ourselves that have become divided in modern society, it will not necessarily lead to any wider social transformation. That must be done by transforming the materialism of our culture, not running away from it. In many ways New Ageism can be seen as just another manifestation of the 'me' generation: a movement for the powerful, not the powerless.

(Mellor 1992, pp.46-47)

The Danish health and environmental educator Bjarne Jensen (1992) notes that both the environmental and the New Age aspects of nature-based education run the risk of romantic escapism – the first into romanticism with nature; the second into romance with oneself – neither of which can solve environmental problems. Jensen goes on to say that "This does not mean that such activities cannot have value in themselves or for other purposes, but they do not solve the paradox of increasing anxiety and the currently increasing action paralysis" of the modern world.

Conclusion

In this paper, I have sought to make a case for a broadening of the agenda of environmental education. I have explored the trends that have given rise to a redefinition of environmental education for sustainable living and its integration with development education, peace education and human rights education. I have explored some of the implications of this for classroom content (through the example of traditional and newer approaches to the topic of biodiversity) and asked us to think beyond nature study as our focus in education in botanic gardens.

Those of us who accept the challenge to "Stand up and be Counted" on issues of sustainability and education for sustainable living may not find it that easy, however. We may need to convince our managers why we need to be involved in education outside the gardens and why we need to take the gardens to the community (rather than the other way around) – in order to show how conservation goals cannot be achieved without attention to values of appropriate development, human rights and democracy as well. We may need to explore the way the principles of sustainable living operate in our gardens. Are they community demonstration models not only of ecological sustainability and conservation principles, but also places where the buildings and the products on sale in the shops model the principles of appropriate development? And do management and personnel practices model the principles of social sustainability, human rights, and equal opportunity and outcomes for all employees? It may be that the first task of education for sustainable living for educators in botanic gardens, is the education of our colleagues and supervisors. It certainly is for people like me who work in universities and colleges.

Giroux (1988) argues that this may be done by educators living and working as 'transformative intellectuals'. Central to the task of being a transformative intellectual is a recognition of the "necessity of making the pedagogical more political and the political more pedagogical". Making the pedagogical more political means consciously working with others to foster democratic values and a deep and abiding faith in the struggle to overcome economic, social and ecological barriers to sustainable living, and to further educate and humanise ourselves as part of the struggle. Making the political more pedagogical means applying the principles of education for sustainable living in developing learning experiences that encourage our groups to enquire into ways in which they can become part of the transition to sustainability – and not just become knowledgeable about biodiversity, as important as that is as a starting point.

Working as a transformative intellectual requires that we "Stand up, Stand up and be Counted".

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Reflections on action: towards a clear framework for education practice in botanic gardens

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Introduction

In pulling together the strands of the Congress, I would like to reflect on some of the ideas and methods shared and issues that have emerged through the course of the week. The sessions I have been fortunate enough to attend have been both inspiring and challenging, and have enriched my vision of possibilities for botanic gardens education. Despite the title of this paper, I do not believe it is possible to create a single guiding framework for education practice in botanic gardens. The uniqueness of each of our situations, coupled with our own particular experiences, personalities and perspectives, means that each of us will return home with a different story to tell of this gathering.

I therefore share with you the themes, ideas and issues that stood out for me during the Congress, and how I have tried to make sense of the richness and variety of experiences. My insights are very much a reflection of living and working in South Africa in transition, and our sensitivity to authoritarian decision-making. So what I have to say should be interpreted in this light.

I hope that my reflections will encourage you to return in your minds to your experiences of the week, and build these into a framework that will continue to challenge and inspire you as you return to your own places of work.

I start by reflecting on the main and subsidiary themes of the Congress, and in each case draw out examples of good practice and issues to be considered.

Overview of Congress themes

Teaching for the twenty-first century: perhaps nothing characterises the last decade of the twentieth century (and by extrapolation the twenty-first) more than the rate and extent of change which affects every aspect of our lives. At this Congress alone we have discussed the changes affecting our ecological environment, and how we should be educating for sustainability. We have heard of rapid changes in publishing technology: from print to DTP to the Worldwide Web. Much has been said about multicultural approaches, and yet cultures and traditions that once seemed stable are also fluid and changing as we all become citizens of the global village.

As environmental educators we are in the business of dealing with and responding to change. We are galvanised into action to resist rapid and destructive environmental change, and in our enthusiasm to arrest this destruction, we often consider it our duty to change the attitudes and actions of others.

The first caution I would like to raise is how we approach this issue of attitude and behavioural change, as this says much about how we view our roles as educators, and the process of education in a changing society.

As teachers we are used to being the purveyors of knowledge. As environmentalists we are accustomed to inhabiting the moral high ground. Therefore on two accounts we must beware of the tendency to view ourselves as 'good', the public as somehow 'bad' or 'ignorant' and our role as changing their attitudes and behavioural so that 'they' can become more like 'us'. This approach may appear particularly rational – however, it is also presumptuous and inappropriate if the sustainable world we envisage is to be peopled by active, critical-thinking citizens participating in a just society.

I would like to illustrate by example two alternative approaches to dealing with change. In one case, the locus or site of the change is outside of me: I am the one who knows and understands, and who has a blueprint for the planet and society. My job is to change the behaviour of others. In the other column, I see myself as part of a society which is learning to make sense of rapid social and ecological change. I accept the need to change myself as, in collaboration with others, I learn more appropriate ways of operating.

| US AND THEM | US TOGETHER |
|--|---|
| <ul style="list-style-type: none"> • Message transfer My agenda for your action • Rational interventions (strategies) – social engineering • Knowledge as absolute • You need to change to be more like me: informed, empowered, responsible • Models and recipes – can be generalised • Linear, rational process with a predetermined end • Dualistic thinking: what shall we (the experts) do about them (the earth and society)? • We need to bring about (direct) change | <ul style="list-style-type: none"> • Shared meaning-making Shared agenda for action • Reflective social processes • Knowledge as socially constructed and contextual – botanic gardens as cultural institutions • We need to learn together to do things better – I too have much to learn • Emergent, particularistic solutions: contextual • Open-ended, cyclical process (e.g. action research) • Integrated thinking: how shall we, in partnership, live better with one another in the world? • Let us engage with and learn from change |

Table 1 A comparison of deterministic and participatory approaches to change.

A point to make here is that one should not assume that one of these extremes is ‘right’ and the other ‘wrong’. However, by simplifying and juxtaposing extremes, we may become more critically aware of the choices available to us, and become more able to make informed decisions as to approaches that would be most appropriate for the context in which we live and work.

Times of rapid social change are characterised by much uncertainty. The conventions which once applied cannot be trusted, and the answers we once depended on seem simplistic and inadequate. This is both threatening and exciting for educators who can embrace approaches to education which engage with the challenges of change. I shall now endeavour to draw out some examples of good practice by focusing on the Congress subsidiary themes.

The Global Village

This Congress has been an opportunity for botanic gardens educators from all over the world to gather and learn from one another. The richness of this gathering has been in the sharing of perspectives and experiences influenced by our different histories and present social, political, ecological and philosophical environments.

As human settlements expand into every habitable part of the earth, so the boundaries between people and cultures become blurred. As we become more mobile, as global communication becomes faster and information more accessible, so we truly become global villagers.

It is interesting to reflect on the origins of botanic gardens and remember that many have their roots in imperialism and colonialism. This is reflected, for example, in the two dominant languages at this Congress, viz: English and Spanish. How are we responding to this historical legacy in the present? It appears that there are two very different approaches.

On the one hand, many gardens, particularly those in developed countries with collections of plants from many parts of the world, are being used to celebrate multiculturalism and deal with issues of globalisation. An increasing sensitivity to and respect for the cultures and countries represented by the plants in collections is evident in some of the programmes shared. e.g. storytelling, tree dressing, healing plants and the global greenhouse. Awareness of global issues, for example North-South relationships, are also being addressed through activities such as the Whole World Cake.

However, many of the developing countries which still have significant but threatened native floras, are developing programmes with a more nationalistic or regional flavour by celebrating indigenous plants and local cultures, in particular the plant-related knowledge of indigenous peoples.

Both these perspectives emphasise people-plant links, seeing plants in their social contexts. As someone representing an institute which has as its mission the promotion of the native flora of southern Africa, I have been challenged by the more multicultural programmes listed above which provide an understanding of cultures and which promote understanding and respect.

BGCI as a network, and this Congress as a meeting-place, provide an excellent forum for global communication to explore some of the apparent differences in our approaches, and to have our assumptions challenged by the practices of others.

Botanical Knowledge

A popular sociological perspective discussed earlier holds that knowledge is not absolute but is socially constructed. Indeed, as educators our choice of what constitutes useful knowledge is strongly influenced by local political and cultural imperatives. Furthermore, how we deal in knowledge says much about how we view both relationships between teachers and learners, and issues of power as related to knowledge transactions.

There has been very little evidence of the 'jug and mug' approach to education at this Congress. We have moved on from the days when all-knowing, all-powerful teachers dispensed digestible parcels of knowledge (which they considered essential) to passive, empty-headed learners.

From my own experience in South Africa, however, this transition has not been made by the majority of classroom teachers. Perhaps many of the educators represented here were lured away from formal education by the creative opportunities provided within botanic gardens to develop responsive curricula. Reflective practitioners such as these are characterised by an openness to learning from experience within a flexible teaching environment.

Movements such as child-centred education, environmental education and enquiry learning have helped us to revise many of the old teacher-centred approaches which we ourselves experienced as young learners. Informed by these movements, botanical knowledge – far from being dead, dull and smelling of mothballs – is very much alive.

There is much evidence of active, hands-on learning situations where learners are encouraged to clarify concepts, formulate and challenge values, develop practical and cognitive skills, participate in enquiry-based programmes – and generally have enormous fun in the process of learning.

There is also much evidence of an integrated approach to botanical education, whether this means that botanic gardens are offering cross-curricular programmes, or encouraging an understanding of plants in their ecological or cultural contexts.

So integrated, learner-centred approaches characterise much of what is happening in botanic gardens education. And in addition, many gardens are responding to more recent challenges to go beyond the development of the *individual's* cognitive, creative and critical faculties, in order to address learning as a *social* process of meaning-making. Here again there is exciting evidence of innovative programmes. The Smith College Summer Science Program for Girls deals proactively with a social issue (that of the underrepresentation of women in science). Furthermore, some school greening programmes, such as that of the University of Wisconsin Madison Arboretum's Earth Partnership Program, acknowledge the sustained nature of learning in a social context by enlisting the support of the family as well as that of the teachers.

Learning as an ongoing social process has also been addressed by the New York Botanic Garden's Teacher Enhancement Program, in which small groups of teachers are involved in an ongoing professional development programme. These programmes challenge those of us whose main activities involve one-off visits to botanic gardens with little follow-up or few opportunities for critical reflection with a group of colleagues in education.

Urban Horticulture

Among the most inspirational sessions I attended at this Congress were those that dealt with the very practical pursuit of horticulture. How educational it can be to get good earth under one's finger nails! Perhaps one of the reasons why urban horticulture programmes are so educational is because, in general, they represent sustained action in a social context. Here one has the opportunity to learn useful skills and develop communities of action. Working together is a sure way to develop and practice essential life-skills of communication, problem-solving, negotiation and patience and to learn these from the surest of teachers: experience. Urban horticulture involves practical action to improve one's living environment, making it more beautiful, healthy and productive. In so doing it addresses the negative social forces of degradation and despair.

Here we must pay tribute to our hosts, the Brooklyn Botanic Garden, who pioneered the children's garden concept so many decades ago, and whose vision has inspired similar movements all over the world, and certainly those of us who have been fortunate enough to attend this Congress

Education for Sustainability

Perhaps the most useful overarching theme for education in botanic gardens is the one I have chosen to end with: Education for Sustainability. Educators involved in the BGCI network, I would presume, share a common concern for the survival and continued health of life on Earth. As our understanding of living systems has developed, so our earlier responses to challenges such as the environmental crisis have sometimes appeared to be inadequate, and we have had to revise our responses and indeed our vocabularies.

Thus, to my mind what characterises 'good' education for sustainability is not simply conservation education, but, as John Fien reminded us (Fien 1998), education that responds in an integrated manner to ecological and social issues. I would contend that, while many of us are passionate about the subject we teach and about conservation as an issue, as educators our first commitment is to the people with whom we work – and to their (and our) aspirations and growth in competence, confidence and vision.

While a sense of the interrelatedness of all things is essential for an understanding of sustainability, I would suggest that it is necessary to go beyond simply an awareness-raising stage or developing an understanding of ecological concepts in our programmes. The simple but useful model of environmental education as being education *in, about* and *for* the environment, reminds us that action is essential to meaningful education. And perhaps instead of seeing education as leading to action, we should rather look for inspiration to the many examples of *education through action* that we have been privileged to hear about at this Congress.

Indeed community action programmes for environmental restoration provide fertile opportunities for learning together to care for the earth, while at the same time learning how to live and work together effectively as active, participating citizens. When these programmes involve school-going youth and when learning is linked to the curriculum, formidable opportunities for environmental education are created.

Conclusions: a framework for education in botanic gardens:

So, in summary, what has stood out for me as evidence of good practice in botanic gardens education?

Firstly, our programmes need to be sensitive to context. They may be inspired by ideas from afar, but they need to acknowledge local political, social and economic imperatives, and the ecological environments in which they are located.

Secondly, good education is characterised by integration – of areas of learning, of sociocultural and ecological systems and issues, of theory and practice, and of institutions of learning and real life situations.

Because it takes place within a changing environment, good education is dynamic. It requires participants to engage in ongoing evaluation, both individually and together, so that themes, methods and approaches remain socially relevant.

Good education acknowledges the apparent contradictions and conflicting schools of thought which arise in different contexts, understanding that it is these tensions which maintain the dynamic and responsive nature of teaching and learning.

Finally, what has stood out for me at this Congress is that good education *starts with* rather than *results in* action to address issues of common concern. Through such action, learning is automatically contextualised, useful and collaborative. It requires the clarification of ideas, values and understanding – and generates ever-changing social situations in which we learn by experience to engage in the processes of participatory democracy.

I hope that, through sharing something of what this gathering has meant to me, you will be encouraged to return to your abstracts, notes and memories, and develop a set of principles which have meaning for you in your situation.

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Planning and Policies

The education master plan: making choices for the future

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Introduction

Planning is about making choices. Everyone has more work than they can do. People are in this field because they are creative, innovative and when they identify a need they feel the urge to act upon it. However, both personally and institutionally, it is impossible to plan, develop and implement every good program idea that comes along.

So how do people make choices? How do they justify them? How do they adjust to the changing social, environmental, political and educational environments within which they live?

The North Carolina Arboretum is an emerging institution with a small staff, located in the magnificent mountains of Western North Carolina. The botanical, cultural and social heritage provides a wealth of opportunities for program planning as does the changing political climate. One of the first tasks as education coordinator was to begin developing a programmatic 'road map', to help guide the institutional choices for what education programs should be implemented first and then what should be done next.

Planning is often thought to be a luxury, one only the idle have time to indulge in. However, without a programmatic plan, education programs in botanical gardens run the risk of becoming unfocused, or worse, stale and unnecessary. In an effort to avoid these pitfalls, a plan was devised to collect information that would help staff identify the educational needs within North Carolina, then target specific projects that could be done well in order to meet those needs.

This information-gathering phase lasted months. It was called 'Market-based Program Planning' because the ideas were generated from outside the organisation. A primary source of information was a series of ten focus groups that were held in 1993, and periodically over the next several years. Included in this paper is information on planning and implementing a focus group session, a technique that was found to be particularly valuable and rewarding.

It became clear that choices must be made concerning which programs should be implemented first and that these decisions must be justified in some objective way to our Board of Directors and to other decision-makers affecting the future of the Arboretum. This next phase involves a system of three filters that are detailed in this paper. It is hoped that this system, modified to the needs of the reader, will be a useful planning tool for making choices for the future development of their garden.

Market-based education programming: step by step

- 1 Establish the design process with the Executive Director, Board members, other staff. Establish goals and time frame for completion,
- 2 Gather information
 - A) Internal Analysis
 - Review education program history
 - Identify current resources (staff, facilities, gardens, trails, funding)
 - Tabulate and analyze response to current programs
 - B) External Analysis
 - Conduct focus groups
 - Attend conferences
 - Visit related educational institutions
 - Investigate American Association of Botanical Gardens and Arboreta's Resource Center
 - Interview your professional counterparts at other gardens
 - Utilize questionnaires and surveys (teachers, current and potential students, etc.)
 - Poll your institution's staff and volunteers in other departments
 - Carefully read and listen to local news media

- 3 Assimilate information
 - A) Assemble all program ideas from all sources
 - B) Identify relevant major trends based on the external analysis
 - C) Identify major program areas and audiences to be considered
- 4 Conceptualize and establish criteria, or 'filters', for selecting programs to be implemented
- 5 Select appropriate programs based on above criteria
- 6 Summarize findings and present to Executive Director and other decision makers
- 7 Develop work plans for personnel in your department.

The focus group: An effective information-gathering tool

Guidelines used to establish focus group sessions for the education Master Plan at the north Carolina Arboretum:

- 1 Identify the target areas to be studied, including age groups, related professions, interests
- 2 Assemble lists of people and institutions to be represented in each target area. Eight to twelve participants per session is optimum
- 3 Establish times and dates for each target area, choosing TWO different times for each focus group topic (two separate focus groups per topic). This gives you the opportunity to compare the ideas and suggestions for each topic. Two hours per session is ample time.
- 4 Contact participants by phone, describing process and goals, and asking for their help. Give them a choice of meeting times.
- 5 Send a written confirmation letter reviewing the 'phone conversations, confirming the time, and outlining the discussion with the list of questions to be addressed. You can also send a brochure and the mission and goal statement of the institutions.
- 6 Provide a comfortable attractive place to meet. Ambience is important to the healthy flow of ideas
 - Refreshments appropriate to the hour
 - Be certain you will not be disturbed
 - Place name in front of each person in letters large enough to read across the table
 - Provide a list of all participants and their affiliations for each topic
 - Provide a copy of the outline sent earlier
 - A thank-you gift is great, perhaps a pen, note pad, small plant
- 7 During the focus group session:
 - Start on time
 - Introduce yourself, describe the purpose of the session and how the information will be used
 - Use the outline sent in advance to generate ideas. Begin by going around the room, but be flexible if dialogue begins among participants
 - Carefully take notes on everything said, noting who said it, wherever possible
 - It is important to remember that the facilitator does NOT contribute ideas, or accept or reject any ideas generated in the session. The role of the facilitator is to keep the discussion on track, to record ideas, to provide a positive atmosphere for sharing of ideas, and to review what is said at the end
 - Fifteen minutes prior to the scheduled ending time, wind-up the discussion, review your notes with the participants and ask for additional ideas. This is often the most productive time of the session
 - Ask if the review is accurate and complete
 - End on time
- 8 Send thank-you notes immediately, then later send a summary of your findings if interest warrants.

Focus group session outline

The following outline was mailed to each focus group participant, and was made available to them upon their arrival at the session. It provided a broad agenda for discussion, but allowed for enough flexibility to enable brainstorming to develop.

Dear Focus Group Participant:

Thank you very much for your willingness to participate in a ‘brainstorming’ session for the Education Master Plan for the North Carolina Arboretum. Your input will be invaluable to us as we examine the educational roles that the Arboretum will fill over the next several years.

Below is a list of general questions that we will address in our discussion:

- What general trends in education seem important?
- What are the important trends in your specific field as they relate to education?
- Are there general trends in the fields of horticulture or landscape design with which you are familiar?
- What are the existing or developing needs related to any of the above trends?
- What are ways these needs can be addressed?
- In what ways can the Arboretum fill these needs?
- Can you identify major educational ‘niches’ that are not now being addressed that would be appropriate for the Arboretum?

Thank you for your help!

Teacher survey for the education master plan

The following survey was sent out to teachers.

Thank you for your help in filling out the survey below. Your responses will play a key role in formulating our future plans for education offerings at the Arboretum.

Prior to today, what, if anything, had you heard about The North Carolina Arboretum?

What grade level(s) do you teach?

Are you a resource teacher?

Do you teach children with special needs?

What are they?

What topics would you most like to see the Arboretum address? (Rank in order of preference)

- Arbor Day activities
- Gardening (hands-on and/or classroom activities)
- School mini-arboretums
- Ethnobotany (the study of people/plant relationships)
- Recycling by nature and people
- Careers in horticulture, landscape design, outdoor education, etc.
- Environmental issues (which ones?):
- Other (please describe):

What materials would be most useful to you? (Rank in order of preference)

- Newsletter
- Pre-field trip activity guide
- Post-field trip activity guide
- Videos
- Slide presentations
- Film strips
- Supplemental reading materials and teacher’s guides
- Classroom activities (please describe briefly):
- Other (please describe):

Which specific objectives from the NC Standard Course of Study would you like to have additional supportive materials for? (You needn’t limit your thoughts to the science curriculum).

Do you have ideas on how the Arboretum could best help you as an educator with issues involved in curriculum integration?

Opportunity for evaluation and comments

The following evaluation form was used to gather information about the education program

Your opinion is important to us. We would very much appreciate your letting us know what you think about the lecture you have just attended. We would also like to hear any ideas you have about what you would like featured at the Arboretum in the future. By filling out this form you will help us to serve you better.

Title: _____ Date: _____

Please circle the appropriate number:

Rate your general impression of the program you have just attended:

1 2 3 4 5 6 7 8 9 10
Poor _____ Excellent

How helpful were the visual materials (handouts, slides, displays, plants, etc.)?

1 2 3 4 5 6 7 8 9 10
Poor _____ Excellent

Was the speaker clear and informative?

1 2 3 4 5 6 7 8 9 10
Poor _____ Excellent

Do you have suggestions for improving this program?

What education programs would you like to have the Arboretum offer in the future?

Please tell us something about yourself.

Please circle your gender: M F _____ What is your occupation?

In what age category do you belong?:
___18-35 ___36-50 ___51-64 ___65+

How many miles did you drive one way? In what County do you live?

How did you hear about this program? If you read about it in the newspaper, please tell us which one.

How many other Arboretum programs have you attended?

Are you a member of The North Carolina Arboretum Society? Yes No

Additional comments

THANK YOU!

Filter one

The following criteria were identified as primary considerations when examining education program ideas. Primary considerations may vary, or may include additional criteria. Each question should be answered with a yes or no. If any question is answered in the negative, the program does not go to the next stage or filter.

The following questions should be asked of each program being considered:

- 1 Is it relevant to the Mission and Goal statement?
- 2 Was the program generated as a result of the external analysis?
- 3 Is the program relevant to an identified major trend?

Description of questions:

Mission and Goal: The North Carolina Arboretum's Mission and Goal statement clearly identifies the major purposes and areas of activity that the Arboretum is involved in. Obviously, the relevance of a specific program to the mission and goals can be anywhere from strong to non-existent. If it is the latter, it will be eliminated at this point. If it is relevant at all, its strength will be evaluated in filter three.

External analysis: The External Analysis is the heart of Market Based Education Program Planning. In order for the program to advance to the next filter, a need must have been identified in the external analysis (surveys, focus groups, interviews, etc.). If the program need or idea was not generated as a result of this on-going external analysis, then it will be eliminated here.

Major Trend: A number of major trends were identified in the external analysis, and are periodically up-dated using focus groups. In order to be optimally effective, all programs should coordinate in some fashion with a major trend. Examples in North Carolina include: early childhood education (pre-school), School-to-Work career development, accountability of individual schools for student performance, gardening as the number one hobby in the United States, significant increases in retirees moving to Western North Carolina, rise in tourism in our area, etc. Trends in readers' areas may vary from these, and will change over time.

Filter two

This filter offers an opportunity to use a comparative scale to continue to rank programs. It is best to have the same person rank all programs, in order to remain consistent. Your filter may include additional criteria, or perhaps you are the 'decision maker' and need not be concerned with outside opinions of your program choices.

The following criteria should be rated on a scale of 1-10:

1. Complexity of implementation (1 = most complex, 10 = least complex)
2. Perceived ease of obtaining funding (1 = least likely, 10 = most likely)
3. Perceived impact on decision makers: (1 = no impact, 10 = significant impact)
4. Intuitive response of the reviewer (1 = negative response, 10 = positive response)

Description of questions:

Complexity of implementation: Some programs require minimal input from the organisation's staff and volunteers, little research, marketing and 'up front' work, and can generally 'run themselves'. Others can quickly overwhelm an entire organisation. Most programs fall in between these two extremes. This criteria provides the opportunity for estimating the range of difficulty and amount of preliminary work or research that must be done in order to implement the program.

Perceived ease of obtaining funding: If funds have already been designated to the project or are easily obtainable, or if the program costs little to implement, then it will receive a high rating here. If the reviewer cannot fathom a funding possibility, then it will receive a low rating. It should be noted that there is some subjectivity involved in this rating – it is only the perceived ease of funding that can be measured, as there is often no guarantee that a project will receive public or private funding, even if the likelihood seems high.

Perceived impact on decision makers: Most gardens are accountable to someone: a Board of Directors, local Commissioners, State or Federal legislators, funding sources, or perhaps the general public. Their perceptions of the value of a program are very important to the continuation of the garden or arboretum. If too many programs are deemed of little value by decision makers, the future of the garden could be brief.

Intuitive response of the reviewer: Often intuition is a key ingredient in a program's success or failure, and is used here in an effort to balance more objective criteria. Intuition is not created in a vacuum, but rather, is based on the sum total of the reviewer's professional experiences. Many programs are selected solely on the reviewer's response, however it should only be one factor in a decision-making process.

Filter three

At first glance, this filter may seem daunting and overly-complex. With a little practice, however, you can become quite proficient at using this system, and may choose to use it for every new program idea. A program that has reached this point needs to be further scrutinised as to its overall effectiveness and impact relative to other programs. Each criterion is rated on a scale of 1-10, with one being the least effective and 10 being the most effective. This *rating* is then multiplied by the *weight*, or *priority* of the criterion in question. Your criteria and their relative importance may vary from this list. The individual totals are then added to reach a final score. Again it is best to have the same reviewer do all programs in order to remain consistent.

| Program name: | Weight | Rating | Total (weight X rate) | Date reviewed: | Comments |
|--|--------------|--------|-----------------------|----------------|----------|
| Supports mission and goal | 15 | | | | |
| Increases institutional credibility in state | 14 | | | | |
| Builds a valuable constituency base | 13 | | | | |
| Enhances Arboretum's value with decision makers | 12 | | | | |
| Meets constituents' need for program | 11 | | | | |
| Increases perceptual cost of not doing program | 10 | | | | |
| Has positive impact on public judgement | 9 | | | | |
| Enhances opportunities for collaboration | 8 | | | | |
| Blends with current mix of activities | 7 | | | | |
| Has a favourable cost/benefit ratio | 6 | | | | |
| Increases investment toward a targeted whole | 5 | | | | |
| Has potential for volunteer/financial help | 4 | | | | |
| Is appropriate for developmental stage of audience | 3 | | | | |
| Is difficult to defer to a future date | 2 | | | | |
| Intuitive response of reviewer | 1 | | | | |
| | TOTAL SCORE: | | | | |

What kids really want in a garden for children: fact vs. fiction

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Introduction

In order to create the most enjoyable and stimulating garden for children at The Dallas Arboretum, children aged 6 - 12 years old were involved in its planning and design. Students in first to fifth grades were asked to draw a picture of their ideal garden for children (FICTION).

Observations were also made of school children who visited the Arboretum to determine their interests and activities within the Arboretum's current gardens (FACT). The results of these two studies were compared and contrasted to determine the most appropriate garden designs, features, topography, plant materials, and visitor activities for a future garden for children.

Why was this research study conducted?

The Dallas Arboretum determined that it needed a garden for children. The mission statement for the Garden for Children is:

The Garden should stimulate exploration, discovery, dramatic play and imagination. It should provide memorable senses of place and promote feelings of security, safety and orientation while explored by children. The Garden should be properly scaled and accessible to children of all ages and learning styles, with a special sensitivity toward those with disabilities. It should integrate children and allow opportunities for shared experiences with adults, friends and family members. The Garden should offer diversity, reflect a sense of continual change, stimulate the senses and provide abundant opportunities for horticultural education, all in an aesthetic setting with a positive ambiance.

The Garden also determined to involve the audience in the planning

Fiction: drawings

Who was involved? Students in the first to fifth grades were asked to draw a picture of their ideal garden for children. The total number of students involved was 241, mostly from the Dallas public school system. Almost equal numbers of white, African-American and Hispanic students were involved.

How were the student's responses collected? Through visiting classrooms, mostly in Dallas public schools.

What were the results? The frequency with which certain items appeared in the drawings was calculated. These frequencies are listed below:

| | | |
|------------------|-----|---|
| Plant Materials: | 80% | flowers (i.e. 80% of the drawings contained one or more flowers) |
| | 69% | a tree |
| | 60% | grass |
| | 21% | fruit tree(s) |
| | 20% | vegetables |
| | 6% | shrubs |
| | 1% | seeds |
| Flower Color: | 46% | red flower(s) |
| | 34% | yellow flower(s) |
| | 34% | purple flower(s) |
| | 28% | pink flower(s) |
| | 26% | blue flower(s) |
| | 23% | orange flower(s) |

| | |
|--|---|
| Wildlife habitats: | Plants that support wildlife Bird houses, etc. Natural ponds. |
| Opportunities for Activities: | Areas for planting by children Wildlife-viewing areas Assisting with daily watering, etc. |
| Additional structures and garden elements: | Treehouse. |

The design process for the Children’s Garden at The Dallas Arboretum

To design and build the Children’s Garden, staff carried out the following steps:

- 1) conducted background research on other children's gardens throughout the USA (staff)
- 2) formulated the beginnings of a program statement, goals, and objectives (staff). Submit draft to Education & Research Committee
- 3) researched potential funding sources through the establishment of a Funding Sub-committee
- 4) provided opportunities, workshops, and special events to enable kids to give their input on what they would like to have in a children's garden. It would be most advantageous to solicit thoughts from 9, 10, and 11-year olds because of their ability to verbalize. Also consult local school teachers and science specialists
- 5) established a committee to select a designer for the children's garden
- 6) created a long list of potential designers
- 7) called for design-firm proposals
- 8) selected a design firm
- 9) established a design committee for the children's garden
- 10) selected the appropriate site with the designer
- 11) developed the conceptual design, the theme of the garden, components, discovery stations, etc. in collaboration with staff, committees, and the designer
- 12) established the preliminary design
- 13) began a fundraising drive
- 14) created mock-up garden discovery stations and components
- 15) conducted audience-testings by observation. Modified mock-ups as necessary
- 16) analyzed observation results
- 17) modified components and discovery stations
- 18) completed the final design with construction documents
- 19) began development of education programs that supplement the children's garden, such as teacher packets, school programs, birthday parties, etc.
- 20) called for bids (city)

- 21) selected a contractor
- 22) fabricated the discovery stations and constructed the Garden
- 23) grand opening!

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La utilización de los jardines botánicos como recurso didáctico: planificación de una visita al Jardín Botánico Viera y Clavijo

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Introducción

Consideramos que los jardines botánicos constituyen una vía idónea para el aprendizaje de los contenidos conceptuales, procedimentales y actitudinales del currículo de la educación primaria desde una perspectiva globalizada al mismo tiempo que permiten afrontar de forma integrada los denominados ejes transversales, fundamentalmente la educación ambiental.

Si la planificación de la visita es la adecuada pueden lograrse una serie de metas educativas tales como:

- utilizarse como eje globalizador que permita aunar aspectos relacionados tanto con el área de conocimiento del medio como con las áreas de matemáticas, lengua y literatura y expresión plástica . . . , ya que el propio carácter de los jardines botánicos es interdisciplinar, y su estudio puede abordarse desde distintas áreas científicas
- estimular el aprendizaje de contenidos conceptuales al comprobar los estudiantes que estos conocimientos facilitan la observación y comprensión del entorno así como la localización de determinados elementos de los jardines
- permiten plantear problemas e invitan a reflexionar sobre soluciones para conservar el entorno y evitar posibles impactos medioambientales
- contribuyen a esbozar diseños experimentales en el aula y a contrastar, posteriormente en el medio, muchos aspectos de sus hipótesis de partida
- propiciar el desarrollo de técnicas que faciliten la selección y sistematización de las observaciones realizadas:
 - ◊ al trabajarse técnicas de observación y recogida de datos, desarrollan la capacidad de síntesis y análisis para la interpretación de los resultados y la elaboración de informes
 - ◊ favorecen la utilización de criterios para organizar y clasificar los materiales que observen, recolecten, fotografíen
- antes de planificar una visita didáctica a un jardín botánico, conviene que el profesorado se plantee una serie de cuestiones, entre las que destacamos:
 - ◊ análisis de la capacidad de sus alumnos/as para realizar trabajos en grupo y de campo
 - ◊ si no están muy adiestrados en lo anterior, elegir un jardín próximo al centro y realizar una visita previa como «simulacro» de visita al jardín botánico
 - ◊ documentarse sobre el jardín a visitar y la zona en la que está ubicado.

Respecto a las posibilidades que ofrece el jardín botánico a visitar, debe seleccionar qué aspectos considera que son más adecuados para trabajar con sus alumnos/as. Entre otros, podría tener en cuenta los siguientes puntos:

- que sea atractivo para el alumnado y que facilite la conexión entre lo que conocen y lo que pretendemos estudiar
- que permita desarrollar además de los contenidos conceptuales, los actitudinales y procedimentales
- que haya conexión entre el trabajo del aula y lo que se va a trabajar en el jardín botánico

- que permita trabajar a partir de planteamiento de problemas que favorezcan el montaje de diseños experimentales sencillos
- que ofrezca aspectos que puedan trabajarse desde distintas áreas
- que permita planificar actividades para desarrollar en el aula como ampliación de lo trabajado.

Objetivos

La finalidad de la visita didáctica que proponemos es la observación directa de aspectos relacionados con los jardines botánicos, a partir de la cual se desarrollarán diversos contenidos científicos. Entre los objetivos que se pueden alcanzar con dicha visita citamos como más significativos los siguientes:

OBJETIVOS

- desarrollar una metodología para la preparación de visitas didácticas a jardines botánicos
- utilizar dichas visitas para desarrollar contenidos conceptuales, procedimentales y actitudinales
- demostrar que es necesario conocer el jardín botánico que se quiere visitar para la adecuada planificación de las actividades
- utilizar el entorno del jardín como eje de globalización.
- demostrar la importancia de que se establezcan relaciones entre los aprendizajes del aula y las actividades en los jardines botánicos
- motivar a partir del planteamiento de problemas relacionados con el jardín a visitar
- observar e identificar la flora más característica recopilada en este entorno
- reconocer la utilidad de las plantas
- practicar técnicas de recogida e interpretación de datos
- utilizar aparatos sencillos para determinar algunas variables.

Contenidos

Con la realización de la visita didáctica al jardín botánico se pueden desarrollar, entre otros, los siguientes contenidos:

CONCEPTUALES

- los mapas, planos y maquetas como instrumentos para la ubicación de lugares
- la vegetación: características diferenciales de especies arbóreas, arbustivas y herbáceas
- morfología, fisiología y utilidad de algunas especies del entorno. Estudio de algunas plantas endémicas de Canarias
- el clima y su influencia en las características del paisaje
- las condiciones ambientales como requisito para la germinación y desarrollo de las semillas
- los sentidos: su importancia para el estudio del entorno.

PROCEDIMENTALES

- exploración de un jardín botánico
- desarrollo de estrategias y pautas de observación que le permitan reconocer la flora canaria recopilada en este entorno
- utilización de técnicas de recogida e interpretación de datos
- iniciación a la observación y registro del crecimiento y desarrollo de las plantas
- elaboración de un herbario siguiendo determinados criterios
- confección de murales
- planificación de estrategias para elaborar y dramatizar una historia relacionada con la visita al jardín botánico
- participación y toma de decisiones en equipo
- desarrollo de técnicas de localización en mapas y planos
- experimentación con materiales del entorno
- consulta de forma organizada y sistemática de la bibliografía
- elaboración de informes utilizando distintas fuentes de información
- reconocimiento de los jardines botánicos como espacios multidisciplinares objeto de estudio de diferentes materias.

ACTITUDINALES

- despertar el interés y la curiosidad por identificar y conocer los elementos más característicos del jardín botánico visitado
- disfrutar con la estética del entorno.
- inculcar el respeto hacia el entorno y los seres vivos que en él habitan
- valorar la diversidad y riqueza de las especies que se encuentran en un jardín botánico
- reconocer la importancia de los sentidos para el conocimiento de lo que nos rodea
- considerar la importancia del trabajo en grupo
- cumplir las normas establecidas
- valorar la importancia de la precisión al realizar experiencias, observaciones, recogida de datos etc.
- reconocer que un jardín botánico no es objeto de estudio exclusivo del área de las ciencias de la naturaleza sino que está muy relacionado con otras muchas disciplinas.

Metodología

Se ha escogido el vivero escolar, como un aspecto de las múltiples posibilidades que ofrece el Jardín Botánico Canario Viera y Clavijo, para ilustrar la metodología utilizada en la planificación de la visita didáctica.

Se expone a continuación una serie de tareas a llevar a cabo tanto por parte del profesor como por los grupos de alumnos y que pueden servir de pauta al profesorado para la organización de una visita didáctica a un jardín botánico.

En el desarrollo de esta planificación, hemos elegido el drago (*Dracaena draco*) como ejemplo para pautar las distintas actividades a desarrollar antes, durante y después de la visita al jardín. Sin embargo, consideramos conveniente elegir una especie diferente para cada dos grupos de trabajo, para que la experiencia resulte más enriquecedora, se puedan contrastar ideas entre los grupos que han trabajado lo mismo y establecer comparaciones con los otros en cuanto a tiempo de germinación, condiciones ambientales, características de las semillas etc. Un criterio de selección podría ser el estudio de los distintas plantas que son símbolos de la naturaleza para las Islas Canarias y que todas ellas se pueden encontrar en el Jardín Botánico Viera y Clavijo, Aprovechando posteriormente los animales que son símbolo de las mismas como actividades de ampliación.

| ISLAS | | SIMBOLOS |
|-----------|---|--|
| EL HIERRO | Sabina (<i>Juniperus phoenicea</i>) | Lagarto gigante (<i>Gallotia simonyi machadoi</i>) |
| LA GOMERA | Viñáigo (<i>Persea indica</i>) | Paloma rabiche (<i>Columba junoniae</i>) |
| LA PALMA | Pino canario (<i>Pinus canariensis</i>) | Graja (<i>Pyrrhocorax pyrrhocorax</i>) |
| TENERIFE | Drago (<i>Dracaena draco</i>) | Pinzón azul (<i>Fringilla teydea</i>) |

| | | |
|----------------------|--|---|
| GRAN CANARIA | Cardón (<i>Euphorbia canariensis</i>) | Perro de presa canario (<i>Canis familiaris</i>) |
| FUERTEVENTURA | Cardón de jandía (<i>Euphorbia handiensis</i>) | Hubara o Avutarda (<i>Chamydotis undulata fuerteventurae</i>) |
| LANZAROTE | Tabaiba dulce (<i>Euphorbia balsamifera</i>) | Cangrejo ciego (<i>Munidopsis polymorpha</i>) |
| ARCHIPIÉLAGO CANARIO | Palmera canaria (<i>Phoenix canariensis</i>) | Canario (<i>Serinus canarius canarius</i>) |

Planificación de la visita

1 – Actividades en el aula previas a la visita

En esta primera fase se dará a conocer al alumnado la finalidad de la visita así como los contenidos implicados que tenemos intención de desarrollar, para pasar luego a realizar un estudio en el aula de las características de la zona a visitar y aquellas actividades que consideramos necesarias para aprovechar al máximo la visita posterior:

Trabajo del profesorado

- Fundamentar claramente la finalidad de la visita al jardín indicando qué objetivos pretende y los contenidos que se van a trabajar
 - Justificar la elección de un aspecto o de una zona a estudiar
 - Organizar los grupos de trabajo de 4/5 alumnos/as cada uno
 - Motivar al alumnado hacia el estudio de una determinada planta a través de leyendas, su posible extinción, plantas que son símbolos de cada isla etc.
 - Distribuir mapas, bibliografía y mostrar documentos gráficos del jardín botánico, suscitando un debate sobre lo que se va a trabajar
 - Marcar las pautas para que, utilizando la bibliografía, elaboren un resumen esquemático sobre el jardín botánico.
 - Diseñar (o elegir entre las publicadas), fichas de observación sobre árboles, arbustos, flores, semillas ...
 - Distribuir tareas a realizar durante la visita por los distintos grupos e indicar:
 - ◊ El material que han de llevar
 - ◊ Muestras que han de recoger
 - ◊ Observaciones a realizar etc.
 - Pautar el diseño de experiencias sobre la germinación de las semillas, indicando a cada grupo qué variable independiente tiene que manejar.
 - ◊ Planificar actividades para medir la altura de los árboles de acuerdo con los conocimientos de matemáticas de su alumnado.
 - Localizar en el mapa el Jardín Botánico Canario Viera y Clavijo.
 - Utilizando la bibliografía, hacer un resumen esquemático en el que indiquen condiciones ambientales de la zona, la historia del jardín ...
 - Decidir, con la ayuda del profesor, los factores que se van a estudiar.
 - Realizar consultas bibliográficas para investigar las características de lo que van a observar.
 - Distribuirse dentro de los grupos las tareas a realizar por cada uno.
 - Hacer un estudio, en este caso del drago, en el que refleje:
 - ◊ Morfología general y de cada una de sus partes
 - ◊ Características generales de su reproducción
 - ◊ Dibujos o fotos de las diferencias en su aspecto a lo largo de su vida
 - ◊ Tipos de semillas, época y tiempo de germinación.
 - Debatir en pequeño grupo distintos problemas y plantear hipótesis. Ejemplo:
 - ◊ ¿Tardan todas las semillas el mismo tiempo en desarrollarse?
 - ◊ ¿Requerirán las mismas condiciones de luz, temperatura, humedad? ... ¿Será el drago tan alto y vivirá tantos años como dicen los libros? ¿Cómo podemos averiguarlo?
- Diseño y realización de experiencias relacionadas con las hipótesis planteadas.

2 – Actividades a realizar durante la visita

Trabajo del profesorado

- Ayudar a los distintos grupos a localizar en el vivero las semillas y los dragos en desarrollo.
- Suministrar pistas para la localización de los dragos que se encuentran en el jardín botánico.
- Coordinar las actividades de gran grupo indicando la hora y el lugar de reunión.
- Recalcar la importancia del respeto al medio y a los seres que lo habitan, evitando el «coleccionismo indiscriminado».
- Distribuir el material para realizar el calco de cortezas, la medida de la altura del drago
- Organizar la elaboración de la historia en gran grupo:
 - ◊ Coordinar la elección de un portavoz por grupo y de un secretario que registre el conteo que se va elaborando.
 - ◊ Elegir un coordinador que dará el turno de palabra a los distintos grupos.

Trabajo del alumnado

- Utilizando el plano localizar la zona del vivero.
- Localizar en el vivero las semillas y los pequeños dragos.
- Hacer dibujos y/o sacar fotografías.
- Confrontar las características que han estudiado sobre su germinación, desarrollo, etc. con la información que pueda suministrarle el encargado del vivero.
- Si es la época adecuada, transplantar un drago y observar y dibujar las distintas partes que observen. Si no lo es, informarse sobre la época idónea.
- Localizar el dragón del jardín botánico en el plano y dirigirse a él.
- Observarlos detenidamente y hacer fotografías generales y de detalles.
- Tomar nota sobre el deterioro que encuentren en los mismos indicando posibles causas.
- Calcar la corteza siguiendo las pautas dadas.
- Medir su altura y el diámetro de su tronco.
- Observar y describir cada una de sus partes utilizando todos los sentidos (olor, textura, color, sonido de posibles animales que hayan o el que produce el viento ...)
- Inventar un cuento en el que "su árbol" sea el protagonista.
- En gran grupo se hará una historia tratando de enlazar los cuentos de los distintos grupos.

3 – Actividades a realizar después de la visita

Trabajo del profesorado

- Ayudar a los distintos grupos a completar las actividades.
- Coordinar el debate sobre la visita realizada.
- Explicar claramente cómo hacer el informe recalcando la importancia de su adecuada presentación.
- Suministrar plantas diferentes a las estudiadas en el jardín botánico para establecer relaciones de similitud y diferencias entre sus distintas partes.
- Enseñar las técnicas de prensado de hojas y flores y la conservación de frutos y semillas.
- Planificar las actividades de ampliación que estime oportunas, por ejemplo:
 - ◊ Observación con lupa o microscopio de las distintas partes de una planta.
 - ◊ Estudio del polen y de la formación del tubo polínico
 - ◊ Establecer relaciones entre las características de las plantas y su polinización:
 - Colores-insectos-aves
 - Ligereza-viento
 - ◊ Estudio de otros organismos del medio que se hayan observado etc.
 - ◊ Actividades que pongan de manifiesto la importancia de todos los sentidos para el conocimiento del medio.
- Evaluar los resultados introduciendo las modificaciones oportunas.

Trabajo del alumnado

- Debatir en pequeño y gran grupo sobre la visita e indicar las dificultades encontradas en cada una de las propuestas de trabajo.

- Realizar un memoria de las actividades relacionadas con la visita.
- Elaborar un dossier sobre el drago en el que incluyan:
 - ◊ Fotografías tomadas con su leyenda correspondiente
 - ◊ El calco de la corteza
 - ◊ Los resultados de las observaciones y medidas realizadas: altura, grosor, número de ramificaciones del tronco etc. en un dibujo esquemático del mismo
 - ◊ Dibujos de las hojas, flores, frutos y semillas
 - ◊ El cuento elaborado con dibujos alusivos al mismo
- Comparar las distintas partes del drago con las de otras plantas estableciendo relaciones de similitud y diferencia.
- Practicar las técnicas de prensado de hojas y flores y la conservación de frutos y semillas
- Realizar las actividades de ampliación que el profesor/a proponga y realizar una síntesis de las mismas
- Debatir los resultados de los diseños experimentales realizados y sacar conclusiones.

Conclusiones

La visita didáctica a un jardín botánico:

1. Constituye un hilo conductor adecuado para el tratamiento interdisciplinar de distintos contenidos tanto de educación primaria como de la secundaria obligatoria.
2. Si está bien estructurada y conecta los aprendizajes formales con el entorno, fomenta el interés del alumnado y despierta su curiosidad por conocer nuevos contenidos.
3. Constituye un marco ideal para el desarrollo no sólo de contenidos conceptuales sino de los procedimentales y actitudinales.
4. El aprendizaje de la metodología de cómo preparar dicha visita hace, que el profesorado se implique en la misma y deje de ser un mero espectador de las actividades que sus alumnos y alumnas realizan en los jardines botánicos.

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The potential role of African botanic gardens in environmental awareness programmes and the need to be involved in education

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Introduction

This paper attempts to highlight two main issues, namely:

- the role of African botanic gardens in the creation of environmental awareness among the local people through education and
- the need to involve African botanic gardens in the world-wide crusade to protect the environment from extensive exploitation and degradation.

To enable us have a clear perception of the potential roles of African botanic gardens in these sub-sectors, it is important to briefly discuss the historical development of these gardens on the continent.

Overview

In tropical Africa many of the botanic gardens and arboreta were established in the latter part of the 19th century in response to a number of factors, the primary ones being:

- to undertake the exhaustive exploration of agricultural resources with a view to finding suitable economic plants for European markets
- to experiment on both economic and decorative plants from other tropical and sub-tropical countries with a view to finding out which ones could thrive under local conditions
- to teach scientific methods of agriculture to local farmers.

Botanic gardens not only served as part of the instruments of colonial expansion but also acted as experimental stations for the introduction of new crop plants in the local agricultural economy.

The pursuit of the latter objective led to the establishment of agricultural experimental stations in most botanic gardens and there is no doubt that the promotion of agricultural activities within botanic gardens adversely affected their development. With the setting up of Departments of Agriculture in the gardens in the 1940s, the botanic gardens were freed from the suffocating influence of agricultural activities and began to develop in their own right.

Today some of the 60 botanic gardens and arboreta in Africa are among those botanic gardens that are leading the worldwide fight to save plant diversity, as well as creating an understanding and awareness for the promotion of methods of conservation and development of plant resources. Despite financial constraints, a number of African botanic gardens are implementing major reforms under the auspices of Botanic Gardens Conservation International, to enable them play a more purposeful role in conservation.

The creation of environmental awareness among the populace

African's biological diversity is not only of continental economic importance but is also of global significance. Unfortunately, existing arrangements for the utilization of the continent's biodiversity cannot be considered sustainable and this is having serious repercussions on development programmes in Africa. The rich plant diversity in Africa is indiscriminately harvested for a number of purposes including:

- cultivation and production of food and cash crops for domestic and external interests
- herbal medicine
- construction.

Luckily, in spite of their continued exploitation, botanic gardens and other habitats still contain some of the richest assemblages of plant life known on this planet. Thus African gardens are appropriate institutions with the necessary capacities and plant diversities for use in environmental awareness programmes.

The success of environmental awareness programmes will largely depend upon the communities' understanding of the functioning of the environment, the problems it presents, and their expected contribution to its protection and improvement. The pursuit of conservation-oriented practices to halt the degradation and extinction of plant resources will depend not only on their acceptability, but also on the active support and involvement of the populace at large. In addition, people need to be well informed, sensitized and motivated towards adopting specific plant conservation practices and the sustainable use of plant resources.

It is well known that plants are the key to life on Earth and the prime element in biodiversity. They dominate our landscape, providing the framework of natural ecosystems that provide the habitats for animal species and make life on earth possible for humans as well as other living beings. Yet in spite of this common knowledge of the importance of plants in human survival, plant life is being lost at an increasing rate not only in Africa, but also throughout the whole world. This is the result of economic pressure on the developing countries and careless human activities. Until unfair transactions, particularly in trading systems, are addressed and humans made the centre of attention, only a limited impact will be made in our effort to control the excessive utilization of resources and the regenerability of the various life-sustaining systems on the Earth.

The United Nations Conference on the Environment and Development (UNCED) held in Rio de Janeiro in June 1992 (known as the Earth Summit) raised issues related to sustainable development. An output of the conference, Agenda 21, brought into focus ways and means in which the nations of the world could conserve their biodiversity for use by future generations. Botanic gardens in Africa have come to realize the enormity of a varied range of environmental problems that exist on the continent and have taken up the challenge of addressing them. Lack of awareness is a major constraint in the implementation of measures to conserve biological resources. African botanic gardens therefore need to spearhead a major awareness campaign at all levels. This is necessary since conservation cannot be ordered. Conservation is more of an attitudinal issue. There are existing laws to ensure biodiversity conservation but the efficiency and effectiveness in enforcing these regulations still leave much to be desired. The full participation of the public and the use of existing religious and traditional knowledge as a basis for the activity are therefore essential for the success of education programmes.

Educational programmes and their contents

The design and content of such programmes should be related to local conditions. There should be collaboration between local authorities, town development committees, social clubs, non-governmental organizations and the friends of various botanic gardens, since they all can help not only to sustain existing botanic gardens, but also to improve the local environment.

African botanic garden and arboreta remain some of the only few places where the continent's natural plant richness has been preserved and are thus the present windows to the wonders of the plant kingdom. They are excellent centres for education and resource centres for conservation research and development. The need for African botanic gardens to get involved in public environmental education cannot be overemphasized. Botanic gardens should therefore not overlook the role of education in their strategic plans for the improvement of the environment. The offering of guided tours, giving out information sheets, organizing exhibitions and labeling of plants will go a long way to stimulate the interest of visitors and earn revenue for the gardens. Garden staff should always ensure that any educational programme they embark upon will help raise the level of public awareness of environmental issues to a point where individuals, groups and organizations will, of their own accord, fully assume responsibilities in safeguarding the environment.

As regards school programmes, staff can arrange educational tours, provide in-service training for teachers, organize treasure and plant-hunting, and mail information packs to local schools. These programmes will help, instruct and excite future generation about plants. Finally, friends of the gardens, other non-governmental organizations,

religious groups and community leaders can be used effectively for implementing some of the environmental educational programmes.

Lack of awareness is still a major constraint in the implementation of measures to conserve plant resources. The need for African botanic gardens to be involved in the education and creation of environmental awareness could not have come at a more opportune time than in today's world. A major awareness campaign is necessary at all levels using the educational system. The full participation of the public is also essential for its success. Such a campaign must encompass everyone in society from the school child to the decision/policy maker (i.e. all stakeholders). The involvement of African botanic gardens in education will also increase the recognition of, and support for, their progress towards becoming educational and environmental awareness centres, thus playing a crucial role in the sustainable use of the continent's plant diversity resources.

Conclusions

As educators, the major objective should be to educate people to use plant resources sustainably through:

- promoting awareness among policy makers in the community
- providing training for botanic garden staff and selected group leaders in the community
- promoting greater public awareness and motivation for environmental action.

Botanic garden educators should also bear in mind the following implications for educational campaigns:

- that the concept of education for sustainability begins with the ideas and aspirations of the stakeholders.
- that through learning by participation, members of environmental groups are enabled and empowered to make informed decisions about their relationship with their own environment.

The successful implementation of educational programmes will largely depend on the availability of professionally qualified and well-motivated staff, logistic support, appropriate policies and a congenial political environment.

Finally, for African botanic gardens to effectively realize their potential role in environmental awareness programmes, they will need the support and

encouragement from well-established botanic gardens in the developed countries through international networking and exchange programmes.

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Un modelo para la enseñanza de la ecología en el área de influencia mediterránea

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Introducción – importancia de la flora y vegetación de la Provincia de Cádiz

La Provincia de Cádiz, en el extremo meridional de la Península Ibérica, es excepcional dentro del marco europeo, en cuanto a biodiversidad y grado de conservación de sus espacios naturales. Tanto es así que la superficie declarada como Parque Natural o Reserva Natural alcanza aproximadamente el 30% del total provincial.

El tipo de vegetación dominante es la vegetación termomediterránea o vegetación adaptada a un clima con sequía estival y libre de heladas. Este tipo de comunidades se encuentra fundamentalmente formando una estrecha franja a orillas del Mediterráneo y sólo en la Península Ibérica y en el noroeste de África donde alcanza zonas de mayor extensión hacia el interior.

El gran atractivo turístico de las costas mediterráneas ha generado una terrible degradación de todos estos ecosistemas que, por otra parte, son extremadamente frágiles debido a las bajas precipitaciones y al lento desarrollo de sus especies, con lo que es muy fácil provocar procesos de desertización prácticamente irreversibles a corto o medio plazo.

Con todo esto, vemos que estas reservas naturales de la Provincia juegan un papel fundamental en la conservación de la flora termomediterránea, no sólo a nivel nacional, sino también en el contexto internacional.

Sin embargo, no hay que idealizar la situación. En los últimos tiempos, el estado de las cosas ha cambiado. Los usos tradicionales de estos espacios, que permitían su mantenimiento, ya no son rentables. Por otra parte, estos enclaves se han convertido en centros turísticos, que acogen cada vez a un número mayor de visitantes de las áreas metropolitanas más próximas (Bahía de Cádiz, Sevilla, Campo de Gibraltar, Málaga y Costa del Sol). Estas personas demandan una serie de infraestructuras de uso público y privado que están produciendo una gran transformación y alteración de la zona.

La población mayoritaria que ahora utiliza estos recursos naturales procede de zonas “alejadas”, culturalmente hablando, de estos bosques mediterráneos, pues bien provienen de la Bahía de Cádiz, constituida principalmente por marismas, o bien de poblaciones con una fuerte tradición agrícola como Jerez, con lo que no hay tradición de respeto y conocimiento del bosque.

Una parte importante de las actitudes negativas ocurren simplemente por desconocimiento del delicado equilibrio de nuestros ecosistemas y de su escaso poder de amortiguación de impactos ambientales, comparados con otros ecosistemas europeos, en los que la falta de agua no es un problema.

Aspectos educativos

Muchos docentes de enseñanza secundaria de la zona entendemos que la mejor manera de aminorar el peligro que corren nuestros espacios naturales es la educación. Llevamos ya varios años trabajando en este sentido y, entre otras cosas, hemos transformado nuestras programaciones para que el estudio de los ecosistemas gaditanos sea la parte fundamental y, el hilo conductor sobre el que ensamblar todos los conocimientos exigidos por los planes de enseñanza.

Sin embargo, nos encontramos con un obstáculo importante a la hora de transmitir los conceptos necesarios para que los alumnos comprendan lo que es un ecosistema, su funcionamiento y en qué consiste el delicado equilibrio ecológico de nuestro entorno. El problema es que un ecosistema es un sistema multivariable, es decir, un espacio en el que interaccionan múltiples factores variables tanto físicos como biológicos. Este concepto es excesivamente complejo para que se pueda comprender bien sin una preparación adecuada y sin embargo, es la clave que nos conduce al objetivo que se pretende que es que los alumnos se den cuenta, de verdad, de que una pequeña acción en un ecosistema puede incidir en muchos aspectos del mismo y tener una repercusión que el ejecutante de la acción no esperaba.

Otro objetivo principal que también se pretende es crear vínculos emocionales de nuestros alumnos con estos espacios naturales, convirtiéndolos así en futuros defensores de los mismos.

La programación de actividades encaminadas a conseguir nuestros objetivos es de marcado corte constructivista y nos lleva todo un curso escolar (9 meses) alcanzar dichos objetivos con los alumnos de 15 años. En esta programación, son parte fundamental las salidas al campo, en las que se avanza extraordinariamente en el proceso si estas salidas están bien programadas, claro está.

Sin embargo, el elevado precio de los autocares, la inseguridad de los profesores ante cualquier accidente de sus alumnos y otros factores hacen que, lamentablemente, cada vez sea más complicado salir al campo con nuestros alumnos y en los últimos años estamos notando que no se alcanzan del todo los objetivos previstos.

Por consiguiente, cualquier instalación en la Bahía de Cádiz que ayude a paliar esta situación, será de una importancia decisiva para la enseñanza de las ciencias naturales en nuestra zona.

Con este objetivo el Parque Natural Bahía de Cádiz se plantea la construcción del Jardín Botánico de San Fernando, con el de ser una herramienta eficaz de la “educación para la conservación”, pues las plantas son, obviamente, los mejores indicadores de las variaciones de los factores ecológicos en cualquier medio.

El Gran Cuadro Central del Jardín Botánico de San Fernando

El Jardín Botánico de San Fernando, situado en un vivero histórico de la ciudad de San Fernando, en la Bahía de Cádiz, está totalmente diseñado con fines educativos y en él se podrán apreciar gran parte de las especies vegetales que viven en nuestro territorio, tanto silvestres como cultivadas. Vamos a desarrollar aquí la parte central del mismo, llamada “Gran Cuadro Central – Jardín Mediterráneo”.

El Jardín se plantea como una trama ortogonal de cuadros de plantación en la que, según los distintos ejes, van variando una serie de factores ecológicos que consideramos fundamentales para entender nuestros ecosistemas.

El tamaño y diseño de este Jardín se vieron en un principio fuertemente condicionados por el respeto a la estructura histórica del vivero forestal, constituido por terrazas atravesadas perpendicularmente por caminos por los que discurría un sistema de riego en superficie.

Sin embargo, inmediatamente apreciamos que tanto su tamaño moderadamente pequeño (unos 3500 m² aproximadamente), como su estructura ordenada en cuadrícula, tenían enormes ventajas desde el punto de vista educativo, pues convertían nuestro Jardín en una gran “gráfica viviente” con sus ejes de coordenadas, perfectamente abarcable por el alumno para aprender y apreciar, de forma ordenada, todas las posibilidades de nuestra vegetación ante la variación de los factores ecológicos.

Los tres factores que consideramos más importantes para entender el funcionamiento de nuestros ecosistemas mediterráneos son los siguientes:

- **grado de acidez del suelo.** En nuestra provincia los materiales geológicos dominantes son las calizas y las areniscas cuarcíferas, cuya meteorización origina suelos claramente diferentes
- **grado de humedad edáfica.** Este es el factor más importante, pues de él depende la mayor o menor adaptación de nuestras plantas al factor limitante de toda la zona que, como dijimos anteriormente, es la sequía estival. Así, dependiendo del grado de precipitaciones, que puede variar considerablemente en la provincia, y de la proximidad de vaguadas o cursos de agua, distinguimos cuatro grados de humedad edáfica:
 - suelos secos. Precipitaciones medias anuales inferiores a los 600 mm. No hay cursos de agua próximos. Especies extremadamente adaptadas al factor limitante
 - suelos frescos. Precipitaciones medias anuales superiores a los 600 mm. No hay cursos de agua próximos. Especies bastante adaptadas al factor limitante
 - suelos moderadamente húmedos. Propios de vaguadas, umbrías y zonas relativamente próximas a cursos de agua. Especies que presentan pocas adaptaciones al factor limitante

- suelos húmedos de ribera de ríos. Especies que no presentan adaptaciones al factor limitante.
- **grado de antropización del medio.** La influencia del hombre ha sido muy importante en nuestra zona durante miles de años. La extracción del corcho, la ganadería, la agricultura, los incendios provocados, etc., han ido cambiando el aspecto de nuestros bosques hasta tal punto, que es muy difícil encontrar comunidades verdaderamente climácicas en nuestras latitudes. Así, planteamos tres grados de antropización:
 - bosques climácicos. Es importante conocer la vegetación potencial de nuestra zona, aunque no esté perfectamente representada
 - matorrales. Constituyen la mayoría de nuestros espacios naturales y suponen un grado medio de intervención humana
 - zonas agrícolas. La intervención aquí es radical, pues con la agricultura se substituye totalmente la vegetación de una zona por otra completamente diferente, en la que se incluyen los cultivos propiamente dichos y todo su cortejo de plantas oportunistas, ruderal – nitrófilas, que constituyen la flora arvense. Dentro de esta flora se encuentran también muchas plantas interesantes, utilizadas tradicionalmente como medicinales, ornamentales o como condimento. No hay que olvidar que la flora arvense (que incluye las injustamente llamadas “malas hierbas”), ocupa grandes extensiones de nuestros territorios y muchas veces son los vegetales que resultan más familiares a nuestros alumnos y los más asequibles y adecuados para utilizar en el aula, sin peligro para su conservación.

Así pues, nos encontramos con 24 posibilidades diferentes, ordenadas en gradientes de tres factores ecológicos, en los que crecen nuestras especies vegetales según las particularidades de sus zonas de origen.

Como se puede apreciar, desde el punto de vista de su mantenimiento, esta situación también representa una ventaja, pues todas las especies que se encuentran en un mismo cuadro tienen los mismos requerimientos hortícolas.

Además, este Jardín puede ser útil también en programas de conservación *ex situ* de especies amenazadas, pues casi siempre tendremos las condiciones óptimas para su cultivo dentro de estas 24 posibilidades.

Para todas aquellas que no puedan desarrollarse bien en los 24 cuadros del Jardín Mediterráneo, el Jardín contará también con pequeñas rocallas de solana y umbría, estanque de plantas acuáticas, dunas y marismas artificiales.

Fundamento didáctico del Jardín – selección de las especies a incluir

El fundamento didáctico de este Jardín está basado en el principio de que las plantas son los mejores indicadores de las condiciones ambientales. Si una especie está adaptada a un medio, casi siempre se pueden apreciar a simple vista algunas de las estructuras que le permiten superar el “estrés” creado por los factores limitantes en ese medio. Así, si conocemos y comprendemos el por qué de la necesidad de estas estructuras, podemos deducir cuáles son las condiciones generales de ese medio.

Por ejemplo, el factor limitante más importante en nuestra zona es, como dijimos anteriormente, la sequía estival o veraniega. Este hace que las plantas que tienen que soportarlo deba presentar una o varias de las siguientes estructuras adaptativas:

- hojas más pequeñas
- hojas más duras
- hojas más tomentosas
- hojas más glaucas
- hojas más perennes
- plantas más espinosas
- plantas más pequeñas

- plantas más compactas.

Según el factor limitante sea más acusado, las plantas que lo soporten presentan más adaptaciones y por consiguiente, el aspecto del paisaje va variando.

Por tanto, teóricamente, con la observación a gran escala (paisaje) y a pequeña escala (espécimen) del mundo vegetal, podemos conseguir integrar “todas” las variables que condicionan los ecosistemas y comprender, aunque sea sólo de manera intuitiva, su funcionamiento, su dinámica y su estabilidad frente a las perturbaciones.

Esto lógicamente es la teoría. Pero, en la práctica, puede que la realidad no coincida con nuestros supuestos previos. Y sin embargo, es de vital importancia que las especies que aparezcan en los cuadros y su abundancia relativa, coincidan con la realidad de nuestro entorno lo más posible pues si no, el conocimiento adquirido en el Jardín no se podría traspasar al medio natural, que es uno de nuestros principales objetivos.

Para la selección de las plantas de cada cuadro, se realizó un trabajo estadístico contrastando todos los estudios realizados y publicados sobre nuestra provincia en este siglo. Además, hemos completado la información con nuestros propios inventarios de campo.

Con todo ello se han elaborado las listas de las especies más representativas del paisaje en cada una de las distintas situaciones. Afortunadamente, más del 75% de los especímenes presentes en cada cuadro presentan estructuras visibles que explican su presencia en ese cuadro en concreto, con lo que no hay que “alterar” nada para que este espacio sea útil a nuestros propósitos.

Sin embargo, hay que tener en cuenta que algunas especies son muy exclusivas y otras se repiten en muchas situaciones. Otras, que en condiciones secas sólo aparecen dentro del bosque, en condiciones más húmedas aparecen en el matorral, etc. Todas estas coincidencias y divergencias son de un elevadísimo valor didáctico, porque generan preguntas en nuestros alumnos que nos ayudan a explicar cuestiones importantes de los ecosistemas como competencia, microclimas, biodiversidad, etc., y no tenemos que olvidar lo importante que es que la curiosidad del alumno sobre cualquier tema surja antes de nuestra explicación sobre el mismo.

Otros aspectos del Gran Cuadro Central

Para terminar, comentar algunos detalles interesantes desde el punto de vista hortícola y paisajístico, que creemos enriquecerán y harán más atractivo nuestro Jardín.

Respetando la estructura del antiguo vivero, se han potenciado aquellos aspectos hortícolas tradicionales en nuestra zona que, procedentes de la época árabe (en plena Edad Media), han perdurado casi hasta nuestros días. Los cuadros de plantación se hayan en terrazas horizontales para facilitar el riego por inundación y la conducción del agua, procedente de un pozo con noria de tiro, se realiza a través de acequias realizadas con tejas de barro por las que discurre lenta, pero continuamente, dejando a su paso un agradable rumor. Los cuadros de plantación están excavados, hundidos sobre el terreno, para aprovechar más el agua al evitarse una evaporación excesiva. (Esta técnica todavía se utiliza en la zona).

El conjunto se completa con una serie de fuentes “pilones” que recuerdan a las utilizadas para el riego en los jardines botánicos del siglo XVIII. Tienen la particularidad de que se utiliza de nuevo la gravedad para hacer llegar el agua hasta ellos, por “vasos comunicantes”. Todo este sistema hidráulico vierte a una alberca inferior, desde la que se bombea el agua de nuevo a la alberca superior, cerrando el circuito, con lo que las pérdidas de agua son mínimas.

Como se ve este pequeño jardín tiene muchos e interesantes recursos para la enseñanza de la ecología en primer término, pero también permite desarrollar en él unidades didácticas de hidráulica básica, agricultura tradicional, historia de la ciencia, etc.

Esperamos con entusiasmo que nuestras expectativas, que creemos están sobradamente razonadas, se hagan realidad y que este jardín se convierta verdaderamente en una herramienta indispensable para la educación en nuestra comunidad.

Botanical gardens education in the new South Africa: towards just provision of educational opportunity

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Part 1: The experience and legacy of apartheid education

By Joel Mkefe

This paper aims to share experiences and relate real issues that have affected education in the past in South Africa. Traces are still hard to remove from the present South African education system. I will start by sharing what I experienced both as a scholar and student under what was termed "Bantu Education", and later as a teacher during the period of transition from the apartheid system to our new democracy.

Bantu Education

Let me first explain that this was a system of education which did not happen accidentally but which was carefully planned and meant for Black South Africans. The education system was designed to make sure that Black people stopped thinking critically. If I may quote the words of Dr Verwoerd, a previous Minister of Native Affairs from the opening debate in Parliament in 1953:

Bantu relations cannot improve if the wrong type of education is given for Natives. They cannot improve if the result of Native education is the creation of frustrated people who, as a result of the education they receive, have expectations in life which circumstances in South Africa do not allow to be fulfilled immediately, when it creates people who are trained for professions not open to them.

When there are people who have received a form of cultural training which strengthens their desire for the white-collar occupations to such an extent that there are more such people than openings available. Therefore, good racial relations are spoiled when the correct education is not given.

What is the use of teaching the Bantu child mathematics when it cannot use it in practice? What is the use of subjecting a Native child to a curriculum which, in the first instance, is traditionally European?

I just want to remind Honourable Members that if the Native inside South Africa today, in any kind of school in existence, is being taught to expect that he will live his adult life under a policy of equal rights, he is making a big mistake.

(Suzman, H. 1993 pp34-5)

From that year, State funding of Black schools was drastically reduced. There was a dominating, powerful bureaucracy of inspectors, principals and teachers. A teacher would teach in order to meet the demands of the syllabus, rather than to respond to children's needs.

The experience of Bantu Education

Schools were poorly resourced, having no laboratories, scientific apparatus or sports fields. We were expected to use public sport fields in our communities. I remember that, when we "did" experiments, we did not actually do them, but memorized them. For example, if you mix carbon dioxide with lime-water it will turn milky – we would sing that off by heart, not even aware of what lime-water was or what it looked like.

Black colleges and universities were much like schools themselves. Student teachers were concerned more with learning to pass exams and obtaining a certificate than with learning to become an effective teacher. When new teachers got to schools they had little to offer and little experience of practical teaching, so they simply reverted to

the way in which they had been taught. They depended on the text-book as the sole source of information and just summarised notes for the children, making them memorise them (by rote learning) and reproduce what they had told them, with no room for discovery learning or learning through play. Huge classes, averaging 60 pupils, were one hindrance that caused the school not to have time for extra-mural activities. By 2 pm teachers would be so tired that they would not want to do anything else but go home.

There was, and still is, no coordinated in-service teacher development offered by the Education Department. For example, while I was teaching, there was only one science subject-adviser for more than 300 Black primary and high schools in the Western Cape. The inspector would therefore concentrate on matriculation teachers only, and the rest would suffer. Whatever was offered was provided by non-governmental organisations, which played a very significant role in aiding and equipping teachers with the necessary support.

The legacy of Bantu Education

A perception developed that education occurs in the classroom only, and that the quantity of written work was more important than the quality of work and level of understanding of pupils. Bantu education created a "Uflat picture" or text-book reality. There was little or no relationship between learning and life. For example, I would know a stigma, style and ovary from a text-book, but never imagined that they existed in the flowers of the plants I walked past daily.

Worse still, nature conservation and environment were seen as "White things", because accommodation in game reserves and other resorts had for many years been reserved for Whites only. The fact that a White man would travel in a pickup with his dog on the passenger seat and the Black person on the back, sent a message to people that animals were more important than Blacks.

Now that we have a new democracy in South Africa, all of us, whether individually or as members of institutions, need to decide how we shall respond in order to redress the imbalances of the past.

Part 2: The NBI's vision and response

By Ally Ashwell

A vision for environmental education in the NBI

One way in which the NBI can help to address the issues and challenges raised by Joel Mkefe is through the establishment of environmental education programmes in our eight National Botanical Gardens. Since 1992, education officers have been employed in three Gardens, namely Kirstenbosch, Witwatersrand and Pretoria. By the end of the year 2000 AD we aim to have at least one, and preferably two, education officers in each Garden. These education officers run a variety of programmes focusing on different needs and issues. None are all-encompassing in their effect, but we are making a start – and are committed to learning from experience.

Before I introduce you to some of the programmes, I would like to share our vision of environmental education. Environmental education has been described as a response to the environmental crisis. So our understanding of the term 'environment' will in large measure determine the form our environmental education programmes take. In South Africa, as Joel's talk will have indicated, it is impossible to view the environment simply as an ecological or physical entity. People's lives have been so deeply affected by the political economy of Apartheid that the environmental priority to be addressed is that of social justice.

We view the environment as being social and ecological in nature, and the role of environmental education as addressing the linked issues of ecological sustainability and social justice. The botanical gardens in which we work provide the themes and resources which give content to our interactions, but the wider context of South Africa in transition provides the challenge which inspires us as educators.

The political system for which South Africans have fought is a participatory democracy. Yet the demands of such a system on the citizenry are enormous. Effective participation requires access to information and resources, clarity in terms of the issues at stake and options available, confidence in oneself and one's opinions, and skills of communication, decision-making and problem-solving.

We believe that, within the context of our botanical gardens, the provision of quality education programmes can contribute to the development of an informed, critical and confident citizenry equipped to participate in decision-making about our shared resources towards a sustainable future.

Issues to be addressed: access to information and resources

The Kirstenbosch outreach bus, provided by the Anglo-American De Beers Chairmans Fund, and sponsorships raised to provide educational visits for pupils, are making the Gardens more accessible to first-time visitors. In this way we are addressing the issue of access to these resources, so that people can in future make informed choices about visiting the Gardens. In fact, from February to the end of August (1996), the bus has transported 8,800 pupils to Kirstenbosch, the vast majority of whom have been first-time visitors.

Providing career programmes opens up options for pupils about future employment. We see this as a particularly important initiative for the NBI in addressing its affirmative action policy.

Production of low-cost resource materials provides accessible information on our Gardens and indigenous plants. In some cases these materials are produced in collaboration with other organisations, teachers or our part-time education officers. Educational guides to the Gardens put knowledge into the hands of the learners, who are then able to take responsibility for finding out about their surroundings.

Issues to be addressed: appropriate educational approaches

Getting over the legacy of apartheid education and an authoritarian political system means challenging some ingrained habits of teachers. Part-time education officers help the full-time staff to run guided educational visits, and make it possible to offer programmes which are more pupil-centred and oriented to group work than simply being guided tours. Making choices about our education practice, such as between a teacher-centred guided tour and a group-orientated enquiry process, reflects our commitment to challenging those practices which entrench old power-relationships.

Bill Graham from the Birmingham Botanic Garden, UK visited Kirstenbosch at the beginning of this year, courtesy of the British Council, and provided us with a capital of ideas on issues-based approaches which we have been using to encourage critical thinking and debate in the groups. These approaches have helped us to put our vision of environmental education into practice, through activities that clearly show the social and ecological nature of the environment.

Teaching in a garden provides rich opportunities for integrated studies, active, hands-on learning, experiential approaches and learning through fun. Developing an enthusiasm for learning is essential if we wish to rebuild a culture of learning in our country, where many years of disrupted education have resulted in a demoralised and disinterested school community. Furthermore, providing outdoor learning opportunities helps pupils to start reassessing their ability to learn from first-hand observations and discussions, and not simply from the text-books upon which many teachers are completely dependent.

Issues to be addressed: building effective networks

Small staff numbers, such as one or two officers per Garden, could pose a problem in terms of effectiveness, but running collaborative programmes with other environmental and science education organisations has proved to be the best way of ensuring that Garden visits take place in a context of ongoing contact and follow up. A good example of this is Joel's work with the Primary Science Programme, a group that has contact with all primary science teachers in Black schools in the Western Cape Province. Programmes run at Kirstenbosch do not take place in a vacuum, but are part of an ongoing programme of teacher professional development.

All our education officers participate actively in the Environmental Education Association of Southern Africa (EEASA) network, through which we keep in touch with developments in environmental education in southern Africa. Our centres provide meeting places for EEASA gatherings, and, through this, many collaborative programmes have been initiated.

At this time of reconstruction and development, curriculum and qualifications systems are being completely revised. NBI education officers are playing a proactive role in curriculum development, by participating in curriculum forums

and resource-material development initiatives. We hope in this way to advise on the incorporation of themes and topics that will enliven and localise the teaching of botany and environmental education in schools.

Issues to be addressed: capacity building

When the African National Congress came to power in 1994 it instituted a nation-building initiative known as the Reconstruction and Development Programme (RDP). Although the Programme has been criticised for lack of delivery, we believe that the spirit of the RDP should inspire us all to rebuild the country and the capacity of its people. As educators, we see our involvement in the RDP as contributing to teacher professional development.

We both offer and host workshops for teachers on a variety of topics, including environmental education, professional development in botany, and planting and propagating plants in school grounds.

Our own staff also require opportunities for further professional development in this broad and ever-widening field. Therefore an annual NBI Educators Week is organised to discuss education issues in all eight National Botanical Gardens. Monthly enrichment programmes are organised, at which full- and part-time staff either attend an informative lecture or outing or work together to develop, evaluate and refine their programmes and materials.

In the last two years, Suzelle van der Westhuizen, education officer at the Witwatersrand Garden has been organising regular monthly enrichment programmes for the labourers in the garden, to deepen their understanding of the sections in which they work, and of topics of general interest in the Garden. This highlighted a need for literacy training, which is now being addressed, with the gardeners attending classes for an hour a day.

Community-based action

Finally, significant opportunities for learning how to participate as active citizens in a democratic society come from actually addressing issues in our communities. Through the experience of planning, negotiating and taking action, we learn to work as partners in improving living conditions in our communities.

We believe that one of the things we need to develop further with the resources and expertise available to us in the NBI, is support for schools which want to develop their grounds. The mission of the NBI is to conserve and promote indigenous plants. Through the development of indigenous gardens, schools can help to conserve local plants and act as green nodes in a web of urban nature reserves. These gardens in turn provide teaching and learning opportunities, both in terms of materials for study and as a focus for sustained local action.

Conclusion

One of the reasons why we have come to this Congress is to learn from the experiences of others who have gone so much further than us along this road. We hope to return home with clearer vision and greater determination to continue addressing the environmental and educational challenges of the new South Africa through our programmes in the National Botanical Gardens.

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Assessing the value of an exchange visit to the Witwatersrand National Botanical Garden

Nkopane Moteka

Witwatersrand National Botanic Garden, South Africa

Introduction

The legacy of the past system of government has left education within Black communities in a state where teachers are chasing a specified syllabus. A rigid system of monitoring adherence to the syllabus through regular inspection and assessment has left teachers very little or no scope for exercising their own initiative. For most teachers, completing the syllabus meant using text books written according to the requirements and topic-sequence of the syllabus, so leading to an uncritical dependence on the text books.

Exchanging ideas

It therefore becomes something of a tall order to change to a situation where you have a measure of freedom to use one's imagination in attempting to make learning an experience of discovery and fun for the students. To encourage this among teachers, Mary South, Education Officer at the Sir Harold Hillier Garden and Arboretum, UK was invited to South Africa to share some of her experiences at a number of workshops. The outcome of the workshops were as follows:

- only 30% of the participants in Mary South's workshop attempted the activities. However, 90% agreed that the activities were possible to implement in their own situation without much adaptation. All participants agreed with and saw value in the activities
- Almost all environmental centre officers that attended used the activities at their centres
- 30% of the participants used the ideas presented, with some teachers adapting them for implementation in schools
- Pupils were keen to do more activities and a lot more questions were raised. It was felt that the pupils had a better understanding of the concepts when working on activities

In many cases, back in the schools other members of teaching staff became curious about the results, and in some cases negative criticism was made:

- pupils were noisy during such lessons
- it took a long time for *all* the pupils to understand and grasp the concepts – finishing the syllabus is still a factor. 60% of the teachers who attended the workshop did not attempt the activities because they could not plan their lesson to fit the 30-minute periods. 10% of the teachers were already following a programme agreed to earlier. This entailed using worksheets and writing a common examination in general science. To many teachers, environmental education is something new that needs extra lessons in the school timetable
- 80% of the workshop participants used worksheets rather than activities. The worksheets were mostly developed by non-government organisations and tested in workshops with the teachers to refine their suitability. 40% of the teachers have been teaching for periods ranging between two and five years and 30% between five and ten years. The rest more than ten years. All teachers hold recognised teaching qualifications at various levels.
- teachers in pre-primary classes used activities all the time, however few of the activities presented in the workshop were adaptable to their level.

NBI's goal for its education programmes

The mission of NBI's Education Directorate (EEDU) is to use the gardens and resources of the NBI to inspire and enable people to take responsibility for their environment.

The feeling is that by engaging teachers and pupils in experiential learning, it will lead to the discovery of their place and role in the environment and therefore result in a positive change in attitude to the environment. This approach to teaching, as in the methods demonstrated by Mary and used or adapted for use by EEDU, places NBI's programme among holistic and cross-curriculum development forums in South Africa.

The education system in South Africa is committed to the development of an *outcomes-based* system, around which guidelines for learning programmes and corresponding assessment will be drawn. At the Garden we are working to create a core of educators who will be committed to facilitating learning situations. The aim of these situations is to give pupils an opportunity to discover knowledge, think creatively and look at life with a critically enquiring mind, as well as work with others to achieve set goals.

Mary South's visit coincided with my arrival in this organisation as outreach officer. Needless to say, it sparked a lot of debate and helped clarify the direction of the programme. While worksheets are still held in some esteem, learning through activity is better suited to environmental education.

Conclusion

In a democracy of the type South Africans are trying to build, consultation and discussion on issues are important. The citizenry of South Africa is undergoing a learning process of doing things for themselves. The development of the curriculum mentioned earlier is one such process where teachers have an input in order that they become stakeholders in education rather than unconcerned channels of "knowledge".

Our contact with teachers is to ensure their participation in making environmental education the backbone of all subject areas of learning.

Propuesta didáctica para el Jardín del Huerto de las Flores Agaete - Gran Canaria - Islas Canarias

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Introducción - historia

El Huerto de las Flores se encuentra en el municipio de Agaete, en el noroeste de Gran Canaria (Islas Canarias). Situado junto al barranco, en su margen derecha, en el mismo casco urbano del pueblo, es en la actualidad un jardín municipal que alberga una nutrida colección de plantas exóticas procedentes de diversas partes del mundo.

En su origen, el actual jardín fue un huerto familiar (de la familia Armas) en el que a lo largo de los años se fueron plantando diversos tipos de árboles y arbustos frutales, ornamentales, exóticos, y una amplia variedad de flores, lo que determinaría en definitiva su denominación actual. El valor de la producción permitía incluso que sus propietarios lo mantuvieran arrendado, reservándose lo más selecto de la cosecha. Durante los años de arrendamiento a Isidro García (conocido en la localidad como Isidrito el juez), el Huerto aumentó notablemente sus especies, puesto que dicho señor encargaba semillas y plantas a sus conocidos y amistades. Así, se introducirían distintas especies, sobre todo procedentes de Cuba, lugar de destino de buena parte de la emigración canaria de la época. De la importancia de la colección de plantas existentes puede servir de referencia el hecho de que desde el Jardín de Aclimatación de La Orotava, en Tenerife, se acudió al Huerto de Agaete para hacerse con algunas especies que allí no se encontraban.

En los años de mayor apogeo, en el Huerto se recogían abundantes frutos, dando ocupación a varias personas. Uno de sus cultivos más destacados fue el café, de reconocida fama dentro del ámbito insular.

En cierta medida, este lugar constituía uno de los centros de atracción de la localidad y en su momento a la sombra de sus árboles celebrarían sus tertulias algunos de los más destacados representantes de la literatura canaria, como es el caso de Alonso Quesada y Tomás Morales.

Con buen acierto de sus propietarios, se decide que el Huerto pase a ser propiedad municipal, con la idea de destinar al uso público un atractivo espacio y que podría ser centro de numerosas actividades. Sin embargo, si bien en un primer momento esto fue así, llevándose a cabo la catalogación de las especies existentes, cuidándose su mantenimiento, y desarrollándose distintos tipos de actos y jornadas culturales, con el paso del tiempo este espacio iría cayendo en el abandono, destinándose incluso a actividades impropias de un lugar de estas características, perdiéndose buena parte de su espíritu original.

Sin embargo, el Huerto de las Flores en la práctica constituye un jardín con características únicas dentro de Gran Canaria, estrechamente ligado a la historia económica y cultural de la Villa de Agaete, ofreciendo unas enormes posibilidades desde el punto de vista educativo y, por extensión, recreativo. Desde esta visión se plantean una serie de acciones encaminadas a la recuperación de dicho espacio y su puesta a punto para su mejor aprovechamiento no sólo por los canarios, sino por los numerosos visitantes que llegan a esta localidad, en la que la actividad turística se ha convertido en la práctica en su principal factor económico.

Aportaciones educativas

Las aportaciones que a la Educación Ambiental ofrece el Huerto, podrían sintetizarse en los siguientes aspectos:

- la presencia de especies botánicas originales, raras o desconocidas dentro de las Islas, y que nos acercan a la realidad de otras regiones del planeta
- el papel jugado por los humanos en la distribución de las distintas especies vegetales y el aprovechamiento que de ellas se hace
- la importancia de los jardines botánicos, que trasciende del ámbito científico o económico, como elementos destacados al servicio del desarrollo cultural de las comunidades donde se encuentran

- particularmente el Huerto, al margen de su riqueza botánica, por su situación y dimensiones, ofrece unas condiciones que lo hacen idóneo para su recorrido y estudio, o la simple contemplación y disfrute.

Dentro de las acciones a desarrollar para poner en uso el Huerto, se consideran como prioritarias la reposición en la medida de lo posible de aquellas especies que se hayan perdido, así como el tratamiento adecuado de las plantas ya existentes y el adecentamiento general de todas las instalaciones. Ello se hará extensivo a los edificios anejos, que vendrían a ocupar la función de centro de información e interpretación. Aquí, una serie de paneles darían cuenta del origen y evolución histórica de este recinto, además de algunas de sus especies botánicas más relevantes. Sería también el espacio dedicado a la proyección de los materiales audiovisuales.

Unido a lo anterior, resulta necesario la colocación de carteles indicativos que señalen los nombres comunes y científicos de las distintas especies presentes, además de su procedencia. Se estaría entonces en condiciones de abrir este Jardín para el público en general, ofreciéndose la posibilidad de acceder a una serie de información complementaria, observando las preferencias o intereses de los distintos visitantes. De otra parte, ser capaces de transmitir, en un sentido amplio, un claro mensaje relativo a la relación entre los humanos y el medio, en este caso concreto, con el mundo vegetal, y la necesidad de su conocimiento y conservación.

Oferta educativa escolar

Es fundamental elaborar la documentación para trabajar con los escolares los contenidos a desarrollar en el recorrido por el Huerto. Serán los correspondientes "cuadernos de trabajo" para el alumnado de Secundaria y Bachillerato, acompañados del consiguiente "cuaderno del profesor". Complemento necesario serían otros medios, tales como diapositivas, vídeo o CD Rom.

La estrategia y metodología educativa debe definirse, teniendo en cuenta tanto a los alumnos como al profesorado, atendiendo a las necesidades, intereses o iniciativas concretas de cada grupo. En cual caso, se consideran elementos básicos una motivación previa, antes de la visita; una introducción a la historia Huerto y su significación, utilizando el centro de información e interpretación; desarrollo de la visita (recorrido autoguiado o dirigido); puesta en común final y evaluación, tanto dentro del jardín, como ya de vuelta al aula.

Oferta educativa al público en general

Se pretende que cualquier visitante pueda llevarse una idea aproximada del Huerto, lo que puede lograrse acudiendo al centro de información e interpretación y posteriormente recorriendo los distintos senderos disponibles. Ello se complementa con los consiguientes folletos y publicaciones que aporten la documentación suficiente para aquellas personas más interesadas en ampliar sus conocimientos.

Gardens and Schools: A Natural Alliance

Graduate Studies at The New York Botanical Garden

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Introduction

The New York Botanical Garden (NYBG) has trained doctoral candidates in botany since its founding; over 200 graduate degrees have been awarded through this program. From the very beginning, the Garden has taken a leadership role in botanical research and has maintained a commitment to basic studies in systematic botany, economic botany, and ecology, as well as in service to the scientific community. The Graduate Studies Program is an essential component of the scientific research effort at the Garden and will continue to produce botanical scholars into the next century.

The Garden was officially chartered in 1891 by the New York State legislature, who set aside a 250-acre tract of mostly forested land in what was then Bronx Park. Funds were raised soon thereafter for the construction of a conservatory, or glasshouse, and a museum building, which today houses the Garden's 5.8 million-specimen herbarium. Both of these structures have become New York City landmarks and form the nucleus of the Garden's physical plant.

Staff organization

The research staff has been organized into two institutes: the Institute of Systematic Botany (ISB) and the Institute of Economic Botany (IEB). The ISB was officially created in 1991 in recognition of the traditional strength of the Garden in plant systematics and taxonomy. The IEB, formed in 1981, is focused on applied questions of human concern, including tropical deforestation and environmental degradation, the search for new medicinal therapeutics, the uses of plants in prehistoric times, human hunger, and alternative energy sources. The IEB is known for its interdisciplinary approach to applied research in biological and social sciences.

The goal of the Graduate Studies Program is to train scientists of the highest caliber who will move on to leadership positions at academic and research institutions around the world. At this point in time, biologists face a daunting challenge: the imperative to explore, document and justify the conservation of the earth's remaining biodiversity before it vanishes in the wake of unprecedented resource consumption. In the words of one noted scientist: "Despite two centuries of research by biologists exploring every corner of the world, there is still much to learn about life's diversity. Millions of species – perhaps even tens of millions – remain unknown to us. Yet these species stabilize the delicate balance of ecosystems, have the potential for expanding and diversifying our agricultural production, and hold new and effective cures for diseases that plague human populations. Because of this vast potential, scientists have a mandate to advance our knowledge about these species." (Systematics Agenda 2000). Unfortunately, at a time when demands on the worldwide scientific community are greatest, the number of personnel currently trained as systematists or economic botanists is alarmingly small. NYBG's Graduate Studies Program is one of only several programs in the United States with the capacity to provide students with opportunities and resources for broad-based monographic, floristic and economic botanical research.

Affiliations

The Graduate Program is currently operated in conjunction with the Plant Sciences Program at the Lehman College campus of the City University of New York (CUNY), the Biology Department at New York University (NYU), the Center for Environmental Research and Conservation at Columbia University, the School of Forestry and Environmental Studies at Yale University, and the Biology Department at Cornell University. One of the Program's greatest assets lies in its flexibility, including multiple opportunities for interdisciplinary study. In addition to the core courses in plant sciences, students may take courses in biology or other disciplines at other colleges, including City College, Hunter College, the Graduate Center and Queens College. An agreement between all major universities in New York City entitles students to register for courses in virtually any school in the city. Independent tutorials can be arranged with staff at CUNY, Columbia, NYU, Cornell, Yale, NYBG, or the American Museum of

Natural History. The broad range of courses offered throughout the New York area and the opportunity to interact with researchers in the natural and the social sciences, provide a unique opportunity to develop skills in different fields relating to economic and systematic botany. These include phytochemistry, molecular biology, ecological physiology, archaeology, anthropology, linguistics, economics, computer science, and nutrition.

Research facilities

Graduate students have access to all laboratory facilities and equipment at the Garden. These include an electron microscope and instrumentation for biochemical, anatomical, phytochemical, chemosystematic, numerical taxonomic, and vegetational studies. The New York Botanical Garden has one of the outstanding botanical libraries in the world, with more than 1,250,000 accessions, a herbarium with over 5,800,000 specimens, and 10,000 species of living plants maintained in several greenhouses, including the Enid A. Haupt Conservatory.

The Lewis B. and Dorothy Cullman Program for Molecular Systematics Studies, a joint initiative of The New York Botanical Garden and The American Museum of Natural History, supports nearly all forms of molecular research in its newly renovated facilities. The Cullman Program explicitly supports diverse research programs from the far reaches of the biodiversity problem, although its mainstay is the traditional phylogenetic study of plants. A second major research emphasis involves systematic study of the molecular bases for flower and root development.

The Institute of Systematic Botany

The New York Botanical Garden's Institute of Systematic Botany was created in the spring of 1991 in recognition of the traditional strength of the Garden, and to underscore the urgency of the inventorying, conservation and rational utilization of the world's natural resources. The foundations of the Garden's systematic research program are the Herbarium, the largest in the Western Hemisphere, and the Library, the largest botanical research library at a single site in North America.

ISB scientists comprise a core of thirteen full-time scientists with project activities concentrated in the Western Hemisphere. Providing critical support to the work of the ISB is a group of systematists associated with the Herbarium and the Institute of Economic Botany. Eight graduate fellows conduct dissertation research under the direction of ISB scientists.

The work of the ISB focuses on the discovery, identification and naming of plant species, and the understanding of their evolutionary relationships. To accomplish this task, projects encompass large-scale monographic and floristic research. The projects of the ISB are broad ranging in scope. For example, ISB scientists are actively involved in the study of the flora of the Intermountain region of the United States and of the floras of California and New York, among others. In collaboration with local institutions in Colombia, Brazil, French Guiana, Ecuador, Cuba, and other countries, the ISB is engaged in creating detailed inventories of tropical forests for scientific, conservation, and utilization purposes. Current monographic research by ISB scientists includes techniques such as cladistic analysis, DNA sequencing, and life history studies of fungi *in vitro*. Investigative objectives of the ISB are as follows:

- monographic research coverage includes, but is not restricted to, projects on several groups of fungi, mosses, hepatics, lichens, pteridophytes, Cycadales, Gnetales, Anacardiaceae, Menispermaceae, Lecythidaceae, Ericaceae, Connaraceae, Leguminosae, Burseraceae, Simaroubaceae, Solanaceae, Scrophulariaceae, Rubiaceae, and the Cyperaceae
- floristic research projects and field activities are currently carried out in North America, Mexico, Central and South America, and the Caribbean. While not limited exclusively to these areas, the ISB has recently restructured its floristic research under eight program areas, each one a different geographic region of the Americas: North America, Mexico and Central America, West Indies, Andes, Guayana, Amazon, Planalto, and Eastern Brazil.

The Institute of Systematic Botany also has close programmatic linkages with the Garden's Institute of Economic Botany. ISB scientists cooperate with IEB scientists in the collection and identification of plants that are being screened as potential therapies for AIDS and cancer by the National Cancer Institute.

ISB scientists publish in national and international scientific journals, including the Garden's own publications: *Brittonia*, *Memoirs of The New York Botanical Garden*, *Mycologia*, *North American Flora*, and *Flora Neotropica*.

The New York Botanical Garden supports the largest scientific publications program of any independent botanical institution in the world.

In addition to research projects, the ISB is heavily involved in teaching, with formal programs at the City University of New York, New York University, Columbia University, and Yale University. ISB scientists serve as advisors and hold adjunct faculty positions at the collaborating universities.

The ISB programs continue to concentrate on those aspects of systematic botany that The New York Botanical Garden has the capability to investigate by virtue of its diversified scientific staff and the extensive holdings of its Herbarium and Library. The ISB's active, integrated program of botanical exploration, systematic research, and publication on New World plants, combined with its program of graduate education, is unique in the United States today.

Institute of Economic Botany

The New York Botanical Garden Institute of Economic Botany was founded in 1981 to focus a portion of the Garden's research program on applied topics of human concern. With close programmatic linkages to the NYBG Institute of Systematic Botany, Library, Herbarium, and Harding Laboratories, IEB scientists comprise a core of 29 staff, students and interns based at the Bronx campus with project activities around the world. The projects of the IEB encompass five principal activities which support the primary mission of the IEB: understanding the relationship between plants and people. The activities of the IEB are:

- collecting and evaluating useful plants through field research in both tropical and temperate regions
- studying ways plant resources can be used in a sustainable manner
- promoting the conservation of useful plants and their habitats
- teaching students and training specialists in economic botany
- strengthening the capacity of institutions worldwide in economic botany research activities.

The IEB is known for its interdisciplinary approach to applied research in the biological and social sciences. This new synthesis incorporates a rigorous methodology, using contemporary tools and perspectives from a variety of academic disciplines. By expanding the intellectual frontiers of economic botany, the work of the IEB is contributing towards the rebirth of interest in this important discipline.

In addition to research projects, the IEB is heavily involved in teaching, with formal programs at the City University of New York, Columbia University, Cornell University, New York University, and Yale University School of Forestry and Environmental Studies. IEB staff serve as advisors to the students and assist in identifying, funding and implementing field programs in many tropical nations.

Conclusions

Responding to the accelerating rate of habitat destruction in the tropics, NYBG has placed a priority on tropical research and the training of more botanists, not only from the US, but from other countries as well. The program serves a diverse student body with students from North America, Asia, Africa, Europe, and Latin America. Upon graduation, the majority of foreign students return to their countries of origin to hold substantial positions in government agencies, universities, and botanical gardens, working in the country they know best, in order to combat local and regional environmental problems. In this way, the Garden makes a major contribution to the development of sound environmental policies in many nations struggling with the often-conflicting goals of economic development and conservation.

Creating *ex-situ* conservation gardens in schools and the wider community

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Education is enshrined in the mission statement of the Royal Tasmanian Botanical Gardens (RTBG), which is as follows:

‘To further sustainable development by:

- increasing awareness and understanding about plants and their economic, ecological and social importance
- programs of conservation and research and
- stewarding the Royal Tasmanian Botanical Gardens having regard for its scientific, educational, recreational and tourism values.’

The RTBG’s Community Education and Training Service has identified three program streams to support the mission of the Gardens: environmental education, horticultural training and community awareness. Audiences and programs have been identified for each stream.

This paper concentrates on the environmental education stream and how the programs within this stream support the plant conservation programs undertaken by the Gardens. The inclusion of education within the overall program recognises the need for an integrated approach to conservation. Integration occurs at a number of levels. Firstly, the need to research, propagate, replant and educate. Secondly, the need to integrate across governments, non-governmental organisations and the general community, and thirdly the need to work *in situ* and *ex situ*. The integration of all these elements should result in the successful conservation of plant species.

By way of introduction the conservation programs conducted by the Gardens will be briefly introduced. Firstly, the Gardens collect seeds and cuttings from the wild and propagate the material in the nursery.

Some of the resulting plants end up in the Tasmanian Section of the Botanic Gardens, where approximately 600 species are on display, including around 80 of the state's 150 or so threatened species. Site interpretation for this section highlights the Gardens’ role in plant conservation. Because of size restrictions, the main purpose of the Tasmanian section is to raise public awareness of native species and the conservation issues associated with them, rather than to act as a collection for *ex situ* conservation purposes.

Other plant material is collected as part of recovery plans for endangered species. This program, carried out in conjunction with the National Parks and Wildlife Service and members of the Australian Network for Plant Conservation, aims to propagate endangered species and return them to the wild, thus ensuring their survival *in situ*.

In conjunction with the Department of Roads, the Gardens also provide a Roadside Rescue Program, where plants threatened by roadworks are collected and propagated and then returned to the new roadside once the roadworks are completed.

The RTBG sees its horticultural expertise as one of its main contributions to plant conservation. However, this work is all being done as intensive care at the bottom of the extinction abyss. It is treating the symptom rather than the cause. In almost all cases of plant endangerment, the cause can be traced back to human choices and behaviour.

It is therefore necessary to work at the ‘top of the cliff’ to prevent species from falling over or, more accurately, stop them being pushed. This means that there is a need to raise people’s awareness of their responsibility in creating a threat to plants, and their responsibility to act personally to repair the damage. The education service at the RTBG sets out to achieve this by working to raise awareness and concern, encourage changes in behaviour and provide opportunities for personal action. Two outreach programs conducted by the Gardens (GreensCool Program and the Botanical Guardians) aim to address these issues.

The GreensC'ool Program

The aim of the GreensC'ool Program, which may extend over 18 months with individual classes, is to:

- use education to minimise threatening processes, so that fewer species will require our assistance in the future;
- involve students in the repair process of preventing those species already designated as endangered from becoming extinct.

Following the introductory sessions of the Program, students collect seeds from the wild, sow them, grow them and plant them out in their school grounds. They record provenance, collection and planting information. This information is then recorded at the Botanic Gardens, in effect becoming an extension of the *ex situ* collection held in the Botanic Garden. The Schools' collection then becomes integral to conservation studies for many years afterwards. The Program has not been limited to school grounds; students have also assisted with the return of plants to the wild.

The horticultural component of the GreensC'ool Program provides an opportunity in a very direct and hands-on way. Schools are provided with encouragement, support and guidance to create *ex situ* gardens of endangered species within their school grounds. The species used are those identified in species recovery plans and so extend the scope of those plans. When possible, plant species originally present in an area are used, providing the added incentive of restoring the species to its past range.

At the completion of the GreensC'ool Program, students have come to understand the importance of plants as the foundation of all life, are aware of the plight of plant species and their responsibilities in this process, and have realised that they as individuals need to act. They have been given the opportunity to personally make a difference by assisting in the saving of species, by repairing the damage of the past and ultimately determining the type of world they wish to inherit.

A number of schools and students have undertaken this Program. Armed with their new conservation awareness, they have gone on to develop recycling programs, composting programs, install water-wise irrigation systems, participate in power-saving plans, adopt local parks and waterways for repair and cleansing, question excessive packaging, go green shopping and generally walk softly on the earth.

The Botanical Guardians

Like the GreensC'ool Program, this new network has been developed to provide two important outcomes; an informed community and an involved community. The Botanical Guardians is aimed at the general community. To get the message out to as many people as possible, the Gardens joined with three existing community-based networks (the Understorey Network, the Threatened Species Network and the Australian Network for Plant Conservation) to produce a quarterly *Botanical Guardians* newsletter. This newsletter has the advantage of not only letting people know what is going on with plant conservation generally, but also allows the three active groups to let each other know what they are doing. Because many people were found to be members of several of the groups, this system also cuts down the number of newsletters produced.

The second component of the Botanical Guardians is a membership database which records the ways in which individuals would like to contribute to plant conservation. These may include:

- growing endangered plants for recovery plans
- planting endangered species on their farm or in their garden
- assisting with plant collecting
- monitoring replanting sites
- surveying vegetation in local areas, or
- organising education and training days in their area.

Government departments, such as the Botanic Gardens, Parks and Wildlife Service and Department of Forestry, have access to this information and are therefore able to easily contact and involve locals when they are working in the field. Justification for this program can be seen from a letter sent by the first member to join the program. Richard Burns wrote 'The reason I want to be involved in the Network is so I can find out what is going on, to meet like-minded people, and to get involved in the practical work of community involvement in rare and threatened plant conservation. I would like to be asked to do something'. The commitment required from the Gardens education service to ensure the success of these programs is significant, requiring, in relation to the GreensC'ool Program for example, several contacts with each school class over a period of up to 18 months. These contacts include introductory sessions in the Botanic Gardens, field trips to collect seed, sowing and planting in the schools, and in some cases helping students design an endangered species garden. It often requires work with all the teaching staff and ground staff of a school to explain the project to and encourage the commitment of the whole school. These sessions sometimes include parent groups and school management councils. However, the end result is worth the effort. It is inspiring to witness the change in attitude and behaviour of students over this extended time, and the physical improvements to their environment.

This commitment must be reflected in how the Gardens allocate resources and staff to the education service. The RTBG commits only around 5% of its total budget to education, despite identifying it in its mission statement as a primary role of the Gardens. Unfortunately this undercommitment is representative of many, if not most, botanic gardens around the world. Despite this, botanic gardens are carrying out some effective and imaginative educational programs. The effort is worth it, these programs can make a difference, attitudes and behaviour will change and are changing. As a result of this type of work the Gardens believe that there are now fewer species stepping to the edge of the extinction abyss than if these programs were not provided. Members of the community want to be involved in the process, and must be involved, if the work is to continue after the scientists and education officers move on to other projects.

Promoting science participation through garden explorations

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Kids, adults, caterpillars, and flowers made science discovery come to life during Garden Explorations at the South Carolina Botanical Garden (SCBG) in Clemson, USA. An inquiry-based program, Garden Explorations focuses on promoting science participation by girls, as well as providing professional development opportunities for teachers and pre-service teachers. By involving girls, their families, and teachers in hands-on, inquiry-based science activities, Garden Explorations supports and encourages participants' interest in science (particularly life sciences and ecology). The hope is that further explorations and discoveries will be made after the end of the program.

Garden Explorations has two primary components: Family Science Saturdays sessions and a two-week Summer Science Camp. Both use the themes 'Plants and their partners', 'Plants and their environment' and 'Web of life' to explore the South Carolina Botanical Garden's 270 acres of niche gardens and natural areas, as well as using the classroom and teaching greenhouse to carry out inquiry-based activities.

Family Science Saturday sessions took place over three consecutive Saturday mornings. Participants were 4th, 5th, and 6th grade girls (ages 9-12), accompanied by an adult family member or friend. Teachers and pre-service teachers, who served as facilitators for each session, came for pre-session workshops on the Thursday prior to each Saturday. At these workshops, facilitators learned how to use inquiry-based teaching techniques by modeling activities planned for families on Saturday. The two-week Summer Science Camp incorporated all three Garden Explorations themes; it was preceded by a one-week pre-session workshop for teachers and pre-service teachers.

Lessons were modified from excellent existing curricula, using hands-on, inquiry-based activities from *The Life Cycle of Butterflies* (a National Science Resources Center unit), as well as activities in *The Growing Classroom: Garden-based Science*, *GrowLab: Activities for Growing Minds*, and *Hands-On Nature: Exploring Nature with Children*. Using Garden Exploration tote bags to carry notebooks, insect nets, microscopes, and other gear, participants carried out investigations in the Garden's managed and natural areas, using activities designed to engage and actively involve participants in 'doing science'.

Inquiry-oriented techniques encouraged participants to 'see' and discover things for themselves. Children and adults quickly became absorbed in investigating, observing, and sharing their discoveries. Brainstorming sessions and group discussions stimulated active exploration of ideas, both during pre-session workshops and the sessions themselves. For example, participants wrote mock 'advertisements' to invite bees, butterflies, and hummingbirds to visit flowers and shared them with the rest of the group. This set the stage for a lively field investigation of how frequently pollinators visited different kinds of flowers in both the 'Plants and their partners' Family Science Saturday session as well as during the Summer Science Camp.

The South Carolina Botanical Garden is a great place to have a science camp based on the themes Plants and their Partners, Plants and their Environment, and Web of Life. For example, the Wildflower Meadow, at its peak in June, is a magical place to compare the favorite flowers of bumblebees, honeybees, and butterflies and follow the intricacies of their paths from flower to flower. The comment from one of our elementary education graduates during the pre-camp workshop was telling; after expressing his enthusiasm for the activity, he said "I hadn't thought that there were any differences in flower visitors before – or that it was even interesting."

The 'Web of Life' program began by using topographic maps to discover where the Garden's stream finishes (in the campus lakes near the football practice fields), followed by testing experimentally how soil and vegetation affect water and sediment movement. Participants also investigated how the stream changes in its paths from above the Garden's ponds towards the Beech Grove and what happens along the way. Iridescent adult mayflies, ferns, dragonflies, diving beetle larvae, blue-green algae, mosquito fish, crayfish, and various interesting sediment dwellers were just a few of the organisms encountered along the way. Side trips to the wonderfully frog-rich Meadow Pond made an interesting comparison to the biological diversity present in the Duck Pond and the Heritage Pond.

The girls' faces over the two-week camp told the story of the camp's success: the excitement over seeing that their caterpillar had formed a chrysalis, amazement at the spectrum of colors on a beetle under the Magiscope™, and the enthusiasm when a dragonfly larva or a tadpole was discovered.

The Garden's lecture room served as the camp headquarters for two weeks (belieing its sedate character during adult programs the rest of the year). Everyday scenes (when participants were not out in the Garden) included: close-up observation of discoveries, using field guides for identification, creating realistic paper flowers, constructing a water environment (complete with animals made out of modeling clay) and, closing each morning with a rousing song called 'Six Plant Parts' (complete with choruses).

Preparing for 65 girls and adults at the Garden for two weeks, arranging van transportation and planning snacks for hefty appetites, were background requirements for the camp. As it turned out, one of the favorite snack periods involved using tweezers, straws, and scraping tools to compare how chewing, biting, and sucking insects could eat cookies, apples, green peppers, grapes, and bananas. This was a great hands-on activity, but imagine the results of all of the campers eating cookies with tweezers!

Hands-on learning reached well beyond the Summer Science Camp and Family Science Saturday. It is estimated that the Garden Explorations program will reach well over 1,200 additional children over the course of this year and the following. The impact on teachers, pre-service teachers, and their students, with the involvement of friends and other family members will increase the multiplier effect.

In the Summer Science Camp, approximately two-thirds of the participants were from low-income families; it is hard to underestimate the opportunity that participation in this program represented for them. However, for all of the participants, if some become scientists, or science teachers, or simply remain interested in science as a result of the program, it will be grant money well spent.

The results of the project have been very encouraging and support the effectiveness of using an inquiry-based approach in a public garden setting. Assessment and evaluation surveys reflect the importance of open-ended experiences in encouraging student, teacher, and adult interest in science. Joint exploration of new discoveries made learning a cooperative experience. Mutual enjoyment of the activities was strong reinforcement for continued science investigations by both girls and adults.

The inquiry approach of Garden Explorations is simple: encourage close observation of the natural world, promote open exploration of ideas and "I wonder ..." questions, allow ample time for investigation, and see science happen!

The program was made possible by grants from the Eisenhower Professional Development Program, a United States Department of Education program administrated through the South Carolina Department of Education, and the AAUW (American Association of University Woman) Educational Foundation. Both organizations support programs that promote science participations, especially in under-represented groups.

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Restoring our relationship with the land – linking children to nature

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Introduction

Sixth grade students at Oregon Middle School in Oregon, Wisconsin, are excited about school. They are involved in a highly successful educational reform project at their school and what grabs them is what they are doing. They are planting, tending, sharing and learning from the restored prairie in the school's front yard. They investigate plant adaptations on the prairie, describe prairie insects musically, and explore the history of their school and pioneers by studying their prairie's land history. They collect prairie seed for schools throughout the area - local third, fourth and fifth graders have visited this naturalized outdoor classroom. They have mathematics, science, language arts, social studies, music and art classes in their prairie.

The staff of the Arboretum's Earth Partnership Program who have trained and worked with this school, are repeating this scenario around the State with thousands of children. The idea is catching like wildfire. We see, and teachers agree with us, that this is a highly successful way to inspire students, invigorate schools and strengthen education.

The Earth Partnership Program, sponsored by the University of Wisconsin-Madison forges links between students, their schools, their communities and their environment, through the restoration of native plant and animal habitats on once barren grounds. The University of Wisconsin-Madison Arboretum has been a leader in the restoration of native ecological communities for more than 60 years. In recognition of the powerful potential for using the restoration process in school classrooms and with children, the Arboretum initiated the Earth Partnership Program in 1991. Since that time, over 300 teachers in 89 schools have been trained and they in turn have reached thousands of students.

Why the Earth Partnership Program?

If children are to learn how to solve problems, learn to love learning, and learn to work cooperatively amongst themselves and with adults, then they must be given opportunities to ask questions and be part of the search for solutions. If children are to learn about the environment that sustains the human race, to develop a sense of wonder and place, then they need to be offered places to stimulate their natural curiosity and compassion. For children to realize that an individual can make a difference and have hope, then they have to be given opportunities to actively engage in something positive. They need to be offered problems to solve in school that are real, where they can see the fruits of their decision-making. The Earth Partnership Program shows teachers how they can work with students, parents and community members to create profound opportunities as they create a beautiful school yard of restored native habitat.

Arboretum staff have found that as the students learn about and relate to the natural environment through the arts, science, social studies, math and language arts, so they begin to develop a sense of place in the world, to act as stewards to the native communities and begin to develop the attitudes, knowledge and skills necessary to become active citizens. This does not occur at the cost of the standard curriculum; rather this Program provides a meaningful context for much of the material that teachers already cover. In addition, school restoration of a prairie site opens the doors for many new experiential, hands-on techniques for teaching science and other subjects.

Operational procedures

The two Program components that have been the keys to its success are the in-depth teacher-training workshops and the ongoing school and community support. The two-week workshops offer training in activities to engage children in the process of habitat restoration and historical exploration of their community. Activities include mapping, site analysis, ecological research, exploration of music, art and other avenues through which people relate to the environment. Staff seek out a pair of teachers from a committed school or school district to act as school and

community leaders to begin the effort of bringing together the coalition of school, citizen and community interests for their project. They receive an initial two weeks of training and return the following year with a team of four more teachers for another two weeks of training.

In addition to the workshops, the Program offers comprehensive ongoing support for the schools. This includes; community activities for students and their families, student research guided by ecologists, field trips for students, continuing education for teachers and community members, curriculum development support, networking with other communities, and in-service staff development.

Why restore habitats in school yards?

For thousands of years, human beings have learned about the environment because they had to know where to find firewood or where to find medicinal plants or food. Since the 1950s the places where children in our country grow up have changed remarkably, so that for many people the only living things nearby that are not human are under direct human control; pets, lawns, and a few trees or flowers that an energetic gardener has planted. The ability of children, or adults for that matter, to interact easily and daily with a natural community has been extinguished. Wild places still exist, but they are often far away. Children do not often get the opportunity to interact in an intimate way with wild objects, losing a sensory and emotional engagement with the environment. This often affects their behavior. Studies have shown that children at schools with asphalt playgrounds are more apt to engage in aggressive domineering behavior. When playgrounds are naturalized, children have a wider range of choices as to the type of play. Students who want to avoid competitive games or bullying behavior can go for a quiet walk among the plants. This is why restoring habitat to school yards is so important. (Titman 1994; Nabhan and Trimble 1994).

Many schools in the United States today have very little nature around them. Playgrounds are often paved with asphalt. Biology is taught inside classrooms from books instead of by observing plants, animals, weather and other natural processes outside. Only 9% of children in 5th and 6th grade listed experience with nature as the way they learned about the environment. Over 54% learned what they know about the environment from television. And yet the years from age 7 to 14 are the most important years for learning, it is when children's brains learn in a uniquely receptive and playful way. It is the best time for societies to pass on culture and traditions and it is also the best time to allow children to interact with animals and plants. Through this they can develop a sense of place and a sense of how the natural world works (Trimble and Nabhan, 1994).

School curricula are more apt to have children studying the rainforests of South America than the watershed and ecological systems of their home. Even though the two are linked naturally, studying only the distant ecosystems prevents children from understanding what has happened to their local environment.

There is an effort by educational reformers to change the way subjects are taught in the United States so that students have a better understanding of how to apply knowledge, solve problems, and maintain an engaged interest in learning throughout their school careers. The University of Wisconsin's Earth Partnership Program is one initiative that addresses both the need to reform how children are taught and also to change the physical nature of the school and neighborhood landscape.

In our Earth Partnership Program we teach teachers and children about the environment that gives us food, air, and supports the plants and animals with which we share the earth by involving them in planting a small model of a natural community on their school yard. Children become not only active gardeners by planting seeds and plants in a prairie garden, they become active hands-on learners.

But why the restoration of a natural habitat instead of a vegetable garden? The Earth Partnership Program promotes the restoration of natural habitat in school yards for three purposes. Firstly, to increase local biodiversity, secondly to provide rich curricular activities that improve teaching, and thirdly to give students broad new experiences with the natural world.

Firstly, local biodiversity needs to be improved because most of the natural ecosystems that once existed in our area have been reduced until they are confined to parks or preserves. The prairie in Wisconsin is reduced to less than one-tenth of one percent of its original area. Very few people have a chance to see the hundreds of flowers and thousands of insects, birds and mammals that live on the prairie, reducing opportunities to experience a beautiful and complex piece of nature.

Secondly, the process of analyzing a site, planning to restore a model of an ecosystem, planting it and then studying it, is rich with teachable concepts and opportunities. Instead of sitting in a classroom learning biology, math, history or language arts from a book, children can go outside and see real, living insects, butterflies or bees pollinating

flowers in the complex relationships of an ecosystem. They can collect the seed from those pollinated flowers and learn how to grow more. They can see what a square metre or one hundred square metres looks like.

Thirdly, our experience shows that children can be much more interested in learning when they deal with real things, in a rich context. History comes alive when children track down whoever owned the site, and how often it was sold to someone else. The selling of land could often be tied to an historical event, such as the agricultural depression of the 1930s. Children are more interested in this history because it is tied to the people who owned the land that the children are planting. They can look at records about these land owners and learn something about their lives. For instance I learned through census records from 1880 that my great-great grandfather and great-great grandmother could not read. They had immigrated to Wisconsin from England. All of their eight children could read because of the emphasis in frontier America on providing schools. These real connections help children learn and want to learn.

As students investigate their school yard restoration, they can share the excitement of exploring real scientific questions for which the answers are currently unknown and share their findings with adult scientists. In the context of the restoration, the experiment becomes more than an outdoor exercise for learning the scientific method – it becomes a search for an answer needed to understand the workings of their prairie and all prairies. Students involved in building and studying nearly-extinct native ecosystems begin to understand the passions that motivate the work of scientists. For some students this can become the experience that propels them into a scientific career.

School site restoration provides a much-needed unifying framework for inquiry-based learning across grade levels and disciplines. Rather than teachers using scattered activities in different disciplines, each of which demands different equipment and background knowledge, restoration provides a broad context in which to conduct many different experiments at different levels. Each inquiry contributes to a growing base of knowledge about the school's new ecosystem, and more importantly, generates even more questions for further student investigation.

School site restoration creates an inexpensive outdoor learning laboratory. Creating a school yard restoration does not require a large portion of land or substantial money. It requires students, teachers and a community who are willing to enter jointly into an educational experiment. At the Arboretum staff are still learning and refining prairie restoration based on the models begun 60 years ago. The Arboretum prairies are still not entirely like the prairies that once existed in Wisconsin, but they are helping us to better understand the prairie ecosystem in the process. For the Earth Partnership Program for schools we have chosen to teach first about prairies because of our long experience with them. These schools are actually joining our long term experiment with restoration.

At the same time staff wanted to find a way to teach about the environment in all subject areas. They wanted this teaching to be as fully integrated among subjects as possible and to have a contextual, problem-solving framework that related the lessons to real problems. Of course, they wanted to draw upon the strengths of the University of Wisconsin-Madison Arboretum, ecological restoration and offering people a way to live Aldo Leopold's land ethic – being ethical citizens of the land community.

The prairie

In Wisconsin, indeed in most of the prairie region, people of other cultures had lived with the prairie ecosystem for thousands of years, not just the last 200. The last glacial period ended in Wisconsin about 10,000 years ago. As the climate warmed, the ice retreated and grassland species populated the State from the southwest. The vegetation most common in southern Wisconsin was a grassland with widely spaced trees, known as savanna, covering some 7.7 million acres. There were 2.2 million acres of open grassland without trees, called the tallgrass prairie. What is called the 'prairie biome' covered one-third of the United States (Curtis, 1954).

Even before glaciers retreated from Wisconsin, there is evidence that Paleolithic people were utilizing the land resources by hunting the great species such as the woolly mammoth. As the grasslands moved into the State under warmer climatic conditions, these ancient peoples adapted or learned from others how to live with this ecosystem.

The grassland ecosystem of the mid-continent contained 150 species of grasses; over 600 hundred flower species, so the prairie can have 20 to 40 different species of flowers coming into bloom each week. The prairie teemed with numerous herds of large herbivores, carnivores, hundreds of species of grassland birds and flocks of thousands of migrating birds that used the prairie as a stop-over between summer nesting grounds and winter homes. There were also thousands and thousands of insect and invertebrate species. No one knows how many insect species belong to the prairie but there are at least 18,000 insect species in one state alone. Europeans, seeing this vast grassland for the first time as they came out of the forests of the eastern United States, had difficulty describing it to people in the old countries. They described it as a 'sea of grass', with waves like the ocean as the wind blew across it. In fact, they

even had to navigate by the stars as if they were on the ocean, because there were vast areas with no landmarks as far as the eye could see.

The primary processes in maintaining the great tallgrass prairies and open savanna of the eastern part of the prairie province were grazing by herbivores and fire. Early explorers told of bison, at one time numbering as many as 50 million. They also wrote of single herds of 20,000 elk, an animal that both eats grass and browses by eating woody twigs. The bison and the elk in Wisconsin, in particular, were important in maintaining the openness of the prairie by the browsing and trampling of trees.

Lightning started many grassland fires, but the American Indians also used fire as a tool for hunting, warfare and to improve the grassland near their hunting grounds so as to attract the bison. There is evidence that on average, a given piece of land would experience a fire once every six years. Fires were important in inhibiting the invasion of trees and shrubs into the prairie (Curtis, 1954; Madson, 1994).

The grassland ecosystem of the mid-continent evolved and adapted to the climate, geology and natural processes, as mentioned earlier. These adaptations include very deep and extensive root systems that were an adaptation to drought, harsh winters, grazing and fire. While many European grasses that are now used for American lawns have root systems 6 to 12 inches deep, are not tolerant of the climate in the prairie region, and require a lot of watering and fertilizer. The prairie species had root systems that reached 6, 12 even 20 feet deep, with millions of rootlets that filled the soil. These root systems constantly renewed themselves by sloughing off and regenerating as much as 30 per cent of their biomass each year. This would put organic material deep into the soil. The roots were able to hold water and draw up nutrients.

The extent of underground animal life in the soil, such as worms, nematodes, ants, and small mammals, was as great by weight as the weight of the massive herds of bison above ground! All of this underground life led to the prairie ecosystem creating the wonderfully productive soils, called prairieerths, that have enabled North American farmers to be so productive. The soils of America's 'breadbasket' are a product of the prairie.

When settlers arrived to establish farms and towns, they not only plowed up the prairies and savannas, but they also stopped the fires, and replaced the native herbivores with cows and pigs. One of the first things a settler would do was plow a fire break around the homestead, as Laura Ingalls Wilder (1935) depicted in *Little House on the Prairie*. By stopping the fires, these settlers discouraged the prairie plants, which were adapted to fires, and allowed woody plants to grow into dense woodlands instead of open savannas. The native savanna and prairie were settled by farmers and covered by towns so that only isolated remnants remained.

Why should this matter to us?

It has to matter because people in the United States, indeed, much of the world, are dependent upon the food grown on prairie soils. Unfortunately, farmers in the United States have essentially been destroying the soil since the prairie was plowed, either through soil erosion or more recently through nutrient loss. Their fields have required increasing inputs of chemical fertilizers. The soil that remains in the vast corn and wheat fields no longer resembles the prairie soil because the vast intertwining root systems are gone and the rich underground life-forms with them. In addition, the loss of the prairie ecosystem greatly changed the ability of the soil to hold water or remain in place, so that the rivers and streams now carry a much greater load of water and sediments. This eroded soil is eventually carried by smaller rivers and streams into the Mississippi River and down to its mouth, where a vast delta of soil from the prairie has been built up below New Orleans.

This change has occurred very rapidly; in less than 150 years. So rapidly, that only a few voices were raised in concern over this change from a highly complex ecosystem, that had evolved over thousands of years and supported many cultures of people, to a simple input-intensive system of monoculture that supports modern society. This massive destruction has come to the point that there is concern about the extinction of individual species as well as the loss of the group of species which functioned together to form the grassland communities. Many look for reasons to explain why individual species should be saved. 'The butterfly weed is beautiful, let's save it'. 'Purple coneflower has powerful medicinal properties for humans, let's save it'. But the concern over the loss of individual species is really misplaced, for most of the species thrive better within the community of plants and animals in which they evolved. So for the most part, it is difficult to save any significant number of species without saving the community. It would be like saying in human society that we wanted to save the most glamorous movie star or doctors that can heal us. But movie stars and doctors cannot survive if the rest of a city or society is destroyed. And so small groups of people throughout the country are now trying to do what the Arboretum started over 60 years ago; to restore areas

of functioning natural communities of plants and animals that evolved together over time and together make up a healthy ecosystem.

Of course, as Aldo Leopold (1949) said, the first rule of intelligent tinkering is to save all the parts. So the first rule for restoration, is the PRESERVATION of the few remaining remnants of the natural ecosystems. This is done through preservation of natural areas by organizations such as The Nature Conservancy and Audubon Society which buy remnant natural areas to preserve them.

As people work to ensure the preservation of the remnants of these ecosystems, others are using restoration to study the ecosystems. Restorations increase the genetic pool of the species and spread the communities or act as buffers around natural areas to help avoid loss to natural catastrophes. In addition these ecosystems are important in a global, not just local, sense. Many of the birds and some insects that live in Wisconsin in the summer, migrate south in the winter, some as far as the tip of South America. School children in Wisconsin study the monarch butterfly. It eats only milkweed when it is a caterpillar. These butterflies migrate from Wisconsin and other states to Mexico for the winter. When children in Wisconsin plant milkweed in their school prairie they are helping a species that crosses national boundaries.

Staff at the Arboretum have learnt that the attempt to recreate an ecosystem is a very humbling experience and are still learning how to do it. We have learned that the process of restoration in many ways also restores the humans who are engaged in the process. In urbanized and industrialized society, restoration is a kind of gardening that gives people a chance to be in touch with nature again, to pay attention to the seasons, to learn the rhythms of nature, and to understand that human beings are a part of nature, not apart from it.

The Earth Partnership for Schools Program was started because it was not possible to show all Wisconsin school children the Arboretum grounds in order to give them experiences with nature. To really make a difference in their lives, we needed to find a way to put natural areas where children spend a lot of time, and where they could both study and enjoy a restoration.

Workshops were established for training teachers in the restoration process. During these workshops, the teachers would also experience many activities, new ways of teaching and curriculum integration ideas. Through the prototypes staff learned that one-shot workshops do not necessarily result in effective sustained programs. That is why 'lead' teachers are created, a full team at each school, to get involved in the curriculum at all levels, and to offer workshops and follow-up visits to achieve assimilation into the school environment. Lead teachers receive 160 hours of instruction throughout the workshops as well as consulting time with staff. Associate teachers receive 80 hours of instruction and consulting time. They receive *Prairie Restoration for Wisconsin Schools*, a binder which includes a how-to and why guide to restoration, species lists and bibliographies, and at least 100 activities and a K-12 scope and sequence.

During the workshops the teachers' growing enthusiasm was witnessed and their discussions of how they can use hands-on methods in their classrooms. Their enthusiasm flows directly to the students. For example, one teacher said, 'I have taught science in fifth grade for years; it was boring to me and therefore boring to the students. Now with these new ideas, methods, and a fascinating living prairie to study, I find I am curious and interested right along with my students.'

Teachers have noted that they have been more motivated to take students outside when they have a restored prairie, where '...the experiences bring the lessons to life'. A fourth grade teacher at Kennedy School in Madison said that her students are now writing letters of much higher quality because they are motivated to write to officials about environmental concerns such as stopping the mowing of roadside vegetation that supports the monarch butterflies. Teachers find students are more creative writing about nature when they are sitting surrounded by flowers than when they are surrounded by walls.

Teachers learn a variety of activities that address different learning styles. For instance, an activity called 'Flight of the Bumblebee' was used to introduce students to the study of insects and the skills of critical observation. Students sit outside observing an insect for 15 minutes. Then they describe the insect through music rather than through the characteristics of insect orders. They then listen to the 'Flight of the Bumblebee' by Rimsky-Korsikoff as it has been played by many people, from flautist James Galway, to string quartets, to cellist Yo Yo Ma and Bobby McFerrin. Students try to decide which best depicts the insect. This stimulates their observational skills much more than studying a collection of dead specimens, because they see the insects in the context of their environment but are forced to describe them in an unusual way.

The use of restoration at schools can be done in any situation, anywhere in the world. Firstly, students and teachers study what types of plants or plant community might have been on the site. Or they determine what ecosystem could currently exist on the site under the existing conditions such as soil type, shade, hydrology, slope, direction of the

slope toward the sun and other environmental factors that determine what plants will live there. Secondly, the students and teachers determine what to plant, by studying a model of that ecosystem, if one exists. In Wisconsin there are no good models for savannas because they have all been farmed, leaving only the large trees without the grassland groundlayer. Students have to piece together the types of plants that comprise their best guess of what was once there, plant them and see if they thrive. This is done by carefully observing plants in groups that might have once been savanna, pick out those that would work best in savanna conditions and experimenting with what will thrive. Sometimes they are lucky and find an old study, usually by a doctor looking for medicinal herbs, who wrote down what he found growing together.

Thirdly, teachers develop an action plan to cover all aspects of the project. They plan how to involve other teachers, and what curricula to change. Teachers then work with their classes to decide where the prairie will go, how to prepare the ground for planting, how to get rid of existing vegetation that is not appropriate to the prairie, when to plant, and how to manage the area over many years' time. Students are involved in every stage, so they can see the results of their work as the prairie grows.

Arboretum staff have found that it is very important to involve the community of parents and other interested adults with the restoration project. This is particularly important at first, because most adults have never seen a prairie and need to know what is going on. It is helpful to have families involved who can help to take care of the planting during the first few years – watering or weeding – until the prairie is established and does not need much maintenance. The plan for students is to involve them in some aspect of environmental study on their restoration site each year with age-appropriate activities. First graders can study simple shapes, learn colors and letters while they are outside observing nature. Older students will do scientific experiments, write music, create stories and use the natural habitat in many different ways.

Students discover that human beings can improve an environment through their actions. They can get beyond the helplessness and despair they might feel if they only study the destruction of the rainforests or the plight of whales. By learning that their actions can make a difference, they become better citizens of a democracy, willing to take action either in the way they live, by the letters they will write, or in the way they will vote for responsible care of the environment.

Thomas Berry, a Roman Catholic monk and philosopher wrote,

‘If we have powers of imagination, these are activated by the magic display of color and sound, of form and movement such as we observe in the clouds of the sky, the trees and bushes and flowers, the waters and the wind, the singing birds. If we have words with which to speak and think and commune, words for the inner experience of the divine, words for the intimacies of life, if we have words for telling stories to our children, words with which we can sing, it is again because of the impressions we have received from the variety of beings around us. If we lived on the moon, our mind and emotions, our speech, our imagination, our sense of the divine would all reflect the desolation of the lunar landscape.’

(Berry, 1988)

Our relationship with the earth involves something more than pragmatic use, academic understanding or aesthetic appreciation. The plants and animals that make up the ecosystems of the earth have a right to exist beyond their usefulness to humans. We cannot be so arrogant as to assume that we know how important an ecosystem is to the health of the planet, for we have seen when we have tried to restore ecosystems that we have a lot to learn, even after 60 years. Our children should be properly introduced to the world in which they live, to the trees and grasses and flowers, to the birds and the insects and the various animals that roam over the land – to the entire range of natural phenomena.

Aldo Leopold (1949) said in *A Sand County Almanac*, ‘When we see land as a community to which we belong, we may begin to use it with love and respect. A land ethic enlarges the boundaries of the human community and human ethics to include soils, waters, plants and animals, or collectively the land. It changes the role of *Homo Sapiens* from conqueror of the land community to plain member and citizen of it.’

As children sow the seeds of the prairie, they sow the seeds of hope that ecological restoration gives us. People, wherever they are, can learn to live with the land and heal the wounds caused by past mis-guided actions. Environmental education does not always have to be negative and fill people, especially children, with despair. Restoring the land demonstrates the love and respect that enriches it and ourselves, through the development of a healing relationship with the diversity and beauty of the natural landscape.

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Nuestro programa de educación ambiental cumple con la frase 'piense globalmente pero actúe localmente'

Raúl E. Rivero

The Marie Selby Botanical Gardens, Sarasota, Florida, Estados Unidos

Introducción y antecedentes

El Jardín Botánico Marie Selby (JBMS) está ubicado en la costa oeste de la península de la Florida en los Estados Unidos. Fundado en 1973, el jardín ocupa aproximadamente unas cinco hectáreas (doce acres) de área costera alternada con bosques mixtos subtropicales. Los primeros directivos tuvieron un gran interés por las orquídeas, y sumado a la ubicación geográfica del área, su clima subtropical y la necesidad de un jardín botánico especializado en epífitas, dirigieron los esfuerzos en constituir lo que es hoy el JBMS. La misión del jardín se traduce en *fomentar y estimular la comprensión y apreciación de las plantas tropicales, con énfasis en plantas epífitas, a través de programas de conservación, exhibición, educación e investigación, y ofrecer además, el disfrute de todos los que visitan el JBMS.*

Aproximadamente 61% de la flora en el estado de la Florida tiene procedencia tropical, y de tales grupos, 91% están representados en el Caribe. La disponibilidad de agua y luz en Florida son factores determinantes en la presencia de muchas plantas excepcionales localizadas usualmente en bosques tropicales: epífitas. Muchas de éstas epífitas localizadas en Florida no se encuentran en ningún otro lugar de los Estados Unidos. Una de las epífitas que proporciona una apariencia tropical en Florida es *Tillandsia usneoides*, comúnmente conocido como barba de viejo, barba de palo, y muchos otros nombres en muchas regiones latinoamericanas.

Esta planta presenta un rango de distribución muy amplio que va desde Chile hasta Virginia, en los Estados Unidos. Comúnmente se encuentra sobre robles (*Quercus virginiana*) y muchos otros árboles en la zona central de la Florida. Por muchas razones, *T. usneoides* y en general las epífitas, se asocian como plantas parásitas lo que constituye un reto educativo permanente para el departamento de Educación de el JBMS. Unido a la mala interpretación del hábito, al desconocimiento del público en general sobre la biología básica de las epífitas, y el importante papel que tienen dichas plantas en la dinámica ecológica de muchos bosques tropicales y subtropicales, el JBMS ha estructurado un programa educativo donde se ha incorporado actividades interactivas para niños y adultos. Este programa cuenta con variedad de temas que le permiten al visitante del jardín obtener una experiencia educativa y pragmática.

El reto educativo se hace de mayor magnitud cuando se considera que desde 1950 el desarrollo urbano en Florida ha incrementado a un 650%. Es por ello que mediante programas combinados con el sistema escolar público, residentes de la comunidad, organizaciones de la localidad, y visitantes, el JBMS está promoviendo acciones responsables dirigidas al manejo, protección, y conservación de los recursos naturales de la Florida.

Integración de esfuerzos en la problemática ambiental

Desde que el programa de Protección Ambiental de las Naciones Unidas (PANU) fué divulgado en la década de los 70 diferentes modelos y estrategias metodológicas fueron elaboradas para promover la catálisis en la educación ambiental (Johnson 1980). Como se ilustra en la figura 1, la responsabilidad de los acuarios, jardines botánicos y museos en fomentar conciencia ambientalista como parte de los programas educativos no-formales se hizo imperante. El modelo educativo exigió cambios en la misión de muchas de esas organizaciones y el JBMS no fué la excepción.

De la simple exhibición y disfrute visual carentes de algún mensaje ambientalista, se incluyeron modalidades educativas que proporcionarían al visitante un mayor interés hacia la conservación del recurso natural y del ambiente en general. Proporcionar conocimientos, generar actitudes y promover destrezas son ingredientes de vital importancia para la catálisis de la educación ambiental. Para lograr tal objetivo es necesario integrar el componente docente y técnico en las organizaciones de la comunidad (incluyéndose los jardines botánicos y el sistema escolar público), y de ésta manera ofrecer entrenamiento y capacitación a maestros de la población. Por cada maestro que se motiva ambientalmente, el logro se calcula multiplicándolo por el número de sus alumnos.

Actividades lapso 1991-1992

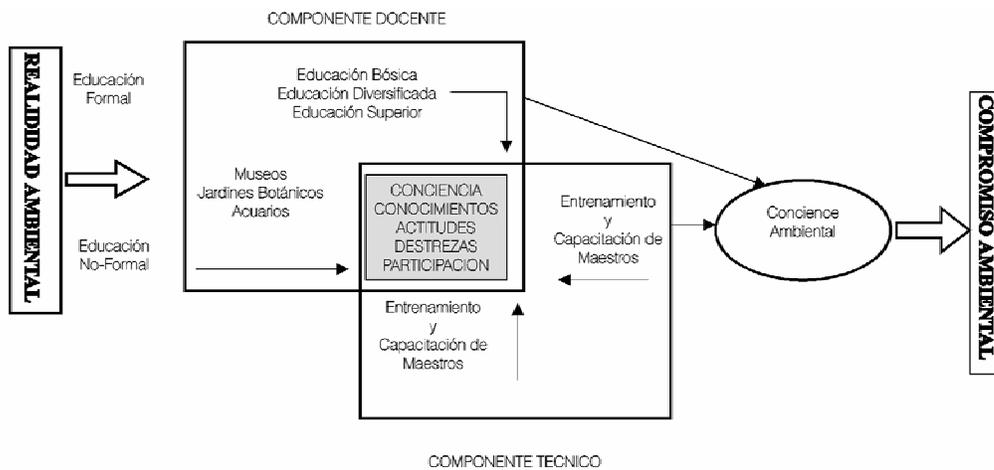


Fig 1 Integración de los componentes docente y técnico en programas educativos dirigidos a fomentar conciencia ambientalista a docentes de la comunidad.

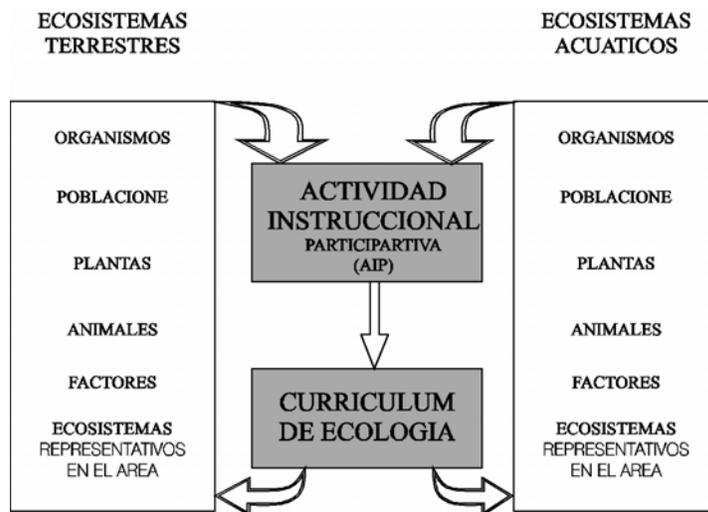


Fig2 Estrategia metodológica para un programa de enriquecimiento académico con estudiantes de sexto al octavo grado del condado de Sarasota, Estados Unidos.

Por iniciativa del sistema escolar del condado de Sarasota y con la participación de entidades científicas de la localidad, se inició un programa dirigido a enriquecer la actuación académica de estudiantes del sexto al octavo grado. El programa tuvo como tema central la ecología de la zona central de la Florida, incluyéndose el condado de Sarasota. Dos componentes identificaron el programa: ecosistemas terrestres bajo la coordinación del JBMS, y ecosistemas acuáticos con la participación del Laboratorio Mote Marine.

La estrategia metodológica (fig. 2) para éste programa de enriquecimiento académico incluyó primeramente, 20 horas de entrenamiento para maestros del sexto al octavo grado. Esta fase inicial permitió a los educadores conocer la estructura organizativa de las dos instituciones científicas participantes en el programa e identificar su potencial didáctico. Durante el entrenamiento los maestros recibieron en el JBMS información sobre fundamentos biológicos y ecológicos de plantas, con especial énfasis en plantas nativas y plantas epífitas. Por su parte el LMM, instruyó a los

educadores con conceptos y términos vinculados con la biología y ecología marina presente en la bahía de Sarasota y el Golfo de México.

Al final del entrenamiento, cada uno de los maestros participantes planificó una Actividad Instruccional Participativa (AIP) para ser ejecutada en una de las dos organizaciones científicas involucradas en el proyecto. Previo a ésta segunda fase un representante de el JBMS ó LMM dispensaría una visita a la escuela, y con la ayuda del maestro, informar a los estudiantes de lo que trataría la AIP. Ello permitió que los educandos conocieran de la institución a visitar y tuvieran un mínimo de preparación académica para la actividad. La AIP consistió de cuatro estaciones de aprendizaje, cada una de éstas con un tema ecológico diverso e integrado, y con una duración máxima de 20 minutos.

La tercera fase del programa de enriquecimiento académico permitió a los educadores participantes elaborar, con la asistencia técnica del personal de el JBMS y el LMM, un curriculum de actividades instruccionales vinculadas con la ecología del area central del estado de la Florida. El curriculum llenó un gran vacío existente en la carencia de recursos bibliográficos para la enseñanza de ésta disciplina adaptada al nivel académico del sexto al octavo grado. Asimismo, el curriculum permitió que los maestros tuviesen una referencia instruccional para iniciar, completar ó reforzar contenidos incluidos en la AIP.

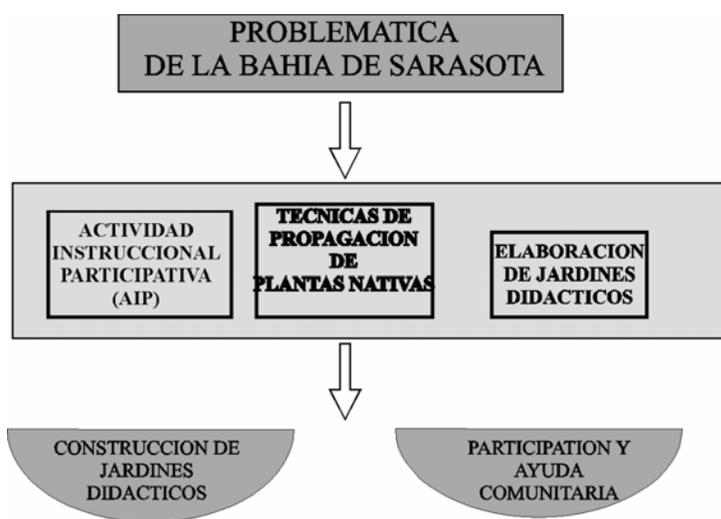


Fig 3 Esquema instruccional utilizado en la participación del sector educativo en la solución de un problema ambiental de la comunidad de Sarasota, Estados Unidos.

Actividades lapso 1992-1993

Continuando con la responsabilidad de contribuir en la busca de soluciones a la problemática ambiental local y regional, el departamento de Educación de el JBMS participó en otro proyecto educativo de integración institucional. En ésta oportunidad, además del sistema escolar público, se sumaron dos organizaciones conservacionistas de la localidad: el Programa de la Bahía y Estuarios de Sarasota, y el Servicio de Extensión Agrícola del condado. El propósito del proyecto era ofrecer actividades educativas dirigidas a promover cambio en las prácticas de jardinería en la comunidad. La presencia de contaminantes en la bahía era alarmante, y ello respondía mayormente a residuos producidos por uso excesivo de fertilizantes y otras sustancias químicas utilizadas en jardines residenciales del condado de Sarasota.

Mediante el uso de un esquema metodológico integrado (fig. 3) se incluyeron tres componentes educativos. El primero proporcionó definiciones y conceptos de la problemática ambiental existente y un entrenamiento de 20 horas para capacitar a los maestros de cómo ayudar con soluciones desde su escuela y el aula. Al mismo tiempo que el educador aprendía nuevos términos y prácticas hortícolas, se le exigió diseñara un jardín en su escuela que permitiese transmitir lo aprendido a sus educandos y éstos a sus padres y representantes. Uno de los nuevos elementos a usarse en los jardines era utilizar plantas nativas. Mediante ello se reduciría la cantidad de fertilizantes y otros químicos nocivos, y se atraería fauna autóctona como mariposas, colibríes, etc.

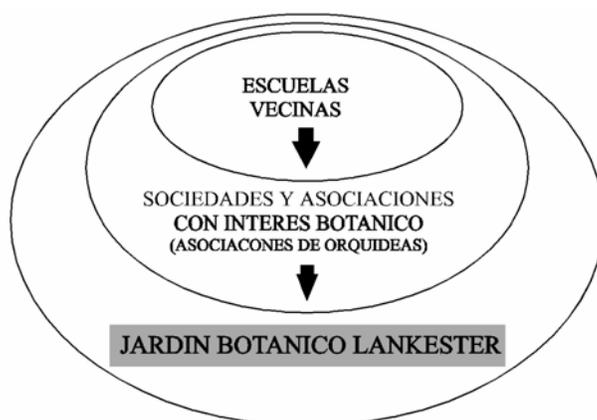
La segunda etapa del proyecto fué la de ofrecer sesiones de AIP en el JBMS con el propósito de enseñarles a los maestros y educandos mayor información sobre la flora autóctona del condado de Sarasota. Utilizando la misma

metodología de años anteriores con cuatro estaciones de aprendizaje con duración máxima de 20 minutos, 1.300 escolares del sexto al octavo grado y 30 maestros participaron activamente en las sesiones instruccionales. Los contenidos aprendidos permitieron a los participantes no sólo que reconocieran plantas locales y regionales de la Florida, sino también su ecología, distribución geográfica, y utilidad económica.

La última etapa del proyecto fué la de financiar la construcción de diez jardines escolares en el condado de Sarasota mediante ayuda financiera de la Agencia de Protección Ambiental. La selección de los mismos fue mediante postulación de propuestas por parte de las escuelas participantes en el proyecto. Cada una de estas propuestas fue elaborada por un equipo de docentes de una misma escuela y contó con la asesoría técnica de profesionales de las organizaciones conservacionistas involucradas en el proyecto. Las escuelas seleccionadas contruyeron jardines didácticos en los que incluyeron modelos con plantas nativas para atraer fauna y otros que requieren poco mantenimiento y riego.

Actividades lapso 1993-1994

Durante diez años, el JBMS ha estado participando en el inventario de orquídeas de Costa Rica, mediante una acción combinada de los departamentos de investigación de el JBMS y el Jardín Botánico Lankester en Costa Rica. Las dos instituciones botánicas han creado un sistema de cooperación mutua, y actualmente se encuentra en etapas de consolidación. De allí nació la idea de extender el componente educativo de el JBMS a otras fronteras.



Forero (1991) resalta la importancia de los jardines botánicos como centros educativos para promover conservación de plantas. Por otro lado el mismo autor destaca que de las casi 90.000 especies reportadas en latinoamérica, aproximadamente 15.000 pudieran ser orquídeas que requieren programas especiales para su preservación. Finalmente, la impresionante diversidad biológica, el alarmante número de orquídeas, la elevada pérdida de bosques naturales, y la carencia de un programa educativo estructurado en el Jardín Lankester, justificaron la imperativa necesidad de que el JBMS iniciar un proyecto de conservación educativa en Costa Rica.

Braus y Wood (1994) consideran la conservación educativa como un componente de la educación ambiental dedicada al adiestramiento de personal calificado para promover conservación y manejo de un recurso natural en particular. En éste caso particular, el recurso natural eran las orquídeas y bajo la misma definición se concibió el proyecto de conservación educativa de el JBMS en Costa Rica. Heywood (1987) sustenta la iniciativa diciendo que el futuro de la conservación de muchas especies en peligro de extinción con importancia ecológica, depende de las comunidades botánicas. Para el proyecto se definió como comunidad botánica toda aquella que propaga, utiliza, y colabora en la conservación de plantas, incluyéndose como líderes de esas comunidades los jardines botánicos (fig. 4).

Finalmente, con el proyecto en Costa Rica se quería demostrar que la tarea investigativa y de conservación de un jardín botánico es inoperante sin la presencia de un plan educativo. Dentro de las acciones de éste plan se incluyeron aquellas para promover en las próximas generaciones la necesidad de resguardar un patrimonio natural tan excepcional como el costarricense. Para lograr los objetivos planteados del proyecto se diseñó una estrategia instruccional que permitió entrenamiento dinámico y pragmático a 108 maestros de escuelas aldeanas al Jardín Lankester (Rivero 1995). La metodología utilizada en el entrenamiento permitió en los educandos el aprendizaje de conceptos vinculados con la diversidad biológica, el epifitismo, y los mecanismos de adaptación de orquídeas, mientras entendían más sobre la misión del Jardín Lankester.

Debido a la ausencia de un currículum único en el sistema escolar público del condado de Sarasota y la carencia de contenidos fundamentales en los planes de clases dirigidos a promover una conciencia ambientalista en educandos de la escuela primaria, el JBMS introdujo un Programa de Educación Ambiental (PEA). Las actividades contenidas en éste currículum innovador tienen por finalidad instruir a los niños desde temprana edad en conceptos de relación simbiótica entre organismos animales y vegetales, y fomentar una conciencia ambientalista desde temprana edad.

Hershey explica en su publicación *Construyendo un currículum relevante para la biología de plantas* (1992), las razones por las cuales Wilkins (1988) revela por qué las plantas son, entre los organismos vivos, las más importantes, menos comprendidas, y más ignoradas. Aunque las explicaciones de Hershey están más orientadas hacia la enseñanza de biología de plantas, a nivel universitario, el autor considera que los conceptos sobre la vida de las plantas deben vincularse más con la vida animal. Así el estudiante puede entender la consonancia entre organismos, su medio ambiente, y de ésta manera entender más sobre la importancia de las plantas en su propia vida.

Tomando en consideración la deficiencia curricular existente en el sistema escolar público y el deseo de ofrecer un programa educativo que incentive a los educandos a entender y valorar las plantas, se creó el conjunto de unidades temáticas de PEA sustentada con la filosofía didáctica resumida en la figura 5. Los niveles académicos fueron divididos y adaptados en tres categorías siguiendo los niveles de desarrollo intelectual de Jean Piaget, los niveles de aprendizaje de Benjamín Bloom, y las consideraciones incluidas por Braus y Wood (1994) para estructurar un programa escolar con contenidos ambientales. Cada una de las unidades utilizadas en el proyecto se enmarcaran dentro del esquema metodológico de la AIP. Dependiendo del nivel académico del educando cada actividad tiene una duración que oscila entre 12 a 20 minutos. En este sentido hemos considerado el lapso máximo de atención del educando en una situación de aprendizaje participativa y con una relación educando-educador suma de 1:15.

Por razones de capacidad de transporte se ha estipulado una clase de 55 estudiantes como ideal para realizar la AIP. Previo a la actividad, la clase entera es recibida en nuestro auditorio donde se les da la bienvenida, a la vez que se les hacen preguntas vinculadas con los temas de la AIP. Es de vital importancia que el estudiante domine una lista de conceptos del vocabulario de cada unidad instruccional, la cual se envía al maestro con un mes de anticipación para su respectiva preparación. Finalmente, antes de iniciar la AIP se muestra un programa de diapositivas con audio sincronizado, con el propósito de informar más aún al estudiante de su participación en la AIP.

Cada unidad instruccional incluye además de las actividades a realizar y su correspondiente descripción, una serie de preguntas para constantemente incentivar al educando durante la situación de aprendizaje. Igualmente cada estudiante recibe al final de la estación de aprendizaje una hoja instruccional con actividades para que con ayuda del maestro pueda completar en el aula de clase. De esa manera se le permite al educando una oportunidad para revisar los conceptos aprendidos, y al maestro una ocasión para ofrecer refuerzo instruccional a contenidos previos o posteriores a la AIP.

| GRADO ó NIVEL | MODALIDAD INSTRUCCIONAL | CONTENIDO | MAYOR ÉNFASIS EN | MENOS ÉNFASIS EN |
|---------------|--|--|---|---|
| K-2 | Ensayo y error. Habilidad para iniciar ideas mentales. Dibujar objetos que hayan visto. Usar objetos y representar otro. Imitar algo que hayan visto. Iniciar y limitar contenidos. Introducir concepto planta-animal. Asistir en la sensibilidad ambiental. Introducir un concepto de conducta ambientalista. | Relación estructura-función Explorar características de plantas y animales Interacción planta-animal Asociación de conceptos, mostrar algo y buscar algo similar en los alrededores. | Conciencia y Actitud ambiental | Conocimiento, Habilidad y Participación |
| 3-5 | Comparaciones entre organismos. Organización por afinidades. Explicar los por qué de lo observado. Investigar fenómenos causa-efecto. Insistir en aprendizaje por descubrimiento. Intercambiar ideas sobre problemas ambientales de la localidad. | Introducir conceptos de diversidad y clasificación seres vivos. Examinar características de plantas y animales asociados con su medio ambiente. Integrar conceptos previos con los recientes. | Conocimiento y Actitud ambiental | Conocimiento, Habilidad y Participación |
| 6-8 | Especular conceptos desconocidos. Promocional habilidades de razonamiento. Expandir el nivel intelectual utilizando juegos, simulaciones, debates y pensamiento crítico. Incentivar el uso de conocimiento para la solución de problemas ambientalistas. | Interacción organismo-ambiente. Requirimientos ambientales para la supervivencia. Usar flora nativa y su relación climática y geográfica. Diseñar y conducir experiencias sencillas en pequeños grupos. | Conocimiento, Actitud y Habilidad ambiental | Conocimiento y Participación |

Fig 5 Filosofía educativa y esquema instruccional del Programa de Educación Ambiental existente en el Jardín Botánico Marie Selby, Estados Unidos.

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PLANTS IN MOTION: AN ATTEMPT TO CAPTURE THEIR DEVELOPMENT AND CONSTRUCTION.

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In youth, the tulip-tree, or *Liriodendron Tulipiferum*, the most magnificent of American trees has a particularly smooth trunk, and often rises to a great height without lateral branches: but in its riper age, the bark becomes gnarled and uneven, while many short limbs make their appearance on the stem. ... Embracing the huge cylinder, ...

Edgar Allan Poe from 'The Gold Bug' (Tales of Mystery and Imagination)

'Plants in Motion' is inspired by Edward Muybridge's ideas and photographic work to capture the movements of living creatures.

The dynamic nature of plant morphology, as emphasised by Bell (1991), allows a new approach to the relationship of structure to function, thus easing the task of interpreting the elusive biological properties of form, to use the words of Tomlinson (1983).

A teaching herbarium is proposed where herbarium specimens are taken at different stages of a plant's development, such as flowering, branching, fruiting and dormancy. By photocopying the specimens, a sequence of events may be captured as snapshots of plant growth-movements, and at the same time of its construction.

A particular tree's architecture can also be analysed and placed in the range of architectural models proposed by Hallé, Oldeman and Tomlinson (1978). The features are described using the following terms: monopodial or sympodial trunk, continuously or rhythmical growth; orthotropic or plagiotropic branches; lateral or terminal flowering, and secondary changes in the direction of growth.

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Plants and culture: ethnobotany and education

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Indigenous knowledge is important, extremely important to humanity. It's a new way of thinking, a new model. It's an alternative model, which we can in fact learn from if we're going to stop this senseless destruction ...

Darrell Posey, ethnobotanist (1990).

Indigenous knowledge and senseless destruction

Much has been written and many conferences have been held concerning the conservation of plants and their habitats. Among the general population, at least in the Western world, there is a high level of awareness regarding species loss and the critical importance of forests and other natural ecosystems in maintaining biodiversity. Most people will have seen documentaries on television or read articles in newspapers or magazines dealing with this issue and they will have clear images in their mind of devastation caused to a landscape through development of one kind or another. As long-distance travel becomes commonplace, a smaller but significant number will have witnessed this destruction at first-hand. Clearly an education programme dealing exclusively with plant and habitat conservation can presume some prior awareness or experience and aim to build upon this base.

A second, and probably less well known, botanical tragedy has occurred in recent decades in parallel to the first – the disappearance of indigenous plant knowledge among the native peoples of all five continents. This loss is much more difficult to assess. Hidden within human minds, and only rarely written down, indigenous plant lore does not appear on satellite maps or provide the media with images which can be used by those seeking propaganda. It is most often linked to minor languages through local plant names and specialist terms, and to traditional customs, for example those concerning health and healing, and these too are threatened.

This knowledge is of profound importance because many traditional societies have a unique understanding of their immediate environment. As Mark Plotkin (1994) has written of the tropics:

In a conservation context, we stand on the edge of a precipice. We are scrambling to find ways to save the rainforest, yet thousands of years of accumulated human wisdom — the knowledge of how to use the forest without destroying it, to the benefit of humankind — is going to vanish over that precipice within the next generation. Throughout the tropics species are disappearing, but the knowledge of how to use those species is disappearing at an even faster rate.

Appropriate and inappropriate education

Almost every development activity which takes place, including many which are generally regarded as environmentally positive, such as the provision of primary health services, improved agriculture and horticulture, and even wildlife conservation, is a potential threat to the survival of traditional plant lore. However, we believe the most important factor which is operating to destroy indigenous plant knowledge is education, in particular the Western model of school-based education being actively promoted by governments and missionary societies throughout the developing world. As Helena Norberg-Hodge (1991) says in her book *Ancient Futures - Learning from Ladakh*:

School is a place to forget traditional skills and worse to look down on them. The school curriculum rarely places a value on traditional plant lore and can, in fact teach students to despise the knowledge of their parents and grandparents. The result is not, as people often imagine, the gradual erosion of indigenous knowledge but its rapid and total disappearance during a single generation, as one vital link in the fragile oral chain is broken. Once lost from everyday use, if this information has not been recorded, it will cease to exist and it is inconceivable that it could ever be recreated.

These changes can be illustrated by the changes which are taking place today within a remote region of Indonesia. To the outsider, a highland village on this island in the eastern province of Maluku offers an impression of the Garden of Eden. Surrounded by lush rain forest and productive gardens, people enjoy a way of life seemingly free from stress, eat organic food, employ natural medicines, breathe unpolluted air and benefit from the security of a tight family-orientated social structure. Wild sago, provides an abundant, free source of carbohydrate, and consequently fishing, hunting, and gathering wild products are pursued to provide variety rather than as ceaseless requirements for survival. Villagers show a remarkable range of forest skills, including the ability to recognise and name almost every tree they encounter

Although this highland village has a timeless, paradisiacal feel, it is not as unchanging as first appears. Traditional ways are under threat from a number of outside influences. The government would prefer to see all the islanders living on the coast where they can be assimilated into "mainstream" Indonesian society. For generations the people have resisted pressure to relocate, because they wish to preserve their independence, but it is unlikely that they will be able to hold out much longer. Children will be encouraged or required to attend school in a cosmopolitan coastal settlement a long day's walk from the village. They will probably find themselves in a minority among other children from a wide range of ethnic backgrounds and be taught in a language which is not the same as the one spoken at home in the village. Teachers from other islands will instruct them in subjects which have little relevance to living in the forest. They will not be taught to respect the traditional knowledge of their parents and grandparents and, as in Ladakh, they may begin to despise it.

It is a matter of opinion whether what these children gain from schooling is greater than what they lose and which type of education is more appropriate for their future. It is, however, beyond question that the loss to humanity of precious indigenous knowledge within a single generation through the widespread introduction of school-based education is an immense tragedy. Experience in other places, in Europe, North America and Australia, suggests that indigenous people often do not value aspects of their cultural heritage, including plant lore, until after it has all but disappeared. In the popular song Big Yellow Taxi, Joni Mitchell sings the line "You don't know what you've got 'til it's gone". If this is true what can we be doing now to preserve traditional plant knowledge and afford it the respect it deserves before it is too late?

Travel and expeditions

As isolated communities have increasing contact with the outside world, exposure to the blue jeans and Coca-Cola culture can exert a powerful influence which is often exacerbated by arrival of travellers, including well meaning adventure and science expeditions, from overseas. But travel, like education, can be a double-edged sword. While there are numerous examples of insensitive tourism destroying the culture that the tourists travel to experience, there is an argument for ecotourism in which the traditional way of life, the skills of forest people and their knowledge of the local environment become highly valued commodities. The philosophy which states that you must "use it or lose it", might view the interest of outsiders as a positive factor in preserving at least the more exploitable aspects of indigenous culture.

The Royal Botanic Garden Edinburgh (RBGE) is occasionally approached by groups of school or university students wanting to organise an overseas expedition and who are looking for a worthwhile scientific project to undertake. Botanical projects, especially in the biologically-rich rain forests, are notoriously difficult to carry out, due to the immense problem of identifying plants, especially trees, whose flowers and fruits, if they exist, may be 30 or 40 metres above ground. High biodiversity, coupled with a long period of coevolution, have resulted in one of the most taxing taxonomies, which will confuse even the experienced botanist. Ethnobotanical research projects, although they have a lot of popular appeal, can be even more difficult because of the added complication of folk taxonomies not necessarily corresponding with scientific systems. The RBGE has, however, devised a simple show-and-tell technique for carrying out ethnobotanical investigations ideally suited to this type of group with no experience but offering enthusiasm, time and willingness to travel.

The RBGE provided basic ethnobotanical training to two groups of school students (17–18 year olds) taking part in expeditions to Sarawak, Borneo. Preparations included pressing and mounting specimens of a number of plant species from the tropical collections at Edinburgh, known to occur in Western Borneo and to have some local use. This small reference herbarium was then carried by the expedition on their travels and in each of the communities they visited it was used to stimulate a dialogue with local people on domestic plant use. Semi-structured interviews were conducted in 13 different Sarawak villages and yielded useful new information about these plants (Edwards 1992, 1993). This information has subsequently been used by the education programme at RBGE in guided tours, schools programmes and interpretation.

To give an example, the orange-red heartwood of sebang (*Caesalpinia sampan*) is well known as both a fabric dye and a food colouring (Burkhill 1935). The 1992 Sarawak expedition, gathered information on the gathering, processing and use of sebang as a dye from Iban and Dayak people, even in communities where this plant has disappeared or is no longer used. However, people in the Penan community of northern Sarawak, one of the few groups who until relatively recently lived a nomadic lifestyle based entirely on hunting and gathering, had quite a different use for the plant. The Penan used the foliage, which appears to contain saponins, as a natural lathering agent for washing their bodies. Although the presence of saponin in other *Caesalpinia* spp is known, and it is widely employed as a fish poison, this specific use of sebang does not appear to occur in the literature and this may be the first time it has been recorded.

This gathering of information on useful plants was not carried out for any commercial rewards but as a way of demonstrating to the communities in Sarawak that our society appreciates their specialist botanical knowledge. If there is a gain, it is in enriching our understanding of the relationship between people and their environment, and in particular the ecologist's ultimate goal of sustainability.

Artefacts and the imagination

Not all students are able to visit the real rain forest and meet with the inhabitants. However, a certain affinity with the lives of rain forest dwellers can sometimes be achieved through the use of artefacts. Items that the RBGE has acquired for use with visiting school groups are not regarded as museum pieces or objects d'art but as examples of everyday use of plants and craftsmanship of indigenous people. Their main value is to inspire creativity and encourage an appreciation of the ingenious use of natural materials. Gerardo Reichel-Dolmatoffin says in his marvelous book about the Tukano Amazonian Indians (1996):

These artefacts (a clumsy term) are made from raw materials (another clumsy term, as seen from a Tukanoan perspective) extracted from the forest: wood, stone, clay, bone, pigments, all of which contain 'energies', in terms of colours, smells, textures, temperatures. Are these then artefacts? They are part of nature and, however transformed, they continue to be part of nature.

A basket made by forest people from forest vines will be used to carry forest products until finally, once it has reached the end its useful life, it will be returned to the forest to rot. Is this basket any less a part of the forest than a tree, bird or monkey? The use of artefacts can therefore give students in Scotland an opportunity to touch the real forest, experience those primal 'energies' and, hopefully, let the forest touch their lives.

Living in a Rainforest was the title of an RBGE environmental education programme which successfully immersed Scottish schoolchildren in life in the Borneo rain forest. A Borneo-style house, constructed in the Education Centre, was used by school groups as a base for mounting forays into the simulated rain forests of the tropical glasshouses and to investigate the many useful plants growing there. During the day they were surrounded by artefacts and images chosen to generate an interest in the lifestyle of contemporary rain forest people. They also took part in activities, such as batik, music and shadow puppetry, which enabled them to explore other aspects of the rain forest world and express their concern for the threats to habitats and forest people.

The key to the success of *Living in a Rainforest* was its ability to capture and stimulate the students' imagination. Environmental education must seek to engage participants in this way, otherwise it cannot deal with the emotions raised by ecological issues or touch the spirit. Creative use of imagination is an important element in virtually all of the RBGE's primary school programmes and the response from both children and their teachers has been positive. We have called our approach "earthshrinking" and make the wildly extravagant claim that we can take a class on a journey to anywhere on earth (except possibly Antarctica) through the world of plants. Consequently every day groups of children travel to Africa, Australia or Amazonia without ever leaving the 25ha area of the Edinburgh Garden!

A recently developed RBGE schools education programme which uses the earth-shrinking approach is called 'Expedition!'. Classes are invited to join an expedition to a remote area of the Chinese Himalaya to investigate the flora of a river valley which is shortly to be dammed, submerging both forests and villages in water. Pupils, having seen an appeal for volunteers to join this important mission, respond by sending details of themselves and their relevant skills. On the day of the expedition school groups are given a briefing at the RBGE before setting off on an exploration which takes them through a shrunken world of miniature forests, lakes and mountains. The journey requires the use of a wide range of practical skills – from using a map and compass to drawing, collecting and pressing plant specimens. During the day the students learn about aspects of Chinese ethnobotany by discovering plants that can help cure them when they fall sick, sustain them when they are hungry, or provide them with the

materials to build shelter. When they find that some of the plants of special cultural or practical significance are growing in the area soon to be flooded it stimulates some very lively discussion concerning the conservation of natural resources.

The RBGE has particularly strong links with China which extend back to the beginning of this century. 1997 saw the official opening of the Pringle Chinese Hillside, a new project in which part of the RBGE's extensive Chinese plant collection will be displayed in a landscaped setting, complete with stream, pond and bridges. In planning educational activities and events focusing on the Chinese Hillside it has been essential to involve members of the local Chinese community, who represent the second largest ethnic minority in Scotland. Various aspects of Chinese culture, including dance, festivals and cuisine, flourish in Scotland and will be incorporated into the public education programme in the future. Meanwhile some Scottish-Chinese school children have already taken part in our Expedition! programme where their bilingual skills were especially useful.

Interpretation and plant stories

Faced with the interpretation of an innovative development like the Chinese Hillside, the first question that might be addressed is: what are the stories we can tell visitors about these plants? An ethnobotanical approach would be to look at the essential role of the plants within Chinese culture for food, herbal medicine, religious ceremonies, etc. According to one Chinese proverb, bamboo alone has as many different uses as there are days in the year. Also, because they offer a rich supply of stories of human endeavour, one might consider the adventures which have taken place in connection with the introduction of horticulturally important plants from China to the rest of the world. It is not necessary to rely on plant-hunters of the past (some of whom were quite unethical characters) because the plant-hunting expeditions of the present day, carried out in partnership with Chinese botanical institutes, are an equally exciting source of material. In traditional societies around the world people rely on stories, reinforced with practical demonstration, as a means of passing on essential knowledge and skills from generation to generation. In the history of humankind the written word is a relatively recent invention and we must consider if there is not something significant in the more ancient approach. As Kieran Egan (1988) points out in *Teaching as Storytelling*:

The story form is universal, everyone, everywhere enjoys stories. The story, then, is not just some casual entertainment; it reflects a basic and powerful form in which we make sense of the world.

Considering their importance in people's lives, it is not surprising that there are many stories about plants and that these may have an educational value beyond the society in which they were created. Often they tell the listener something about the plant's biology or ecology, distribution, history, uses and methods of exploitation, or cultural significance. These are important narratives, with tremendous potential in botanic garden education and interpretation (see Graham and Bird, 1997, in this volume).

Gradually our repertoire of botanical plant stories from throughout the world increases, and as it does we have more to share, not just with school groups and the public, but with others in botanic gardens who value this approach. This is why we used this Congress to propose the setting up of an international "plant story bank" which would contain informative stories on specific plants from throughout the world. These stories might be entirely factual, for example the historical account of the discovery of a new medicine; they might take the form of a traditional myth, for example how people first learnt the use a particular plant; or they could be contemporary stories based on real or fictitious events. The essential thing is that the plant must be identifiable as a specific plant (e.g. travellers tree, banyan fig or coconut palm, not simply tree, fig or palm) and should be central rather than incidental to the main storyline.

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Connecting to the curriculum: kehidupan sehari-hari – an Indonesian-language trail in the Adelaide Botanic Garden

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Looking at ways of using botanic gardens to link to local and national school curricula can be a great exercise in lateral thinking. This is especially so if you wish to move away from traditional areas like plant science, but still maintain a strong environmental perspective.

This session looks at some of the innovative ways in which educators in botanic gardens integrate their programs across diverse curriculum areas. A particular case-study on teaching foreign languages in botanic gardens is used to highlight the way that plant collections, when used creatively, can give students the chance to learn languages within a cultural and environmental context. The session also looks at how cross-cultural themes can exploit new and perhaps under used areas of botanic gardens.

The way we teach is as important as what we teach. This session also looks at how different arts-based approaches can quickly gain and hold students' attention. Learning through the arts can become an almost incidental byproduct of the process of creating or enjoying a performance or an exhibition. With well chosen themes, sympathetic to garden collections, arts programmes can be a powerful educational springboard for a multitude of different learning themes.

Connecting to the curriculum should not just end at the garden wall. Technology now lets us reach distant audiences cheaply and instantaneously. This helps overcome some of the distance disadvantages which precludes isolated communities from access to our Garden and our expertise. Technology can also provide the opportunity for other Garden staff to share their knowledge, with a minimum of disruption to their daily work.

Teachers are key players in the educational community. By targeting the curricular needs of schools, well designed teacher training programs can influence the design and delivery of classroom teaching. Teacher training can be particularly effective when programs have a strong practical bias towards developing local resources for ongoing ecological and biodiversity studies.

If botanic gardens are to be leaders in environmental education, they must provide innovative, diverse and relevant programs that are adapted to the changing needs of the education communities that they serve.

A key element in developing new education programs in the Adelaide Botanic Garden has been to broaden the appeal of the Garden to a much wider range of teachers than the traditional specialist botany or biology teacher. In looking at what types of teachers use our Garden it was not surprising to find foreign language teachers a rarity.

On discussing the reasons for this with language teachers a number of points emerged. Firstly, few language teachers ever considered the Botanic Gardens as a resource for their subject. Secondly, because of their training and teaching background, many lacked the confidence to deal with plants and thirdly, even if they were interested in using the Gardens, no relevant materials were available to support their visit. These comments provided the stimulus and the challenge for the development of our Indonesian language-trail, 'Kehidupan Sehari-hari'.

Developing the trail

Rationale

The trail was based on the rationale that the learning of language is more powerful, meaningful and intrinsically interesting if taught within the cultural context of the country whose language is being studied. Botanic gardens are ideally placed to exploit this notion. Their plants, collected from all over the world, possess fascinating stories relating to the people and the culture of other countries.

Choosing a language

The choice of the Bahasa Indonesia language was an easy one for us. Apart from the fact it is taught in over 80 local schools and is the language of one of Australia's nearest neighbours, our tropical Bicentennial Conservatory collection has many plants which come from, or are used in, Indonesia.

Working collaboratively

The trail was developed jointly with a leading Indonesian-language specialist who provided advice on suitable curriculum content, methodology and age-appropriate activities. Funding was obtained through a grant for the development of local initiatives in the area of language and cultural education programs. The trail was aimed at middle-school students between 9 to 14 years of age.

The trail

In Indonesian, Kehidupan Sehari-hari means 'daily life' and embraces the idea of living in harmony with others and with nature. This approach provides both a cultural and environmental perspective to language development.

The trail itself was written as a self-guiding booklet based around a simulated visit to an Indonesian rainforest. Its combination of practical language-based tasks and cultural information on the uses of plants is designed to give students a glimpse of traditional Indonesian village life while experiencing the feeling of being surrounded by a tropical rainforest environment.

Kehidupan Sehari-hari is divided into six main sections:

1. Selamat Datang - Welcome!

As the doors of our Bicentennial Conservatory pull back, students are encouraged to believe they have just touched down in the wilds of Indonesia, courtesy of Bicentennial Airlines. Their first task is simply to explore, in small groups, the environment of the rainforest inside and to note, in Indonesian, their first impressions of the Asian rainforest environment and how it differs from the local (Adelaide) environment.

2. Village Visit

Once students feel acclimatized, they begin an Indonesian plant-hunt by translating navigational directions given in Indonesian. As they find each of the ten listed plants, they match the living plant to a drawing of it on their Indonesian village scene page. Once they have a match, they then write the Indonesian name of the plant in the appropriate place on their village scene.

3. Plant Cards

Once the ten plants have been located, students revisit them to learn about their different cultural uses. They are required to read information and respond to questions about the plants in Indonesian. A vocabulary list on the side of each page is provided to help with more difficult words. Questions included in this section involve explaining how rotan fish traps work and what must be done to *Pandanus* leaves before they can be used for weaving.

4. Di Kebun Raya

After finding a suitable spot in the Conservatory or the Garden, students use a postcard-writing activity to reflect on what they have learnt about Kehidupan Sehari-hari in Indonesian.

5. Other Places to Visit

This is an optional activity for students to collect further information about Indonesian plants growing out in the Garden and to explore the tropical foods on display in our Museum of Economic Botany.

6. Back at School

A series of post-visit activities have been developed to follow on from a visit to the Gardens. Suggestions range from re-creating an Indonesian village from natural or recycled materials to finding things at home that are made from plants which might grow in Indonesia.

The booklet

The trail was published in an easy-to-photocopy booklet form. It contains extensive teacher planning information, a vocabulary list, and diagrams of plant parts, fruits and spices, all labelled in Indonesian. Our Garden's artist developed numerous delightful drawings for the student activity pages. The drawings are an integral part of the learning activities, as they provide important visual clues to help students with their language translations.

Some outcomes

Following the launch of the Trail and associated teacher workshops, many schools teaching Indonesian have successfully used the trail. One of the main benefits has been the use of the Garden by a group of teachers who would not normally have done so. Already teachers of other languages have requested similar trails for their students. The trail has also enabled language teachers to broaden the boundaries of their subject by integrating an environmental perspective into their teaching programs.

Students enjoy the plant-hunt approach. They also respond well to working in small groups independent of the teacher. There is often a lot of discussion and collaborative decision-making evident, as they translate directions and answer questions about the plants they have found.

Of particular value to the Garden Education Service has been the opportunity to work with an outside curriculum specialist in the development of the program. Collaboration like this brings in new knowledge, skills and a different perspective of the Gardens. It also provides a ready-made network of contacts with the wider education community. This has been especially useful in the evaluation and promotion stage of the project. The partnership has also led to the successful completion of a junior primary trail 'Dunia Alam - the Natural World', and a further grant to develop an 'Asia in Australia' theme trail.

Kehidupan Sehari-hari highlights how botanic garden plant collections can help to give students a glimpse of other parts of the world and experience the language, culture and environment of another country. It is also another example of the enormous range of learning opportunities that our diverse plant collections can bring to the school curriculum.

Down the garden path: the use of stories and storytelling to raise environmental awareness

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Stories and storytelling are powerful tools for creating excitement, explaining difficult concepts, raising issues and promoting a greater understanding of botanic gardens. This paper outlines three case studies of successful storytelling projects and offers practical ideas for projects that could be used by other botanic gardens.

Using stories as a stimulus

Birmingham Botanical Gardens creatively uses the rich heritage of stories about plants in the United Kingdom and around the world as a central part of its education programme. We hold a constantly-updated collection of story books, selected by criteria which include relevance to our situation, a botanical context and a clear message which offers an explanation or raises environmental issues.

With older children, books can be used to encourage them to start raising issues about the wider world. A resource which can initially be used to help them develop a questioning approach is the Compass Rose (see Fig.1) devised by the Birmingham Development Education Centre. The aim of which is to involve children in creative work which explores ways of bringing a global dimension and a development perspective to the curriculum.

Storytelling Projects

The three following case studies are examples of how schools and botanic gardens can be linked through storytelling.

Plant folk tales: The Tree of Good Health

There is a rich heritage of folk tales about trees which can be tapped into to stimulate children's interest. Lordwood Girls' School felt that this was a wonderful opportunity for their 14-15 year-old students to collect stories from their wide cultural backgrounds and to produce written stories. The preparing and redrafting of the stories also met the requirements of the English National Curriculum.

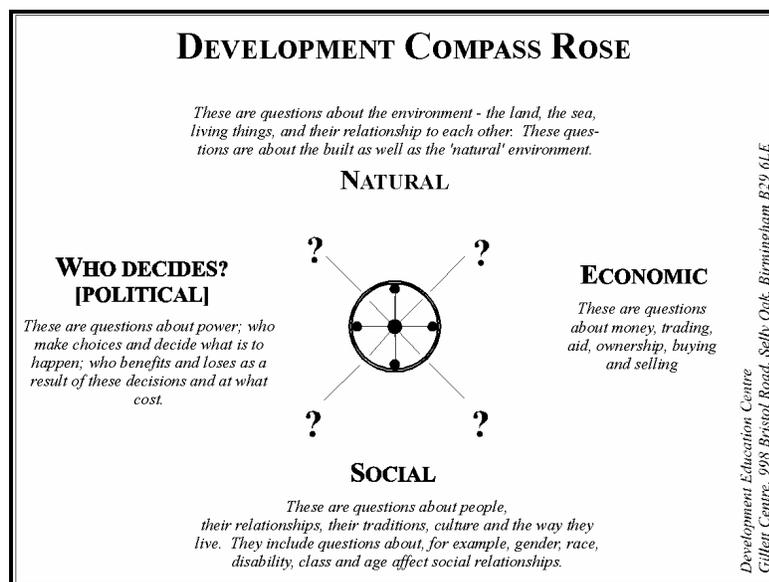


Fig 4 Development compass rose

In successive stages, the girls collected stories – in many cases from family sources – recorded oral versions; shared and shaped the stories to their satisfaction; wrote them out as drafts and made revisions. The girls also took a prominent part in the final selection of stories included in the published booklet called *The Tree of Good Health*. Art students undertook the tasks of laying out, designing and illustrating the booklet.

With the help of support services - members of the local community and the bilingual skills of the students - the booklet was translated into Punjabi and Urdu. It was felt that this project reflected and celebrated the cultural diversity of the school and of Birmingham itself.

Plant folk tales: The Princess and the Jujuba Tree

This project involved the use of traditional stories to explore ways in which plants play a part in religious cultures around the world. The same school offered its help and the students undertook a similar process. The published booklet of stories was called *The Princess and the Jujuba Tree*.

Both projects were very fulfilling for the girls involved, who now show signs of being more confident writers. They have also resulted in the production of booklets of tales which are a great asset to all those wishing to use stories to stimulate an interest in plants and awaken a greater awareness of the environment we all share.

People Who Work With Plants



Fig 5 Illustration used for the story "Guru Nanak and the soap-nuts" from "The Princess and the Jujuba Tree"

In this project junior-school children created stories to be told to each other about the many and varied ways in which people work with plants; an aspect of life which tends to be forgotten about in an urban context.

The idea of the project was raised at an environmental education teachers meeting at Birmingham Botanical Gardens. Five schools agreed to participate and help with organising this project was offered by the Birmingham Education Business Partnership.

In order to raise teacher competence, a day of in-service teacher training was provided, with input from a professional storyteller. Twilight sessions were also used to ensure effective planning of the project.

Groups of teachers spent a day at the Gardens in order to develop their interest in the project and for them to generate stimulus material for their pupils to work on. Some decided to look at the roles of present-day employees working with plants and recorded interviews with them. Others, for example, took a historical perspective and discovered more about Victorian plant hunters. Professional storytellers were invited into school to help the pupils further refine their stories.

The culmination of the project was a storytelling day involving the pupils in using various locations at the Gardens for telling their stories to audiences made up of other children and adult guests. This high-profile celebration was a great success and was enjoyed by all.

Developing Stories

The Botanical Gardens' Education Centre has successfully collaborated with Birmingham Development Education Centre for a number of years. In secondary schools, this development approach has traditionally been the domain of geography departments. It was therefore seen as a real challenge to engage a group of English teachers in a project which used plants and their environments from around the world as the starting point of stories which raised issues of development.

Having advertised the idea to schools, five teachers came together to form a project group. After some training and planning sessions with the teachers, students visited the Gardens and carried out a wide range of activities in order to help them create ideas for their own stories. Having worked on their stories back at school the students returned to tell or perform them in the location where they were inspired. For example, one group used an Australian aborigine 'dreamtime' approach to storytelling in order to take the audience on a journey around the Gardens.

The students' outcomes were considered to be far superior in comparison to their usual work in school, especially for those who were less able or who had special needs. Many of these students however, did not raise development issues within their tales and on reflection, this was considered to have been an overambitious objective. Yet through the process of storytelling, all involved gained a greater understanding of how environmental, economic, social and political factors can affect plants and their environments around the world.

In all three case studies there are certain elements which we have found make the projects a success. This success always depends on creating partnerships with schools and other organisations. There is a wealth of expertise in schools which teachers are happy to share with others, providing it has a relevance to the school curriculum and helps enhance the quality of childrens' learning. Often the support of other organisations helps further enrich the project by them, for example, acting as a facilitator, providing funding or offering specialist skills.

Ideas for storytelling activities

Group logistics: Ideal group size – 3 to 5 pupils maximum

Methods of recording: Individuals
One child as scribe and / or narrator for group
Teacher or helper as scribe
Draw up a storyboard
Use a tape recorder

Sharing: The need to set the ground rule that all members of the group must contribute

Using Artefacts

Children in groups are given an artefact to handle such as a seed necklace, food, or a product we use or a musical instrument. They are then asked to discuss:

- what it could be used for
- where it might come from
- the people who might use it
- how these ideas could be the starting point of a story.

At this stage a photograph of a single person or group of people could be introduced to act as characters in the story. A visit could also be undertaken to one of the environments at a botanic garden where the story could take place.

Magic Eye

Pupils use a mirror to look up at one small section of the canopy vegetation and try to answer the question: "What is life like up there"? Pupils may wish to imagine that they are one of the plants or creatures living up in the branches and describe life around them. Similar focusing activities can be used for objects such as the forest floor.

Picture Stimulus

Use pictures of the people and/or animals living in a particular environment as the starting point for asking and answering questions. These ideas can then be used as the framework of a short story such as "A Day in the Life of . "

Storyboard

Pupils draw an observational picture based on one of the environments and then add a person or animal from their imagination. As a group, pictures are then ordered and a story created, in the form of captions underneath the pictures.

"How did the ...?" topics

For example:

- 'How did the cheese plant get its holes?'
- 'How did the climbing plant get its tendrils?'
- 'How did the Bo tree get its leaf tips?'
- 'How did the Acacia get its hollow thorns?'

Role play

Pupils may imagine they are explorers or a survivor of a crash or shipwreck and try to answer questions such as:

- What would I eat?
- What could be used as a shelter?
- What would be frightening?

The pupils may also be provided with a tin containing a collection of items as baggage, or they can choose ten imaginary items to put into their tin, which are then used in their story.

Introductions

Each group has a sheet of paper, with the introduction to a story on it. Pupils now have to imagine what will happen next. For example:

"The forest was very shady this late in the afternoon and the air was misty with moisture. This part of the forest was new to her and as she leant against a tree to rest, a twig snapped behind her . . .".

Rare plant conservation education for children

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Bok Tower Gardens' mission includes conservation and education. It is located on the Lake Wales Ridge, a region of high endemism, and became a participating institution of the Center for Plant Conservation in 1986. Rare-plant conservation issues are presented through a variety of programs, including tours, presentations and as part of other educational activities.

This paper will describe activities that have been incorporated into a first-grade science program, within which the study of plants plays an important part in Florida. The Gardens' *ex situ* conservation collection, and its on-site rare habitat, the Pine Ridge Preserve, are teaching tools for plant science, ecology, stewardship, and conservation.

This past year, five first-grades from one school participated in a program combining a presentation and a propagation activity at the school, with a visit to the endangered plant collection and natural habitat. The first step is to orient the students to concepts of different habitats, plant adaptations to different habitats' characteristics, and the fact that special plants grow in special places. They study a satellite map of Florida, and identify major geographic features. These features include Lake Okeechobee, the Lake Wales Ridge, the Gardens, and areas of high development pressure. They talk about how habitats might differ in these areas. At this point, the students compare different types of soil – dry sand with little organic material, and dark wet mud, such as might be found at Lake Okeechobee. They also talk about habitat loss . . . loss of special places and special plants.

Different terms are also discussed; 'Endangered', in danger of becoming extinct, lost to the world forever, 'Endemic', very unique plants growing in one special area, and nowhere else in the world, and 'Species'. These classes have been exposed to the scientific names of plants, and time is spent discussing grouping. A deck of cards is a useful tool for demonstrating family, genus, and species. Certain characteristics at one level describe a family (the entire deck of cards). Sharing other more specific similarities describes a genus (one suit within the deck). A species is named for a very specific set of characteristics (one card within the deck).

Species are discussed in relation to a rare plants, the scrub plum (*Prunus geniculata*). This is the Rose family (a florist's rose is used to convey family), the Plum genus (grocery-store plums are used to demonstrate genus), and a potted endangered scrub plum demonstrates the species. By using familiar plants, the unfamiliar rare plant is put in a more accessible context. The students also learn that this rare plant is a relative of food crops, and that it tolerates drought. When they visit the *ex situ* collection, they continue to discuss species, comparing rare plants within the same genus.

In the greenhouse, students are introduced to another endangered endemic species, Harper's beauty (*Harperocallis flava*), from a different habitat and region. Here the students examine the flower parts, roots and soil and talk about propagation, and how gardens can grow plants to help conserve species.

There are several 'blue flag' stops both in the greenhouse and in the outdoor collection. At these stops, a paper bag contains a surprise; a fruit, seeds, leaf material, or a photograph of the flower. A student assists by reaching into the bag, and helping to identify what he or she finds. Questions are asked like "Does this look like something you might grow in your garden?" or "What is different about these seeds?". This stop is the Okeechobee gourd (*Cucurbita okeechobeensis*), a rare cucurbit native to Lake Okeechobee. Students talk about this species' in relation to pumpkins and gourds, changes in its habitat, and survival strategies. For example, the gourd acts as a boat, carrying its seeds to new appropriate habitat.

Each of the 'blue flag' species has an interesting story. Scrub ziziphus (*Ziziphus celata*) is one of our Lake Wales Ridge endemic species, thought to be extinct until 1987. The idea of discovery is stressed during the students' visit; there are still many exciting things that can be learnt about these plants. At this stop, they study leaf size and shape, spines for plant protection, and seeds. They also talk about plant geography (this species' closest relatives live in the desert southwest). Other 'blue flag' stops include the Florida bonamia (*Bonamia grandiflora*), a native scrub morning glory; the scrub blazingstar (*Liatris ohlingerae*), an endangered endemic; and the *Dicerandra* species, endangered mints which contain unique oils in the leaves.

What are the take-home messages?

- these rare plants are unique, with interesting strategies for survival
- some of them are very beautiful
- they are related to plants that people use, and may be important in plant-breeding programs
- they grow in important habitats
- they are part of the regional natural history
- they are rare mostly because of habitat loss
- each person can play a role in species conservation.

How do educators ensure that some of these ideas go home with the students when they leave the Gardens?

On a hike through the Pine Ridge Preserve there is an emphasis on hands-on, touching and looking closely. Several federally-listed plant species are native to the sandhill preserve and during the hike, students see the plants growing in the habitat. What makes the habitat and the plants that grow there special are discussed as well as why these places and plants are rare.

Older students have planted a Florida endemic along the nature trail while first-graders have propagated wiregrass, a non-endangered but keystone sandhill species. These types of hands-on projects involve the students and emphasize that they are part of conservation efforts.

What of the future? The first-grade program will continue, and may be incorporated at some level on a county-wide basis. The aim is to reach out to other schools, by having activities at various levels that teachers could incorporate into classes. Such activities include traveling posters about Florida's rare plants and their conservation, and activities that familiarize students with a particular species, its ecology, and conservation.

The rare-plant-conservation education activities have dovetailed well into the first-grade science curriculum at one school. Other benefits of working with younger students include their receptivity, the opportunity to make a lasting impact, and the fact that they still talk to their parents about the activities. Many of the students have revisited the Pine Ridge Preserve with their families after their class visit and it is felt that this combination of experiencing rare plants *ex situ*, rare habitat, and participation, creates a positive learning atmosphere for all.

Botanical electives within the Smith College Summer Science Program

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The Smith Summer Science Program (SSSP) is a one-month residential program for young women with strong interests and talents in science. Each summer, a group of high school students from across the US and abroad come to SSSP to do hands-on research with Smith faculty members in the life and physical sciences. The Botanic Garden of Smith College (BGSC) is well positioned to serve this Program, with diverse collections of plant materials represented in our rock garden, campus arboretum, various climatic zones within the conservatory, and nearby woodland areas. Botanical electives within this program are in a process of constant evolution. The following topics are presented on a rotating basis. Two sessions, each two weeks in length, are offered every July

The **Diverse World of Plants** elective explores plant life-cycles and the diversity of form and function within the plant kingdom. Wisconsin fast plants (rapid-cycling *Brassica rapa*) are employed in classroom studies investigating germination, growth, pollination, and seed formation. Additionally, the systematics garden at Smith is utilized to illustrate the relationship of orders within the plant kingdom.

The **Ethnobotany** elective investigates botanical influences in the lives and cultures of the participating students, as well as a variety of diverse cultures throughout the world. Using the BGSC collections, students discover the many fascinating and useful crops of the world. Investigations include a forensic botany "murder mystery" to solve, and projects on plants used for food (chocolate, jam-, and bread-making), fiber (paper and papyrus construction), and beauty (manufacture of cosmetics).

Environmentally Sustainable Agriculture is an elective which investigates the students' connections to the land. Methods of low-input and low-impact agriculture are explored, including organic, biodynamic, integrated pest-management (IPM), and aquaculture systems. Composting and vermicomposting projects illustrate the impact of kitchen waste generated by the SSSP meal-site. Trips into the field help farmers enrolled in local IPM projects to scout and trap pest populations.

The newest elective, entitled **Medicines, Potions and Poisons**, is an investigation of the history and uses of medicinal, psychoactive and poisonous or allergic plants by humans. In this project, students explore the medicinal uses of plants in a variety of cultures throughout history. Investigations include the synthesis of aspirin (from the genus *Salix*), and a close look at cancer cells and the way that taxol (from the genus *Taxus*) is employed by cancer researchers.

Educational activity at the University of Padua Botanic Garden: an educational experiment for partially-sighted schoolboys

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Introduction

Towards the end of the 1980s, the management of the University of Padua Botanic Garden had begun to notice an appreciable increase in requests from pre-university schools for guided visits. This development was due to the awakening of interest in environmental themes brought about by the mass media. These themes had made an impression on public opinion and had induced teachers to set up educational projects aimed at developing an awareness and a defence of the environment. The Italian educational system had not equipped teachers to set up projects in these educational and cultural areas. Yet many teachers, prompted by public opinion, have favoured teaching children the importance of environmental topics and have taken some initial steps (relying on their own knowledge with the help of an occasional expert) with results of uncertain cultural, teaching and educational efficacy (Bonfanti *et al.*, 1993).

To make up for this lack of preparation, the management of the Botanic Garden felt it their duty to organize various cultural projects.

The first steps

The activities described below were begun in the 1989-90 academic year. They aimed to update schoolteachers' knowledge of the environment and biology and to experiment with new teaching methods for students in the teaching of botany (Rebecchi, 1990).

At first, together with the interested teachers, the programmes proposed by the Ministry of Education were examined, i.e. the study of the natural sciences in the various types of school (nursery school, 3 to 6 years; elementary, 6 to 10 years; middle school, 11 to 13 years). This work, carried out by the schoolteachers and with university professors, resulted in several types of teaching activities being proposed for use in schools (Curti, 1993).

For this purpose, educational materials and equipment belonging to the Botanic Garden, including a laboratory fitted out with 30 microscopes were made available to students. The teachers were offered follow-up courses aimed at renewing the knowledge that they had acquired during their university years. There were also given the opportunity of trying new methods of teaching botany with their classes at the Botanic Garden.

Activities were included in the teachers' annual teaching schedule and involved three levels of proficiency: the knowledge and the description of facts, the ability to make connections between different facts, and the personal application of similar connections in new contexts. Finally, these activities were introduced in an inter- and pluri-disciplinary perspective (Orefice, 1993). The lessons were held throughout the entire school year, although certain activities could only be carried out in the Botanic Garden. For the first time in Italy, pre-university schools were offered an opportunity to experiment in a rigorous and structured way, a method of study based on a sequence of research-observation-discovery (Curti, 1993). Thus the Botanic Garden was transformed into a decentralized classroom.

The Botanic Garden and the non-seeing student

A challenge arose to make the Botanic Garden 'visible' to students with partial sight. At Padua there is a local branch of the Italian Blind Union and, at one time, there used to be an institute for partially sighted students, with an elementary and middle school annex. This no longer exists, as partially sighted students now attend 'normal' schools. The solution to this problem was to be able to offer these students a programmed educational service that

fully satisfied the Ministerial programmes and their educational needs, and made full use of the material available at the Botanic Garden.

The work has always been carried out in collaboration with the families of the partially sighted, with their teachers and with the voluntary personnel working at the Italian Blind Union (Trisciuzzi, 1992).

It was not long before it was realized that the activities programmed for 'seeing' students could, with minor changes, be utilized by partially sighted students as well. The first problem was to draw up a list of plants which would be useful for the teachers while carrying out the programme. Teachers had requested that sufficient species were made available to show the characteristic of the principal biotic communities of our mountains. Fifty-two species were initially suggested. The choice later concentrated on 27 species; this was based on feedback from the partially sighted students and from their teachers. Finally a total of 35 species was agreed to be adequate. The first step was for the Botanic Garden to make available the requested plants (Curti & Todaro, 1993).

The educational itinerary

The planning of the display was considered next. The plants were potted in medium-sized flowerpots, each with an informative label (common name of plant, scientific name, family and area of origin) written so as to be legible both by the seeing and by the non-seeing students. The pots were arranged on wooden benches two meters long, supported by hollow metallic bars about 70 cm high. Iron rods fastened to the ground were placed inside the hollow bars. The benches were lined along the edge of a flower bed in an easily-reached position in the Botanic Garden. The bed is located outside the part closed in by the circular wall, in an area called the *Arboretum*. Potting the plants and distributing them on benches allowed the partially sighted students to move along the educational itinerary in a relatively easy and independent way. At their suggestion the creation of customary lanes or handrails obliging them to move along a set route was avoided – a very important aspect from a psychological point of view.

The size of all the plants in the pots was more or less similar (average height ca. 1 meter). This was in order that partially sighted students could visualise the morphology and the dimension of the plant and its parts above ground with the two senses at their disposition – touch and smell. For this reason we were asked to have plants of reduced dimensions and with forms as similar as possible to the adult plant. The partially sighted person lacks the ability to comprehend the real form and structure of the foliage and the dimensions in height of a tall tree. At the end of this work an educational itinerary had been created in order that the lessons could be enjoyed by all school classes. This is important because at the present-time partially sighted students attend the same classes as the seeing students. The plants are easily replaceable. The educational mission of the Botanic Garden is able to respond in a rigorous, organic and coherent way to the objectives and aims of the teaching of the natural sciences foreseen by the programs of the Ministry of Education (Todaro *et al.*, 1994).

The Garden visit

During a visit to the Botanic Garden, partially sighted students are requested to read the label and transcribe it, completely or in part, onto a special card. Then they are to determine certain morphological characteristics of each plant by themselves (simple leaf, composite leaf; with or without leafstalk; form of the lamina and edges; possible scent) and with other students (measurement of the leafstalk, the lamina, calculation of the surface of the lamina, etc.). The results of all these various activities are to be recorded on the card.

A map of the Garden is then given to the students, which indicates the place where they can see an adult example of the same species growing in the ground. They will find a label similar to the one read earlier and will be able to gain further knowledge (morphology of the bark, percussion of the trunk with the hand, circular dimension of the trunk, insertion of the trunk in the ground, possible scent). Finally, they are given a 10cm cube of wood so that they can determine its texture, weight, smell etc.

The card written up during the visit is collected by the teacher of the class and commented on at school in the following days. Before the group leaves the Garden the person acting as their guide has each student fill in and hand in a check-card indicating the activities performed during the visit. On leaving, the students are also given informative cards with botanical information about the plants they have observed (morphology of the tree, area of origin, use by man, history, myths, local legends, etc.).

Final analysis

Some days later a meeting is held with the teacher to learn how the students have reacted during the visit. This moment is particularly important because it reveals how the student worked and allows us to judge the educational value of the visit, to reflect on both the teacher's work and ours and to decide whether the objectives have been reached. Here are a few answers the students gave to the questions on the check-card:

‘What is a Botanic Garden?’

‘A museum of plants’
(Marco, seeing student, age eight)

‘A book where each tree is a page’
(Emanuele, partially sighted, age nine)

‘A green oasis in the middle of so much smog’
(Paola, seeing, age ten)

‘A place where many plants live without being mistreated’
(Luca, partially sighted, age nine).

‘What would you have liked to do?’

To have more time to touch the barks’
(Luca, partially sighted, age nine)

‘Try to improve the nauseating smell of the ginkgo seeds’
(Giovanni, seeing, age ten)

‘For my dad to have been with me’
(Maria, partially sighted, age ten).

In the following years teachers have asked if it were possible to have benches on which to display, during particular periods of the academic year, certain plants which are especially useful in their teaching work. Thus medicinal plants, plants for the production of essences, varieties of species belonging to the same genus, etc. were made available to them. During the continuing discussions concerning the ‘Partially Sighted Project’ it was more and more evident that, with only slight adjustments, the greater part of the educational material of the Garden could be used by both seeing and partially sighted students (Todaro & Tornadore, 1995). For example, the label provided with each pot indicates, in normal writing and in Braille, the common name of the plant, the scientific name, the family and the area of origin. The part written in black is in very large print that can be read by persons having only 1/20 vision.

Teaching aids

A number of illustrative pamphlets have been printed over the years for the various types of schools and have been made available to both seeing and partially sighted students:

- For elementary schools: The morphology of a tree; history of a fruit-tree; the apple; the stories of the old oak tree; educational cards to fill up during a visit to the Garden.
- For middle schools: Illustrated atlas of plant anatomy (Trisciuzzi, 1992; Bonfanti *et al.*, 1993); the medicinal plants of the Botanic Garden; the history of the Botanic Garden (three volumes); a visit to the Botanic Garden (three pamphlets); a wooden book describing a tree; the historic trees in the Botanic Garden.

The guide to the Garden has been taped on an audiocassette. Various entertaining and amusing materials have also been prepared and found to be successful. The traditional Italian school involves the teacher being at the front of the class and the students listening; the idea of games as a teaching instrument is ignored by most teachers. However, if "playing" is considered in the right light, it can allow us to learn whether the content of a topic has been presented in an efficient manner, whether the students have assimilated the content in an appropriate way and if the teacher, too, has dealt with the subject in a pedagogically correct and educationally valid way. Moreover, with this type of stimulus, the child can regain the pleasure of active learning (Trisciuzzi, 1992; Bonfanti *et al.*, 1993). In an atypical

classroom such as the Botanic Garden, "playing" can simultaneously involve both the teacher and the student without the need to renounce the disciplinary rigour and order to be observed in such a place.

Again aiming at learning activities, treasure hunts have been organized, where the treasure is the tree most observed during the course of the year. The tree is discovered only after a series of questions that involve remembering the knowledge dealt with in the course of the academic year.

Various games have been prepared: wooden puzzles using 48 varieties of wood and bark corresponding to the principal essences in the Garden; domino with leaves, 'Know the Trees of Your Botanic Garden' and finally 'Save the Trees in the Botanic Garden', a game of collaboration set up on the tested methodology of role play and including pedagogical, cognitive, social, creative and recreational aspects. A rich teaching agenda is proposed with an ecological theme which allows the players to touch on specific topics such as the history of the Botanic Garden, its historical trees and the various collections (medicinal, poisonous, aquatic plants, etc.) as well as themes of a more general character such as botany, pollution, ecology, etc.

Conclusions

The visit of the seeing and partially sighted students to the Botanic Garden must be related to the students' school work, in the context of the whole year's teaching programme.

The experiential character of the work provides students with first-hand experiences on which they can reflect and make use of in subsequent school work (Orefice, 1993). It requires the active participation of the students and the involvement of the teacher prior to the students visiting the Garden.

The study of the tree must be included in the wider context of the study of other disciplines. Nevertheless, the work at the garden is important and needs to be continued so as not to disappoint the requests and enthusiastic reactions on the part of the partially sighted students, their families and their associations.

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WITH EYES SENSITIVE TO GREEN

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People in big cities today are generally the third generation of town-dwellers and are often far removed from nature. Many of them do not know much about plant species, and this lack of knowledge makes people feel insecure. Many town-dwellers feel safer in the centre of the city on a Saturday night than they do in a forest on a Sunday morning.

What most people do know, in theory, is that plants are important to us in a physical way; green leaves produce oxygen and food, trees provide timber and fibers etc. Most people also agree that parks are important. A park is a place where you take children, it is a place you visit when you need to relax. But do people realise that plants make these places different from the rest of the town and that they affect their psychological health, especially in growing children?

Scientists have found that children are more harmonious, develop a better feeling for language and play better and for longer if they have a lot of green areas with plants in their environment. Most school yards in town schools all over the world are covered with asphalt or concrete. Even though children in cities have artificial, laid-out green areas to play on, they have a very long way to go to experience 'wilderness'. Adults want to create safe playgrounds for children, open places covered with asphalt, sand or grass. The equipment is ready-made and it is not often that you can change it while you are playing. Wild areas, with natural trees to climb and bushes to hide in, are not so common, and are thought to be dangerous by adults.

Children's activities always involve a certain amount of wear and tear; thus there is always an element of 'destruction' in laid-out green areas which is not found in 'wild' wooded areas.

Children learn with all their senses. They need to create a relationship with nature, and build on experiences they acquire.

There is no doubt that botanical gardens play a great part in educating people, especially children and youngsters, about plants. It is a good thing if botanical gardens can give children some feeling for nature, but it is also important to make city planners aware of the importance of having wild areas close to residential areas, where children can develop their own relationships with nature. I think that the way to people's intellect is through their emotions. If you can make them feel something for plants, they also start asking questions and will want to learn about them.

The aim of the workshop called 'With eyes sensitive to green' was to encourage participants to open their minds and to experience the environment in a different way, to make all the senses more awake. We started by laying down on the grass in the Garden and we travelled away in our dreams to the time we were about seven or eight years old. Then the participants went, in their dreams, to their favourite place, the best place they knew as a child. Maybe they went there for playing, or maybe for relaxing but this place was special. Sitting there, in their fantasy, memories of the sounds, the smells and the spirit of that special place passed through them and gave them good feelings . . .

Back to the reality of the Brooklyn Botanical Garden in 1996; discussion in the group showed that 98% of the participants had been to places not prepared by adults but to places that are a little bit wild and untouched. It could be up in a tree, behind an outhouse or in the bushes. These places are not often used by grown-ups who saw them as 'messy', 'not taken care of', or 'needed to be tidied up'. Maybe these kinds of places are the most important ones for children because, it is here, they can develop their own relationship with 'wild' plants and nature without disturbing adults. One thing is obvious, it is very common that adults, somewhere inside themselves, have a hidden place with this 'wild' character that they remember as very important in their childhood, despite the fact that it is often later forgotten. If you want to convince people about the importance of this kind of place, encourage them to close their eyes and thinking about their favourite childhood place. It usually helps and makes a lot of talk unnecessary.

After this dreaming we started to walk in the Brooklyn Botanical Garden with eyes a little more sensitive to green. We went into a shrubbery; here the participants had to follow a rope, one by one, behind a big bush and be alone for a while. It can be a big experience to a child, even frightening, to be alone with nature. If you have a place that is a little bit more 'wild' in your garden, you can try this. The rope is the security link to civilisation. After meeting the bushes we started hugging and talking to trees. They often have interesting stories to tell if you open your mind and listen. Then the group moved outside the Garden into a busy New York street. The participants now had both

sensitive eyes and ears, so that when they were asked to listen to the language of the place, the language spoken without words, they were able to experience the difference between the Garden and the street.

Back in to the Garden, we went into the calm and silent Japanese Garden and discussed the contrasts between the different places we had visited and how different they made us feel and maybe also behave. One of the questions that came up was; can children grow up to be conscious of the environment if they do not have their own relationships with nature built up in their childhood? Many would say 'No! – they need more green natural places to play in.'

Botany for young children: a workshop to explore teaching methods using art to study plants

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Introduction

In her book *The Ant and the Peacock*, Helena Cronin describes humans as: 'Walking archives of ancestral wisdom'. She makes the comment that the human eye, our brain and our instincts are 'embodiments of the cumulative experience of our past' (Cronin, 1991). For Cronin, part of that embodiment is the legacy of science. For myself, the recording through art of the visual and the tactile, is another legacy. Our work at Chelsea Physic Garden seeks to combine both these notions.

In using the methodologies of art we explore the ideas of science (in the broadest sense). In making leaf-sculptures children gain a wider understanding of natural materials: their tensile strength, brittleness, transparency, fragility and elasticity. By using drawing and magnifiers, relationships of structure and scale can be investigated. By making choices about what kind of marks to use to describe a plant through drawing, processes of decision-making and problem-solving will have been explored.

Approaching the science of environment through the senses provides a whole range of experiences that can be built upon through constructed investigations.

We might find ourselves in the vicinity of the garden, the cultural artefact that is ground in the messy, dark, nurturing decay of its own production. In the garden, we are in the space of nature and culture, form and matter, concrete and abstract, exterior and interior.

(Bloomer, 1996)

The botanic garden is a site of contrasting histories and functions; one of its functions is that of education. Linking art with science can be an important feature of this role, for:

Now is a time when creative artists and scientists are needed more than ever to remind us of our immersion in the natural world and to deepen our understanding of it.

(Nesbitt, 1989)

With the new Millenium approaching, children need to be involved in an educational process which demonstrates a working relationship between art and science, in order to encourage a range of perceptions and approaches to the environment. We have been immersed in a culture of separate practices for too long. Botanic gardens, with their intrinsic diversity, contain the perfect ingredients for a more holistic future of inquiry.

The workshop

The workshop consisted of two 'hands-on' activities. Firstly an exercise in using touch to gain information and drawing to record that experience. Each participant was given a small bag containing part of a plant with drawing paper attached, and a pencil. They were asked to draw what they felt. Everyone was surprised when they emptied the contents of the bag and compared it to the drawing, how closely the drawing resembled the plant. The skin 'reads the texture, weight, density and temperature of matter' (Pallasmaa, 1996).

Secondly, participants were given a variety of plant material and asked to construct a simple sculpture. After completion, each participant was asked to share with the group one thing that they had discovered about the plant material that they had worked with. Qualities such as flexibility, strength, versatility and diversity were mentioned. Several people commented that the process itself had nourished their relationship with plants. I hope that this workshop illustrates that studying plants can be approached through art activities and that a scientist's 'perceptions of the natural world, as well as her interpretations, come through her senses, herself as a person and her culture' (Reiss, 1993).

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El jardín botánico como taller de expresión plástica

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Marco teórico

Recogemos en este apartado las teorías en las que basamos los principios didácticos tenidos como marco de referencia en el diseño de los talleres.

El espacio como recurso didáctico

El espacio, su organización, distribución y decoración es un importante factor que influye directamente en el acto educativo (Santos Guerra, 1993). Entendemos por espacio educativo, sea cual fuere, aula, taller, laboratorio, museo, jardín botánico ... , aquel que cubra los siguientes objetivos:

- estimular la creatividad, tanto del profesor como del alumno
- aumentar la receptividad de los alumnos, atrayendo su interés hacia el tema
- crear un clima pedagógico acorde con la propia naturaleza del acto educativo, proporcionando información para el aprendizaje
- ensalzar y aumentar el protagonismo del alumnado, estimulando de esta manera su independencia y el empleo de destrezas.

Así, la utilización de "otros espacios", dando una alternativa al aula, como único lugar educativo, enriquecerá el proceso de enseñanza/aprendizaje y constituirá un exponente directo de la metodología empleada.

Esta cita textual de Cano y Lledó (1990) puntualizará el marco conceptual en el que nos estamos moviendo: el medio ambiente escolar ha de ser diverso, debiendo trascender la idea de que todo aprendizaje se desarrolla entre las cuatro paredes del aula. Deberán ofrecerse escenarios distintos -ya sean contruidos o naturales- dependiendo de las tareas emprendidas y de los objetivos perseguidos.

La investigación como metodología

Responder a la pregunta de cómo transmitiremos los contenidos del currículum lleva implícito una toma de posición acerca de los principios metodológicos generales y, como consecuencia de éstos, los medios y recursos didácticos empleados y la organización del entorno educativo. La metodología será, por tanto, el componente curricular que define más claramente el modelo didáctico empleado.

Teniendo como justificación la teoría del proceso de construcción del conocimiento, ampliamente reconocida en la actualidad, proponemos como metodología un modelo didáctico basado en la investigación, cuyos principales aspectos pasamos a detallar.

Entendemos por proceso constructivo, según afirmaciones de J.E. García y F.F. García (1993), aquél en el que se adquieren nuevos conocimientos mediante la interacción de las estructuras presentes en el individuo con la nueva información que le llega, de tal manera que los nuevos datos, en cuanto que se articulan con la información preexistente, adquieren un sentido y un significado para el sujeto que aprende. Esto es lo que llamamos "aprendizaje significativo". En este proceso de construcción del conocimiento intervienen los conocimientos previos del alumno/a y sus procesos de pensamiento (Coll, 1988), los cuales el sujeto modificará y ampliará en la medida en que integra éstos con las nuevas adquisiciones. Este concepto, como es lógico, supone una nueva forma de entender el proceso educativo. El aprendizaje del alumno/a ya no dependerá exclusivamente de la influencia del profesor y de la metodología de enseñanza utilizada, según la concepción tradicional de la enseñanza, además se hará especial hincapié en el conocimiento previo del alumno/a y en sus procesos de pensamiento (constructivismo).

Coll (1988), en su teoría sobre el constructivismo, relaciona el aprendizaje escolar con la construcción de significados, haciéndose eco de las teorías de Piaget afirma que los significados se construyen integrando y asimilado el nuevo aprendizaje a los esquemas que ya se poseen de comprensión de la realidad. Lo que realmente da un significado al aprendizaje adquirido es su asimilación e inclusión en los esquemas previos.

Los elementos que se interrelacionan en la metodología investigativa serán: el/ la alumno/a, el/la profesor/a y el contexto:

- el/la alumno/a: pasará de ser un sujeto pasivo a uno activo, no se limitará a escuchar lo que el profesor tiene que transmitirle, sino que será protagonista de su propio aprendizaje, adquiriendo éste un significado particular para el/ella
- el/la profesor/a: no queda relegado a un papel pasivo en este tipo de metodología, sino que adquiere una dimensión diferente como organizador y coordinador del proceso enseñanza/aprendizaje
- el contexto lo constituyen los aspectos organizativos (temporalización), los espacios educativos, el ambiente de aprendizaje, los recursos y los materiales didácticos.

Proponer una metodología basada en la investigación supone que, así como el/la alumno/a se convierte en un constructor de su propio aprendizaje, investigando desde las propuestas del profesor/a, éste además de facilitar, en todos los aspectos, el aprendizaje de sus alumnos/as, deberá convertirse en un investigador de los procesos del aula (Rafael Porlán Ariza, 1987).

Eisner (1972) al teorizar acerca de si se debe o no investigar en el campo de la didáctica de las artes plásticas apunta dos posiciones encontradas, las que están a favor de la investigación y las que no la creen necesaria. Desde una posición más innovadora y acorde con la realidad actual se muestra totalmente de acuerdo en que investigar en este campo es necesario para el perfecto desenvolvimiento del currículum artístico y para solucionar posibles problemas que surjan, tanto en el alumnado como en el profesorado. Concluye, *la mayor contribución de la investigación en el campo de la educación artística reside no en su habilidad para proveer directrices, sino en proveer perspectivas, formas de mirar, enfocar el fenómeno educativo y maneras de cuestionarse nuevas preguntas.*

Las artes plásticas como fuente de conocimiento

Por último, otro principio didáctico observado en el diseño de los talleres será la utilización de las artes plásticas como fuente de conocimiento y desarrollo del potencial creativo.

Existe una orientación de las enseñanzas artísticas basada en el valor intrínseco del arte y defendida por numerosos filósofos y estetas, entre los que destacan: J. Dewey, la filósofa S. Langer, Herbert Read y Schiller. No nos extenderemos en detallar dichas teorías, aunque sí hacemos eco de la tesis de Herbert Read (1982) que defiende el arte como base de la educación y que toda educación debe conducirse a través del arte.

A través de la experiencia que como educadores y creadores adquirimos y teniendo como fundamento la tesis defendida por Read, enfocamos la enseñanza desde la perspectiva de las artes plásticas, utilizando como fuente de recursos la historia de las corrientes artísticas y la práctica artística.

Una propuesta: el jardín botánico como taller de expresión plástica

Hasta aquí hemos planteado el marco teórico que engloba los principios didácticos generales bajo cuya perspectiva hemos desarrollado las experiencias llevadas a cabo en el Jardín Botánico Viera y Clavijo –Jardín Canario–. A continuación se detallarán de forma exhaustiva, pero no agotadora, las actividades que en estos talleres hemos realizado.

La idea genérica del proyecto consistía en traspasar el ámbito de las aulas llevando a cabo una serie de talleres en otro marco educativo, en este caso el Jardín Canario.

Las actividades desarrolladas en los talleres fueron diseñadas desde las artes plásticas, interrelacionando éstas con otras materias como las ciencias, así como otras de carácter transversal –educación ambiental–. El espacio físico del Jardín Canario se convertiría en un recurso didáctico importante.

Dado el elevado número de alumnos por aula y la exigencia del proyecto de una estancia mayor que un sólo día de visita al Jardín Canario, la experiencia se planteó a los alumnos del Centro Superior de Formación del Profesorado

(CSFP) que realizaran sus prácticas en él. La ventaja, al trabajar con alumnos de prácticas, estribaba en que una vez realizados los talleres orientados por la profesora, ellos incluirían, a su vez, estas actividades con las visitas que preveían recibir y guiar de los colegios. De tal forma que claramente existían dos vertientes, una el propio aprendizaje e investigación de los alumnos del CSFP, y otra, una vez asimilado este aprendizaje, su integración en las actividades que ellos mismos programaran para trabajar con niños de educación infantil y primaria.

Como primer paso, presentada la idea del proyecto a los alumnos de prácticas del CSFP, ésta es aceptada unánimemente como una experiencia enriquecedora. A continuación se llevó a cabo el sondeo de los conocimientos previos de los participantes para preparar, según los resultados, el material curricular necesario

Los talleres seguían la siguiente estructura:

- sondeo de los conocimientos previos sobre sus aspectos específicos y según éstos introducción y planteamiento de las actividades a desarrollar en el taller. Esta parte puede llevarse a cabo en el aula del CSFP o bien en el propio Jardín Canario
- en el Jardín Canario, una vez que se ha tomado contacto con éste, conocido sus zonas e instalaciones y las posibilidades que éstas ofrecen, se presentan experiencias similares que sirvan como punto de referencia al taller. No hay que olvidar que trabajaremos desde los recursos que el referido espacio nos oferta. Esta fase es básica, dada la importancia de que los/las alumnos/as implicados/as conozcan las metas del taller y la metodología de trabajo, permitiéndoles así organizar adecuadamente la distribución de los espacios y los materiales de trabajo necesarios
- puesta en marcha del taller una vez organizados los espacios y preparado el material.

Cabe destacar las tareas que la profesora desempeñará a lo largo de todo el proceso, desde las preparaciones previas al taller hasta el desarrollo del mismo. Según hemos apuntado en el apartado anterior, éste se resumiría en organizadora y coordinadora de los talleres, pero nos interesa matizar y concretar todas las tareas desempeñadas por la profesora:

1. diseñar los diversos talleres que se pueden realizar en el espacio físico del Jardín Botánico
2. seleccionar y organizar la información necesaria
3. secuenciar las actividades de los talleres
4. dotar de materiales
5. aportar informaciones útiles en el proceso de los talleres y facilitar el acceso a diversos recursos
6. coordinar, incentivar y garantizar la continuidad del trabajo
7. estimular, motivar y exigir la responsabilidad del alumno/a en el desarrollo de su trabajo
8. planificar estrategias para crear un clima activo y participativo
9. solucionar dudas sobre contenidos de estudio o procedimientos
10. dinamizar los debates y las puestas en común.

Se diseñaron tres talleres cuya temática era bien diferente, pero aunados por el lema *crear en y con la naturaleza*. Éstos eran:

1. elaboración creativa de papel a partir de materias vegetales y de papel reciclado
2. modelado en barro partiendo de formas observadas en la naturaleza
3. el color en la naturaleza.

De los tres talleres el que mas interés despertó en el alumnado fue el primero, por lo que dado el tiempo disponible, se desarrolló con mayor profundidad. Esta es la razón que nos conduce a detenernos de una manera especial en dicho taller.

Elaboración creativa de papel a partir de materias vegetales y de papel reciclado

En principio realizamos un sondeo de los conocimientos previos mediante un diálogo con los/as alumnos/as. Enfocamos este diálogo con preguntas sobre el proceso del reciclado y elaboración del papel, su interés y necesidad para la actual sociedad. Este diálogo nos dió pie para introducir una breve historia del papel y su elaboración manual utilizando plantas y trapos de algodón, describiendo detalladamente las fases del reciclado y elaboración de papel.

A continuación se visitará el Jardín Canario, realizando un trabajo de campo en el mismo, estudiando los diversos vegetales que sean susceptibles de ser empleados en la elaboración del papel. Esto se traduce en un paseo de observación y toma de datos por el entorno sugiriendo posibles plantas, según sus características, con las que se pueda realizar papel. Estas observaciones pueden completarse con anotaciones sobre la familia a la que pertenecen las plantas, su procedencia, características y algún dato curioso sobre las mismas. En este caso concreto hemos trabajado con plantas cuyo origen es, esencialmente, del archipiélago canario.

Como ya se conoce teóricamente el proceso de elaboración y reciclado de papel, organizaremos el espacio distribuyendo por zonas de trabajo los materiales necesarios para cada una de ellas y realizaremos los preparativos previos, tanto de papel para reciclar como de plantas. Estos consisten en poner de remojo, por separado, el papel troceado y las plantas.

Es importante que estos preparativos se hagan con antelación, por lo menos de dos días, así el día del taller todas nuestras energías irán concentradas a la consecución del objetivo principal, utilizar los recursos, vegetales y no vegetales, de una forma creativa a través de la investigación y del conocimiento de los mismos, para la elaboración de papel.

Además de papel reciclado se utilizaron los siguientes tipos de plantas: las hojas secas del drago –*Dracaena draco*– las hojas secas encontradas en el bosque de la laurisilva, hojas secas de la tabaiba y del ágave, corteza de la palmera canaria –*Phoenix canariensis*–, así como las ramas y las hojas del palo de sangre. Para teñir el papel se emplearon como tintes artificiales: las ténperas y las anilinas. Como tintes naturales el té, el azafrán, el café y la cochinilla –*Coccus cacti*–. Ésta última se sometió a un proceso de secado al aire libre (unas tres semanas aproximadamente) y posteriormente a un triturado, tamizado y mezclado con agua, para, por último, añadirla a la palangana en la que se encontraba la pulpa.

Todo este proceso de elaboración y reciclado de papel y sus resultados se explican, a continuación, gráficamente.

Una reflexión sobre la práctica

Toda clase de modificaciones que favorezcan y enriquezcan el proceso de enseñanza/aprendizaje supone un avance positivo en lo referido a la práctica educativa.

Es tarea del docente no estancarse en su quehacer diario del aula, proponer y promover nuevas actividades que estimulen y oxigenen dicho proceso. Desde esta perspectiva toda nueva experiencia debe encuadrarse en un marco enriquecedor y motivador de la enseñanza. Por supuesto, no todas las experiencias innovadoras llevadas a cabo en la enseñanza se coronan con éxito y a veces, una vez realizadas éstas, nos damos cuenta de que el éxito no ha sido el esperado o que los resultados van por otro camino diferente al que nos habíamos propuesto.

Como docentes, del área de la didáctica de las artes plásticas, nos resulta atractivo el proponer nuevos marcos educativos que favorezcan y desarrollen la creatividad concediendo a las artes plásticas la importancia que merecen en el currículum educativo.

Al plantearnos utilizar el Jardín Botánico Viera y Clavijo –Jardín Canario– como un recurso didáctico, cuyo espacio nos proporcionara, desde la metodología de la investigación, los materiales e infraestructura necesarias para desarrollar nuestros talleres, tuvimos claro un objetivo: implicar activamente a los/as alumnos/as tanto en la organización como en el desarrollo de las actividades, de tal forma que la experiencia resultara altamente significativa. Parafraseando a Tonucci (1975) *todo auténtico conocimiento nace de la investigación*. Así como adquirir una conciencia estética al tener la naturaleza como modelo.

Pudimos observar que el cambio de espacio educativo fue favorable en cuanto que, como en este caso, al acercarnos a la naturaleza se creó un ambiente de trabajo distendido y de colaboración mutua que facilitó el aprendizaje.

El alumnado se implicó activamente desde que propusimos los talleres hasta el final, mostrando un mayor interés en el desarrollo de los mismos, a medida que iban adquiriendo protagonismo. Además de llevarlos a cabo, asimilando los contenidos, los experimentaron con las visitas de los colegios, haciendo suyo el papel del profesor de guía y

orientador de los mismos. El alumnado agradece la posibilidad de llevar a la práctica la teoría y sus propios aprendizajes, lo cual se hace patente en el grado de implicación y entusiasmo que manifiesta.

La práctica educativa se construye con experiencias, a nuestro criterio, enriquecedoras como la que nos ha traído a este Congreso, por lo que queremos apuntar que, éstas son tan sólo el comienzo de una serie de prácticas que realizaremos, en forma de talleres, en este ámbito.

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Why do we need trees?

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The games demonstrated in this workshop attempted to explain the importance of plants. The session did not involve discussion about the uses of plants, but rather looked at why they are essential to all life on Earth. During sessions with children, time is usually spent discussing how we can all adjust our usage of plants for the sake of the health of the planet. The sessions also lead onto direct personal action, in the form of growing trees, and are used as a lead-up to the creation of conservation gardens in schools as part of the 'GreensC'ool' Program discussed in another paper presented at this Congress (Smith, 1998b).

Setting the scene

Lay everyone on the grass, with eyes closed. Hold on tight, because the planet we are on is presently speeding through space at about 110,000 km/h. It is also spinning like a top and the whole solar system we are in is turning slowly over and over. Every inch of space we travel through is a new one, we have never been there before. Luckily for us we take along a special supply of energy. The Sun. Sunlight powers all life on earth. But can you eat sunlight? Have a go – open your mouth and see if you can catch enough sunlight to chew. So how does the sun power us? How do we get hold of the Sun's energy? Well, there is only one group of living things that can turn the Sun into energy. The plants. Imagine you are a leaf on a tree. Just under your skin there are small green dots called chloroplasts. They are what makes you green. Those green dots are able to catch the Sun, mix it with water and carbon dioxide and, hey presto, energy! So soak up that sunlight and make energy for you to grow.

Photosynthesis game

So what happens inside a leaf? You will need table tennis balls to represent molecules of H_2O , C , O_2 and sunlight. These join together with velcro dots to make H_2O , CO_2 and a sunlight ball (a number of each). What does a plant need for it to grow? Pass out the water, carbon dioxide and sunlight molecules. The plant mixes these ingredients to make sugar – CH_2O . See if you can fit the molecules together to create a sugar molecule. It will only stick together if you include the sunlight ball ($C+Sun+H_2+O$). The Sun's energy has been captured in the sugar molecule. But how do other living things, such as people, get hold of that energy? We eat it, we eat the plants. So we depend on plants for our food.

What is left over from photosynthesis? There should a number of O_2 molecules left over. What is oxygen good for? Every living thing on the planet depends on the ability of plants to produce food and oxygen.

Lunch break

The aim: that children understand that they are individually dependent on plants for food.

Is it true that we depend on plants for food? Well, what did you have for lunch/dinner/breakfast? Did any of your food not come from plants? (Everything originates from plants because they are at the base of all foodchains.)

Living tree

The aim: that children understand that a tree is a living organism and how it works.

We are going to construct a tree using you as the parts. Choose the tallest and strongest person in the class. He/she is the HEARTWOOD of the tree. The heartwood is the strength of the tree, holding the tree upright but the heartwood of the tree is dead. (That is why a tree can be hollow and survive, although structurally weakened – only the dead heartwood is missing.) Around the heartwood is the area of the tree where all the action takes place – the sapwood. This is made up of two sections. The first one is the XYLEM. The xylem is where the water is drawn up

the tree to the leaves to be mixed with sunlight. Choose three people to be the xylem by joining hands to make a circle around the heartwood. The second part of the sapwood is called the PHLOEM. The phloem is where the energy made in the leaves (in the form of sugar) flows back down the tree to feed the roots and branches. (The fact that there is sugar can be seen when a tree is injured and the sap flows. In many trees this actually tastes sweet e.g. in maples and eucalypts.) Choose five people to be the phloem by joining hands to make a circle around the xylem. What is on the outside of a tree? The BARK. What does the bark do? It protects the tree from insects and diseases, a bit like a suit of armour. Choose eight people to be the bark by joining hands to make a circle around the phloem. The rest of the children can be the ROOTS (except for two). They need to lay on the ground with arms spread wide (and long hair fanned out as rootlets) to find the water needed to make the whole thing work.

This is how you make the tree live. The roots say “sluuuurp!” The xylem says “sluuuurp” and waves its hands in the air. The phloem gasps loudly (taking in carbon dioxide), says “aaah”, and then sags at the knees. This has to be done in a synchronised way so that the tree sounds like this: "sluuuurp, sluuuurp, gasp, aaah!" Practise for a short time to make sure the tree is working. The two remaining children are INSECTS. Their job is to get to the heartwood of the tree within 5 seconds. If they manage it, the tree is dead. If the tree stops pumping then it is dead. (Choose sensible children to be insects, otherwise rough play will bring the lot crashing down.) Ready, set, go, 1. ... 2 .. 3 4 ... 5, stop.

Other activities related to this are:

- Catching evaporated moisture from the tree by placing a plastic bag over some of its leaves. Talk about where the moisture would have ended up if you had not captured it.
- Listening to a tree's heartbeat with a stethoscope. This is particularly good with smooth-barked trees.

A patch of oxygen

The aim: that children understand that they are individually dependent on plants for oxygen. And that there is something they can do to stop the loss of trees.

One of the by-products of the tree's life is oxygen. How many trees do we need to produce enough oxygen for one person? An area of plants of about 625 square metres is required to supply sufficient oxygen for one person. If the trees continue to breathe, so does the person. That is a square 25 big steps by 25 big steps (25m x 25m). Step it out at a run, so that everyone is puffed out at the end. Stand in the centre. There is only enough oxygen in this square for one person. So, when I say, everyone has to hold their breath. I will touch one person at a time. When I touch you, you may take two deep breaths but you must then stop breathing again. Continue this until people are obviously no longer able to hold their breath. OK, everybody breathe! So how is it that we can all breathe? There are lots of trees in other places.

Discuss the importance of areas like the Amazon forests as oxygen suppliers. But every plant helps. Discuss the rates of deforestation around the world. Discuss how we all can adjust the things we do in every day life to reduce the amount of forests cut down. Ask for suggestions. Recycling, using less, planting trees. Follow up the session, at a later date, with another to grow a personal oxygen supply (i.e. trees).

The slishy sloshy swamp

The aim: that children understand that animals depend on plants as habitats. And even ugly places are important. And to protect animals we need to protect the places where they live and the other species in those places

Imagine the following place – the Slishy Sloshy Swamp. The Slishy Sloshy Swamp is totally unique. There is bright orange mud, one-metre deep on the floor of the swamp. It is warm and bubbles slowly. There are giant trees that stretch into the sky for over 100m and create a canopy which blocks out most of the light. So it is dark in the swamp all the time. The animals in the swamp include giant flies which come into the swamp to lay their eggs (the size of hens eggs) in the mud. The warm mud incubates the eggs. There are giant mosquitoes too. And poisonous tree snakes, which luckily spend most of their time in the tree tops, because their venom causes instantaneous death.

Ask each child to design and draw an animal that is capable of living in the swamp. It can have any feature you wish to give it as long as there is a reason for it. It needs some way to eat (hollow fangs to suck the eggs perhaps), protection from its enemies (a shell or spines or a horrible smell), a means of moving around on the mud (big flat

feet) and a way of finding its way around in the dark (big eyes and ears, whiskers, sonar, luminous nose) and so on. Compare imaginary animals.

Compare imaginary adaptations with those of real animals. Write a news-article about your amazing animal.

Invent a threat, e.g. someone is going to pump out the orange mud to sell as undercoat paint. What will happen to the swamp if the mud is pumped out? The trees die – so no more shade for the animal, the mud is gone – so no more eggs for the animal to eat. The animal becomes extinct. So, what can you do to save your animal? In this case the best solution is to save the place, that is create a Slishy Sloshy Swamp National Park.

Write articles for the Slishy Sloshy News explaining the need to protect the swamp. Write articles explaining the value of “developing” the swamp’s resources. Conduct a debate between the opposing sides. Look for sustainable methods of development which do not degrade the swamp’s ecological value.

What about if someone came in and cut half the trees down? The shelter is gone and half of the swamp is of no use to the animals. How do you repair the damage? By growing more trees from seeds collected from the trees in the swamp (i.e. a recovery plan working with your local botanic garden).

Is there a Slishy Sloshy Swamp near you requiring your help? What lived in your neighborhood before it became a city/town. How can you go about repairing the damage? Create a Greencare/GreensC’ool group to grow and plant local plant species in the school grounds.

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Playing to learn

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Wherever they are played, games have two basic purposes:

- to educate
- to entertain.

In the first instance, rules, structures and equipment are simple; the game is the end in itself. In the second, the rules, structures and equipment are often more complex – the game is an instrument illustrating a concept, process or idea; the game is a means to an end.

All successful games contain the following essential elements in varying proportions:

- tension (challenge)
- involvement
- activity.

However, the overriding criteria for a successful game are that it must be FUN. Pleasure is paramount.

Where games are used for educational purposes, a balance must be maintained between the pleasure enjoyed by playing the game and the content/information it is intended to convey. The complexity of the game will be determined by the development level of the intended participants. Presentation techniques play an important role in the (often) on-the-spot adaptation of games and activities for specific audiences. Appropriate adaptive techniques enable us to take a game and re-engineer it, with a suitable level of detailed explanation, for use with a variety of age groups. The best games can be fun for everyone. The best stories have universal appeal.

A game may be enhanced or refined by:

- involving the players in decision-making
- following a series of sequences
- injecting a greater degree of unpredictability.

In developing an educational game, the first step is to identify the idea, concept, or process which the game is intended to teach and the context in which it will be used. In most cases it is better to restrict the scope of a game as a means of preserving its clarity, e.g. a game which illustrates photosynthesis or seed dispersal would be more appropriate than a game intended to illustrate the complete life-cycle of a plant. It is often useful to consider a variety of naturally-occurring examples of the idea, concept or process to establish its simplest expression and to use that as the basis for developing the game. Most botanical processes can then be clarified into a sequence of interactions which will form the platform for the game.

The translation of those interactions into the game itself will be influenced by the following important considerations:

- **the intended venue.** If the game is new to your audience or there are new dimensions of which you want them to be aware, find a location as free from distractions as the situation will allow. Of course, there is no ‘perfect’ place and there will always be some individual(s) who are easily distracted by a passing gnat or a worm crawling over a shoe, but the reduction of overt distractions will improve the impact of the game *and* make it easier for you to lead. Due consideration must also be given to the safety of the chosen site and the equipment to be used. Although the sanitisation of the environment does not necessarily improve it (perhaps the opposite is more probable), safety must always be at the front of our minds.

- **the available resources.** The examination of our own childhood memories will remind us that the best games are not necessarily 'high-tech'. Being innovative and creative does not have to imply material extravagance. The simpler the equipment and the explanations, the more likely it is that the activity will be remembered and understood. Be well guided on this and do not be distracted by those bearing gifts of great sponsorship.
- **the personality of the presenter.** There is no substitute for genuine enthusiasm, which should not be confused with great knowledge or showmanship. We will be 'new' to many of those who will participate in our games and as such, we must be sensitive to their experience (or lack of it) at our locations and ensure that they are comfortable with us. We must establish a level of trust, and not 'frighten them off' by over-the-top performance or over-the-head knowledge. If you setting up a new programme or thinking about doing so, look for good communicators with experience of working with groups of children. You would do well to look for ex-primary/elementary school teachers. Successful communication with children is not about using smaller words; it is a whole different way of looking at the world.

Having developed the structure of the game, it is important to trial it with an appropriate group. During this activity, it is beneficial to enlist the assistance of a colleague, for either or preferably both of the following functions:

- ask your colleague to observe a) the responses of the participants and b) your presentation. These two important evaluations are best performed on separate occasions and will need to be observed according to previously agreed criteria; do not try to do too much at once
- ask your colleague to make a video recording of the presentation, focusing on the two elements a) and b) above. Once you have recovered from the shock of seeing yourself on video, you will then be able to look in detail at issues such as; clarity of verbal instructions; use of gestures; timing; participant reactions; and review and evaluation mechanisms. Look for reasons, not excuses. Cultivate a sense of awareness; be aware of what is happening within the group as well as the needs of individuals within it, and respond appropriately to what you learn. Remember that what may appear as a total wash-out to you will not be seen so by others. Do not allow your frustrated expectations to cloud your vision of what could be.

A 'good' game can be a powerful educating tool, but it must be carefully developed and enthusiastically presented to have maximum impact.

The Whole World Cake Treasure Hunt

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Introduction

Many primary schools in the UK encourage parents to come into the classroom to share their skills and interests with children. This is the context within which the Whole World Cake Treasure Hunt started. A parent and a schools' worker from Mundos Unidos, a project based at Leicestershire's Development Education Centre (LDEC), worked together to bring some development issues alive for young children using a cake as the stimulus!

The idea was piloted in junior (7-11 year-old) and nursery (3-5 year-old) classes in 1991. Since then it has been adapted for use in numerous contexts and for all ages, and has led to the establishment of a very successful educational project at Leicester University Botanic Garden, based around the Whole World Cake Treasure Hunt.

Initially the aim of the project was simple: to raise children's awareness of the fact that the food they eat comes from around the world, that many people have been involved in its production and that we are interdependent on a global scale. The cake offered a direct link with people on the other side of the globe and children were encouraged to start asking questions about their connections with and responsibilities towards their fellow villagers in the global village.

The move from the classroom to the Botanic Garden added a further rich dimension to the project. It offered the possibility of connecting the ingredients of the cake directly with the plants from which they came, opening up new areas of learning related to the botanical aspects of plants. This is particularly important for children from the inner city, many of whom live a life distanced from nature and who need to develop an appreciation of the importance of the natural world for their own survival. The Botanic Garden also provides an exceptionally stimulating learning environment within which to enhance children's and adults' experiences.

The pilot project - the Whole World Cake in the classroom

The project was piloted with three different groups: 32 nine- and ten-year olds, 28 seven- and eight-year olds and 26 three- and four-year olds. With the two older groups there was an afternoon session once a week for about 12 weeks. The nursery project was contained in two sessions.

The basic format of the project was the same with all three groups:

- the children ate a piece of cake
- they found out where in the world the different ingredients had come from
- they looked in more detail at some of the ingredients and at issues around their production and distribution, and related issues
- finally the children made a cake themselves in school and ate it.

The sessions included activities and themes such as:

- **Eating and guessing**

After eating the cake, the children guessed what was in it and where the ingredients had come from.

- **Mapping**

The children were divided into groups and given shopping bags with various ingredients in packets that clearly showed their country of origin. They were also given world maps, globes and blank outline maps, to map out where the ingredients came from.

- **Drawing and public displays**

The children drew colourful pictures of the different foods and made a display for the classroom wall, which was later transferred to a prominent position in the local Cooperative Society supermarket for shoppers and proud parents to see. The managing Cooperative Society also agreed to give the school the ingredients to make the Cake themselves.

- **Forests**

Taking Brazil nuts as a starting point, the children focussed on the rainforest, and looked at things such as deforestation, cattle ranching, peoples of the rainforests, animals, global warming, climate, and forests around the globe.

Pupils had the idea of building an artificial rainforest in their own classroom. Their teacher provided a large blue plastic sheet, which she hung from the ceiling rather like a tent, and the children made paper models of monkeys, snakes, creepers, flowers, leaves etc. to hang inside it.

The whole effect was quite realistic as the plastic sheet not only provided a dim blue light but also raised the temperature beneath by several degrees!

When a visitor from the brazil-nut factories in Brazil came to visit the local Christian Aid office, the class invited her to their rainforest, where she sat telling them about her work through a translator – a very special learning experience for everyone.

- **Banana trading games**

Starting with bananas, the class played a trading game where the children were split into different banana growing groups and had to ‘produce’ enough bananas to sell to earn their yearly cash requirements. Each group was given instructions for making the ‘right’ kind of bananas, which would be acceptable to the buyer from the multi-national company. Each group was given the same amount of paper, but different amounts of scissors and yellow crayons; and they then had a limited time to ‘grow’ enough bananas, which were not bought by the company if they were ‘sub-standard’! The process was repeated several times to simulate circumstances over several years, during which time the costs to the banana farmers rose considerably more than the price they were paid for their produce.

Each child was given a card on which was written the task of someone involved in the production and distribution of bananas. They were asked to move around finding out who everyone was and then line themselves up in the correct order from grower to eater.

They then worked on a short play showing the journey of the banana and how the money spent on a banana is distributed between the people and countries involved in its production and distribution.

- **Flour production and energy**

The flour used in the Cake was from the UK and had been ground in a windmill; this was used as a starting point to look at different ways of generating energy (including hydro-electric schemes and referring back to schemes in the Amazon).

- **Leicester City Farm**

Children visited the City Farm to see crops growing and the animals which produce ingredients for the cake. They collected free-range eggs and milked the goat. The farm offered the school a plot in their polytunnel to try growing tropical crops themselves. There was discussion about animal welfare issues and farming techniques.

- **Sugar and Columbus**

Sugar was the starting point for work on the impact of Columbus and his contemporaries in the West Indies, the growth of the slave trade and the impact of modern tourism. It also offered an opportunity to look at nutrition and dietary issues.

- **Cooking and eating!**

In the final session the children made the cake themselves. This was done in groups; each group having a small supply of each ingredient to chop, mash, melt, mix etc. Then each group's mix was put together for the final baking of one big cake, some of which was shared with parents at an open evening shortly afterwards.

Nursery work

With three-and-a-half to four-year olds, there were just two sessions on consecutive days for a total of about four hours. On the first day the children were invited to help collect the ingredients for a cake and were sent off to find items from around the world; in reality bases around the classroom. In each area of the world there were activities to do and an ingredient to take away. For example in Tanzania there were musical instruments to play and honey to collect. In the Caribbean there were clothes and masks to see, the children made their own masks out of paper plates and they took away bananas etc. On the second day the children made the cake (very slowly and carefully!), baked it and presented it to their classmates in the afternoon session.

From classroom to botanic garden

Whole World Cake Treasure Hunt

Six schools in Leicestershire were involved in the development of the Whole World Cake Treasure Hunt. Teachers developed the basic idea their own way. One school used it as the basis of a class assembly, another to support their work on the rainforests while another brought the whole staff in for a teachers' day at the Garden. This resulted in the whole school using the cake as the basis for the first half of the Autumn term's work in every area of the curriculum. It was enhanced by the availability of a new resource, the Whole World Cake Pack, produced by Christian Aid and based on the ideas from the pilot project described above.

SEED- Support for Education in Environment and Development

The Whole World Cake Treasure Hunt proved so popular with all who took part in it that it gave rise to a new education project based at the University Botanic Garden. The project was named SEED – partly because it was given half the existing seed storage area of the Garden for its office base, partly because of the educational imagery around the concept of a seed, partly because of the obvious connections with the cake, and partly because SEED stood very neatly for 'Support for Education in Environment and Development'!

The Whole World Cake Treasure Hunt

Since the first hunt in 1994, hundreds of children from schools and youth groups throughout Leicestershire have taken part. The response to it has been consistently enthusiastic:

'Thank you for my best day out ever' - an 8-year old

'I can honestly say I personally enjoyed it more than any other trip (ever)!' – a teacher.

Another teacher wrote, rather nicely drawing out the 'treasure' aspect:

'Nothing beats the real thing. Left a good impression with children as science follow-up was nearly a week later and images were well retained. It has also acted as a stimulus for RE work. The children gained from the experience an appreciation and a sense of wonder about the variety of life and an appreciation of the conditions plants live/survive in. In the future I can envisage using the World Cake idea for harvest stimulus, geography, teaching about farming ... it can certainly be cross referenced with and used to illustrate/remind children of work already done. Just found it a gem. And to think I've been in Leicester for nearly 20 years and hadn't visited it [the Garden] before!'

How the Treasure Hunt works

So it's fun, but what is it and what do the children actually learn from it? When they arrive at the Garden the children are ushered into the classroom, where they are greeted and invited to help make a cake. Why come to a Garden to make a cake? What is extra special about a lot of the plants in a botanic garden? Is it a race?

The answer to the last question is definitely 'No', and to encourage the children to keep their eyes open and senses alert as they go round, their appetite for plants is whetted by a demonstration of the way in which three different types of insectivorous plants work. They are told to look out for the giant redwood tree (a smaller example of the most massive organism the world has ever seen!) and the bristlecone pine. Growing in the mountains of eastern California, the bristlecone pine is probably, at over 4,600 years of age, the longest-living organism on earth.

The Hunt is explained, and the children then set off with their leader, in groups of no more than seven, to find the ingredients of the cake. Each group has a map with a different starting point, but everyone completes the trail through woods, meadows, rainforest and desert, collecting hazelnuts, honey, raisins, walnuts, lemons, sugar, bananas, pineapple and cocoa, which they find next to the plants from which they have come. They return with their 'treasure' at an appointed time, and the ingredients are all put into a huge mixing bowl. This is accompanied by a lively commentary, with pictures and objects to look at, and questions and discussion about the plants they originated on, where in the world they have come from, and the people involved in their production and distribution.

At last the mixture is put into the magic oven and two minutes later everyone has a piece of Whole World Cake to taste!

During the two hours of the Hunt, the children have great fun in a beautiful environment. They begin to learn to connect the food they eat with the plants from which they come, and with the people involved in its production and distribution:

'Where do we get chocolate from?' ... 'The shops.'

'And before that?' ... 'The factory!' ... and so on!

They experience different environments, they practice map reading and working as a team. The potential for learning is enormous. To maximise that potential, each school receives a pack on booking, which assists with the planning. A follow-up pack is being prepared. Christian Aid's Whole World Cake Pack is also a useful resource.

The Treasure Hunt is an excellent activity for youth groups, community groups and the general public. In the summer of 1995 a number of Brownie and Guide groups and a Woodcraft folk group tried it out. A summer playscheme planned all their activities around the Whole World Cake, and a Church Sunday club is experimenting with using it. Recently an adult discussion group put it onto their evening programme.

The following pieces were written by two teachers, the first from a small village school:

'The Botanic Gardens provide a refreshingly different venue for a class outing. The wide open spaces give scope for adventurous activities, contrasting well with the enclosed environments of the tropical and cactus houses. It has proved to be a hugely popular place for all age groups in our primary school. We have explored areas of science, art, geography, religious education, P.S.E., and development education in our projects on 'The Whole World Cake' and 'Trees'. The potential is enormous. We have made 4 visits in the last 14 months. Visiting the Gardens has become an established element in our school topic cycle as well as providing a focus for mini-whole-school projects to start the academic year, culminating in a Harvest Festival.

If you haven't yet discovered the 'Gardens', then you don't know what you're missing!'

and the second from an inner-city school:

'The quality and range of learning opportunities is exceptional. Children experience the climate of the rainforest and hot desert. Their senses are awakened by the steamy, wet, musty profusion and the sounds of the rainforest tape awakened fear in my 7-year olds:

"Are there monkeys in there? Are they real?," said Ashley, backing out of the door!

There was fascination as Sue showed us the shiny, sticky droplets on the insectivorous sundews, silent horror as she triggered a Venus fly trap and loud disgust as she opened a pitcher plant to reveal the remains of ladybirds, wasps, beetles and other unlucky insects within.

The striking contrast of the three major habitats provides a first-hand opportunity to understand that different animals and plants are found in each, showing how they are adapted to their environment.

With permission we gathered soil samples from the rainforest, desert and temperate climates to help with our work on soil back at school.

The Whole World Cake Treasure Hunt is great fun and is a real map-reading opportunity. The search for the cake's ingredients by the various plants – walnuts, raisins, hazelnuts, cocoa, banana, sugar, lemons etc. – adds a further dimension, bringing in opportunities to explore the global origins of food, our interdependence, food journeys 'from plant to plate'.

Using maps, getting lost, enjoying a ramble in the beautiful multi-faceted garden with its Victorian mansions ... the quality of the experience is hard to beat - and all within the city boundaries!

The way ahead

The Whole World Cake Treasure Hunt started in Leicester, a multicultural city. At the last census 71.5% described themselves as white, 22.3% as Indian, 1.5% as Pakistani or Bangladeshi, 2.4% as Black, from Africa or the West Indies and the remaining 2.5% as Chinese or other Asian ethnic groups.

Leicester also won the title of the UK's first 'Environment City', showing the commitment of many sectors of the community (business, the voluntary sector, the health authority, the city and county council) to the challenge of environmental improvement and the concept of sustainable development. At present many groups representing the different sectors are drawing up their response to the 1992 Earth Summit's Agenda 21, working on a 'Blueprint for Leicester' and are also working within a group called FABLE (Forum for a better Leicestershire).

Many children are aware of environmental issues, and the SEED project hopes to support them and their teachers as they grapple with them, both within and outside the National Curriculum subject areas.

During the pilot project the Whole World Cake Treasure Hunt idea was shared with development education practitioners in five different European towns.

At the 1994 annual conference of the Botanic Garden Education Network (BGEN), a workshop on the project led to Oxford Botanic Garden putting it onto their schools programme. Now there is a workshop at an international congress of botanic garden educators. Is this an idea you can adapt and use in your garden? Could botanic gardens (and schools) running Whole World Cake Treasure Hunts across the world be linked together on a computer network, sharing ideas and resources and up-to-date information? There is the invitation and the challenge. I have given you an idea of the ingredients, now you can create your own Whole World Cake!

Acknowledgement

I would like to express my thanks to John Ireson for his part in the original project.

Does a visit to a botanic garden really matter?

Mary South

The Sir Harold Hillier Gardens and Arboretum, Jermyns Lane, Ampsfield, Romsey, Hampshire SO51 0QA, UK

As educators we probably all like to believe we are making an incredible contribution to our students' attitudes and knowledge. However, given that pupil contact time is very short, unless we are engaged in running long-term courses, how can we be sure that we have any affect at all?

This question lead to a short survey of schools visiting the Sir Harold Hillier Gardens and Arboretum, UK. Initially the survey consisted of verbally asking complete groups of children a series of open-ended questions, accepting the first three answers offered and holding a 'vote' on each one, using a show of hands. The results were disastrous! It took too long; children voted with their friends; they voted for the answers perceived as 'correct'; there was no change from the answers given at the start of the visit and those received at the end, for the same questions. The most unsuccessful result was obtained by asking teachers to carry out the same test at school, after the visit. Most did not respond at all (99%). Only one school returned results – for 18 hand-picked pupils taken from the 95 that had attended the Gardens on the visit.

Undaunted, we continued with some analysis of the children's answers. Those compiled at the Gardens seemed to indicate that their visit had had little impact upon them. Answers from the children were directly attributable to work done with the teacher, and these were adhered to, even when work done during the visit had highlighted previous concepts as erroneous i.e. there were flaws in the teachers' conceptual understanding which were accepted by their pupils.

Disheartened but unbowed, a new approach was devised. This time, each child was asked to draw their idea of a leaf at the start of the visit and also at the end of the visit.

A maximum of five minutes was spent each time, the children were unashamedly hurried and conditions chaotic, deliberately giving them little or no time to think, but to respond instinctively. The two sets of drawings were compared by the number of 'standard' leaves drawn by each group, at the start and finish of their visit. Expressed as percentages, the results are as shown in Table 1.

Table 1 Percentage of 'Standard' leaves drawn by classes before and after a visit to the Gardens

| Age range | Before visit | After visit |
|------------|--------------|-------------|
| 5-6 years | 92% | 36% |
| | 76% | 54% |
| 7-9 years | 72% | 41% |
| | 87% | 41% |
| 8-9 years | 81% | 61% |
| | 97% | 51% |
| 9-10 years | 73% | 46% |

Total sample: 10 classes (285 children)

Taking both surveys together, they seem to indicate that educators at a garden can have an impact, even after a short visit. But overall, the indications highlight the obvious point that it is the teachers' attitudes which are far more important than anything we can hope to accomplish in a few short hours. Therefore, should one of our primary aims be to teach the teachers?

Yes – of course we must teach the children, but if we are truly dynamic, imaginative and original in our approaches, we will also teach the teachers at the same time.

It is necessary not only to remove any erroneous ideas and information they may have about certain concepts and topics, but also that our enthusiasm and love of plant life should inspire them too. If we really wish to alter attitudes in the citizens of the future we need to accept that this can only be achieved indirectly, through their teachers. They

are the ones with the greatest influence over the children – not us. If we want to make some impact on the future of the environment, it needs to be through the educators – not the pupils.

Within limits, it is acceptable to 'preach to the converted' – after all, teachers will be passing on their enthusiasm to many classes during their teaching careers. However, one teacher during a child's time at school cannot achieve miracles, anymore than a botanic garden can. The same enthusiasm and concern for plants, the environment and the globe needs to be reflected by every teacher on to each child that he or she comes into contact with during his or her school career.

Programmes for school visits need to be varied and cover as many subjects as possible, to have an appeal to a broad band of teachers. The content needs to include many activities that can be used by the teachers in the school situation. Positively encourage teachers to try some activities on their return to school, give samples of materials, offer tips on the use of these materials but most of all, let the teachers return with some useful experiences by seeing what can be achieved with their children.

Offering a variety of topics can attract other teaching disciplines to the botanic garden. Often it is the botanic and scientific aspects of the garden which are at the forefront of an educational programme, but creative writing, art and music can all be inspired by the plant world too. Whilst the international aspects of the collection can heighten geographical awareness, tales of the plant hunters give historical insight and ethnobotany ideas afford greater understanding of other cultures. With so many topics on offer, the education officers at botanic gardens use up a lot of ideas and materials for activities. There is a great need to be able to generate an almost non-stop stream of new ideas and activities for the children, in order to stimulate their teachers.

Many teachers are very conservative and if they are pleased with the programme they first encounter at a botanic garden, they will request the same one for their next visit, and the next, and the next . . . This, in itself, indicates a rather unimaginative approach to the use of gardens and or plants in general as a teaching aid. We need to be at our most inspired when these teachers and their classes come to visit us!

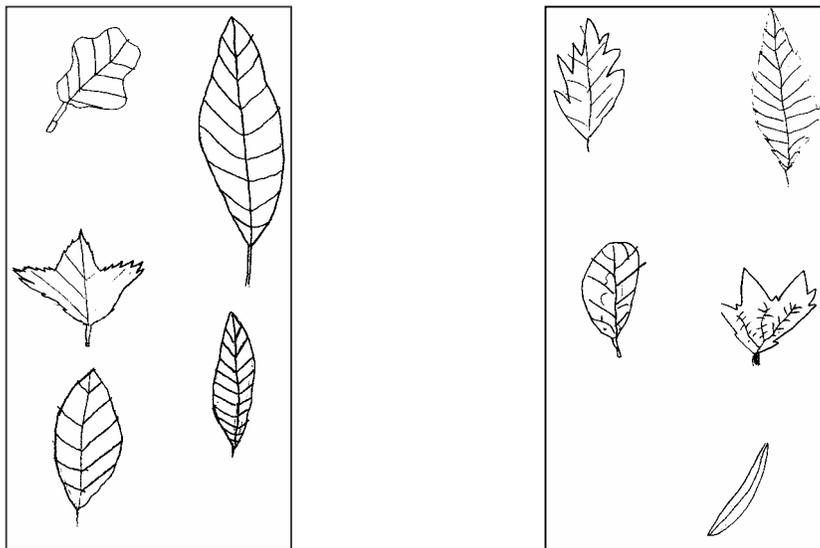


Fig 1 Leaves drawn by 8-9 years-old children before Gardens visit (left-hand box) and after Garden visit (right-hand box).

Educational activity of the Botanical Garden of the Ukrainian State University

Yaroslav Dudych

Botanical Garden of the Ukrainian State University of Forestry and Wood Technology, Lviv, Ukraine

Introduction

The Botanical Garden of the Ukrainian State University of Forestry and Wood Technology at Lviv is an institution of national significance for scientific research, education, and the protection of nature. Founded by the Decree of the Ukrainian Government dated February 22 1991, it originally comprised an Arboretum (in Kobylyanska Street), an Arboretum Park (in Pushkin Street), and an arboretum in the village of Stradch, in Yavoriv district. The Garden occupies an area of 26 hectares.

Education activity

Education is one of the main tasks at the Botanic Garden.

The Ukrainian State University of Forestry and Wood Technology trains specialists for the following fields: forestry, parks and gardens management, applied ecology, landscape architecture, logging technology, woodwork and technology, chemical and mechanical processing of timber and wooden materials, design, accounting and auditing, product management, and the management of foreign economic enterprises.

We pay great attention to educational work in order to spread botanical knowledge. The students of our University are trained in the Botanical Garden, where they acquire practical skills in over 20 subjects, including botany, dendrology, ecology, conservation, seed science, vegetation science, forest cultures, plant protection, and ornamental gardening.

Active educational activities are carried out with the pupils of a Natural Science Lyceum, which is part of the University, and with the students of the Small Forest Academy of our University. Educational work is also carried out with the general population in order to increase knowledge about ecology and conservation. With this end in view, we use collections of living plants, herbariums, seed collections, special exhibitions; we publish popular scientific literature, guides, booklets, and other publications; we also organize lectures, seminars, and deliver lectures via the mass media.

The study of the natural richness of the flora and the introduction into culture of new decorative plants according to their economic is very important as regards the protection of nature. The western region of the Ukraine, in its natural state, is very diverse and is of particular interest because of the wealth of both flat and mountainous parts. The mountain region of the Ukrainian Carpathians is very rich in its floristic composition. It occupies 37 thousand sq. km (6.1 percent) of the territory of the Ukraine. About one half of the State's plant species are concentrated here – 2112 species or 46.7 per cent.

However, out of such a great number of plant species an insignificant part is used despite the fact that in their natural state, i.e., without additional cultivation and hybridization, many of them are valuable for the economy (forestry, planting trees and bushes, medicinal raw material, food industry, fodder production, etc.) Besides, plants of natural flora are more resistant to diseases and insects than cultured ones. Among them there are rare, disappearing and endemic species, which is why they need to be studied in order to preserve and spread them.

The above underlines the urgency of the introduction of representatives of the natural flora of the Western Ukraine into the Botanical Garden collection. These plants also need to be introduced into culture in order to preserve, spread, and rationally use them in different areas, as well as for educational work with students and the public.

La historia de los jardines botánicos como recurso didáctico: el Jardín Botánico Canario "Viera y Clavijo"

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El diseño y creación de parques y jardines es un arte común a la mayoría de las civilizaciones, desde las más antiguas hasta las de nuestro tiempo. En la antigüedad los jardines ocuparon un lugar importante tanto en la civilización egipcia como en la mesopotámica, contando esta última con los jardines colgantes de Semíramis (Babilonia) considerados como una de las siete maravillas del mundo. Roma impulsó la expansión de esta actividad, como se ha podido comprobar en los frescos de la época, y alrededor de las grandes villas y palacios, se extendían amplios y bien cuidados jardines en los que proliferaban las esculturas, los estanques, las fuentes y las avenidas de setos recortados. Durante el medievo, con el establecimiento de los monasterios en Europa, el arte de la jardinería, se redujo alrededor del claustro. Fue a partir del siglo XIV cuando se vuelve al modelo de la antigüedad, con los jardines renacentistas combinados con las edificaciones igual que en Roma.

El jardín concebido como un ornamento decorativo va evolucionando así hasta la actualidad con estilos diferentes. Por ejemplo, los franceses los construían con amplias avenidas de árboles y numerosos setos y arbustos recortados de forma simétrica, siguiendo el modelo de Versalles. En cambio, el estilo inglés, se caracteriza por unos jardines formados por céspedes verdes y suaves, grupos de árboles y aguas corriendo. Más tarde se construyen temples de estilo oriental, pabellones e incluso ruinas artificiales, cobrando importancia el jardín público a lo largo del siglo XIX.

En definitiva, a través de todas las épocas, los jardines han sido lugar de reposo y recreo para todas las personas y si en un principio cubrían extensiones en torno a los palacios y mansiones de los nobles que podían permitirse el lujo de mantenerlos. Con el paso del tiempo se han convertido en algo cotidiano a lo que los ciudadanos tienen acceso gracias a la creación de parques públicos.

Sin embargo existe otro concepto de jardín distinto del meramente ornamental. Se trata del jardín botánico que, además de servir de objeto decorativo o de placer visual, sirve de elemento educativo e incluso de investigación. Desde su creación como tales, los jardines botánicos han pasado por distintas etapas hasta constituirse como los conocemos actualmente.

En los siglos XV y XVI se crean los primeros jardines botánicos en Europa, sustituyéndose el criterio decorativo por el que se agrupa la flora del lugar. Pero es en el siglo XVIII, cuando Carl von Linné (1707-1778), con la introducción de nuevas técnicas taxonómicas y de la nomenclatura binomial, sustituye la recolección de plantas por un estudio más científico para el reconocimiento y posterior clasificación de las mismas. Fue a partir de ese siglo cuando los jardines botánicos se transforman en verdaderos lugares de investigación sobre el mundo vegetal, además de preocuparse por la conservación del patrimonio vegetal, estudiando y controlando las especies en vías de extinción.

En la actualidad un jardín botánico es, ante todo, un centro de educación que se ha ampliado a todos los niveles, tanto en la enseñanza reglada como en la informal. Son estos jardines un punto de confluencia para la ciencia, la historia, el arte y la cultura en general, desempeñando su función como instituciones ligadas al desarrollo cultural de los pueblos que los poseen.

Por su parte, la historia oral supone una aportación innovadora a la investigación y a la docencia de la historia. De acuerdo con el nuevo sistema educativo español, debe ser una de las fuentes utilizadas para reconstruir nuestro pasado más reciente. Este tipo de historia permite conocer acontecimientos de la vida que a menudo permanecen ocultos. La utilización de las fuentes orales nos acerca más al pasado que no hemos vivido directamente y descubrir una realidad diferente. Por este motivo, al alumnado hay que estimularlo para que haga uso de este método que a su vez le convierte en protagonista de la historia y así pueda transmitir su conocimiento a otras personas.

El uso de estas fuentes orales tiene muchas ventajas, pues enseña a utilizar las fuentes primarias de investigación histórica. Es una experiencia muy válida para llegar a conocer los cambios ocurridos en la vida cotidiana, incluso poderse identificar con personas, comprender determinadas actitudes, reconstruir la historia de una institución, etc.

Los antecedentes de la historia oral los tenemos en la literatura griega, y en las civilizaciones que por tradición se transmiten de forma oral los acontecimientos que le han sucedido a su pueblo de generación en generación.

La historia oral es además interdisciplinar: se trabaja en sociología, en antropología, en sociolingüística, en geografía, y hasta sirve como método de investigación para estudiar la transformación del paisaje de un lugar determinado, los cambios de vegetación que no se pueden medir por sistemas tradicionales de análisis, etc.

Este trabajo consiste solamente en una primera aproximación a la historia de un jardín Botánico, por ello hemos hecho uso de dos fuentes: orales y gráficas. Se pretende estudiar desde los años cincuenta, con la creación del Jardín Botánico Canario "Viera y Clavijo", y su evolución hasta la década de los setenta. Para desarrollarlo se parte de la elaboración de un cuestionario, la búsqueda y selección de los informantes, la realización de la entrevista y su posterior transcripción que configura el trabajo.

En esta ocasión se ha elegido a una persona que vivió intensamente la creación y desarrollo del Jardín Botánico Canario 'Viera y Clavijo', y que entabló una gran amistad con la persona que se encargó de poner en marcha el Jardín: Jaime O'Shanahan Bravo de Laguna.

Objetivos de la investigación

- descubrir la importancia de Enrique Sventenius como fundador del Jardín Botánico Canario 'Viera y Clavijo'
- analizar las causas que provocaron la elección del lugar donde se ubica el Jardín Canario
- aprender a interpretar lo que se observa y comprender la importancia del Jardín Canario y su entorno
- descubrir y reconocer a los científicos y naturalistas que visitaron nuestra isla
- comparar las realidades existentes entre los años en que se crea el Jardín Botánico y la actualidad
- registrar la información que se recoge a través de la entrevista
- conocer la vida en el pasado a través de la fotografía.

Metodología

La metodología que se ha seguido es la propia de la historia oral basada en la recogida de información a través de entrevistas. Su realización se apoya en la aplicación de una encuesta orientada hacia la obtención de la "historia del jardín".

El proyecto debe completarse a partir de la investigación sobre los orígenes de los nombres que reciben los diferentes lugares, para ello utilizaremos un mapa del jardín y trataremos de averiguar el por qué reciben esa denominación.

También podemos localizar fotografías históricas valiosas y utilizar la historia oral para registrar las explicaciones de las personas que conocían cómo era ese lugar hace 20 o 30 años. Las fotografías, evidencia visual de la historia, están atrayendo mucho la atención de los historiadores, pues nos ofrecen una visión única de la vida en el pasado y de igual manera deben servir a los estudiantes. En este proyecto el estudiante debe localizar fotos antiguas, realizar una pequeña entrevista a alguna persona que conoció la zona, fotografiar el lugar tal y como es en la actualidad y por último llevar al aula todo el material para proceder a hacer una exposición. Así tenemos tanto una imagen histórica como el contexto del recuerdo oral.

Cómo elaborar el trabajo

Para llevar a cabo este trabajo es necesario elaborar un cuestionario donde se recojan los aspectos más relevantes de la creación del Jardín Botánico Canario para que a través de él se conozca cómo era y cómo ha sido su evolución.

Cuestionario

¿Por qué se creó el Jardín Canario? ¿cuál fue el motivo?

¿Qué pasos se dieron para su creación?

¿Quiénes fueron las personas que colaboraron en que se hiciese realidad el proyecto?

¿Recuerda como era Sventenius? ¿y alguna anécdota suya?

¿Por qué se eligió ese lugar y no otro? ¿se necesitaba un clima en particular?

¿Quiénes eran sus propietarios? ¿se compró o se expropió?

¿Qué utilidad tenía el suelo dónde hoy se encuentra el Jardín? ¿qué se cultivaba? ¿era de regadío o de secano?

¿Qué supuso para los vecinos la creación del Jardín?

¿Supuso actividad económica para la zona?

¿Las instalaciones, han sido siempre las mismas? ¿qué modificaciones se han hecho?

¿Cómo era la zona en los años 30, 40 o 50 antes de la ubicación del Jardín?

¿Cómo se ha transformado el paisaje, la flora y la fauna?

¿Qué procedencia tienen las plantas que se encuentran en el Jardín?

¿Por qué reciben diferentes nombres las zonas del Jardín? ¿qué extensión tiene?

¿Cuántas personas han trabajado y trabajan ? ¿qué funciones desempeñan?

¿Quiénes son las personas que lo visitan?

¿Qué ha significado el Jardín Canario para la educación, la cultura, la ciencia, ... ?

¿Tiene repercusiones económicas, sociales, ... la investigación que se realiza en el Jardín?

¿Qué valoración final puede hacer del Jardín? como por ejemplo ¿en qué aspectos hay que volcarse más, qué mejoras serían de interés para todos?

Conclusiones

La aplicación del cuestionario no es cerrada en ningún momento, se pretende que el alumnado que va trabajar este tema, puede añadir lo que estime necesario para una mejor comprensión. No podemos olvidar que la fuente oral es el instrumento ideal para trabajar la historia, despertando el interés sobre diversos temas. Buscamos información, no sólo de personas que ocuparon cargos de relevancia, sino de todos aquellos que contribuyeron a su creación y consolidación.

Promoviendo conservación de orquídeas en Costa Rica

Raúl E. Rivero

The Marie Selby Botanical Gardens, Sarasota, Florida, Estados Unidos

Introducción y antecedentes

En octubre de 1993, el Jardín Botánico Marie Selby (JBMS) extendió su misión en conservación y educación a los trópicos, gracias al apoyo económico de la Fundación Nacional de Ciencias y la Agencia Internacional de Desarrollo. Para lograr tal expansión, seleccionamos una institución botánica en Costa Rica con un cometido afín al del JBMS: el Jardín Botánico Lankester (JBL). Estos dos centros botánicos se han comprometido a desarrollar un modelo de interacción y cooperación en la conservación de las orquídeas de Costa Rica.

Las instalaciones del JBL tienen un potencial didáctico incalculable para educar a los costarricenses y a los 40.000 ecoturistas, nacionales y extranjeros, sobre la importancia de las orquídeas, sus amenazados hábitats, y su requerida conservación. El JBMS, y especialmente su departamento de educación, está comprometido a brindar la asistencia técnica al JBL para que en éste se propaguen al máximo las acciones educativas que aseguren la conservación de epífitas, y en especial la de las orquídeas de Costa Rica.

Desde el punto de vista de la conservación, las orquídeas constituyen un grupo estratégico. A todo el mundo les encanta contemplar su belleza, y por lo tanto el público se interesa por conservarlas, aún aquellas que no son tan atractivas. Con aproximadamente 1.200 especies nativas en Costa Rica, y el 90% de éstas de hábito epífita, las orquídeas constituyen un grupo de suma importancia para este pequeño país. La importancia de estas plantas para los costarricenses se refleja en haber escogido, desde hace mucho tiempo, la orquídea epífita *Cattleya skinneri* como su flor nacional. Nuestro programa de cooperación con el JBL consistió en el diseño e implementación de un programa de entrenamiento para maestros de escuelas vecinas al jardín, la confección de dos puestos de interpretación, y la construcción de un jardín de mariposas. Todo éstos elementos docentes fueron dirigidos a promover intensamente la conservación de las orquídeas a través de la educación en Costa Rica.

Entrenamiento y capacitación

Los maestros de escuela primaria se entrenaron para conocer más sobre jardines botánicos, y aprender a utilizar el JBL como un recurso didáctico y promover conservación de orquídeas con sus educandos. El programa educativo incluyó los siguientes objetivos:

- instruir a los maestros de escuela primaria acerca del papel que tienen las orquídeas, y en general las epífitas, en los ecosistemas boscosos
- ayudar a los maestros a incorporar éstos conocimientos en sus actividades diarias de docencia en el aula
- promover en educadores y educandos un sentimiento de orgullo de la exuberante biodiversidad de Costa Rica, y
- fomentar la participación de éstos maestros como promotores de conservación de orquídeas en sus respectivas comunidades escolares.

Mediante las sesiones de entrenamiento integradas y pragmáticas, los maestros se han capacitado y hoy entienden cabalmente la diversidad ecológica existente en Costa Rica, la importancia del epifitismo en la dinámica de los bosques, y las excéntricas adaptaciones existentes en el mundo de las orquídeas (fig. 1). El aprendizaje de éstos conceptos creó en los docentes una vasta gama de actividades instruccionales con ideas innovadoras que pueden realizar al aire libre en las instalaciones del JBL. Algunas de las lecciones instruccionales preparadas por los maestros durante el entrenamiento incluyeron temas como los siguientes:

- las epífitas como elementos de reciclaje en el bosque
- las raíces de las orquídeas son verdaderas esponjas
- las bromélias tienen forma de embudo y alojan muchos huéspedes.



Figura 1 Esquema instruccional utilizado en la capacitación de maestros en el Jardín Botánico Carlos H. Lankester, Costa Rica.

Los maestros aprendieron a desarrollar sus lecciones utilizando las extraordinarias colecciones de plantas y otros materiales existente en el JBL. Considerando recomendaciones del entrenamiento en limitar los gastos y utilizar materiales de bajo-costos, los docentes incluyeron en sus actividades instruccionales árboles y ramas caídas, y cualquier material vegetal en proceso de descomposición. Además de aprender sobre los recursos didácticos existentes y su máxima utilización, los maestros aprendieron conceptos básicos de horticultura y propagación de plantas con la ayuda del personal del JBL.

Después de completar su entrenamiento, los maestros pudieron utilizar lo aprendido mediante la elaboración de lecciones instruccionales de corta duración. De acuerdo al nivel académico que enseñan, los docentes se agruparon en equipos de tres o cuatro e implementaron la actividad instruccional planificada, mientras que los otros maestros actuaron como los educandos en esa situación de enseñanza-aprendizaje. Las evaluaciones del entrenamiento indicaron que los docentes mostraron una actitud favorable durante y después del entrenamiento. Igualmente la evaluación indicó que el entrenamiento les permitió aprender a ser mejores maestros y conocer más de su patrimonio natural. Finalmente, los educadores calificaron a la modalidad de entrenamiento utilizada como excepcional, puesto que les permitió aprender con el instructor, sus colegas, y por sí mismos.

Participación comunitaria y futuro de la conservación de orquídeas

Involucrando a los maestros, éste programa de conservación educativa no sólo ha creado un impacto positivo en los docentes, sino que ha permitido su difusión a las comunidades aledañas al JBL (fig. 2). Concluido el entrenamiento, los maestros se han convertido en promotores de conservación y del JBL con su misión institucional. Mediante éste programa docente, interactivo, y pragmático, el JBL cumple parte de su tarea educativa poniendo en los hombros de los maestros la responsabilidad de promover conservación a través de la educación en las futuras generaciones de costarricenses. El programa ha sido concebido por varios de los medios de prensa nacional como “el nuevo reto del JBL en promover la conciencia verde en el país”.



Figura 2 Modelo propuesto para promover participación de orquídeas en Costa Rica.

Este proyecto amplió las perspectivas del papel educativo de los jardines botánicos como el JBMS. Aunque la limitante situación económica no permite que los jardines botánicos puedan preservar bosques tropicales mediante la compra directa áreas naturales amenazadas, podemos tener un efecto impactante educando aquellos, que al final serán los administradores de su conservación, que en nuestro caso son los propios costarricenses. Creemos que proyectos similares a éste permitirán abrir una vía efectiva para garantizar la conservación de los bosques y las orquídeas en otros países.

¿Educamos en los jardines botánicos?

Ezequiel Guerra de la Torre

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Introducción

En la actualidad los jardines botánicos de todo el mundo cumplen un papel importante en la tarea de difusión de muchos de los preceptos de la educación ambiental. Su labor de preservación de las especies vegetales, así como de divulgación de los importantes valores que éstas poseen, fomentan la concienciación sobre la necesaria conservación de la flora mundial y, en muchos casos, la puesta en marcha de planes de actuación para que ésta se lleve a cabo de una manera efectiva.

La trascendencia de su labor conservacionista, llevada a cabo desde hace tantos años, ha dado lugar a que los jardines botánicos sean mirados por la sociedad, como ejemplo de la actuación positiva que los seres humanos podemos tener en nuestra interrelación con otros seres vivos que pueblan la Tierra.

Es probablemente esta imagen la que los ha convertido en un lugar común de las visitas escolares, que encuentran en ellos un recurso de primer orden para el estudio de la flora, su biodiversidad, sus características morfológicas, y su papel en el ecosistema terrestre. Éste hecho se ha incrementado notoriamente en las últimas décadas, en las que en los currícula de educación se ha ido introduciendo el concepto de educación ambiental con todas las connotaciones que ello conlleva, como, entre otras, el fomento del trabajo experiencial de los escolares, ligado éste en gran parte a la realización de trabajos de campo en el exterior de las aulas.

En este sentido el Jardín Botánico Canario Viera y Clavijo no ha quedado al margen y son muchos los escolares que, acompañados por sus profesores, visitan sus instalaciones. Concretamente, durante el curso académico 1996-97 fueron más de diez mil los que recorrieron sus instalaciones, lo que supone que anualmente se dedican en su interior cientos de horas a la tarea educativa y que además se produzca un uso específico del Jardín por parte de este numeroso colectivo, todo lo cual influye de manera significativa en el devenir cotidiano del Jardín. El esfuerzo que todo ello conlleva por parte de los colegios (transportes, ajustes de horario, profesorado de apoyo...) y del Jardín Botánico (elaboración de material educativo, diseño de itinerarios, coordinación y/o monitorización de las visitas...) nos ha hecho considerar importante la evaluación del grado de dimensión educativa que tienen las visitas escolares, con el fin de que el análisis de los resultados nos permita efectuar propuestas que ayuden a su mejora.

Objetivos y características del estudio realizado

Con éste trabajo hemos tratado de conocer la planificación educativa de las visitas escolares que los profesores realizan al Jardín Botánico. Para ello, mediante una encuesta, hemos intentado detectar los rasgos que caracterizan el diseño previo que realiza el profesor, la metodología didáctica empleada durante el desarrollo de la visita y la imbricación de ésta en la dinámica curricular.

La encuesta fue pasada a la totalidad de los profesores (10) de enseñanza secundaria (alumnos de entre 12 y 16 años) que visitaron el Jardín Botánico entre enero y junio de 1996. Consideramos que aunque nos hallamos centrado en el nivel educativo anteriormente citado, los problemas detectados a partir de las respuestas de la encuesta son generalizables a todos los niveles, ya que, aunque las estrategias didácticas utilizadas se diferencian en función de la edad de los escolares, pensamos que coinciden los planteamientos de planificación y metodológicos, que son, principalmente, en los que hemos centrado la investigación.

De los profesores encuestados los tres primeros lo fueron mediante entrevista personal, al objeto de detectar en la encuesta aquellos aspectos que podían generar confusión en cuanto a su contestación. Las otras siete encuestas fueron remitidas a los profesores tras mantener un contacto telefónico con ellos en el que se les explicaban las características de la investigación que se quería llevar a cabo.

Resultados de la investigación

¿Por qué y para qué visitan los jardines botánicos?

Fundamentalmente los profesores manifiestan que acuden a estudiar en particular “la flora canaria” y en general “las plantas” o “la vegetación”. Esta forma genérica de expresar el motivo de la visita coincide con la de los objetivos que se desean alcanzar en los que expresan que “principalmente se trata de conocer la vegetación canaria”. Sólo tres de ellos hacen una concreción mayor citando como objetivos de la visita el conocimiento de “las interrelaciones que se establecen entre el clima, el suelo, y la vegetación”, “la historia de los jardines botánicos” o “las técnicas de vivero”.

La mayoritaria generalización de los motivos de la visita y sobre todo de los objetivos, nos hace pensar en un planteamiento poco definido de ésta, que induce hacia un proyecto descriptivo-generalista del trabajo de campo. Ésto último nos lo corrobora las respuestas dadas al ítem en el que se preguntaba sobre los “conceptos que se desarrollarían durante la visita”, en el que el 60% de los profesores señala como único concepto a desarrollar el de la “flora canaria”. El otro 40% de los encuestados manifiesta algún concepto o temática organizadora de la visita como la observación de “las adaptaciones morfológicas de las plantas al medio”, “el proceso de desarrollo de un vegetal” o los conceptos de “endemismo” o “fotosíntesis”. Ésto parece indicarnos la mayoritaria inexistencia de un mapa conceptual que clarifique cuáles son los conceptos que van a ser tratados y cómo se organizan éstos en torno a una temática determinada. De esta forma la visita a los jardines botánicos puede convertirse en un planteamiento indiscriminado de ideas y conceptos que, se supone, el alumno deberá organizar y ordenar personalmente.

¿Qué metodología didáctica utilizan?

Todos los profesores manifiestan que su trabajo de campo se basa en la realización de un itinerario. El 60% de ellos ha utilizado un monitor de Jardín Botánico para llevarlo a cabo, mientras el otro 40% ha basado su recorrido en un cuadernillo que los alumnos debían ir rellenando.

Así pues, en el primero de los casos la dinámica de trabajo va a estar dirigida por el monitor del Jardine Botánico, el cual, ante su desconocimiento de las características personales y grupales de los alumnos, suele tener importantes dificultades para la dinamización del grupo.

En el segundo de los casos, es decir aquellos grupos que trabajan con un cuadernillo, existe una dinámica más autónoma de los alumnos, los cuales deben ir realizando una serie de observaciones con las que responder a las preguntas que aparecen en el cuaderno o rellenar los espacios en blanco.

El contacto que desde hace años mantenemos con diversas instituciones a las que los profesores suelen acudir a realizar sus trabajos de campo (jardines botánicos, aulas de naturaleza...), nos hace considerar que, salvo en contadas excepciones, ambas estrategias didácticas poseen grandes limitaciones. La primera de ellas y como ya hemos indicado, por el desconocimiento de los alumnos por parte del monitor, a la que habría que añadir la escasa o nula interacción que se produce entre éste y el profesor. En el caso del trabajo con cuadernillos de campo a completar observamos que, aunque existe una dinámica más autónoma de los alumnos, éstos se hayan excesivamente condicionados por las preguntas que desde el cuaderno se le realizan, de tal forma que suelen obsesionarse por encontrar el elemento sobre el que deben responder, al que buscan con tanta avidez que “no ven” la globalidad del espacio en el que se están moviendo. Por otro lado la mayoría de estos cuadernos suelen generar una dinámica tan poco diferente a la de interior de aula que las preguntas suelen responderse de forma mecánica y en muchos casos apuntadas por el primer compañero que las respondió.

Todo ello nos plantea la necesidad de reflexionar en torno a la búsqueda de métodos de trabajo más adecuados, que se acomoden a las estrategias de enseñanza apropiadas para el nivel de los alumnos y que propicien un proceso de aprendizaje que sea para éstos significativo. Asimismo nos muestra la exigencia de redefinir el papel de los monitores y de los profesores durante el trabajo de campo, al objeto de conseguir una mayor rentabilidad educativa de éste.

¿Qué problemas encuentran para realizar sus trabajos de campo en el jardín botánico? ¿Qué apoyos consideran necesarios?

Las respuestas mayoritarias a estos ítems se dirigen en el sentido de “la recopilación de información”, “la elaboración de materiales” y “el apoyo de monitores”. Como se puede observar los profesores consideran como una gran dificultad el que (además de preparar e impartir las clases que les corresponden, corregir cuadernos y exámenes, realizar tutorías o asistir a reuniones de coordinación...) tengan que recopilar información sobre las características de la vegetación existente en el Jardine Botánico y además confeccionarla de forma didáctica para darle una estructura que permita trabajar con ella a sus alumnos y establezca la conexión apropiada con el currículum. Es probablemente por la dificultad de asumir

este trabajo por la que los profesores solicitan el apoyo de monitores, sin embargo es evidente que son ellos quienes mejor conocen las características del grupo de alumnos y por lo tanto los que podrían utilizar con mayor eficacia las estrategias apropiadas de dinamización y organización. Son además ellos quienes conocen mejor la relación entre los conceptos que se están trabajando en el aula y aquellos que se desean trabajar en el jardín botánico, en su justo grado de complejidad y profundidad.

¿Está relacionada la visita al jardines botánicos con algún tema del curriculum? ¿Realizan una evaluación de la visita?

Es posible que las dificultades anteriormente descritas nos expliquen el que el 60% de los profesores encuestados manifestasen que la visita al jardines botánicos no está ligada al desarrollo de un tema del curriculum, o que un 50% de ellos no incorpore a la visita ningún proceso de evaluación. Esto quiere decir que en un significativo porcentaje la visita no se realiza como un elemento más del desarrollo de una unidad didáctica, sino que surge unida a otro tipo de factores (celebración de la Semana Canaria, actividad “extraescolar” anexa a la programación...), por lo que su aprovechamiento educativo, desde el punto de vista de la educación ambiental, se reduce notoriamente.

Conclusiones

- los problemas detectados nos indican que las visitas escolares a los Jardines Botánicos tienen una rentabilidad educativa muchísimo menor que la que deberían, si tenemos en cuenta los esfuerzos realizados por los profesores, los colegios y los propios Jardines Botánicos
- una gran parte del éxito educativo de estas visitas reside en que los profesores puedan disponer de unos materiales didácticos de calidad, que:
 - establezcan claramente su relación con el curriculum
 - se confeccionen diferenciados para cada ciclo escolar
 - expliquen al profesor la estrategia didáctica a seguir
 - indiquen el lugar del Jardín donde su aplicación es más apropiada, explicando las características de éste. La elaboración de estos materiales difícilmente puede ser asumida por los profesores debido a su arduo trabajo cotidiano
- el papel del monitor del Jardín Botánico como guía de grupos escolares suele ser bastante infructuoso (desconoce muchas características del grupo, ha de afrontar niveles muy variados, la repetición de su actuación va haciéndole perder estímulo...) por lo que se hace necesario redefinir su papel
- aumentar la calidad educativa de las visitas supone que son los profesores quienes deben dirigir el grupo durante éstas, contando para ello con los materiales adecuados y el asesoramiento de los monitores.

Una alternativa posible: el equipo educativo del jardín botánico

Estaría compuesto por:

- **Personal Científico y Técnico del Jardín Botánico:** cumpliría fundamentalmente una labor de asesoramiento, al resto de los componentes del equipo, sobre las características de la flora que el Jardín alberga. Les informaría además de las investigaciones y trabajos que en él se desarrollan y propondría líneas de actuación educativa.
- **Especialistas en Didáctica de las Ciencias Naturales y Sociales:** diseñarían las líneas de actuación educativa, es decir, definirían las temáticas de trabajo para cada nivel escolar (relacionadas con el curriculum). También confeccionarían los materiales didácticos, en los que incluirían un cuaderno explicativo para el profesor en el que se le informe de los contenidos de la unidad temática que se va a desarrollar, la estrategia didáctica más apropiada para ello, el mapa conceptual que la representa, propuestas de evaluación y la zona del Jardín Botánico más apropiada para ponerla en práctica.

Este personal no tendría que ser personal laboral del Jardín.

- **Los Monitores/Educadores Ambientales:** serían quienes llevarían la gestión de la actividad educativa en el Jardín, tanto de educación formal como no formal. En cuanto a su trabajo en educación formal colaborarían en el trabajo de los especialistas en didáctica, y además serían quienes explicarían a los profesores, previo a su visita, los materiales didácticos. En ocasiones apoyarían a los profesores durante sus recorridos especialmente al objeto de captar las virtudes y defectos de los materiales elaborados y posibilitar así su renovación. Informarían a los profesores de los recorridos más apropiados para la temática que deseen desarrollar, al tiempo que propondrían al equipo educativo otras temáticas a abordar y diseño de espacios, o remodelaciones de éstos, para el trabajo educativo.

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The bitter-sweet taste of chocolate

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Supported by Volunteers of the Fair-Trade-Movement (Eine Welt Laden e.V.) the *Greenhouse for Tropical Crops, Witzenhausen, Germany*, offered an education unit for schools about cocoa and its products.

The objectives

Tropical crops are not only interesting because of their botanical and ecophysiological aspects, but also because of their social and political contexts. This program is a first step to increase consciousness and sensibility towards these problems.

Why cocoa?

Nearly everybody loves chocolate – but who knows about the long journey from the cocoa bean to the products we use every day? Or about the relationship of cocoa with the tropical rainforest? And who cares about the cocoa planters' lives and problems? Chocolate as a very well known product is a suitable vehicle to catch children's interest concerning the economical and social importance of a tropical plant.

The programme

- * two months before starting this programme a portable case, including texts and illustrative aids, was made available to teachers. Most of the pupils joining the event were prepared on some aspects of cocoa production and trade. According to age and preparation the group could house different parts of the programme
- * a **guided tour** through the tropical lowland areas of the Greenhouse. The children could see bearing cocoa trees and feel the hot and wet climate of a tropical rainforest
- * a **'tropical pot-pourri table'**.
As an introduction a table containing lots of everyday products was presented. Five items without any connection (either content or packing) to the tropics had to be found
- * a **small exhibition**.
A developing aid organization lent out information boards about cocoa cultivation and trade. A **quiz** motivated the visitors to read the text
- * **games** opened a discussion about the World's development problems, e.g. in a role-play the proceeds of a bar of chocolate – consisting of 18 paper boxes – had to be divided between production and trade. Just one box or 1/18 of the price was left for the cocoa farmer.

Outlook

Even in botanical gardens with limited resources events for schools can be created and carried out. Let's face our task and look for opportunities to enhance environmental education

Partnerships for Learning –
Public and Community
Education

Regional interpretation: linking our natural and cultural diversity

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Introduction

The social value of interpreting regions has come to the fore recently. Regional awareness is being advocated by people from a wide range of disciplines, such as agriculture, ecology, economics, geography, history, landscape architecture, philosophy and politics. I would like to begin with a personal view of the theoretical basis for regional interpretation found in my literature research of those various fields. Then I will follow with the findings of Regional Interpretation motives and methods at my three case-study institutions.

Having spent my formative years in an agricultural landscape, I was emotionally torn recently when reading Wes Jackson's *Becoming Native to This Place*. He spoke of the utility and the beauty of plant adaptations coming together through the minds of farmers to fill the regional niche their land occupied. Jackson theorized that a loss of rootedness in, and appreciation for, the land equates with environmental disregard, homogenization of the landscape and, a loss of natural and cultural diversity.

I felt a sense of fulfillment in myself for having experienced the lessons of the land, understanding what it means to read the climate, the soil, the physical character of a region. Not realizing it at the time, I had obtained a foundation in ecology that no amount of academic training could supply. At the same time, I was moved to guilt at having broken my tie with the place, deserting my family's home ground after three generations of indoctrination to the land.

My point is that our land intelligence has been undermined by modern priorities and by our mobility; even by the mere speed with which we move across the land. Let me demonstrate with an example from ecologist David Orr. Consider the plant exploration trip taken by William Bartram in the eighteenth century, from Pennsylvania to Florida. Imagine the level of stimulation felt by Bartram over the weeks and months as he enthusiastically recorded the many wonders he had experienced. Compare that to a trip by the interstate highway system or jet airliner over the same route. Modern travelers experience only a succession of homogenized images and sounds moving through an engineered landscape tailored to speed and convenience.

A need to reconstruct the land

Human perception of the land has become increasingly abstract, measured as lapsed time and experienced as the dull exhaustion that accompanies close confinement. We have subconsciously developed a sentiment of indifference to the land, the region, to the place we live – it has become more and more irrelevant to our existence. This statement by Liberty Hyde Bailey is as relevant today as it was eighty years ago:

It is incumbent on us to take special pains . . . that all the people, or as many of them as possible, shall have contact with the earth and the earth's righteousness shall be abundantly taught.

I propose that the appreciation of land and place is at the root of our survival. While we may not depend on the knowledge and familiarity with place that agrarian societies had, land is crucial as a part of our civic conscience. If society forgets or no longer cares where it lives, then anyone with the political power and the will to do so can manipulate the landscape to conform to their own social ideals or nostalgic visions. People may hardly notice that anything has happened or assume that whatever happens – if a mountain is stripped of timber and soil is eroded into its creeks – is for the common good. The more superficial a society's knowledge of the real dimensions of the land it occupies, the more vulnerable the land is to exploitation, to manipulation for short-term gain.

As visual and site-specific institutions, public gardens have a perfect opportunity to help to overcome the visual and locational indifference Americans tend to exhibit. Gardens are perfectly equipped to promote the uniqueness of their regions. As a bonus, education about a region's physical and cultural aspects will help a society relearn the stewardship of that region. If we can help people to be aware of what is around them, maybe they will be more likely to *act* to preserve it.

Regionalism defined through case studies

Because regionalism can mean so many different things to different people, I will not get bogged down in the definition and delineation of regions. For the purposes of this article, regionalism is defined as intuitive recognition of the distinct natural features, inhabitants, and history of the region, with an obligation to live within the physical, ecological, and cultural boundaries determined by these criteria. This flows from Webster's definition of regionalism: "devotion to one's own geographical region". The intention of my study was to investigate institutions that focus their mission on conserving and teaching regional culture through regional interpretation. The purpose of these investigations was to: examine the issues and motivations behind developing regionally-oriented programs; illustrate the methods and processes of regional interpretation in museums, especially public gardens; and demonstrate roles for public gardens and museums in regional interpretation, so as to provide a greater social purpose for those organizations.

Based on preliminary literature research, I looked at efforts in the following areas of regional interpretation to select three case-study institutions:

- promoting the uniqueness of the horticulture, ecology, geology, and aesthetics of a region
- using vernacular materials and crafts, involvement of local craftspeople and artists
- recognising human history on-site
- collaborating with resident institutions
- involving the community in programs and planning
- emphasising location-appropriate plants, processes, and techniques
- implementing formal educational activities related to local nature and culture.

My search for exemplary regional institutions led me to the Adirondack Museum in Blue Mountain Lake, New York, the Crosby Arboretum in Picayune, Mississippi, and Red Butte Garden and Arboretum in Salt Lake City, Utah. First I would like to give you a feel for the characteristics that make these three regions distinct, and go a little more in-depth into how the third institution carries out the interpretation of its region.

Case studies previewed

The Crosby Arboretum encompasses a portion of a biological system known as the Piney Woods, in a region defined in the institution's mission as the Pearl River Basin. From the mission, one can easily deduce that the Arboretum is strongly focused on ecological interpretation. It is also evident that the Arboretum was founded by supporters avid about preserving the regional culture. Pinecote, the main site of the Crosby Arboretum, was designed to interpret the plant communities of the region: savanna, woodland, and freshwater wetland, with thematic journeys choreographed into the mosaic. This site is a 64-acre former strawberry farm and pine plantation. Ed Blake, master-planner and first Director of the Arboretum, through months and years of observation, was able to harmonize the human features of the site with the recovering natural communities in a fashion that he humbly describes as "stepping back and letting nature do her thing". As you can imagine, the interpretation at the Arboretum is wholly oriented to the region and its ecology.

The Adirondack Museum is surrounded by a landscape of natural beauty that strikes you with a powerful impact when you enter the region. At six million acres, the Adirondack Park is the largest park in the continental United States; approximately three million acres were designated "forever wild" by a New York State constitutional amendment in 1892. The Museum is located on the site of a former 'gilded-age' resort hotel overlooking Blue Mountain Lake. The immediate region of the Museum is well known for a high density of early resort hotels and summer camps established around the turn of the century. Vast tracts of land were once held as recreational 'Great Camps' by wealthy individuals, with an entire service industry growing up around them. This recreational phenomenon was a major historical factor in the settlement patterns and culture of the region. George Hochschild, the founder of the Adirondack Museum, was a wealthy and environmentally-minded industrialist, who saw fit to preserve that history by personally collecting its artefacts. His collections have developed into a highly-acclaimed regional museum.

My third site is located in Salt Lake City, Utah, in a region known as the Intermountain West. The Red Butte Garden and Arboretum publicize their location as “where the Great Basin Desert meets the Rocky Mountains”. They also claim to be one of the most urbanized locations in the country, with nearly 2 million people within a 40-minute drive. The Garden and Natural Areas consist of a 160-acre site perched on a shelf in the foothills, at the mouth of the Red Butte Canyon. The Garden and Arboretum were dedicated in 1983 to serve as a regional botanic garden. Garden personnel make it a point to tell visitors that this canyon contains one of the few remaining undisturbed riparian ecosystems in the Intermountain West.

The Garden flowed from the vision of a Professor of Botany at the University of Utah, Dr. Walter Pace Cottam. He recognized early what the Rocky Mountain-Great Basin transitional zone meant to ecological diversity. Dr Cottam devoted his entire life to the study and preservation of the natural resources of the Intermountain West, specifically this canyon. As it relates to my definition of ‘regional’, the organization’s mission directs it to promote interest in regional horticulture, to teach regional ecology, and to provide a cultural resource for the community. The Garden overlooks the University and Salt Lake City; therefore, is well situated to serve its audience.

Red Butte Garden is also ideally situated to help connect visitors to the geology of the region. From the foothill vantage-point, one can see the shoreline and beaches of ancient Lake Bonneville at the foot of the far mountain range across the Valley. You can also see the existing Great Salt Lake, a mere shadow of the former lake. The Garden is sited on the beach of the eastern shore of Lake Bonneville. Picture the 1000-foot-deep lake completely submerging Salt Lake City. A geological fault shifts, causing a gap in a ridge to the north, through which thunders enough water to have carved out Hell’s Canyon of the Snake River as it drained. As a docent told this story to a tour group, I realized that this was a dramatic way to help visitors understand the awesome forces which physically shaped this region.

The Garden is divided into the natural areas and the formal gardens. The site includes a diversity of plant communities and habitats considered as living components of the ecological collections – for example sagebrush-grassland, riparian, and oakbrush ecosystems. While the semi-arid environment might not evoke an impression of biological diversity, the Garden does an excellent job of relaying the special nature of the flora. The Garden promotes the region’s flora as the “fifth most diverse in the United States.” As you stroll through the Garden displays, you also notice many vernacular materials, largely constructed and installed by local craftspeople. This is a functionally and aesthetically important aspect of being responsive to your place.

Naturalizing a region’s inhabitants

As I investigated these three institutions, some overriding themes and motivations took form. Firstly, each institution recognizes and masterfully celebrates its distinct cultural and natural heritage in an effort to reacquaint inhabitants with their region. Hopefully you have gotten that idea from the examples just discussed. A second and unmistakable motivation is the desire to instill ecological literacy and environmental stewardship. The third and fourth motivations are related, in that the reason for involvement is to catalyze dialogue and improvement in the region. The following section will discuss examples of regional interpretations that serve to accomplish the aims of connecting to the community and teaching ecology.

The typical first-time visitor to Red Butte Garden tends to think of the surrounding canyon as pristine and undisturbed. In the spirit of ecological enlightenment, the Garden makes an effort to shatter that illusion by showcasing the human impressions on the site. Docents point to the residual signs: the open face of a quarry on the near mountain and the stone ruin at its base are evidence of Salt Lake City’s closest source of the building stone found in many buildings throughout the city. The Garden is researching the history and plans to use this building in future interpretations. The old quarry trails used to haul the stone have been restored for use as hiking trails.

A wildflower meadow is planted on the site of a former rail yard and turntable. With plantings such as these, the Garden is trying to convey a new sense of stewardship in the proper use of water for a desert region. The fragile, semi-arid environment of the Great Basin is one of the least likely places to support turfgrass, yet the Garden needs to work hard at countering the massively intensive lawn ethic that pervades the region. The Garden demonstrates, through example, many drought-tolerant alternatives to lawns. In the State of Utah a majority of the water needs to be imported, yet over 80 percent of the water drawn is used for irrigation. Grass is used in a minor role in the Garden and where grass does exist, water conservation is accomplished by a weather-driven computerized irrigation system.

Human signatures in the Piney Woods

Traveling to the state of Mississippi, in the Deep South, the Crosby Arboretum expresses the ecological interconnection of humans and nature through the physical planning of the Pinecote site. In the words of the “Pinecote Master Plan”:

The organic architecture and location demonstrate how human needs of shelter, comfort, and privacy find their expression in Pinecote’s ecology . . . this interplay between man and the land organizes the thematic composition of Pinecote’s landscape exhibits.

Ed Blake explains that this desire to interpret the interconnection is the reason that they have put something as symmetrical as the pavilion in nature. Blake says “Pinecote is an example of how we don’t deny our rational side. Human impact is superimposed on nature.” He goes on to describe how the building’s architect, E. Fay Jones, spent days “communing” with the site, to best capture the essence of the human and natural aspects in his structure. The location he chose, adjacent to a remarkable grove of longleaf pine trees (*Pinus palustris*), is reflected in elements of the building’s form.

These world-acclaimed organic aspects of Fay’s design help the structure create a truly harmonious composition with nature. In the format of a walking ecology lesson, Blake relates theory on edge structure, canopy layers, companion plants, and succession. Blake explains that “they haven’t come to terms with succession of the site yet”. The original idea was to let the pond follow its natural course back to a meadow. If you compare early photographs of the Pavilion with more recent ones from a similar angle, a dramatic change in the pond surface is evident.

The lesson of how nature sustains and regenerates itself is a prevalent theme throughout the activities of the Crosby Arboretum. Curator Bob Brzuszek tells of how the organization’s aesthetics have evolved “to accept what the land has to offer”. They have not only accepted man’s impact, but in a way have actually elevated the human disturbance of the land to an artistic form of instruction. For example, Brzuszek uses fire to “transform and maintain spatial patterns in greater diversity”, in effect forestalling the forces of succession. Through practices perfected in working with their fire ecologist, Cecil Frost from Louisiana State University, a broad range of vegetation ‘ecotones’ or habitats are differentiated by a distinct burning regimen. The plants that are sustained by this process of rebirth, including an extraordinary array of carnivorous plants, not only tell a story but are incredibly beautiful. I think of Bob Brzuszek as an artist of the land. He will tell you that he has realized, through management of the Pinecote site, that there are “a million ways” human actions create special signatures in the landscape. Each of the management techniques they use at the Pinecote interpretive center are site- (and region) specific. According to Brzuszek, this is the critical message the Arboretum offers:

How man and culture fit into the Piney Woods landscape. We are trying to, not so much simulate, but emulate what occurs in nature. Understanding the processes that form it, what the sustainability and regenerative possibilities are. Though our lands are disturbed, they have potential and it’s very valuable to learn how we can regenerate with the help of ecological processes.

Program design for community participation

The theme of involving the local community was a significant priority among these regional institutions. Each attempts to balance education and entertainment to meet the aims of both attracting an adequate audience and altruistically serving the community and improving quality-of-life factors.

At the Adirondack Museum, the human story of the region is told to children and adults through exhibits and programs with major focus on including people in the story. One story told by the ‘Boats and Boating’ exhibit is that of the indigenous Adirondack guideboat. This is a craft that has evolved explicitly for the unique conditions found in the contiguous lake and stream transportation-ways of the Adirondacks. The heritage behind this craft also serves as the theme of a special event for the community, the annual “No-octane Regatta” weekend. This event offers an opportunity for wooden boat aficionados and the local community to celebrate a regional craft. Children and adults get involved in light-hearted competitions racing the replicas of wooden craft.

The Museum has been able to involve all age levels. Junior high-school students enter *bateau* races in which one of the requirements is that the students build their wooden *bateaux* themselves. The youngest children are given a chance to participate in the model-boat building workshop. The next day they get the opportunity to compete in the Museum’s fountain pond with their own creations.

On a positive economic note, a cottage industry seems to have developed in this region around the hand-construction of museum-quality replicas of the wooden boats.

Each of the institutions make use of natural backdrops as aesthetic settings for cultural and community events. At Red Butte Gardens, concertgoers are exposed to beautiful plant collections when attending events held in the outdoor amphitheater. Use of regionally-appropriate plants and materials are also advocated at various events, including a native plant sale and a harvest festival.

Adult classes at the institutions serve to forge a tie with local inhabitants. The Pinecote Pavilion at the Crosby Arboretum provides another wonderful place for programming that can help to achieve an intimacy with, and appreciation of, the region.

Indoctrination beginning with the young

The theme of children's education is prevalent in the goals and community influence of each of the case-study institutions. Administrators have consistently supported children's programs to fill a perceived gap in the public education system. The calendar for one of the programs at the Adirondack Museum, called "Time and Time Again," has activities every week from January through June. Students can come back every week for a program on a different topic. The Museum serves over 8,000 student contacts annually. The institutions also supply pre-visit materials for the program, to give teachers a better understanding of the region. Red Butte Gardens sends materials to 10,000 elementary school teachers across the State of Utah.

Red Butte Gardens has positioned itself as an outdoor classroom for the community. The Garden's master-planning effort involving educators, students, public agencies and the community in general, revealed an important role for the Gardens to play in environmental education. The Garden worked with the Utah State Office of Education to develop science curricula for elementary and secondary schools.

Pam Poulsen, as manager of environmental education, has a refreshing philosophy of training young people to recognize healthy environments. It was invigorating to watch her in action: she does not recite rules on environmental responsibility, but rather has an amazing technique of stimulating awareness and observation skills. The visits to these institutions provide an unprecedented opportunity that is so unusual to the young, because it is teaching science (in situ) through settings that many have never seen or experienced before. It is becoming a rare occurrence today, when children can experience plants and animals in their habitat of choice. Gary Paul Nahban interviewed children recently in the Sonoran Desert and found that for the most part they were receiving their information about other organisms vicariously. Over 50% of the Mexican, Anglo, and Native American children told him that they had seen more animals on television than they had personally seen in the wild. This lack of contact with the natural world will become the norm, as more than 38% of the children born after the year 2000 are destined to live in cities of more than a million. For that reason alone, this type of experiential learning for children is so critical.

Working together to multiply impact

Collaborations were a common theme among the case studies. The exhibit on display in the Red Butte Garden Visitor Center at the time of my visit comprised the winning entries of a program called 'Celebrate Wildflowers'. In a collaborative effort with environmental education organizations from three states, elementary school students were asked to portray their version of regional wildflowers. M.P. Matheson, Director at RBG, pointed out they have a long way to go with children's perception of nature – many of the children picture wildflowers in vases and pots removed from their local habitats. She said that next year they will strive to communicate "to the kids why we celebrate wildflowers, where they belong and what contributions they make." Matheson said that they "hope to make it more interactive – whether it's with a native hummingbird or bee or a human in the picture – to convey what that wildflower is doing out there where it lives."

Red Butte Garden cooperates with other organizations such as the U.S. Forest Service, the Nature Conservancy and the Center for Plant Conservation. Nature Conservancy members are given tours of natural areas adjacent to the Garden. These areas, owned by the U. S. Forest Service, are used for educational activities through a memorandum of understanding. Red Butte Garden is researching endangered plants in this area, and ecological collections are identified on field maps, including descriptions of individual plant communities. Publications and species checklists help visitors to appreciate the value of regional biological diversity.

A prevailing theme deemed important, if not essential, is bodily engaging people in interpretation or programming. This is accomplished in different ways. Placing the subject in the context of something the visitor would be familiar with is one excellent technique. Another way is to perform the interpretation on a human scale in a personal context. A third is to involve the visitor in an experiential learning technique. Through these processes, regional interpretation can accomplish instruction in the art of simple observation. There is a concern that, with the increasing prevalence of other technologies, basic observation has become a disregarded skill. This provides greater justification for the application of experiential learning, putting the artifact back into the context of its place.

Regaining environmental literacy

In closing, I want say that I think it is more than just a romantic notion to become native to your place. It is to understand that both our physical and spiritual sustenance comes from the land. Interpreting a region's cultural and physical aspects can serve to elevate the role of a public garden as a more respected community resource. Below are some general guidelines that public gardens and museums can use to aid our visiting public in becoming native to their place:

- reintroduce inhabitants to the distinctiveness of the physical and social character of their place
- enhance existing public respect for, and aesthetic appeal of, the land and nature
- re-emphasize the dependence of humans on the land for sustenance and social well-being
- underscore the indivisibility of the relationship between humans and the land
- accentuate an understanding of ecology, how nature sustains and regenerates itself, and how our ecological literacy can positively impact the integrity of the landscape
- optimize the combination of learning and entertainment through techniques which experientially engage the visitor
- understand and enlist the motives of altruism and enlightened self-interest in establishing a commitment to the local community and
- catalyze and facilitate dialogue and action on issues affecting the integrity of the region.

Land provides the identity of a society's culture. By interpreting the regional landscape, we can provide the knowledge to reveal and thereafter, preserve that identity. R. Burton Litton Jr. of the University of California, Berkeley voiced the recognition of regional character as one of the most important challenges to any professional discipline:

The conservation of the regional landscape provides an integrative fabric that we need so that all places are not reduced to some woefully deficient common denominator with the increasing prevalence of other technologies – deficient in identity, aesthetic quality, and rational responses to environmental influences

(Landscape Journal, 1994).

A certain sensitivity to region is already being implemented in many gardens and museums just through the course of good interpretive practices. By consciously celebrating the uniqueness of a region, promoting the site-specific ecological processes, and emphasizing the importance of responsiveness to the region, we can help to combat the homogeneity that attacks our cultural and biological diversity. At the same time, we will further the environmental literacy and ecological competence of the visiting public.

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Public education for all ages at the Singapore Botanic Gardens

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Introduction

The Singapore Botanic Garden's School of Horticulture (SOH) has been the seat of formal training in horticulture and landscape design since 1972. In the early days, it was charged with the training of the horticulturists and landscape-designers needed to transform the island state into a "Garden City" and to see to its upkeep thereafter. This was achieved by the 1980s.

In 1990, the Singapore Botanic Garden (SBG) was granted more administrative autonomy as part of the NParks, a new statutory board formed to formulate new policy for the national parks (the SBG and Fort Canning Park) and the nature reserves. The role of the SOH was reviewed in the light of prevailing needs. The outcome of the review advocated the establishment of a public education arm to provide new initiatives and impetus for educational outreach. This agreed well with the 'quality life-style' aspirations associated with rising affluence.

In the past, the public education programmes were conducted on an *ad hoc* basis without much reference to the needs of end-users. Having embarked on a business and market orientation, they are now more user-focused and user-friendly. Programmes are structured to address the needs of target groups.

The public in general

The success of the 'Garden City' campaign has engendered gardening as a national recreational pastime and has inspired citizens to bring greenery into their homes. In the highly urbanised and competitive Singapore environment, many find gardening therapeutic – a refreshing way to unwind from the stress of work. As one participant put it: 'Sometimes when things go wrong at work, it is nice to come home and see your plants still growing and carrying on'. Whether living on or above ground level (and 80% of the population in Singapore live above ground level) plants have become an integral element of home decor. Notwithstanding the space constraints, undaunted and house-proud high-rise flat dwellers turn their corridors and whatever living spaces they have into their own little gardens.

This group of gardening enthusiasts and hobbyists look to the SBG for tips on gardening. Short gardening courses, mainly of recreational content, such as indoor plant landscaping, indoor plant care, and hydroponics, are designed to meet their needs. A recent survey indicated that the composition of this group had changed from a majority of housewives and retirees to working professionals. Therefore, it is appropriate that classes are held in the evening hours to accommodate their busy schedules.

In 1992 and then again in 1995, the NParks collaborated with the Housing & Development Board (HDB), the Primary Production Department and the Ministry of the Environment in staging exhibitions to promote gardening in high-rise apartments. These so-called 'Skyrise Gardening' exhibitions catered to a wide spectrum of audiences, ranging from the novice to the seasoned hobbyist, and featured mock-ups of living rooms, balconies and other living spaces, decorated with suitable indoor plants. Demonstrations, workshops, competitions and a 'Plant Clinic' to advise on plant care, were also featured. Visitors to the exhibitions were able to pick up creative and practical ideas about the choice and arrangement of plants for different landscaped settings. The NParks' public education programmes were publicised and open for registration at the exhibitions. Due to overwhelming response, additional classes had to be scheduled after both exhibitions.

A reference handbook on 'Skyrise Gardening in High-rise Homes' was produced in conjunction with the 1995 exhibition. This publication covers all practical aspects of gardening in high-rise apartments. It proved to be popular and is now in its first reprint.

The Public Education Unit maintains a database of regular participants who can be updated expediently on new programmes and events at the SOH. A quarterly newsletter produced in-house also serves to keep our audiences informed.

Residential communities

In Singapore, the population is distributed among housing estates, which consist mainly of high-rise flats put up by the HDB. Each residential community is served by a community centre. There are currently some 83 community centres, 26 community clubs and 303 senior citizen clubs island-wide. These community centres and clubs are administered by the People's Association (PA). The PA is an important grassroots organisation responsible for promoting community development through the organisation of social, cultural, educational, youth, sporting, recreational and other types of activities to foster communal spirit.

The PA's network of community centres and clubs offers immense opportunity and potential for the NParks to extend its educational outreach to the masses. In addition to running our residential programmes in the SBG, the Public Education Unit has recently partnered the PA in jointly organising recreational gardening courses at selected community centres that project a 'green' image. While the PA helps to promote our programmes via its established publicity instruments and the community centres provide the necessary classroom venues, the NParks provides trainers, teaching materials and equipment. The selling point of this scheme is 'we bring recreational gardening courses to your doorstep'. The success of the pilot project has prompted the Garden to expand this service to other community centres, thus reaching out increasingly to the people on the HDB estates.

Through this working relationship with the PA, the NParks has also been invited to participate in the PA's Hobbycraft Fair, an annual event to promote popular arts and crafts as hobbies to the public. In 1993 and 1995 eye-catching gardening exhibits were installed at the Fair and attracted sizeable walk-in registration for the courses. In August 1996, the Fair was held in concert with the Family Fitness Festival, a national event with a theme to promote a healthy life-style among Singaporeans. And what could be more relevant than the plant and nature-related activities offered by the NParks. The NParks' Public Education was a central feature at this festival launched by the Prime Minister. The large turn-out of some 32,000 people made the occasion an opportune one to publicise the NParks' outreach programmes at community centres.

Schools

There are at present 187 primary schools, 145 secondary schools and 14 junior colleges in Singapore. As with other botanic gardens, schools represent a very important audience of our educational outreach. In this respect, our programmes seek to complement the formal curricula of schools, especially in reinforcing the outdoor and hands-on content of learning.

Recognising that teachers hold the key to success for the Garden's school outreach, teacher training constitutes an important strategy for reaching out to the student audience and strengthening ties with schools. Training has been initiated for heads of department of schools. Having gained an appreciation of the relevance of the Garden's programmes, these key personnel in turn enthuse the teaching staff of their respective departments or schools. They spread the message about the many possibilities and benefits of using SBG's resources to enrich school-based studies of plant topics and the environment, thus achieving learning beyond the confines of the classroom. Teacher-training programmes are scheduled during the holidays for the convenience of teachers.

In order to sustain teachers' enthusiasm and commitment to the public education programmes, teacher training needs to be on-going. Also, by involving teachers in joint development of new programmes, the Garden can be assured of their continued support. Once teachers become more confident and take ownership of programmes, the SBG staff need merely provide background support. In other words, they just facilitate. This frees in-house trainers to attend to other aspects of public education e.g. programme formulation.

Garden staff have found teacher training to be a rewarding investment and exercise, since every trained teacher in turn passes on the knowledge and experience gained to his/her charges. Hence, the multiplier effect is considerable. Staff have a strong conviction that their partnership with teachers and schools will go a long way.

School children aged 7-18 are in their most receptive years and, through the programmes, values relating to the environment and nature conservation can be instilled, so that as leaders of tomorrow, they will make responsible decisions on environmental issues. The Garden intends to develop a hierarchy of public education programmes to cater for students at different educational levels. Some of these can be project-based. For instance, the reforestation project for the four-hectare patch of primary forest within the SBG enlisted the services of student volunteers seeking to fulfill requirements for the National Youth Achievement Award. This community project took place in 1991-93 and was sponsored by the Hongkong Bank. The student volunteers learned to differentiate between native and exotic species of plants in the forest.

There is an increasing number of requests for staff to speak on plant-related topics and conduct horticultural camps/workshops in schools over the holidays. They also participate in scientific/industrial internship programmes for secondary schools and junior colleges. Where appropriate, they also seek to collaborate with environmental and school gardening clubs in educational projects of mutual interest.

Public outreach is not confined to local schools. Educational programmes are tailored for student groups from overseas institutions, adding an international dimension to the programmes. For example, for the past three years (1993-96), the Nishinippon Junior College in Japan has been sending its graduating Diploma classes for a specially arranged one-day tour and lecture programme at the SBG. The purpose is to expose the students to the horticultural practices and landscaping concepts of a tropical botanic garden. On those occasions, the Garden was very fortunate to be able to engage the voluntary assistance of wives of Japanese expatriates serving as interpreters and guides.

Pre-school children

For this audience group, the Garden staff strives to inculcate good values and habits about plants and nature at a young age. The teaching methods used are different from those for adults. The most effective way to induce children to learn is through interactive play and hands-on activities. Some of the popular childrens' programmes are Dish Garden, Terrarium Workshop and Rainforest Trek.

The first sponsored production of an activity book in 1994, 'Sara, the Forgetful Dinosaur', for children was very well received. This cartoon-illustrated book weaves in Sara's story with activities that young readers can do in various sections of the SBG. Children are encouraged to use their senses in activities such as smelling flowers or touching tree barks in solving clues in a treasure hunt. They can also draw what they see in the SBG in the book. The book is designed to arouse children's inquisitive minds about plants and nature, so that they learn while enjoying the outdoors. Many teachers, especially those from kindergartens and lower primary schools, have been trained to use this activity book.

Recently, a series of parenting workshops was organised with a private concern. The objective was to show parents the possibilities of using the outreach programmes, such as nature tours, as healthy and meaningful avenues to spend quality time with their children. Feedback from participating parents was positive.

Future directions and challenges

At the SBG, the foundation for public education has been laid. Participation rate has gone up over the years (see Tables 1 and 2). The future looks promising.

As the scope of the Garden's outreach education expands and becomes more diversified, it will need to look beyond the traditional core of trainers and guides, i.e. in-house researchers and horticulturists, to deliver the programmes. The Garden will need to meet growing personpower requirements as well as provide the required depth and breadth of expertise. Tertiary institutions, gardening and landscaping societies and the private sector will be increasingly tapped for quality trainers. The service of volunteers and the setting up of a 'Friends of the Gardens' society are being considered in order to expand the personpower pool that we can draw upon.

The SBG's public education programmes are mostly run on a cost-recovery basis. Mindful of ever rising staff and material costs, it is necessary for us to seek sponsorships so as to keep fees at an affordable level or a level deemed equitable by the public. With sound economic growth, corporations are forthcoming with funding for community projects, of which our public education programme is representative. Every effort will be made to strengthen partnerships with the private sector.

The SBG's S\$51 million redevelopment plan is in full swing. As new developments such as the National Orchid Garden, Children's Garden, Sun Rockery and Eco-Lake come on-line, new educational programmes will be developed around them to maximize their value to visitors.

| Year | Adult courses | Childrens' courses |
|------------|---------------|--------------------|
| FY 1993/94 | 1141 | 66 |
| FY 1994/95 | 1488 | 680 |
| FY 1995/96 | 1840 | 965 |

Table 1 Numbers of course participants in 1993/96

| Year | Adult courses | Childrens' courses |
|------------|---------------|--------------------|
| FY 1993/94 | 2880 | 55 |
| FY 1994/95 | 3335 | 760 |
| FY 1995/96 | 3863 | 1248 |

Table 2 Class participant-hours in 1993/96

Conclusion

The SBG's public education programme will be judged by its ability to convey its intent and services to the community relative to people's needs. In order to sustain public support, increase participation and be successful, the Garden must be proactive, relevant and innovative.

Botanical printmaking: art and science education in botanical gardens

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Overview

Botanical Printmaking is also known as ‘Nature Printing’. It is quite different from the art of ‘botanical illustration’. It is one way of recording the physical appearance of a plant, by means of inking it and imprinting its image onto a surface, which is usually paper. Besides botanical materials, Nature Printing includes traditionally many ‘natural’ objects and substances, such as insects, fish, shells, rocks, the human body, as well as textiles and other artificial objects. For the purpose of this study, the author will limit herself here to the application of plants as one area of nature printing and name it ‘Botanical Printmaking’.

Historical background

References to the process of nature printing and its uses began with Leonardo da Vinci's descriptions of ink recipes for botanical/leaf-printing. It was perhaps his interest and discussion of the process that inspired botanists (in particular German botanists), beginning in 1760, to further develop this medium. Their writings indicate an increasing demand for scientific information about the remedial applications of plants, and indeed they promoted the use of their illustrated and descriptive books to apothecaries, medical doctors and lay-people. These botanists printed few editions, inking the plant anew, (including its root system), with lamp-black for each impression. Their printing methods limited repeated use of a plant, and the greatest care was needed to assure consistent printing detail. Hand coloring was part of the documentation process, which at times obscured the delicate veins and skeletal plant structure.

Detailed descriptions of the plant's remedial uses, location and time of harvest accompanied the printed plates, sometimes in two or three languages (German, Latin, French or English). The largest collection of botanical nature-prints is assembled in the book *Ectypa Plantarum Ratisbonensium*. It includes 1000 prints of small plants native to the region of Ravensburg in southern Germany.

By the late 18th Century, botanical printmaking had become recognized as a source of inspiration for the applied arts, for such objects as textiles, wallpaper, furniture, and decorative objects for the home. The technique was praised for its educational values, and for its appeal as a pastime.

Contemporary opportunities for botanical print

Only in the last few years have non-toxic art and craft materials become available, of the types that make botanical printing suitable for audiences associated with botanic gardens.

Applications of this technique, and workshops that can be developed using this technique were presented as inspiration to the congress attendees, or as information ready to be put to practice in the botanical gardens they work in. How the relationship of art and science can be experienced with the help of hands-on projects and workshops for various audiences will now be discussed and illustrated. They are ideally implemented as part of out-reach programs conducted by botanic gardens.

Audiences include:

- **children, adults and families.** The focus is on diversity in nature and how it symbolizes diversity among humans. Includes ‘calleaf-graphy’ banner printing with spiritual symbolism. The art-science aspect is explored in an interactive, playful manner
- **educators working in environmental education.** These include park rangers, community leaders, neighborhood gardeners and staff working in nature centers, museums, municipal and regional parks. Educators

without art experience will find botanical printing an extremely easy way of illustrating botanical diversity, plant anatomy and the recording of variety, habitat and growth-specific data

- **art and design educators.** In private and public schools, college or trade schools. Botanical art and particularly botanical printmaking is an instantly rewarding way of studying composition, texture and proportion, and they relate, for example, to architecture, mathematics, and the interdisciplinary theories of order and chaos in nature
- **therapists and rehabilitation specialists.** These can apply botanical printing in their work. The activity engages the entire person, in that it unifies an individual's sensory, intellectual and emotional appreciation of plant structure
- **recreational instructors.** Those who work with people who have special needs
- **volunteers and staff** who create botanically-imprinted items (scarves, notecards, posters, neckties, for example) that can be sold in botanic garden gift shops, or at events attended by the public. Botanical printing is an educational and lucrative tool for fund-raising and public relations.

Personal background, teaching experience and the creation of botanical prints

This presentation at the congress was interwoven with 'show-and-tell' segments that included botanical prints on banners, scarves, posters and notecards. My professional background is in textile design, and my first explorations with leaf-printing were done entirely for commercial purposes; I directed a group of previously inexperienced teenagers and adults in the mass-production of hand-printed table linens for a major New York City department store. Since this project four years ago, my fascination with leaf-printing has continued to grow, in that it now embraces other plants, especially weeds and grasses. In addition to printing textiles that are sold throughout the USA, I teach botanical printmaking in municipal environmental education centers, art centers, and in schools.

It is here that botanical printmaking comes to full bloom. Each person interprets the possibilities and techniques presented to them in unique ways, often reflecting the diversity of their racial and cultural heritage. So while it is valid to use the art of botanical printing solely for scientific purposes, it has shown much scope for artistic exploration; the boundaries of traditional botanical illustration are stretched into contemporary environmental art and craft.

Visual presentations: art-science objects and slide transparencies

The presentation at the Congress also included slides taken during a leaf-printing workshop conducted in Central Park, New York City with families living in the nearby East Harlem neighborhood. Although it was late April at the time, and the majority of leaves available were from the previous fall (brittle, brown leaves), the tropically colored prints on paper, and the banners created by the class participants bespeak the richness of their 'inner' state of mind.

Poster prints were produced on white posterboard (24x 40 inches). They featured impressions of common weeds harvested in an abandoned lot in the Bronx area of New York City. Each plant was inked with black acrylic paint and subsequently placed onto the whiteboard. The task was difficult to do, because of the plant's increased weight, and tendency to droop down onto the page. (Such printing is ideally suited as a team activity in a classroom.) The plant was then covered with another large sheet of paper, and with equal pressure on the plant, two impressions were made simultaneously. Naturally, all layers of the set-up, plant and papers must remain in the same position until the impression is complete and the top paper is removed. With some practice, beautiful display posters can be created by staff, students or volunteers, which can be further embellished with hand-coloring and calligraphy.

Leaf-printed silk scarves are created from pre-sewn, imported silk scarf 'blanks', available from art and textile craft stores. Textile inks that are fixated with heat are most suitable for this project. (*Deka* is a German-made internationally sold brand). The scarves can be sold for fundraising, and they are also the subject of classes which guarantee filled workshops.

Leaf-printed banners illustrate the application of botanical printmaking for art-science projects and for botanical education. The idea of banners was seen as an ideal medium to have a portable means of making many statements without the use of many words.

The statements are designed to:

- raise awareness about (street) trees, the urban forest, and native forests throughout the world
- illustrate the diversity of trees and the diversity of leaf shapes
- make the analogy between plant diversity and human individuality on all levels
- inspire ecological and spiritual symbolism as an applied art form
- re-introduce the traditional technique of nature / botanical printing in a contemporary manner.

Banners suitable for indoor and outdoor display were imprinted with the images of 108 individual leaves. Each banner was dedicated to one tree variety, for example the ginkgo tree. This tree is very much part of the (New York) 'urban forest' in that it lines many of the streets. The following poem is dedicated to the ginkgo trees of New York.

Ode to the Ginkgo Tree

One ginkgo tree
and one hundred and eight of its leaves
each one unique
expressively
part of one greater unity.

One hundred and eight ginkgo trees
lining the street.
Are they the same?
Willfully present each one
rooted as you and I
with purpose in shared destiny.

One park
many trees.
Do you see their variety?
The wind moves their trunks and branches
and leaves resound to be heard by you and me.

Their shade in Autumn yields to sun,
absorbed with color, life
the tumble and we recognize
their path diverse is in this last
free-fall surrender of identity.

Life and decay
in imminent proximity
in seasons measured still by you and me.

But the ginkgo tree?
Imbued with medicinal substance
it pledges timeless allegiance.

Incarnate sum of consciousness
that we perceive as tree,
one hundred and eight of its leaves
beholding infinite harmony.

Leonore Wertel Aliniz
In celebration of the Ginkgo trees linking the street I live on.
New York City. Winter 1995/6

In a shorter version written specially for children, the poem was written on one of the three banners shown at the Congress. The images of the leaves on the banners were imprinted with black, opaque ink on to white, semi-transparent fabric. Their stark, graphic images contrast with the subtle irregularities of nature. On each banner, the leaf imprints were arranged in a different way:

In the first banner, leaves are in nine rows, separated by hand-written lines of poetry.

In the second banner, leaves are arranged as Rosetta, or mandala.

In the third banner leaves chase each other in spiral fashion, like the tail of a kite, going into the infinity of the sky.

The first and second banner bear the imprints of 108 individual leaves, stemming from one tree for each banner. Because the leaves are arranged in a distinct orderly manner, the viewer realizes how unique each leaf is. The same as how each finger-print reveals the individuality of a person.

The number 108 was chosen to symbolize 108 'perfect natural creations'. Each leaf symbolizes a complete life-cycle, from unfolding to decay. The life-cycle of leaves also illustrates the paradox of communality (appearance, common source, fate and cycles) and individuality. (The poem makes specific reference to this.) The number 108 is sacred in Vedic and Buddhist teachings. It represents nine times twelve. Prayer beads are strung in nine sections of twelve; a mantra is recited 108 times; so is the name of God, as in the sound of "Aum".

Conclusions

Botanical printmaking is an art and a science. The emphasis of classes and/or workshops can be on:

- the playful collaboration with plants
- the scientific documentation of plants
- decorative art and craft.

Classes and workshops can be run by adults and children in rural or urban environments. Workshops can also be tailored to meet specific space and time requirements. No previous experience is needed and while botanical printmaking is an instantly rewarding activity, it requires few inexpensive materials and equipment.

On a practical level, botanical printmaking can earn significant financial revenue. The classes and workshops are popular, and also, items made using the techniques shown, can be sold. Botanical printmaking is a hands-on activity enabling the study of plants, who's shape, structure and purpose are never incidental. Rather they express infinite diversity and order in nature. Botanical printmaking is a fascinating and addictive pursuit. The aim of this paper has been to encourage you to inspire others (who visit your gardens) to try their hand at it. They will experience 'in action' the gentle magic of plants and how they symbolize so much of our own life cycle.

Botanical art and ecological education

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Introduction

There is a botanical art revival going on and it is going on in countries around the globe; Great Britain, the United States, Japan, Australia, South Africa and Brazil are in the forefront, and there are botanical artists practicing in many other nations. Evidence of this worldwide revival is to be found in the prestigious International Exhibitions mounted by the Hunt Institute for Botanical Documentation in Pittsburgh. Another very prestigious exhibit, the Dr. Shirley Sherwood International Collection of Contemporary Botanical Art, opened to highly positive reviews in the spring of 1996 at Kew Gardens Gallery at the Royal Botanic Gardens, Kew, UK and generated lots of public interest in this art form. This collection subsequently toured the United States, where it was shown in New York, Pittsburgh, Charleston and New Orleans, amongst other venues.

This paper will focus on practical ideas that can be undertaken by botanic gardens. First, however, the definition of botanical art needs to be agreed upon. This paper only discusses the Western tradition, but not the long-standing and well-developed botanical art traditions of China and Japan. Botanical art is best defined as art that depicts a botanical subject in a way that is both scientifically accurate and aesthetically pleasing. It can be traced back to ancient times, to the stone relief carvings on the Egyptian tombs at Karnak.

Botanical art through the ages

The earliest known botanical artist was the Greek physician Cretavas, who lived in the first century BC. While none of his work survives, copies of his work illustrated a very famous book, the *Codex Vindobonensis*. This medical manuscript dates from 510 AD, and was itself a copy of an ancient Greek medical manuscript, *De Materia Medica*, by Dioscorides (c. 40-90 AD).

In the Middle Ages, botanical illustrations appeared in books called herbals, which focussed only on plants useful for their medicinal value. Many of these illustrations were copies of earlier illustrations, however, and inaccuracies abounded. Only with the rise of humanism, which joined art to science, did work appear that took nature for its model, as in the work of two great early sixteenth-century artists; Albrecht Durer and Leonardo Da Vinci.

During the sixteenth and seventeenth century artists still painted herbals. However, their illustrations became increasingly decorative, and more concerned with the beauty of the plant. In addition, explorers brought back exotic plants from all over the world. As a result, there was increased demand by botanists and other horticulturalists for accurate depictions of new species and varieties.

The mid-eighteenth to the mid-nineteenth centuries may rightly be called the golden age of botanical art, with practitioners including Georg Ehret, Pierre-Joseph Redouté, and Franz and Ferdinand Bauer. There is insufficient space to go into this fascinating period, save to say that all of these artists understood the science of the plants, their morphology, as well as the demands of their art. They worked in close association with scientists at the Royal Botanic Gardens at Kew and at the Jardin des Plantes, France, for example.

There is also insufficient space to go into the many reasons for the decline in botanical art. Suffice it is to say that botanical art declines substantially in prestige and visibility. The Royal Botanic Gardens at Kew, through its *Curtis's Botanical Magazine*, keeps some recognition of its value alive in Britain, and scientific illustrators continue to eke out a living. But in other places, including the USA, it has all but vanished from public view.

A contemporary revival

The increased interest in horticulture and ecology has helped spawn a contemporary revival. There is now (1998) an international organization, the Society of Botanical Artists, based in Britain, and there is also a Florilegium Society at

Chelsea Physic Garden. There are two botanical art organizations in Japan, and also the American Society of Botanical Artists, founded in 1995. The American Society of Botanical Artists is a non-profit organization dedicated to promoting public awareness of the botanical art tradition. There are approximately 400 members, including 25 International Associates. Many of the members have a strong ecological interest, for example Pat Savage of North Carolina, and Katie Lee of New York, who paint both the wild flowers and wildlife of the north eastern United States and also the animals and plants of the Galapagos.

Some of the specific ideas and activities that the above-mentioned organizations, and also various individuals and institutions, are involved in activities that can be adapted for individual institutions. Adapt, rather than take, as it is recognized that each social context is somewhat different. Also, different levels of resources exist to serve different audiences. Below are some of the ways botanical art is being used to further ecological education.

Exhibiting art on endangered plants, with civic/educational group tie-ins

One example of the potential of botanical art for ecological education is provided by Kate Nessler, a botanical artist living in Arkansas who is also the chairperson of the American Society of Botanical Artists. Kate was so inspired by the native plants she found growing on the Baker Prairie, a 71-acre virgin prairie in Harrison, Arkansas, that she wrote to the Arkansas Natural Heritage Commission, which manages the Prairie, to see if they would be interested in mounting an exhibit of paintings of the Prairie plants. They were, and in March of 1993 Kate started gathering plant specimens, working very carefully with a botanist on the site to guarantee that not a single specimen was lost.

The original goals were to document the wildflowers and grasses growing on the Prairie throughout the seasons; to create a traveling exhibit for artistic and educational purposes; to increase public awareness of the beauty and fragility of such a prairie; and to raise funds through the sale of limited-edition prints (a collection of four selected wildflowers which best represented the Prairie).

By August of 1994 Kate had completed 38 paintings. In addition to the paintings, the exhibit included information signs for each plant depicted, general information about the Prairie, a visitor's guide with educational facts and folklore about the wildflowers, print purchase information, and visitors' response sheets.

The exhibit traveled to sixteen different sites across the state of Arkansas, and each site approached the collection differently. It hung at art centers, universities, libraries, and in a high school media center. The media center used the exhibit as an informal, interactive project involving the entire community; county extension groups, art clubs, garden clubs, grade and high school students and so on. A high school Spanish class, for example spent a week learning plant and flower vocabulary, then viewed the exhibit speaking only Spanish and writing their reports in Spanish.

Moreover, the exhibit has been a topic for talks on the preservation of the tall-grass prairie as well as on the usefulness of botanical art. It has encouraged prairie walks and discussions on how the prairie 'sounds' and 'feels'. The artist and commission representatives did substantial outreach work, talking with art students and science students at all levels of education from grade school to colleges. For those places that did not have facilities to hang the exhibit, a complete set of slides was and is available for lectures and other presentations. Whenever possible, Kate herself participated in lectures and discussions about botanical art and the Prairie Project.

Thus what started as an artist idea based on a spring walk on the Prairie became a co-operative venture involving many different public agencies, from the Heritage Commission to civic and school groups. The great thing about paintings is that they are mobile; they can travel to different sites, and people can too – if like Kate they are dedicated to making a difference and raising public consciousness of endangered local ecology.

Inspiring adult students with a serious program in botanical art

At present, three botanical institutions in America offer certificate programs. The first to be set up was at the New York Botanical Garden, the second at Denver Botanic Gardens, and the third at the Morton Arboretum, outside of Chicago in Lisle, Illinois.

Each program is slightly different, and is tailored to the particular needs and interests of its audience. What they share in common, however, is a substantial time commitment; upwards of 70 class hours, a program that usually takes adult students about two years. Each program has a scientific component. Students learn the very demanding,

precise techniques that have characterized fine botanical art since the seventeenth century, and work in a range of media. Rule number one is that the work must be accurate and rule number two is that every detail must be readable by a scientist. All programs include a course in plant morphology, with students appreciating the fact that they cannot paint clearly what they do not understand intellectually.

The work that results is a far, far cry from the French Impressionists, or the more relaxing, less demanding paintings that you might see from family draw-ins in different gardens, or from courses where you use the garden as a background for feelings or emotions.

Why should someone want to get involved with such a demanding program? Obviously, for the challenge. The experience of the New York Botanical Garden, the Denver Botanic Gardens, and the Morton Arboretum has been that when serious certificate programs in botanical art were set up and publicized, enrollments climbed, and support for the programs grew

Forming botanical art organizations or sponsoring chapters of existing societies

At the New York Botanical Garden, a chapter of the Guild of Natural Science Illustrators meets, which keeps both students and alumni interested in the program and the Garden. At the Morton Arboretum, artists formed a Nature Guild, which included both plant and wildlife artists. The Nature Guild not only holds meetings and exhibits, but is active in all kinds of public outreach and special events held at the Arboretum, and has also donated work for fundraising in sales and raffles.

Sponsoring workshops that combine ecology and art

At the annual meeting of the American Society of Botanical Artists at the Strybing Arboretum, San Francisco, (with the Strybing as co-sponsor) a workshop was presented by Barbara Adair on painting the 'Rare and Endangered Plants of California'. Another Californian artist, Irina Gronborg, has presented workshops on the 'Trees of California', and also one in Arizona on 'Desert Plants'. Topics abound, for the ecologically aware.

Using botanical art in publications and collaborative efforts with other agencies

One of the key words associated with ecology in the American West is 'xeriscaping'. The botanical artists associated with the Denver Botanic Gardens, working under the guidance of Angela Overy, undertook a collaborative effort with the Denver Water Conservation Office. Twenty-five graduates of Denver's certificate program provided the illustrations for the *Xeriscape Plant Guide*, published by Fulcrum Publishing in 1996. This publication was aimed at helping the public use less water in an arid climate. Each artist completed paintings of three to five different plants selected for inclusion by the Denver Water Commission. A professional designer gave the book its overall look and sense of unity and all work was done for free. The Denver Botanic Gardens sponsored a two-day event to celebrate the book's publication. This event included water-wise plant seminars, a display of photographs and artwork, and an opening reception for the hundreds of people involved in the projects.

Angela Overy, who has written about this project and its challenges, says 'I recommend similar projects to other institutions. Although the challenges of working with so many groups can be intimidating, the result is well worth the struggle. Botanic gardens, plant societies, and many non-profit institutions are anxious to find fine-quality plant drawings and paintings at little or no cost for their publications, and there are fine botanical artists wanting to get their work published. Good botanical illustrations can impart information more precisely, and often even more beautifully, than plant photographs, and the *Xeriscape Plant Guide* represents a successful example of a co-operative effort to create a book combining the best of both.'

Sponsoring ecological art tours

Many are familiar with the controversies surrounding ecotourism. But for those who approach it responsibly, there is an audience of artists and art students who are interested in learning about the ecology of other localities. For example, two ASBA artists have sponsored tours focusing on the medicinal and flowering plants of the rain forest and another artist, Katie Lee, has taken a small group of artists with her to the Galapagos.

Involving school children in courses and exhibits

Much more of this has been done in Japan than in the states. In Japan, they hold annual botanical art competitions for older children and adolescents. In Brazil, the Fundação Botânica Margaret Mee raises funds to exchange students between Brazil and Kew. The Fundação also holds an annual competition with botanical paintings exhibited in the National Gallery in Rio de Janeiro. Children are involved in voting for their favorite painting – and last year their choice agreed with that of the judges.

There is so much that can be done in this area. Botanical art is a superb way of teaching careful observation and respect for nature's variety.

The American Society of Botanical Artists will be mounting a major educational initiative and will seek outside funding. Already a public clearing house has been established with information on both American artists and our overseas Associates. A slide lecture has also been produced that can be tailored for presentation to a variety of audiences. The newsletter, *The Botanical Artist*, includes columns such as 'Working With Others', that focus on how botanical artists can become involved with community organizations and programs. And another column informs the American audience about what is happening in botanical art elsewhere.

In conclusion, a reminder that people learn through many different channels. There is not one single form of intelligence, there are several different ones. Art is a form of intelligence that communicates to people in ways that other forms cannot, it can reach audiences who remain unmoved by lectures, by tours, by printed materials, by moralistic calls to ecological consciousness. A botanical art revival is under way, and the artists are increasingly ready and able to respond to institutional needs. This paper aimed to give you some ideas of how botanical art can be used to raise ecological awareness among different audiences and in different settings. It is hoped that it will set readers thinking about what they might do in their own position and institutional setting.

Primer programa de educación pública en el Jardín Botánico Nacional

Marcia Ricci

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Introducción

El Jardín Botánico Nacional, único como tal en Chile, con un área de 404 hectáreas, se ubica en Viña del Mar (latitud 33° S) a 120 km de Santiago de Chile. Fué creado como parque a comienzos de siglo y declarado jardín botánico en 1951.

Anualmente recibe un público cercano a las 80.000 personas; gran parte de éste son estudiantes de nivel básico y secundario que vienen a visitar las colecciones de plantas, en especial aquellas con problemas de conservación.

Dada su cercanía a la capital del país, el encontrarse en la principal ciudad turística y la segunda región de importancia en densidad de población y económica de Chile, donde existe siete universidades y una población estudiantil de más de 400.000 niños y jóvenes, es de vital importancia desarrollar un programa de educación para al menos, los primeros niveles.

Este programa de educación utiliza una metodología eminentemente práctica y participativa. Esto es de gran importancia, debido a que se está en la zona de más alta densidad poblacional del país, la más intervenida y contaminada, y la que posee menor porcentaje de áreas verdes de gran extensión.

Programa de educación

El énfasis del trabajo pedagógico está basado en la observación de la realidad circundante, en la práctica de labores de propagación y cultivo, en la experimentación en pequeña escala y en la sensibilización con respecto al papel de la flora y la necesidad de la conservación.

Además de llegar a alumnos de escuelas primarias, paralelamente recibirán capacitación los profesores de educación básica. Así, se podrá llegar a un número de niños mucho mayor.

Para la realización de este programa educativo se han seguido los siguientes pasos:

1. Se seleccionaron los contenidos didácticos acordes con los objetivos propuestos, tales como conservación, biodiversidad, adaptación, ecosistema, habitat, endemismo, contaminación, efectos antrópicos e impactos ambientales, entre otros.
2. Se seleccionan lugares del Jardín Botánico Nacional que poseen los elementos necesarios para desarrollar las actividades que correspondan a los contenidos que se entregan a alumnos y profesores.
3. Se elabora documentos de trabajo tales como guías para monitores, hojas de información complementaria y de apoyo para profesores y alumnos.
4. Se elabora recursos didácticos audiovisuales y material para experimentación.

Con lo anterior, se pretende que los escolares internalicen la problemática ambiental conociendo los componentes esenciales de la naturaleza, sus procesos y las relaciones sistémicas e intersistémicas que determinan el equilibrio.

Objetivos

En los diferentes sectores y rutas elegidas dentro del Jardín, se pretende mostrar tres grandes objetivos:

- **conocer las plantas:** a través de los órganos de los sentidos: tacto, olfato. Reconocer diferentes colores, texturas, olores, etc. A diferenciar las diferentes formas de crecimiento. Se pretende que los alumnos a través de la morfología, puedan llegar a elaborar hipótesis sobre la función

- **relaciones y adaptaciones:** nuevamente con observaciones dirigidas, llevar a que los alumnos descubran las diferentes relaciones que se encuentran en las distintas rutas: polinizadores, dispersadores, parasitismo, simbiosis, presa - predador, enfermedades que los afectan, etc.
- **contaminación, equilibrio y desequilibrio del ecosistema.**

Principalmente en el sector del Prado Hundido y La Laguna, se pretende que los alumnos distingan los diferentes compartimentos del ecosistema, y además, de potenciar el conocimiento de especies nativas. Junto a ello, los efectos del hombre sobre él: erosión, basuras, tala indiscriminada, etc.

Actividades

Las actividades se realizan al aire libre cuando las condiciones climáticas así lo permiten, y se culmina con un reforzamiento en las salas didácticas acondicionadas en el sector del vivero del Jardín.

Las actividades se han dividido en dos grupos, correspondientes a los ciclos de enseñanza básica:

- primer ciclo básico (niños entre 5 y 9 años):
 - observaciones de diferentes tipos de frutos, semillas, cortezas, hojas, troncos, etc, de especies presentes en el Jardín. Comentarios acerca de todo lo que el hombre obtiene de las plantas: comida, medicina, maderas, etc.
 - inventar canciones con las plantas que han visto, las relaciones y adaptaciones más relevantes para ellos y nuestro deber para con la naturaleza. Por ejemplo, el rap del suelo, o recordar “la Jardinera” de Violeta Parra
 - realizar una representación teatral o de títeres con aquello que más les impresionó: formas, amenazas por actividades del hombre, actividades de salvamento de algunas especies que han visto
 - representación conjunta de la germinación de una semilla
 - recreación de una trama trófica, con especies nativas, y posteriormente, las relaciones ecosistémicas
 - experimentos para formar suelo, para demostrar que las plantas producen oxígeno, etc.
 - sorteo de preguntas de la ‘caja de curiosidades de la naturaleza’
 - observaciones de diferentes tipos de hojas, cortezas, troncos, frutos, semillas, polinizadores, dispersores, etc.
- segundo ciclo básico (niños entre 9 y 12 años):
 - observaciones de diferentes tipos de hojas, cortezas, frutos, semillas, polinizadores, dispersores, etc.
 - Observaciones y comparaciones entre un habitat terrestre y un habitat marino (sala con recreación)
 - experimentos sobre propagación de plantas
 - canciones inventadas por ellos para representar lo que más les llamó la atención
 - la ‘Carrera del Saber’ entre diferentes grupos. En este juego se pretende reforzar las observaciones de diferencias entre las plantas, recordar el mayor número de especies nativas observadas, ayudar a desarrollar la observación para la formulación de hipótesis ecológicas y de conservación, etc.

Para ambos grupos, se finaliza mostrando las actividades de rescate que se realizan en el vivero del Jardín, especialmente a través de técnicas de horticultura: propagación de plantas a través de semillas (o esporas), esquejes, partición de bulbos, tubérculos, cormos, etc. Los cuidados que ellas necesitan y finalmente, técnicas de trasplante a macetas definitivas.

Valorización del programa

Como resultado de estos primeros meses de trabajo, se está validando las actividades propuestas para cada uno de los ciclos básicos con cursos pilotos. Con esta experiencia, y el apoyo de alumnas de la Carrera de Educación General Básica con mención en Medio Ambiente, de la Universidad de Playa Ancha de Ciencias de la Educación, Valparaíso, se pretende tener a fines del año 1996 un programa totalmente probado y que cumple con las necesidades de sus usuarios.

En la actualidad, este primer programa de educación pública en el Jardín Botánico Nacional cuenta con el apoyo del Departamento de Educación Extraescolar de la Secretaría Regional Ministerial de Educación teniendo así el respaldo necesario para que las escuelas y liceos de la Región puedan traer sus alumnos.

También en conjunto con la Secretaría Regional de Educación se está planificando un Curso-Taller sobre Educación Botánica y Conservación – como curso de capacitación para profesores de enseñanza básica del país.

Planting to replace: helping local communities to conserve their forest resources

James Ewane Sumelong

Mount Cameroon Project, Limbe Botanic Garden, P. O. Box 437, South West Province, Cameroon

The Mount Cameroon Forest area: history

Hundreds of years ago, a group of Carthaginian travellers standing on the decks of sturdy ships off the coast of Man O'War Bay, saw a high mountain in eruption. They called it 'The Chariot of the Gods'. That was Mount Cameroon. If those explorers were to come back today, they would see a rich green mountain in the place of the red and yellow volcano, which had so fascinated them. From the sea up to an impressive altitude, the whole area is covered by one of the richest forests in Africa. In fact this mountain now stands as a great symbol for the whole of Cameroon. Historically it is very rich. Early German settlement here has left many remains; architectural, cultural and agricultural. Buea, which is situated on the slopes of the mountain was once the state capital of the Southern Cameroon and is still the headquarters of the South West Province today. One of the more conspicuous reminders of the historical relationship between Germany and Cameroon is the Limbe Botanic Garden.

Geography and ecology

In terms of geography and ecology, Mount Cameroon is a unique and interesting place, for several reasons:

- it is the only area in West and Central Africa which presents a completely uninterrupted vegetation gradient from the coast through montane forest, savannah, to the alpine vegetation at its 4095m summit
- its rich volcanic soil has produced very dense forests, which include Mount Etinde and the Lowland forest of Mabeta-Mohwe. There is also a forest corridor which links the Mount Cameroon Forest to the Onge and Mokoko Forests in Meme and Ndian Divisions. These forests are rich in biodiversity, including:
 - ◇ 42 endemic plant species
 - ◇ 20 endemic bird species (8 of which are threatened) and 5 primate species (3 of which are endemic)
 - ◇ the highly-endangered forest elephant.
- Mount Cameroon is also an important watershed for an extensive area. The whole of Fako Division and beyond depends on the mountain for its supply of fresh water.

Socio-cultural issues

Mount Cameroon is of great cultural significance to the indigenous people. The cultural heritage of the people lies in the richness of the soil and its forests. The forests and all that is in them are a symbol of the continuity of life for these people. Certain animals, like the currently-threatened forest elephant, are sacred to the people. The mountain and forests hide numerous shrines and sacred groves where important religious rites are performed.

This rich volcanic soil has not only made trees grow in the forest, it has attracted a lot of people who came to this area to farm. The existence in Fako Division of the largest agro-industry in the country (Cameroon Development Corporation (CDC)) is sufficient proof of this. There are also many large farms owned by individuals, especially on the northern slope of the mountain. This agricultural frenzy has been heightened by the economic crisis which prevails in the country at present.

Many people have either lost their jobs in cities or do not earn enough to keep them going. The tendency is to open up a farm. The forests around Mount Cameroon are considered an ideal place. People are also ready to do anything to get money and some of these things are environmentally harmful.

The situation is worsened by the fact that the people are not formally educated. Both categories of people living in this area – the indigenous people and the settlers – need a basic education on the environmental hazards that they live with everyday.

Environmental issues

The most pressing environmental issue for Mount Cameroon is the loss of its biodiversity. Two main causes have been noted; over-hunting and deforestation:

- Hunting is carried out in the form of shooting and trapping. Previously it was a traditionally-accepted activity; animals killed were used mainly for subsistence. Although hunting was not an issue then, it is now commercialized and the number of animals killed is alarming. This has had an effect on the ecological system of the area in, for example, the reduction of seed dispersal due to the diminishing numbers of animals acting as carriers. The survival of some plant species is jeopardised in this way.
- There is uncontrolled habitat destruction through commercial logging and the collection of firewood. Around the mountain there is a steady encroachment on the forest through clearing and burning, mainly for hunting and opening up new farms. CDC owns vast areas of virgin forest, more of which is opened up to plantation agriculture almost every year. The forests also contain certain plant species which are harvested without any replacement. This trend has been accelerated by the economic crisis and the quest for money. Species which are collected for food include *Gnetum africanum* (eru), *Irvingia gabonensis* (sweet bushmango), *Irvingia wumbulu/Irvingia excelsa* (bitter bushmango), *Afrostryax kamerunensis* (bush onion), and *Piper guineensis* (West African bush pepper). In addition to several timber species, there are also medicinal plants such as the controversial *Prunus africana*.
- Soil erosion is already in evidence, with too much water running down the mountain. The cause is said to be the disappearance of the forest. In the rainy season, rocks and pebbles are hurled down the mountain by very powerful run-offs. In 1995 in Buea, the capital of the South West Province, a major road was destroyed by running water. Traffic stopped for days and the Minister of Public Works was called in from Yaounde.

The Mount Cameroon Project

These activities by themselves send out a loud appeal for something to be done to save the collapsing ecological system on Mount Cameroon and its surrounding forests. The outcry has been heard by several interested bodies, such as the British Overseas Development Administration (ODA), the German Aid Agency (GTZ.) and the Global Environmental Facility (GEF) of the World Bank. These bodies are collaborating with the Government of Cameroon to address this burning issue through the Mount Cameroon Project (MCP).

The Mount Cameroon Project, which has existed for two years, comprises four parts; administration, forestry management, community development, and the Limbe Botanic Garden.

The existence of the Mount Cameroon Project has widened the scope of Limbe Botanic Garden. It has created the opportunity to go beyond the Garden's walls and actually implement projects born of research carried out in the Garden. The aim of the Mount Cameroon Project is to maintain the biodiversity of Mount Cameroon, using a participatory approach, which benefits local communities two-fold, because in addition to having their forests maintained, they also acquire certain skills.

The example of *Prunus africana*: its distribution

Prunus africana (Hook f.) is a sub-Saharan African montane tree species which occurs from Côte d'Ivoire to Ethiopia and down to South Africa, including the islands of Madagascar, Grande Comore and Sao Tomé.

In Cameroon *P. africana* occurs in the montane forests of the Southwest, North West, Western and part of the Adamawa Provinces (near Banyo). In the Mount Cameroon area, this plant is called *wotangu* in the Bakweri language.

***Prunus africana*: description**

Prunus africana is a tall tree, growing to a height of 30m, usually with a straight trunk. The leaf-type is simple, alternate, oval or lance-shaped. The fruits are spherical, two-lobed drupes (some are single) about 10 mm in diameter (about the size of a coffee grain) and intensely bitter. The wood is reddish brown, heavy and hard.

P. africana is a light-demanding tree which grows well in fertile, well-drained areas. One of the reasons for its decline in numbers is the poor environment for the seedlings to establish themselves, the fact that seedlings cannot survive in the dim floor of the primary forest. They grow better on the forest borders, or in patchy, disturbed areas

Medicinal uses

The uses of *P. africana* as a medicinal plant vary from one region to another. Where it occurs in eastern and southern Africa, it is used as a purgative for cattle (Kaulkman, 1965). It is also used as an inhalant to cure fever and stomach ache. In the North West Province of Cameroon, it is used as an infusion in hot water to cure fever. In the area around Mount Cameroon the bark is used as an infusion in hot water to cure chest infections. It is sometimes used as a tonic; a tea from the bark is drunk and vomiting is then induced by stimulating the epiglottis.

The greatest use so far of *P. africana* has been by the pharmaceutical industry. If this plant is over-harvested today, it is to satisfy the needs of industrial concerns such as Plantecam Medicam (Cameroon), Laboratoires Debat & Fournier (France), Indena Spa (Italy) and Merok and Dohme Ltd (Germany). *P. africana* extracts are used for the treatment of prostrate gland inflammation suffered by males of over 70 years of age (ICRAF 1994). The drugs so far produced from it are Tadenan (Laboratoires Debat), Pygenil (Indena Spa) and Proscar (Merck and Dohme).

Non-medical uses

The timber of *P. Africana* is used for hoe, pick and axe handles, and the poles for fencing, firewood and charcoal. The wood is good for making furniture, although when dried the wood is liable to split during nailing. But nevertheless, it is quite durable, can be easily smoothed and varnishes well. The fruits are eaten by some rodents, bird and primate species, some of which are endemic to the Mount Cameroon area.

Threats to *Prunus africana* in the Mount Cameroon area

Threats to *Prunus africana* on Mount Cameroon are from two angles, human and natural:

- The human threat to *Prunus africana* in the Mount Cameroon forest area is far greater than the natural threat. This shows itself in two ways: over-harvesting and unsustainable harvesting.

Before 1985, the harvesting of *Prunus africana* did not pose a problem because it was monopolised by Plantecam Medicam. However, in 1985, about 50 Cameroonian entrepreneurs were given licences to harvest *Prunus africana* bark. The quantity harvested more than doubled between 1985 and 1991, as an annual average of 1923 tons of bark were harvested; at least 63% of the world market. For this harvest, 35,000 trees were debarked in approximately 63,000 ha of forest (Cunningham and Mbenkum, 1993). In the month of June 1994 alone, 50 tones of bark was confiscated by Forestry Officers on Mount Cameroon. All this shows how much *Prunus africana* bark is harvested. When in 1993 the Government of Cameroon issued yet more licences to exploiters and exportation became general, the price per kg of *Prunus africana* bark moved up from CFA60F to CFA250F and the situation worsened.

The over-harvesting of *Prunus africana* without replacement is an issue in itself. Plantecam, which was then the only exploiter and exporter, used to train harvesters of *Prunus africana*. It was usually done in the dry season (October-May) and Plantecam staff were assisted by young men from the nearest village. Only two quarters (north and south or east and west sections) were to be taken from each main stem up to the first branch. When the price rose four-fold to CFA250F, this golden rule was disregarded. Trees were debarked as the harvester thought fit. Some trees were debarked up to the smallest- branches and others were even felled for maximum bark collection). In a place like Oku, 80% of mature trees died as a result of poor harvesting methods. There is evidence from field trips that the population of *Prunus africana* is declining, with some trees completely dead and others having most of their branches dead.

- There is a natural threat to *P. africana*, caused by the high predation on its seeds by animals and birds. This reduces the possibility of natural propagation. These predators may have been reduced by hunting but natural succession of this plant is still difficult, because even if the seeds of *Prunus* can germinate without light, the seedlings cannot survive without sufficient light. Almost 100% seedling mortality has been observed in the dim forest canopy.

Rationale for action: the issue

The wanton destruction of *Prunus africana* has raised concern in several quarters. The current status of this plant has been much discussed. Today, the question of its survival is no longer a simple conservation issue, but has expanded to involve the whole cultural heritage of the Bakweri tribe. There are a few surviving *wotangus* on the Mountain. What of the future? For how long will these trees remain standing? What will stand in their place when they die or are felled? For the Mount Cameroon Project, it goes without saying that these plants should be replaced.

Involving local communities

The participatory approach of the Mount Cameroon Project is very beneficial to the local people around Mount Cameroon. By maintaining their forest, they ensure the maintenance of their cultural heritage. The planting of *Prunus africana* alongside other species is one way of maintaining their forests. The MCP and Limbe Botanic Garden have been active in educating and encouraging local communities to undertake the cultivation of *Prunus africana* to replace damaged stocks.

Community education

The living collection of the Garden has been arranged according to themes. This arrangement has been made to highlight the inextricable link between plants and people. Local people visit the garden for free, and the feedback that the Garden has received from them has been enriching. In fact the idea of cultivating economic plant species in already-established farming systems came from visitors to the Garden. Cultural events are organised on special occasions in the ‘Jungle Village’ (a natural amphitheatre in the Limbe Botanic Garden). During such meetings local people are shown the importance of plants using guided garden tours. Seminars and workshops on conservation education are organised with local school teachers in the Jungle Village and in other open-air areas of the Garden.

For communities that are a long way from Limbe, slide shows and lectures are organised in their villages. These activities teach the people a lot of things, including necessary techniques such as harvesting roots and barks and, more importantly, the absolute necessity for the forest (and therefore their culture) to survive. Fortunately local people understand the issues and are showing a lot of interest in conserving their forest resources. One example is the village of Mapanja, which successfully barred Plantecam Medicam and other licenced harvesters from debarking *Prunus africana* plants in their forest.

Other community benefits from the Limbe Botanic Garden Nursery included:

- the Cameroon Development Corporation (CDC) established a 3 ha plantation of *P.africana* in Moliwe. It was the first plantation of *P. africana* anywhere in the world and is a direct result of the propagation programme of Limbe Botanic Garden. CDC has already planted 7000 seedlings supplied by Limbe Botanic Garden Nursery
- in the North West Province, a ‘Women in Development’ cooperative has planted a further 1.5 ha of *P. africana*, with seedlings from Limbe Botanic Garden Nursery
- the Forestry Research Division of the Mbalmayo Forestry School received *P. africana* material to undertake further trials in vegetation propagation
- a ‘Women in Development’ cooperative in Fako Division received 1000 *P. africana* seedlings from the Botanic Garden nursery for small-scale planting in fallow areas
- *P. africana* is prominent in the medicinal plant area of the Limbe Botanic Garden. The area was developed using material from the ‘Conservation through Conservation’ Programme. The educational value of such thematic planting cannot be over-stressed
- the Community Development Unit of the MCP has distributed 250 seedlings of *P. africana* to some villages

- The International Centre for Research in Agronomy (ICRAF) intends to establish a gene bank for *P.africana*. Limbe is currently (1996) raising 1700 plants for this.

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A new educational tool for Siberians and ecotourists

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Siberia occupies the largest part of Russia. When people hear the word "Siberia" they often imagine cold, hard winters, prison camps and desolation. This is partly true, because the growing season is only about 100 days, but there are many more aspects of what makes up Siberia.

For instance, Lake Baikal is the deepest lake in the world. It is one mile deep and contains more water than all the North American Great Lakes combined. The Lake itself and its surroundings possess a unique flora and fauna. Over 60% of the 2635 species of plants and animals of the Baikal region are endemic. More than 140 species of the total of about 1800 terrestrial higher plants are included in the list of rare and endangered plants. It has been proposed that in the next few years the Lake Baikal region will be recognized by UNESCO as a World Heritage Site.

The main part of Baikalian Siberia is covered with a wild conifer forest called 'taiga'.

The Botanic Garden of the Irkutsk State University is situated in Irkutsk City, the capital of Irkutsk Oblast. The population is a little over half a million. The Botanic Garden of the Irkutsk State University is the only botanic garden within two thousand miles. It was founded about 60 years ago as a soil and biological research station of Irkutsk State University. It is situated in the heart of the city. According to a new Russian environmental law the Garden, which covers an area of 70 acres, is considered to be a Natural Protected Territory.

Before *perestroika* our mission statement and purpose were very simple. It was to function as an educational facility exclusively for University students. After *perestroika* in Russia, when our country shifted from a totally controlled economy to a market economy, many new demands arose from the general public for free access to the Botanic Garden.

The Garden's collections of living plants, display gardens, educational greenhouses, the library, the herbarium of native plants, special TV programs and articles in local newspapers, are very useful for its expanded educational role.

To meet the increasing demands of the public, more advanced educational programmes are continually being developed to serve different targeted groups of Siberians and ecotourists. Visitors and students have a good opportunity to experience the controlled environment of our greenhouses and conservatories throughout the entire year. This is very important for Siberia, because of its extremely short summers.

Every second family has a small piece of property outside the city limits, referred to as a 'dacha'. They are used exclusively for growing vegetables and fruits to sustain the families throughout the year. People grow approximately 63% of their food and therefore have an excellent working knowledge of growing plants, starting from childhood. Most children know the importance of growing food for survival, because of the difficult economic situation in Russia. People in Irkutsk are very resourceful and they take responsibility for providing themselves with plants for food to prepare for the long winter in Siberia. People are very interested in the advanced growing techniques that the Garden disseminates through classes and practical training. People are also interested in obtaining new healthy plants and seeds to grow at their dachas.

Another popular demand on the Irkutsk Botanic Garden is in the area of the development of local ecotourism. These people are mainly foreigners. Tourism is becoming a major industry in and around Lake Baikal. This diverse landscape of clear water, majestic mountains, expansive taiga, and the mosaic of steppe and forest is ideal for ecotourism development. It is very useful for educating people about our native environment, building on people's natural desire to preserve nature. Scientists from the Irkutsk Botanic Garden take part in organizing and leading ecological tours for people in areas of Northern Lake Baikal. Plants are identified, described and systematically described by our botanists, and the resulting information is included in brochures. These enable both tourists and local visitors to enhance their knowledge of the native plants of central Siberia.

Ecotourism is becoming a very popular way to educate and share with people the richness of the native flora and fauna of this part of the world. Betchart Expeditions, in conjunction with the Chicago Botanic Garden and American Association for the Advancement of Science (AAAS), along with several Russian scientists, have brought several tour groups from the United States to Lake Baikal. Russian scientists were able to enhance the educational value of these tours through their specialist knowledge and their first-hand experience, based on their years of involvement with the Lake. These trips were an extremely successful collaboration.

Healing plants: medicine across time and cultures, an outdoor exhibition and medicine trunk

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Introduction

This paper is an overview of the largest outdoor exhibition ever presented at the Morris Arboretum of the University of Pennsylvania, entitled "Healing Plants: Medicine across Time and Cultures". Also included is an introduction to the Medicine Trunk curriculum and the Healing Plants tour for children, in addition to a compendium of Healing Plants programs for adults.

The Morris Arboretum has created an outdoor exhibition and a related hands-on curriculum which explore the cross-cultural, historical and world-wide use of medicinal plants. Exhibition panels introduce Arboretum visitors to the diversity of medicinal plants and their traditional use by African-Americans, Asians, colonial settlers and Native Americans. The Medicine Trunk contains six lessons and was created for use in grades 2-5. Children discover the similarities and differences between medicinal plants and the people who use them, with materials such as a map of the world, cards illustrated with medicinal plants, smell jars and plant presses. This interactive curriculum, for use in the schools, is complemented with a visit to the Arboretum. During their Healing Plants tour children search for live medicinal plants, pretend they are healers, and 'prepare' herbal remedies.

Healing plants

The Healing Plants project has been six years in the making. It began on July 5 1989 when a specially created Arboretum committee met to outline plans for an international symposium on 'Plants as Medicine', in collaboration with the World Health Organization. The symposium met in Philadelphia in 1993 and for the event we created a preliminary outdoor exhibition: a tour of medicinal trees at the Arboretum. Our modest self-guided tour greatly appealed to our visitors, and this persuaded the staff to consider expansion.

We approached the National Endowment for the Humanities (NEH), a Federal agency, with our idea for a major outdoor exhibition on medicinal plants. NEH was impressed by what we had accomplished and the ideas we presented. Subsequently in December of 1995 the Morris Arboretum was awarded \$250,000 from NEH to create the Healing Plants outdoor exhibition and related programs.

The Healing Plants program has been a unique endeavor for the Arboretum staff in several ways. Not only is the outdoor exhibition the most significant interpretive effort at the Arboretum to date, it is also the first educational project that has been elevated to program status. In other words, the program was not developed in isolation by one person in one department. Instead, as project manager, I worked closely with staff from every department of the Arboretum including Horticulture, Development, the Center for Urban Forestry, Business, Botany, Communications, Physical Facilities, and Education. We met as a committee every two to three months to keep everyone informed of progress and to solicit input, and in between the committee meetings I worked individually with staff from different departments to move the program forward. The interdepartmental involvement in program development and implementation has cultivated a sense of ownership for the Healing Plants exhibition among the Arboretum staff. It has also increased the prominence of Education, with a capital "E", since staff from all departments have contributed in some way to this major educational program at the Arboretum.

I believe that over the past year and a half, staff have increased their understanding of the educator's perspective in exhibition development and how it relates to their part in the process. I have seen staff become less resistant and more accepting of the rationale for approaching their work in a manner that facilitates reaching the set educational goals and objectives of the Healing Plants program. For example, the horticultural staff designed medicinal plant displays so that labels describing the medicinal uses of plants were easy to view. It was a new feat for the Arboretum to have educational goals dictate garden design.

Healing plants – an evaluation and prototyping

This program has been full of firsts for the Arboretum. In addition to it being our first major interdepartmental interpretive program, it was the first time that substantial resources were committed to evaluating prototypes before the permanent features were in place. It was also the first opportunity we had to develop a hands-on, interactive school curriculum with a complementary Arboretum tour for children.

In the fall of 1995 and the spring of 1996 staff and volunteers conducted evaluations of the outdoor exhibition, the Medicine Trunk and the children's tour. Staff involvement in the evaluation process greatly contributed to their increased ability to quote "see" things through the eyes of an educator. They learned evaluation techniques and were introduced to museum standards for developing interpretive panels. Despite some initial resistance, Physical Facilities staff supported the need to create prototype exhibit panels. They came to appreciate the value of crafting mock-up stations to actual size in the garden in order to critique possible designs for their aesthetic and functional qualities. Through evaluation we also learned a great deal about the content or information presented on our mock-up storyboards.

Evaluators asked visitors a series of questions to see if the intended messages were clearly presented and of interest. As a result of visitors' suggestions, some exhibition panels were completely changed, while others had only subtle changes made. Over and over again we received requests to include more information about current scientific research and the modern-day uses of medicinal plants. In our initial storyline developments we shied away from presenting much about the current use of medicinal plants, for fear of liability suits and concerns about accountability. Instead we presented more about the historic or past uses of medicinal plants.

As a result of our evaluation, all exhibition panels now highlight the past and present uses of medicinal plants. To protect ourselves we include a disclaimer or word of caution on every exhibition panel stating that the exhibition aims to provide information and stimulate awareness of plants as medicine. The information is primarily for reference and education. It is not intended to be used for self-diagnosis or self-medication. We also recommend that the diagnosis and treatment illness should come under the direction of a qualified health-care professional.

Themes and exhibition areas

Three major themes are presented throughout the exhibition and related programs:

- ◆ the diversity of cultural practices and how this governs how medicinal plants are used in specific cultures and in different historical periods
- ◆ the significance of botanic gardens and arboreta in Western scientific tradition and the important role they have played in plant medicine for several centuries
- ◆ the ethical considerations related to the preservation, conservation and stewardship of the world's resources.

Six garden areas have become outdoor mini-galleries with large exhibition panels. Below are some of the stories told in the exhibition:

Since the rose garden at the Morris Arboretum is patterned after the design of other university gardens, it is a perfect place for us to learn about some of the first university botanic gardens such as Padua and Oxford, which grew medicinal plants for use in their medical schools. Here visitors also learn about a medicinal tea made from the flowers of the apothecary's rose, which is approved in Germany for the treatment of mild inflammations of the mouth and throat. Visitors also discover that dog-rose hips are valued for their vitamin C.

Near the herb garden visitors learn about the European tradition of growing medicinal herbs in cultivated garden areas. They see an example of a medieval herb garden and historic Philadelphia herb gardens such as the one at the College of Physicians of Philadelphia, which grows medicinal plants that were used in the 18th century.

Another station explores how botanic gardens, pharmaceutical companies, and other research organizations are working together to discover and cultivate medicinal plants. Visitors learn that only a small percentage of the world's flora has been tested for their medicinal value, but even this sample has already produced treatments for cancer, glaucoma, and other major diseases. The botanist Jay Walker of the Institute of Economic Botany of the New York Botanical Garden can be viewed collecting the pods of the San Juan tree, which are then shipped to the National Cancer Institute to be screened for their usefulness in treating cancer and AIDS. The Morris Arboretum, in collaboration with the international pharmaceutical company SmithKline Beecham, conducted research during 1988-1995 on *Camptotheca acuminata*, a valuable plant in the fight against cancer. This Chinese tree contains an anti-

tumor compound recently approved by the Food and Drug Administration for treating severe cases of ovarian cancer in women whose cancer does not respond to other forms of treatment. Visitors also learn that weeds and other familiar plants have medicinal uses such as the dandelion, which aids digestion, and the purple coneflower, which soothes cold symptoms.

Multicultural aspects

The multicultural emphasis of the Healing Plants exhibition is concentrated in three exhibit areas. One station is devoted to African-American herbal traditions. Visitors are introduced to Blanche Epps, a Philadelphia herbalist who specializes in the use of weeds and food herbs for healing. Perhaps to their surprise, visitors also learn that some plants that were used medicinally in the past should no longer be used, such as the sassafras tree, whose root bark was made into a tea to purify blood, for stomach and kidney problems and as a tonic. Today, modern research has shown that the essential oil of sassafras bark is a strong liver toxin and is cancer-causing.

In another station devoted to Native American and colonial plant medicine traditions, visitors see a sample recipe from a colonial remedy book and learn about the treasured medicinal plants that settlers brought with them. They also meet herbalists such as Nora Thompson Dean, a Delaware Indian, who they see sprinkling herbs over a sacred fire.

In the final exhibit area visitors learn about some of Asia's herbal heritage. The Chinese were the first to discover that using plants to heal depended on the interaction of many different chemicals in plants. The exhibition shows examples of familiar plants in American neighborhoods and botanic gardens which are used as medicine in China. Daylily root is used in China to treat cancer. Chrysanthemums are traditionally used to relieve headaches. *Forsythia* stems and leaves treat conditions of the heart and lungs. *Forsythia* seed capsules are used for urinary infections. In Kampo, Japan's traditional plant medicine, prescriptions contain up to thirteen different herbs.

Ancillary programs

The Healing Plants outdoor exhibition is primarily for adult visitors. Additional Healing Plants programs for adults include two indoor art exhibits. One featured Amazonian photographs by the father of ethnobotany, Dr. Richard Evans Schultes. The second was a print collection of medicinal plants mentioned in Shakespeare. As part of our adult continuing-education program we have offered classes and workshops on various topics related to healing plants. By spring 1997 a catalog and self-guided tour will be produced to complement the outdoor exhibition. Lastly, on October 12 1996, the opening of the outdoor exhibition with a Healing Plants festival will be celebrated. This will be a fun-filled day for the entire family.

The medicine trunk

Designing the Healing Plants program for children presented another challenge. Most children think of medicine as something that comes in a bottle, capsule or tube at their local drugstore. The Medicine Trunk was developed for school children in grades two through five, to teach them the cross-cultural, historical, and current uses of medicinal plants. The Medicine Trunk is a box that contains materials and a hands-on interactive curriculum. Prototype Medicine Trunks were developed and tested by teachers and students in the Fall of 1995 and the Spring of 1996. In the "Medicinal Plants in Your Life" lesson, children interview adults to find out what they know about herbal remedies and they examine labels of common medicines which are made from plant compounds. In the "Where do Coughdrops Come From?" lesson students learn how medicinal plants are used all over the world. Here we see sample medicinal plant cards. On the front of each card is a description of how the plant is used medicinally in that continent, and on the back of each card is general information about the continent's climate and the people who live there. Children do some independent research and make posters about medicinal plants that have significant economic importance such as corn, coffee, and cocoa. They then present these to their classmates. In the "Creating a Neighborhood Herbal" lesson students gather and press plants from their school yards or neighborhoods to create a classroom herbal. In both the Medicine Trunk and Healing Plants tour for children at the Arboretum, safety messages and warnings about the dangers of misusing plants or trying to use a plant as medicine without the guidance of an adult are reiterated and reinforced in every lesson and activity.

Healing plants children's tour

After children have done at least one lesson from the Medicine Trunk, they can visit the Arboretum for a special Healing Plants tour. On the tour children learn more about how people from different cultures use plants as medicine. Mortars and pestles, a kettle and saucepan; these are the tools students use to crush, grind and pretend to steep and boil samples of dried plants to make herbal remedies. In our log cabin volunteer guides pretend they are a colonial healer and ask students to imagine they are their apprentices. Together they "prepare" tea from plantain seeds, a lotion from witch-hazel twigs and leaves, and a tea from dandelion leaves.

A Guide will ask "Where do medicinal plants grow? Did you know that healing plants grow everywhere, even in the grass under our feet"? With a frame in hand, students search the grass for valuable medicinal weeds such as white clover, plantain, oxalis, ground ivy and dandelion. Children are surprised to learn that the familiar yellow dandelion flower, as well as its roots and leaves, have all been used as medicine.

In the Fernery, students search for ferns with medicinal value. At the Arboretum's herb garden, students pretend they are a Native American, African-American or Asian herbalist. Their task is to guess a symptom (e.g. stomach ache, sore throat) acted out by one of the students, and then "prescribe" a plant to cure the patients ills. Colorful cards, with pictures of medicinal plants and description of how to treat certain symptoms, help children discover that, according to different cultural traditions, the same plant sometimes treats different ailments and at other times different plants treat the same ailments. Children read and share information about the plants on their cards, then search for the live plants growing in the garden.

Evaluation and feedback

The Medicine Trunk and the tour seem to be successful in providing a way for children to begin to reshape their attitudes about medicine AND plants. Teachers have also been pleased with using the prototype Medicine Trunk, because its lessons can be integrated into almost any curriculum, for example: social studies, science, mathematics, and history. The visit to the Arboretum then brings the lessons to life for both student and teacher.

Healing Plants: Medicine Across Time and Cultures is a significant achievement for the Morris Arboretum. As educators we are reaching outside of our department to draw on the expertise of the entire Arboretum staff. As plant scientists we are reaching outside of our own sphere of research to consult with local herbalists and practitioners. And finally as exhibit curators we are continually asking our audience how we can better communicate the layers of culture and science that we have uncovered in the creation of this program.

The role of botanic gardens in the dissemination of ethnobotanical knowledge in Kenya

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Introduction

Economic development in Kenya, which is and will continue to be largely dependent on the exploitation of plant resources, is at present unsustainable. Many of the plant resources are being mismanaged and cannot sustain their present rates of use. To this effect, biodiversity and the issue of the sustainable use of plant resources have become a primary and urgent concern for the Kenyan government. Botanic gardens have played a major role in the economic, cultural and scientific development of many countries in the world. They have an important role to play in conservation of plants, but conservation cannot succeed without education.

Kenya has few public displays and educational collections that can serve as botanic gardens. There is thus an urgent need to establish botanic gardens in every ecological zone of the country, which can then act as centres for environmental education. Already, plans are at an advanced stage to develop a botanic garden at the National Museums of Kenya (NMK) site. The UK Overseas Development Administration (ODA), through the Plant Conservation Programme at NMK, is committed to funding the initial development stages of the proposed botanic garden. The botanic garden will attempt to address the issue of education for sustainability by teaching about the links between plants and local indigenous people.

Collection and documentation of ethnobotanical knowledge for education

Ethnobotanists in Kenya are playing a very useful role in rescuing disappearing ethnobotanical knowledge and returning it to local communities. The scope of the ethnobotanical knowledge to be collected and documented is very wide as it relates to all aspects of a community's life, including agriculture, taboos, conservation, religion, myths and other plant uses.

Different local communities in Kenya have various uses for particular species of plants. Ethnobotanical knowledge is generally richer among the pastoral communities that depend a lot on the environment for their survival.

Educators in botanic gardens may employ basic methods of collecting indigenous knowledge from local communities though, in my view, the exercise should be left entirely to ethnobotanists and other researchers. Collection may be done through interviews, observations and guided tours. Basic guidelines, which may be followed for collecting ethnobotanical knowledge for documentation, are:

- consumption uses of plants in different communities
- cultural ceremonies that involve plants
- customs, myths and beliefs that enhance plant conservation
- cultural factors that threaten biodiversity.

It is perhaps important to highlight the efforts of NMK as regards the collection and documentation of indigenous knowledge in Kenya. Through its Centre for Biodiversity (CBD) an action programme has been developed that gathers, stores, analyses and disseminates biodiversity information required for sustainable utilisation of biological resources. One of the many objectives of the CBD is to document the indigenous uses of biological diversity and, where appropriate, promote them with the full participation of local communities.

The CBD has two main programmes that will be invaluable sources of ethnobotanical knowledge for botanic gardens in the country; the Biodiversity Database Programme and the Kenya Resource Centre for Indigenous Knowledge (KENRIK) programme. The Biodiversity Database will serve both as a provider and collector of ethnobotanical information for botanic garden education. KENRIK is perhaps the most important contribution of NMK to the collection

and documentation of ethnobotanical knowledge. KENRIK identifies and records indigenous knowledge with a view to preserving cultural and biological diversity for future generations. It further promotes ethnobotanical studies, establishes databases, and carries out community-based research and conservation programmes. Already it maintains an indigenous food plants database with over 800 records of edible plant species in Kenya.

It is anticipated that the proposed NMK botanic garden will greatly utilise the ethnobotanical knowledge that is documented at CBD for environmental education programmes. The collation of indigenous knowledge for the purpose of environmental education is proposed as one of the main activities in the education policy of the proposed NMK botanic garden.

Ethnobotanical approaches to biodiversity conservation

Although Kenya has a very diverse cultural heritage, each community has developed land use systems which include environmental strategies. Most local communities had in-built practices that enhanced conservation of biodiversity. Rationalised harvesting of plant resources ensured sustainable supplies, while over-exploitation was avoided. This does not however imply that human-induced environmental change and degradation did not occur, but it was modest compared to present-day changes.

Respect for ancestral spirits directly contributed to biodiversity conservation. For instance, plants that existed in shrines were protected, as trees were not felled there. The belief that ancestral spirits lived in caves and rock shelters among some communities (Odak, 1990) assured conservation of biodiversity where such physical structures were found. The landscape and trees in such sites were protected against destruction. Trees that were regarded as sacred or ceremonial were never used for any purpose. In many local communities, all big trees were respected and large forests were regarded as sacred.

Myths, taboos and superstitions were also an ideological mechanism of managing plant resources. In some communities, trees near water resources were never cut for any purpose, and if anyone contravened this taboo, the person was fined or punished by a council of elders. Among some tribes, *Erythrina abyssinica* was the basis of a curse and it was believed that the wood could never be burned for fear of attracting lightning. Myths and beliefs that promoted biodiversity conservation are still abundant in Kenya.

It is however disturbing to note that there is a serious tendency for people in Kenya, especially the elites, to abandon the traditional cultures in favour of western cultures. Many have adopted values, attitudes and tastes of western cultures to the detriment of the indigenous ones (Kipkorir, 1980). Consequently, in places where beliefs and superstitions associated with sacred sites have been abandoned, the sites have been degraded and the associated biodiversity damaged. Species of plants that were valued in indigenous cultures have been gradually abandoned in favour of exotic ones. Extensive cash-crop farms occupy lands that supported a wide variety of valued indigenous species (Gatheru, personal communication). One way of arresting this situation is to promote dissemination of ethnobotanical knowledge through botanic gardens.

The potential role of botanic gardens

The Global Biodiversity Strategy (WRI, 1992) lists deficiencies in knowledge and its application as one of the fundamental causes for biodiversity loss. The proposed NMK botanic garden will endeavour to disseminate ethnobotanical knowledge to the public, thereby reinforcing links between local communities and the environment (Martin, 1992). By incorporating ethnobotanical knowledge in its environmental education programmes, the botanic garden will help restore a sense of pride in local cultural knowledge and practices.

One major goal for the proposed NMK botanic garden will therefore be to facilitate the transfer and assimilation of ethnobotanical knowledge. This will promote integration of environment and development, and enhance awareness of, and concern for social and ecological approaches to education for sustainability. Generally, environmental education is not very well developed in Kenya. There is limited use of indigenous knowledge in developing training programmes and little consideration is paid to socio-cultural aspects and the interests of target groups. A major constraint is the shortage of funding and of basic teaching and learning resources and facilities. When they are established, botanic gardens will enhance both formal and non-formal environmental education. Non-formal environmental education has a long history as regards to the protection and conservation of sites of interest by the different cultural groups in Kenya. Sustainable development can only be achieved with the support and cooperation of an informed public.

Various approaches will be used in the dissemination of ethnobotanical knowledge at the proposed NMG botanic garden. These will include workshops, lectures, story-telling sessions and outreach programmes. Story telling and the compilation of folklore narratives that enhance biodiversity conservation will be a major educational activity at the garden. Cultural activities that involve use of plant resources e.g. traditional dances, drama, culinary and technology exhibits, will also be part of the educational programmes that will be developed to disseminate ethnobotanical information.

Outreach programmes to local communities will entail educating them about the need to respect and incorporate their values, knowledge systems and priorities in plant conservation and management. The use of newsletters and popular publications as a way of disseminating ethnobotanical knowledge will be pursued. Newsletters are a simple and inexpensive way of communication and they will provide a forum for exchanging opinions about plants conservation, ethnobotanical knowledge and community development. Efforts will be made to prepare indigenous information packages in local languages for local communities through seminars and workshops. Without doubt, botanic gardens in Kenya, when established, will play a major role in the dissemination of ethnobotanical knowledge for sustainable development.

Education for sustainability

Different communities in Kenya have lived with, sustained themselves from, and conserved plant resources with respect for the environment. Through education at botanic gardens, understanding of cultures and ethnobotanical knowledge will be enhanced, thereby offering the needed options for future biodiversity conservation and development in Kenya. While the country has an extensive network of protected areas, conservation of plant resources outside these areas will depend on the goodwill of the local communities.

The Convention on Biological Diversity (UNEP, 1992) recognises the traditional dependence of many local communities on plant resources and the desirability of enabling them to share equitably in the benefits arising from the use of ethnobotanical knowledge. Education for sustainability at botanic gardens will sensitise the public to the importance of maintaining resource sustainability and will further promote utilisation, marketing and conservation of indigenous plants. With an educated population, it will be easier to protect sacred places and areas of cultural importance.

It will be very necessary that ethnobotanical knowledge disseminated at the botanic gardens is put to effective use by local communities. Applications of ethnobotanical knowledge learned at botanic gardens will include:

- construction of ethnobotanical nurseries

Local communities will be encouraged through education for sustainability to construct village ethnobotanical nurseries where useful species of indigenous plants can be cultivated.

The ethnobotanical nurseries will provide opportunities for the younger generation in the community to learn the traditional knowledge of their elders, particularly that of herbal medicine. They will also serve as demonstration plots where young people will be encouraged to plant indigenous species in afforestation, landscaping, soil conservation and urban park programmes.

- setting up herbal clinics

A large proportion of the Kenyan population still uses herbal medicine in their health care. Ethnobotanical knowledge learned at botanic gardens will be used to document traditional medical practices that may be applied in herbal clinics. This will ensure that herbalists are involved more fully in the management of areas that supply herbal medicines. Setting up of herbal clinics as a result of utilising ethnobotanical knowledge will further encourage agronomic and silvicultural practices in growing indigenous herbs and trees of medicinal value.

- establishment of community herbaria

Community herbaria can be effective tools in working with the younger generation in schools and villages (Martin, 1995). Students will be expected to apply basic herbarium techniques of pressing and drying plant specimens. This will encourage them to learn the knowledge of their elders, a traditional process that is rapidly dying in many communities.

- promotion of arts and crafts

Education for sustainability will enhance the rational use of plant resources in the production of baskets, textiles, woodcarvings and many other handicrafts. The aim of which is to minimise the overexploitation of plant resources.

- applications in forestry

Ethnobotanical approaches to plant conservation learned at botanic gardens will be applied in agroforestry, reforestation, selective logging and the sustainable harvesting of non-timber forest products. Suitable indigenous plant species will be used in agroforestry and in the ecological reconstruction of fragile lands.

Conclusion

As we approach the twenty-first century, the critical challenge for Kenya is to develop the botanic gardens that will be needed to educate people in the sustainable use of plant resources. The botanic gardens will deal with the dynamics of both ecological and social approaches to education for sustainability. They will be used to measure the true value of plant resources, widen the use of indigenous species and establish sustainable harvest-levels in the pursuit of protecting threatened ecosystems. Emphasising the understanding of ethnobotanical knowledge in botanic gardens will offer much-needed options for future plant conservation and utilisation. As educators in botanic gardens, we have an obligation to promote the dissemination of ethnobotanical knowledge for the sustainable use of plant resources and the protection of the environment. It is an objective that the proposed NMK botanic garden will be working hard to achieve.

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Aiming for excellence in adult education: blooming partnership

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Introduction

In New Zealand, a unique partnership between a botanic garden – Dunedin Botanic Garden – and a tertiary institution – Otago Polytechnic – is flourishing. The Botanic Garden, concerned about the low numbers of qualified horticulturists, approached the tertiary institution to develop a 52-week-long, self-funded Diploma course specializing in the operation and management of botanic gardens. The Diploma course that successfully grew from the partnership two years ago provides an exciting innovative approach to training, through the combination of practical hands-on experience within a botanic garden, coupled with the teaching of the philosophy and management of a botanic garden by the tertiary institution.

The Botanic Garden reaps not only the exciting opportunity to train people in its operation, but also has the added advantage of having students undertake research projects based around the Garden, enabling them to be as creative as they like.

The Diploma in Botanic Garden Management course incorporates subjects ranging from the input of computer plant records to plant conservation and tourism interpretation of the Botanic Garden. The course offers students not only the opportunity to be part of a unique course, but ten students participating in the practical work-experience receive a substantial scholarship.

Background

New Zealand has four major botanic gardens, two in the North Island – Auckland and Wellington – and two in the South Island – Christchurch and Dunedin. The Dunedin Botanic Garden was the first botanic garden to be established in New Zealand, in 1863 – two years after the discovery of gold in the hinterlands of Dunedin. The discovery of gold in 1861 and the gold rush that followed lasted for two years. After the gold rush the population of Dunedin doubled and then trebled with an influx of traders and settlers, making Dunedin New Zealand's wealthiest city.

The City of Dunedin is situated on a dormant volcano lying between the Pacific Ocean with white sandy beaches on one side, and mountains with tussock-covered tundra on the other. Dunedin has a temperate climate with mild summer days (average daily maximum 19°C) and cool winter days (average daily maximum 10°C) with periods of snow. Due to the hilly terrain of Dunedin, the Botanic Garden has a mixture of micro-climates which enable subtropical plants, that normally would never survive the cool climate, to grow in the open.

Dunedin has a very green image dating back to the forefathers of the city, who instructed the surveyors in 1847 to provide for parks and open spaces when laying out the town. The green belt that now surrounds the city and the Botanic Garden is due to the foresight of these city planners.

In 1848 Dunedin was surveyed, and a reserve was set aside by the Provincial Government for a Botanic Garden. The first recorded tree planting (two English oaks) was on 30 June 1863, to commemorate the marriage of the Prince of Wales (later King Edward VII) and Princess Alexandra. (The marriage had actually occurred earlier, but it took three months for the news to reach New Zealand.) Unfortunately the Botanic Garden had to be relocated to its present site due to serious flooding of the area, which practically demolished all of the work that had been done. The University of Otago now occupies the old Botanic Garden site. In 1868 the Botanic Garden was relocated (together with the two commemorative oaks), to its present site, which had previously been used by the Acclimatization Society for the introduction of plants and animals.

Education

Looking back through New Zealand's history, it becomes apparent that Dunedin as a city has always placed great emphasis on education. The University of Otago was founded in 1869 as the first University in New Zealand, and the Otago Polytechnic School of Art was founded in the 1870s. Today Dunedin is known as the 'University City' of New Zealand, with students and related business being the main source of revenue for the city.

The Dunedin Botanic Garden placed great emphasis on training and education, and in 1885 the first horticultural apprentice was accepted within the Garden. From the late nineteenth to the early twentieth centuries, the Dunedin Botanic Garden went through a series of major disruptions, caused principally by inconsistent sources of funding, as control of the garden passed between the Provincial Government, the Domain Board and finally to the local government, which today is the Dunedin City Council.

In 1903 David Tannock was appointed Superintendent of Reserves for the Dunedin City Council. Tannock had been educated at Glasgow Technical College and had worked at Kew Gardens in London. He brought with him knowledge, experience and vast amounts of energy. One of his passions was the training and education of staff. He encouraged all employees to become apprentices or to gain qualifications.

Tannock organised public lectures at the technical college in the evenings and on Saturday mornings, covering topics such as botany, entomology, soil science and horticulture practices. To encourage staff to learn about plants, he organised nature walks around the Botanic Garden, teaching and testing the staff's knowledge of the plants. In 1916 he developed a model cottage-garden within the Botanic Garden, and laid it out with flower beds, vegetable plots and lawns as a teaching aid for the staff and public.

Before Tannock travelled to New Zealand he had worked at Kew when the first women trainees were being employed. He was so impressed with the women trainees that, during the labour shortages in New Zealand during the First World War, he began lobbying the Council for women to be employed within the Botanic Garden. But it was not until 1924 that the first woman was employed there. Throughout the Depression years of the 1930s, there was a steady core of 6 to 8 women employed within the Garden, reaching a peak in the Second World War when the staff consisted solely of women. Today the staff of the Garden comprises 80% women. Tannock's enthusiasm for training and education continued throughout his career as Superintendent of the Botanic Garden. He initiated training and rehabilitation programmes that were offered to unemployed men and to returned servicemen after the War. His contribution to education and training within the Garden was considerable, forging the way for later successive educational programmes.

Otago Polytechnic

Otago Polytechnic was one of the first polytechnics to be established in New Zealand in the early 1970s. The first Polytechnic horticulture course was offered in central Otago, providing training in production horticulture topics such as orchards and viticulture. Today, full-time courses at the Polytechnic range from nursing, dental hygiene and tourism to engineering, fishing, computing and Maori studies.

In the early 1990s the New Zealand horticulture and gardening apprenticeship system started to be phased out. The local horticulture industry, and also the Dunedin Botanic Garden, became concerned about the shortage of trained horticulturists. The manager of the Dunedin City Council Parks and Recreation Department approached the Otago Polytechnic to establish a joint training programme, based around the resources of the Dunedin City Council, i.e. the Dunedin Botanic Garden.

From this initial communication a unique partnership started to develop between the Dunedin Botanic Garden and Otago Polytechnic, enabling the first amenity horticulture course at Otago Polytechnic to be offered at Dunedin in 1992. This one-year full-time amenity course offered students practical hands-on training within the Dunedin Botanic Garden, under the supervision of the Botanic Garden Plant Collection Curators, with theoretical training provided by Otago Polytechnic.

The full-time Certificate course in Amenity Horticulture was a success, and the partnership between the Botanic Garden and the Polytechnic developed and strengthened. It became apparent to both partners that there was an opportunity to develop horticulture training further.

Both organisations decided this was an ideal opportunity to develop a second-year full-time course based around the operations and management of a botanic garden.

The Diploma in Botanic Garden Management course was developed. The students applying for the Diploma course need to have completed a first-year Certificate course in Amenity Horticulture or its equivalent, in order to ensure that they have a sound base in horticulture practice. The Diploma in Botanic Garden Management course provides the opportunity for students to gain practical hands-on experience working in the Botanic Garden, with the theoretical knowledge of the operation and management of a botanic garden being provided by the Polytechnic. While students are on practical work experience they are under the supervision of the Botanic Garden staff, but as the course progresses, they gain more responsibility for areas within the Botanic Garden.

The contract

While the development of the Diploma course was proceeding successfully, a third factor was introduced – funding. The Botanic Garden tendered for a commercial contract on the open market. The contract was to supply five full-time gardeners for five days a week, to maintain and develop the Garden under the supervision of the Garden staff.

The Polytechnic tendered and won the contract. Here was an opportunity to fulfill a contract agreement, provide valuable training for horticulture students, secure funding for the Diploma course and supply substantial scholarships to course students.

The Diploma in Botanic Garden Management course and the commercial contract were combined. It is very important that neither the students nor the public perceive the Polytechnic as exploiting the students as unpaid labour. So ten students would be offered scholarships to undertake the practical-work component of the Diploma as qualified gardeners. Each scholarship equates to the minimum wage a qualified gardener would receive on the open market.

Course structure

The Diploma in Botanic Garden Management Course covers the full 52 weeks of the year. It comprises 24 weeks of practical work experience within the Botanic Garden and 28 weeks academic tuition and theoretical work. The length of the course gives students the opportunity to experience all four seasons of the Botanic Garden's year.

The students on the Diploma course are organised into two groups, with a minimum of five students in each group. While one group of students is on practical work experience within the Garden for a particular week, the other group of five students is studying academic subjects with the Polytechnic. By structuring the Diploma Course into alternate weeks of study and practical work, students receive a high level of individual tuition because of the small class size.

The Dunedin Botanic Garden staff includes seven Plant Collection Curators, a full-time Botanical Services Officer (the only one in New Zealand to be based within a botanic garden), an Information Service Officer, a Collections Manager and a Manager Curator of the Botanic Garden. The plants within the Garden are grouped into a series of collections:

- Winter Garden
- Rose and Herb Garden
- Water and Rock Garden
- Herbaceous Plant Collection
- Camellia and Thematic Borders
- Rhododendron Dell
- Native Plant Collection
- Geographical Borders and Arboretum.

The Botanic Garden staff play a major part in the Diploma course, from participating in the selection of the students to allocating students to specific plant collections and supervising them while they work there. For the majority of the time the students are on the Diploma Course, they will be based in a single plant-collection area within the Garden.

Benefits to students working in the Botanic Garden

The students:

- receive valuable one-to-one training by working alongside the Plant Collection Curators
- gain an understanding of the purpose of the plant collection and participate in the development of the collection over the year
- experience the seasonal changes of the plant collection and the tasks involved with each season throughout the year
- are treated as part of the Garden team, rather than just as students
- gain a sense of responsibility for the area they are working in, and develop a sense of ownership of what happens within the collection.

The academic subjects within the Diploma Course reflect the operation and management of a botanic garden. Within the Course, students are required to undertake a research project that is based around an aspect of the Garden that is of interest to them. The contents, method and assessment of their research project is negotiated between the student and the lecturer.

The other subjects covered within the Diploma in Botanic Garden Management Course include the following:

| | |
|---|--|
| • Botanic Gardens' Overview | History, function and purpose of botanic gardens; a case-study of the Dunedin Botanic Garden |
| • Plant Collection Management | Maintenance, development and management of plant collections |
| • Plant Conservation and Ecological Systems | Role of botanic gardens in the conservation of plants and ecological systems. |
| • Property Report | Maintenance, management and future development of a plant collection within the Dunedin Botanic Garden. |
| • Taxonomy | Classification and identification of a selection of plant families. |
| • Plant Identification: | Identification of a selection of plants within the plant collections |
| • Tree Management: | Maintenance, evaluation of, and care and protection of trees. |
| • Introduction to Research: | Types of research, fundamental knowledge and skills to undertake research projects. |
| • Meteorology: | Understanding, interpreting and predicting weather conditions. |
| • Plant Law: | Legal requirements for, and restrictions on, importing and exporting plants and seeds. Also the legal requirements for collecting plants and seeds and the registering of plants within New Zealand. |
| • Computer skills: | Use of word-processing packages and botanic garden database programs |

| | |
|-----------------------------------|--|
| • Tourism and the botanic garden: | Botanic gardens as a tourist attraction: definitions, attractions, expectations, education and interpretation. |
| • Safety in the workplace: | Identifying safety hazards in the workplace and the action necessary to ensure personal safety and the safety of others. |
| • Communications : | Public speaking, preparation and presentation of visual and written material. |

Advantages of this unique arrangement to both organisations

Both organisations are striving for the same goals:

- to educate and train people in the operation and management of a botanic garden
- to produce skilled, knowledgeable and qualified horticulturists
- to utilise the specialist resources and expertise of both organisations.

Conclusions

Dunedin City has a long-standing history of education and training, which is still a very prominent part of its life.

The partnership that has developed between Otago Polytechnic and the Dunedin Botanic Garden is an indication of the economic and social conditions of our times. With its diverse range of plant collections, the Garden has excellent practical training opportunities. Otago Polytechnic is well resourced for providing theoretical training utilising the latest technology for students.

The Diploma in Botanic Garden Management Course is a splendid example of two totally independent organisations working towards the same goal, and utilising the key resources that both organisations have to offer.

I believe that by working in partnership with different organisations, and by capitalising on the strengths of both of them, resources can be effectively and efficiently utilised to the benefit of all parties, especially the students.

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Aiming for excellence in adult education: successful certificate programs at the New York Botanical Garden

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The Garden

The New York Botanical Garden (NYBG) in the Bronx was founded in 1891 and has a area of 250 acres. It is a garden with dramatic rock outcroppings, wetlands, a cascading waterfall, and a 40-acre tract of uncut forest that once covered New York City. For over 60 years, the New York Botanical Garden has been educating students. Early on, the Garden offered guided tours and graduate training. It was however, not until 1930 when the Garden formally established adult education, offering botany and horticulture courses. The first Certificate course was offered in 1932.

Over time, the offerings have changed and grown. Today, the Continuing Education Department offers programs in eight disciplines. These areas are Botany, Botanical Art and Illustration, Botanical Crafts, Floral Design, Gardening, Commercial Horticulture, Landscape Design, and Horticultural Therapy. To give you an idea of the magnitude of our programming efforts, we offered over 538 courses in fiscal year 1996.

Our programs can be divided into three categories: Non-certificate, Certificate, and Special programs. Of the eight disciplines we offer, seven are Certificate Programs. Completion of a Certificate program signifies that a student has successfully fulfilled all of the requirements of a prescribed series of courses. For instance, to receive a NYBG Certificate in Gardening, a student must complete 150 hours of classroom study, taking required courses, as well as a selection of electives. Within a Certificate program, both Non-certificate and Certificate-level courses are offered. Non-certificate courses are introductory type courses geared to the enthusiast. They are good beginner courses and have no prerequisites.

Certificate classes can be introductory, intermediate, or advanced level programs geared to an individual earning a NYBG Certificate. They contain subject-matter that would be relevant to entering the job market upon completion. However you do not have to be enrolled in a Certificate program to take a Certificate course.

The staff

NYBG Continuing Education is headed by the Director, who reports directly to the Executive Vice-president at the Garden. I am the Program Manager, responsible for all course programming, including symposia, special lectures, advanced workshops, etc. We produce a catalog twice each year. As Program Manager, I oversee the Program Coordinators and deal directly with instructors. The Marketing Manager analyzes data to understand our audience and how to best meet the needs of our audience through market research and examination of registration data.

The Communication Coordinator works with the Marketing Manager and me to develop the promotional materials from inception to graphics for the prospective student. The Registrar oversees 4 full-time staff members and 2 part-time weekend staff; our classes run on weekdays from 10 a.m. to 9 p.m. and also at weekends.

Each discipline is headed by a Program Coordinator who is an industry professional. Many of our coordinators own their own businesses, so that they have a pulse on industry needs and the expectations of employers. For instance, the Program Coordinator of Floral Design is the owner of his own floral shop, is a guest instructor of San Francisco College and is an instructor at MUSA Flower School in Yokohama, Japan. Our Landscape Design Coordinator is the principal of her own firm, and a former student. Coordinators are responsible for recommending new classes and instructors, and advising students in their specialist areas. The Coordinators are the key to our class programming, as they make the best use of networking within their own professional areas.

For the 1996 fall and winter season alone, our department is dealing with 132 different instructors. Like our Coordinators, many of our instructors own their own businesses and are well respected in their fields. Many of our instructors are NYBG horticultural and botanical science experts and we make it our priority to use our staff and

resources whenever we can. Our instructors effectively combine book knowledge with practical work experience, and a love for their chosen industry that is directly translated to our students. By having instructors who are in the industry, students respect their accomplishments and their genuine willingness to share information and teach from experience. It is not uncommon to see comments on evaluation forms about instructors being so generous with their 'trade secrets'.

It is the high caliber of instruction and programming that attracts students to our courses. Our certificates truly have meaning and industry acceptance. Recently I enrolled in a night course here at the Garden, and about 30% of the students had enrolled after recommendations by friends who had previously taken courses here at NYBG.

To maintain and improve that standard, we now provide all instructors, prior to the start of classes, guidelines for instruction, as well as sample course syllabuses and a worksheet, so that they can all plan in a uniform fashion. We require that all instructors submit a current resume and course outline (or syllabus) prior to the start of classes. By having these materials on file we insure continuity within a program and within a course, and we are able to observe the evolution and improvement of a course over time. It also results in a more efficient operation of the planning process.

A quality product

Within our Certificate programs we offer 30 courses for college credit recommendation through the National Program on Non-Collegiate Sponsored Instruction (NPONSI). Every five years, select courses are reviewed by a panel of colleagues from universities with the same discipline so they can be approved for college credit. Accreditation is based on an evaluation of course syllabuses, instructor qualifications, homework assignments, textbooks, exams, and student evaluations. An advantage is that students can transfer these credits. If a student does not enroll for college credit, the student still knows that the caliber of the course is highly regarded. Although this is a costly and time-consuming process involving lots of paperwork, we feel it is a useful option for our students.

NYBG also has joint programs with Bronx Community College and Lehman College. Students enroll at these colleges and use the Garden as a campus for their specialized classes. Ultimately, these students will graduate with a two or four-year degree. Another school associated with

NYBG is the NYBG School of Professional Horticulture. This runs a two-year full-time program in which students take all of their academic classes through the Education Department along with work rotations on the NYBG grounds.

Interpretation at the Arizona-Sonora Desert Museum

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Introduction

The Arizona-Sonora Desert Museum is not a botanic garden. It's not a zoo either, although sometimes called one. Nor, despite its name, is it a traditional museum. It is something of all three, and a nature center as well. We say we are a "living museum," because for the most part our collection is alive, consisting of 300 species of animals and 1300 kinds of plants. We also include geological objects (fossils, minerals, rocks) and geologic processes and features. Our entire collection comes from the Sonoran Desert region, a 100,000 square mile area located in Arizona and California in the United States and in Sonora and Baja California in Mexico. For the most part, our collection is not displayed taxonomically, but by community. Thus, there is, for example, a desert grassland exhibit, a riparian exhibit, an Arizona Upland exhibit, a mountain woodland exhibit. Even when the emphasis of an exhibit is on a single organism, as for example our hummingbird exhibit, we stress interrelationships – in this case the co-evolution of hummingbirds and the plants they pollinate. Our museum is located 14 miles outside Tucson, Arizona, in the midst of protected, and nearly pristine, Sonoran Desert. Thus our collection exists, not only within the context of its exhibits, but also within the context of the natural community it interprets.

The regional focus of the Desert Museum, its physical location, and its emphasis on interdisciplinary exhibits are great advantages when it comes to interpretation. No matter what form it takes – exhibit, signage, informal docent-talk, workshop or class – our interpretation focuses on the connections and interrelationships in a community, and the mutual dependencies of plants, animals and the land. We believe humans must come to understand processes and dependencies, ecological roles and services, if they are ever to care about saving either species or habitats and if they are ever to be effective in doing so.

Conservation education - the basis for the Museum

Conservation education was the reason for the Desert Museum's founding in 1952. The founders were a far-sighted museum educator and a conservation-minded philanthropist, both transplants to Arizona from eastern states. They loved the desert but were surprised that their enthusiasm was not shared by most Tucsonans who ignored and sometimes mistreated their environment. For its founders, the Desert Museum was a way to entice Tucsonans into the desert and to showcase its wonders, so that they would come to understand, appreciate and properly care for this rare community. Thinking back on opening day, one of the founders remembered that visitors "streamed along the desert pathway as if it were some magic garden instead of the very Sonoran landscape amidst which they lived". He went on to say that "This may have been the crowning success, that we were showing them how to see and enjoy their own surroundings, which meant education in its most useful form" (Carr, 1982). Today, Tucson is a city which seems to live more compatibly with the desert than do the residents of most other desert cities. Tucsonans, for example, consume less water per capita and are more likely to landscape with native plants than the residents of other Western cities. As Tucson's number-one attraction, the Desert Museum is often credited with encouraging the city's conservation ethic.

It is wonderful to claim tangible results from educational efforts because only rarely can we do so. An educator's greatest frustration is that education often works so imperceptibly. It is especially frustrating for us conservation educators because today's environmental crises are so great and because public knowledge seems so small. We wonder if we do any good at all when we learn from a recent survey, for example, that only one in five Americans claims to have even heard of biodiversity and that of 1500 Americans surveyed, not one mentioned the loss of diversity as a serious problem (Peter D. Hart Research Associates, Inc., 1993). This, despite the fact that millions of people visit zoos or public gardens; indeed one of every three Americans visits a zoo each year, and 92% of them feel they are educated by their experience (Roper Organization Poll, 1995). Although our audience is large and wonderfully receptive, it isn't necessarily getting our message. Conferences like this are so important because they give educators a chance to share experiences, as we all attempt to discover the techniques, lessons or examples that will result in the sort of public understanding that leads to changed behaviors and responsible actions. The remainder of this paper discusses how staff at the Desert Museum have engaged in this search.

Educating the public through storytelling

We use interdisciplinary teams to plan and design our exhibits and to write our interpretive signage. Educators are always members of these teams. We have come to think of ourselves, not as exhibitors of objects, but as storytellers. The stories we tell are about communities and their interdependencies, about the connections between living things and between organisms and their non-living surroundings. If these stories can truly engage the imaginations of our visitors, they will, we hope, come to recognize the importance of biodiversity. They may never again ask "What good is a cholla cactus?". Though they may not be able to say precisely what was lost along with the Mexican wolf, they could imagine broken connections. Stories are important because they illustrate nature's complexity in specific and comprehensible ways: stories are more compelling, memorable and revealing than facts.

Because our Museum is interdisciplinary, we have, within our staff, people who know these stories. And because our museum focuses on one region – and that region is the well-studied Sonoran Desert – we know quite a few stories. We tell of the kangaroo rat which never drinks and of the high-carbohydrate seeds it depends on for metabolic water, and we talk of nectar-feeding bats whose migration back and forth from Mexico coincides with the flowering of columnar cacti and agaves which they pollinate. Or, there is the story of the prickly pear cactus, which is food for the cactus beetle, the javelina which can tolerate its toxic flesh and sharp spines, and the lac insect, cochineal, the source of a red dye which drove Europeans to explore the New World and which is still used by traditional weavers. This plant is also shelter for the packrat, its parasite the kissing bug, and its predator the diamondback rattlesnake. There are long stories about ironwood trees, figs, jojobas, palo verdes, and mesquites. And there is a whole anthology of stories about the saguaro cactus and its many relationships.

Stories are deeply satisfying to the human desire for complexity and continuity. Yet they are not necessarily what our visitors expect. They ask to see individual species, taxonomically arranged (Where is the mountain lion, the mineral room, the cactus garden?). They often want facts about individuals (how old is that saguaro, what have you named the beaver?). They prefer not to read long texts. Most declare themselves more interested in animals than plants, at least at the beginning of their visit. And they would not claim education as the primary motivation for their visit. How then to tell these stories?

Making sure that storytelling is effective

First of all, we try to design exhibits which are themselves stories or at least good settings for stories. We exhibit communities rather than separate species, and in deciding on the components of exhibits, we first consider the stories we want to tell. A few years ago we built a desert grassland exhibit. Such an exhibit had been proposed many years before – as a pronghorn antelope/prairie dog exhibit. The first thing we did was to change the name so that it emphasized the entire community. Then we decided not to exhibit pronghorns after all. They are difficult to keep in captivity, they need the context of a very large area (which we didn't have) and we worried that, because of their size and their allure, they would detract from the community focus and the elements we wanted to emphasize – grass and its diversity and the little things that power the community: termites, ants and soil microorganisms.

Throughout the museum, we have insisted that plants be given equal weight to animals, rather than serving as backdrop or decoration. The plants, animals and, for that matter, the geological features, in each exhibit would be found together in nature. Plants actually dominate our desert grassland exhibit because it is the sea of grass that defines and gives character to this community. We made sure that a large portion contained no animal enclosures to draw attention away from the grassland itself, which was planted with about 30 species of grass and several shrubs – all native to the desert grasslands of southern Arizona. We adjust the timing and amount of irrigation to duplicate the rainfall patterns of desert grasslands. This means that for much of the year the grass is brown. We brought in horses to graze, and we would have set fire to a portion had we been able to obtain permits.

We hope that our exhibits speak for themselves – that they tell their stories, not didactically or through narrative, but more subtly, implicitly, through the arrangement of their parts. The prairie dog exhibit, for example, should show visitors how prairie dogs are adapted to wide-open spaces, how they remove or modify the vegetation, how other animals rely on their shelters.

Stories are most clearly told through words, of course. We try to design and write signs that set forth more than facts, that do not assume a reader's interest but create it, that are as interesting and revealing as narratives. Sometimes we are successful, but we feel we are still learning. We have not yet discovered to our satisfaction the magic that will compel most visitors to read our graphics and understand and enjoy what they have read. We feel that long hours of brainstorming among team members from many disciplines, extensive testing of draft signs, and continual revision are keys to success, but this is a time-consuming process. We are having good success with

simple and informal signs we call yellow tags. These are small cardboard tags, printed with short messages about seasonal or ephemeral happenings. They are hung here and there along the paths. Visitors aren't sure what they are or even whether they're supposed to read them – so they do! And they find out about a bush being pollinated by wasps, or a carpenter bee making a nest in an agave stalk, or the sweet fragrance of desert mistletoe. We have just installed our first 'green tag.' These are also informal laminated cardboard tags, but they are larger than yellow tags and they tell stories about connections. This first one tells about a mysterious event in our newly-remodeled hummingbird exhibit. The birds, which were breeding just fine, built terrible nests that slipped off the branches or disintegrated when the birds sat on them. Every egg broke. Eventually a puzzled staff figured out that when we removed the plants during renovation, we also removed the spiders. Without their webs, the birds could not bind their nests.

The value of docents

We have found that our most effective method of interpretation – besides that offered by the exhibits themselves – belongs to the Desert Museum's docents. Our docents are involved in many educational activities both at the museum and in the community, but their primary responsibility is to interpret on the Museum grounds. Each day between 20 and 30 docents offer a variety of interpretations to Museum visitors, choosing from about 50 topics on different aspects of Sonoran Desert ecology. Each interpretation comes in the form of a kit or a cart and includes natural objects or other hands-on materials. Most topics are interdisciplinary and involve stories about connections. Plant-related topics include the saguaro, the jojoba, adaptations of desert plants, dendrochronology, wildflowers, desert grasses, riparian habitats and pollination. The saguaro cart is our most popular kit – among docents and visitors alike – and that's fitting, since the saguaro is the signature plant of our part of the Sonoran Desert. Docents offer this interpretation outdoors, in the midst of a stand of saguaros. They wheel out a cart in which are stored potted saguaros of different ages, a cross-section of a stem, saguaro ribs, roots, seeds, real flowers and fruits when available and photos when they are not. Docents use the props to tell the life history of the saguaro: the non-biological factors on which the saguaro depends – soils, slopes, rainfall, temperature – its pollinators, its seed dispersers, its nurse plants, the animals which use it for food and shelter, its place in the social, religious and economic system of traditional peoples, and its status today. Visitors gather around the cart, listening to the story for a while, interrupting with questions and thoughts of their own.

We train our docents in an initial 100-hour training program on Sonoran Desert ecology, given by our curatorial staff. They also receive separate training for each interpretive activity, and we have an extensive continuing education program. Our docents are trained to be generalists, as is consistent with our interdisciplinary philosophy. We teach them not to lecture but to use informal and interactive interpretive techniques such as questioning, anecdotes and humor that appeals to the senses. We tell them to put together stories about connections. We train them in interpreting to kids. And then we let them go. The stories are their own, and so is the manner of telling. This freedom has its risks, but it results in interpretation which is personal, spontaneous, genuine and enthusiastic. The stories have a distinctive voice, are accompanied by props and are geared to the interests, background, knowledge, age and time-availability of the audience.

We have about 170 adult docents. We also have about a dozen college students earning credit for their docenting, and we train junior docents, who are junior high-school students, to interpret to the Museum's visitors on weekends and during vacations.

Special programs for the public

In addition to on-grounds interpretation, the Desert Museum offers special programs to museum members and the general public – adults, children and families. These programs share the interpretive philosophy of our exhibits and docent talks. Most are free or offered at very low cost. Enrollments are small, so that instruction can be personal and invite self-discovery. Most classes take place outside, in the desert, and involve direct observation and first-hand experience. As much as possible, content is interdisciplinary, made up of stories about connections. Although Tucson is a desert city, those who live in its heart are often strangers to the desert, more comfortable with concrete than with the desert's prickly plants and animals. We aim to help people feel at home in the desert.

Our Sonoran Studies programs are workshops, classes, hikes, trips, symposia. We offer three to four of these per month, primarily to members. A popular yearly program is the saguaro harvest, during which participants go into the desert to gather the fruits of the saguaro in the traditional manner of the Sonoran Desert's Tohono O'odham – the native desert people whose lives still center on the saguaro cactus. Consultants have helped us fashion our event so

that it is both accurate and respectful. We offer saguaro harvest programs to adults, children, and family groups. Other ethnobotanical events have been sessions on cooking with cholla buds and the medicinal uses of native plants.

Working with schools

We offer free admission to school children on organized field trips – about 23,000 per year. Last year we revamped our procedures, following an extensive evaluation which showed us that too often the kids experienced frustration and fatigue as they rushed from exhibit to exhibit, trying to see it all, focusing almost exclusively on animals, and failing really to experience the desert in their haste. Among other changes aimed at slowing things down and encouraging observation, we have stationed docents at least six places on the grounds with hands-on materials particularly geared toward the interests of children. Two of these involve plants (the saguaro cart and a plant adaptation kit).

We have encouraged teachers to take advantage of the desert near their schools by offering teacher workshops and in-service training sessions on schoolyard habitats, urban wildlife, or using desert washes as classrooms. Because outdoor classrooms are not always possible, we lend kits of materials to bring the desert into the classroom. One kit deals with the life history of the saguaro; it includes background information, parts of the saguaro, seeds, photos, posters, videos. As with all kits, it is complex enough to form the basis of a month-long unit. We also visit classes. In fact, we do so nearly every day of the school year, and we give presentations to adult community organizations. These are always organized around some theme; they include hands-on materials or live animals and plants, and they are presented in an informal, interactive manner.

We have helped a number of schools build desert habitats on their grounds. This will be only one of the projects we'll undertake this year with an elementary school we've adopted as part of a program, Amigos del Desierto, which fosters a partnership between the Desert Museum and an elementary school with a large Latino population. A bilingual educator coordinates the program, which has two primary goals: to bring the desert to inner-city children, and to bring the Museum to the Latino community, in the hope that, as we become more familiar to them – and more friendly – they will visit us in greater numbers.

In addition to the 100 acres which comprise the Museum's grounds, we own 40 acres of desert just a few miles away. This is a great place for field activities and for campouts. We've offered overnight experiences to families, students, summer class participants and teachers. We also use the property for field studies. Last year, we began a Junior Naturalist program, a year-long experience which teaches middle-school students the skills of the naturalist: species identification, surveying and censusing, animal observations, environmental ethics, orienteering, and so forth. The students used the Museum and its off-grounds property as laboratories. Thoroughly familiar with the desert community, at the end of the year they went off to practice their skills in a new community during a two-week camping trip to Utah.

An internship program for high school students also emphasizes first-hand experiences in science. Twenty students come to the Museum for one afternoon a week for a semester. Our staff teach them the fundamentals of desert ecology, as much as possible using hands-on, interactive, and outdoor techniques. Then the students work two hours with a Museum department, usually on a research project. Last spring the botany department's interns researched germination techniques and methods for rooting cuttings, and they observed phenology and pollination. Though reluctant plant researchers at first, by semester's end, the students reported back to their classmates that plants were fun.

International campaign for pollinators

The Desert Museum has been the center of a recent ambitious and well-publicized campaign known as the Forgotten Pollinators. This effort focuses on the critical role of pollinators and the increasingly frequent disruption in pollination – through habitat destruction or fragmentation, use of pesticides, loss of diversity and other factors. The Museum has participated in this international awareness campaign through research, symposia, programs for children and families, interpretive signage, publications, and an exhibition of scientific illustrations of plants and their pollinators. A butterfly garden, a moth garden, and a hummingbird exhibit are the beginnings of what will be a more extensive pollination exhibit.

For two years now we have experimented with keeping much of the Museum open through the evening on summer Saturdays. Visitors love to experience the desert at night; especially lively discussions take place at our moth garden

where large, fragrant patches of sacred datura, evening primrose and other flowers are bombarded by hawk moths. The garden is such a mecca for moths that it has also attracted three researchers from the University of Arizona who are looking at plant fragrances and how they are produced, transmitted and received by the moths. These researchers show up on Saturday nights to talk to our visitors and have taught our docents to substitute for them when they aren't available.

Conclusions

The Desert Museum is regional and interdisciplinary. It is outdoors, for the most part, and located in the environment it interprets. It promotes direct, first-hand experiences of nature. When it comes to education, this is a powerful combination of characteristics. It allows us to tell stories about the connections among all components of our amazingly diverse desert community. We believe these stories have helped Tucson residents to live more harmoniously with their desert surroundings, to see themselves as responsible members of a large, natural community. Over half the Museum's visitors come from outside Arizona, many from outside the United States. We hope they also take from the Museum lessons which help them become better citizens of their natural communities. In conveying these lessons, stories have great advantages. They have universal appeal because they touch the imagination. They reveal general truths deeper and more important than the specific facts which illustrate them. Visitors may not remember all the details of a story – the intricacies of the relationship between, say, the yucca and the yucca moth – but they will retain their sense of wonder and their realization that life is a complicated web, a tangle of connections, which cannot be broken without consequence.

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Australia's native food plants: towards a sustainable future

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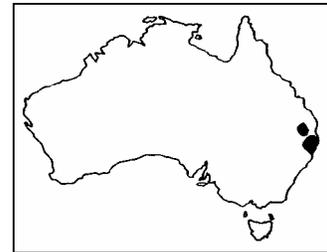
Australian native plants sustained a population of indigenous people for many thousands of years. However, they were largely ignored by early European settlers who brought all their food, salted and dry, on their ships. They also brought farm animals and seeds for growing crops. Between 1788 and 1790 the colony in Sydney nearly starved before good land for wheat-growing had been found.

The fruits, seeds and tubers of many native plants are rich in vitamins, minerals and proteins; today there is increasing interest in the use of native plants for food.

In recent years many native plant foods have been chemically analysed and one – the billy goat plum (*Terminalia ferdinandiana*) has been found to be the richest source of vitamin C in the world.

Macadamia nut (*Macadamia integrifolia*)

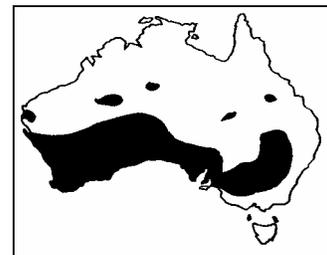
The macadamia nut has long been eaten by the Aboriginal people of southern Queensland, where this smooth, tasty nut grows naturally. Macadamia nuts have been grown commercially on the islands of Hawaii since 1900 and many cultivars have been produced. They have only been grown commercially in Australia since 1963. Salted, candied and chocolate-covered macadamia nuts are available throughout Australia and are also exported.



Sweet quandong (*Santalum acuminatum*)

This is a popular savoury or dessert fruit which may be eaten fresh. More often it is halved, dried and later reconstituted. Sugar is often added to reduce the acid taste and enhance the flavour of the fruit.

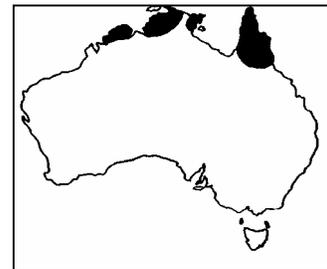
The seed is edible and highly nutritious.



Red bush apple (*Syzygium suborbiculare*)

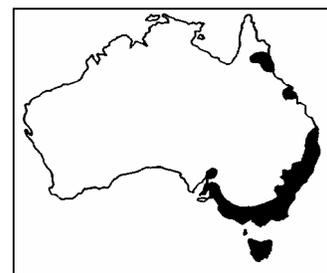
This tree is an important source of food for the Aboriginal people of northern Australia. The fragrant fruits have a spongy texture and contain up to 17 milligrams of vitamin C per 100 grams of fruit. The trees frequently grow on sandy soils behind beaches.

The fruits of this and other species of *Syzygium* are used in jams, relishes, sorbets and ice-cream.



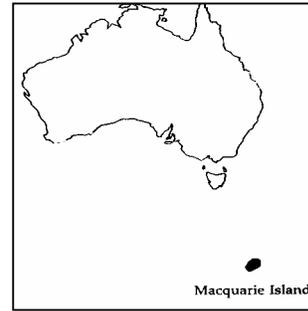
Blackwood (*Acacia melanoxylon*) – a wattle

The seeds of many wattles make good quality flour which is used in making damper, cakes, desserts, pastries and beverages. Milled and roasted seed is also used. The seeds of selected species are traditional food for many groups of Aboriginal people and there is growing interest in their use for food in the developing world. Ripe seeds are very high in protein (17 to 25%), fat (4 to 16%) and carbohydrate (30 to 40%).



Macquarie Island cabbage (*Stilbocarpa polaris*)

This plant is endemic to Macquarie Island, a cold windswept island in the Southern Ocean, about 1000 km south-east of Tasmania. Its large geranium-like leaves were eaten by shipwrecked sailors and seal hunters in the last century to prevent scurvy. Studies are now under way at the Australian National Botanic Gardens in Canberra, Australia, to assess its cultivation potential. This plant produces large amounts of seed annually and adapts readily to different soils. It is tolerant of a wide range of temperatures and regenerates readily from a rhizome.



Illawarra Plum (*Podocarpus elatus*)

This tree is a conifer which grows to a height of 5 to 35 metres. Male and female flowers are carried on separate trees. Blue-black plum-like fruits grow on female trees. A large seed is attached to the 'outside' of the flesh at the opposite end from the stem. The fruit has a subtle plum/pine flavour and is used in savoury foods such as chilli and 'plum' sauces for chutneys, jams and pies.



Native plant education at The Holden Arboretum

Paul C. Spector

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Last month, the Ohio Department of Natural Resources published the results of their most recent survey of the State's native plant populations. They found that of the 654 native plants surveyed:

- 213 were endangered
- 153 were threatened
- 162 were potentially threatened
- 103 had not been found growing in a natural setting since 1974
- 23 had not yet been assigned a status.

This news rated about four column-inches buried in the back of Cleveland's largest newspaper.

The extent of issues facing native plant populations, and the lack of public recognition and concern, are why The Holden Arboretum feels so strongly about native plant conservation and education.

The Holden Arboretum has defined its role in native plant conservation and education through its organizational mission statement and departmental policies and programs. It has made a commitment to actively conserve the genetic diversity of Ohio's many native plants by incorporating them into the Myrtle S. Holden Wildflower Garden for continuing life-history research and public display. In addition, through our participation with the Center for Plant Conservation (CPC), the Arboretum identifies the region's rarest plants and develops research and stewardship programs that will promote long-term conservation of plant species in their natural habitat.

Complementing this research and conservation effort is a native-plant education program that addresses several audiences and levels of interest. The program has its roots in a blending of the organizational mission and the unique physical resources that comprise our 3400 acres of horticultural collections and natural areas. This combination of cultivated gardens (such as the Wildflower Garden and the Butterfly Garden) and natural areas, and the educational programming that results, puts the Arboretum in a unique position to address many facets of native plants; their natural history, use in the landscape, and their conservation.

By providing learning opportunities that promote greater understanding, positive attitudes and appreciation of the natural environment, people can be helped to make a personal connection to the natural world. This connection will enable them to have the understanding and love for native plants that are essential if they are expected to care about and preserve the diversity of plant life known today. Informal education opportunities that include brochures, signage, and exhibits and formal programs such as classes, symposia, and certificate programs, all function within the expressed mission and carry out the Arboretum's objective of educating the public about the significance of maintaining healthy populations of our native plant species.

Below are some of the programs offered that deal with native-plant education:

- when a visitor arrives, they receive the brochure *An Arboretum Defined*. This contains a section on conservation and how it fits into the organizational mission. It also provides information about the work with the CPC, the efforts in habitat restoration, and the Myrtle S. Holden Wildflower Garden
- visitors can pick up other publications such as: *Arboretum Leaves* which is a quarterly publication mailed to the membership, *Plants Alive* which covers native plant work with the CPC, and assorted fact sheets on topics such as 'Landscaping With Native Plants'
- in the garden, interpretive signage draws attention to the specific plants being grown as part of the CPC participation and others that are rare and endangered within the state of Ohio. Developing an appreciation for a

plant in a natural setting, and creating a public awareness of the various conservation and restoration issues, is a major step that often leads to individual action and stewardship.

These types of things hopefully begin to encourage and entice people to want to learn more about native plants and conservation issues. They then have the opportunity of participating in an adult education program. Examples at Holden include:

- the Native Plant Certificate Program – a series of 14 core courses and 8 electives designed to provide a comprehensive foundation of knowledge and skills relative to the understanding of native plants and their communities, and to enable participants to better participate as active stewards of the natural plant communities in northeast Ohio. Classes include topics with titles such as the ‘Flora of Northeast Ohio’, ‘Wetland Plant Communities’, and ‘Conservation Strategies and Opportunities’.
- symposia such as ‘Wildflower Meadows: a Lawn Alternative’ or ‘Natural Areas Management: a Global to a Personal Perspective’ help participants to focus more closely on plant conservation issues and to network with others to facilitate the sharing of information and action.
- field trips to sites of unique native plants engage people in first-hand observation of habitat requirements and the conservation efforts under way to preserve both habitats and specific plant populations. Examples of the locations of past trips include: the Rocky Mountains of central Colorado, the Indiana Dunes National Lakeshore, the Bruce Peninsula in Ontario, and many sites around the state of Ohio.

Scientists at the botanical gardens feel that they can work to save plants that are already endangered. However, educators at botanical gardens must work to save plants while they are still common. The vision for native-plant education is to develop and provide programs for adults and children which will empower them with the knowledge and understanding of the importance of plants in their lives, and with confidence in their own ability to contribute in some way to plant conservation. Once this connection is made, they are more likely to engage in activities that will save these plants while they are still common.

The need for us to connect with plants is summed up well in the following verse from a Joni Mitchell song written 26 years ago:

They took all the trees
And put them in a tree museum
And they charged all the people
A dollar and a half just to see 'em
Don't it always seem to go
that you don't know what you've got
till it's gone
They paved paradise
And put up a parking lot.

(Joni Mitchell, Big Yellow Taxi, *Laural Canyon*, 1970)

Bringing the plant kingdom to life: communities, cultures and creating concepts

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An educational resource

The Royal Botanic Gardens, Kew manages more than 900 acres at Kew in West London, and at Wakehurst Place, Sussex. The Gardens were visited in the year 1995 by 1,303,000 people, including 67,167 schoolchildren.

Our mission is to increase humanity's understanding of the plant kingdom. We have one of the largest and most diverse collections of living plants, comprehensive research collections, including preserved plant material, and an economic botany collection of over 73,500 artefacts.

Our location allows easy access for culturally diverse communities who live nearby. Kew provides learning opportunities for children, both at school and with their families. We encourage them to discover the importance of plants in everyday life, by demonstrating the traditional and current uses of plants and plant products, habitats and the extraordinary biodiversity of plant life.

We want to:

- provide entertaining, high-quality activities by which visitors can learn to value plants
- attract more family groups to visit Kew
- enthuse teachers to pass on information in a resource-effective way
- encourage visitors to come to Kew in our quieter periods – between October and March
- cover costs and make a profit where possible.

Some examples of how we aim to achieve our objectives

Our schools programmes include: on-site tours, topic days, teacher-training and in-service training days (INSET), schools advisory services, placements and environmental education, outreach programmes, events, schools education packs and publications.

Placements for technicians and teachers

We host a variety of placements of mutual benefit to both participants and Kew with a lively interchange of ideas. For example, a professional development course for school technicians and teachers covers a range of topics. These include school greenhouse management, horticultural techniques for use in schools, and strategies for developing school grounds for environmental education. This work also offers experience in the provision of practical classroom investigations in plant science.

Topic days

Students from a local high school learn through activities how to identify plants for survival, a sustainable future and much more – plants for water and energy, plant foods for balanced nutrition and their preparation, and plants for shelter, fibres, dyes and medicines. Opportunities exist for students to investigate extraordinary and useful items from Kew's Economic Botany Collections.

Students work together to design and test a variety of items – from shelters to carrying-baskets and water containers. Students and their teachers frequently bring with them a range of traditional skills in making use of plants, inherent

in the variety of ethnic backgrounds in the communities around Kew. The exchange of ideas between groups benefits all.

Public interpretation programmes

These include: volunteer guiding, adult education courses, exhibitions, publications and events.

Exhibitions:

The exhibition "From New World to Old – Plants and their Uses around the World" displays five cabinets of relevant artefacts from Kew's Economic Botany Collections, together with 50 paintings of plants. These were part of the mass exchange of crops that transformed the lives of people on both sides of the Atlantic. Plants such as maize, tomatoes and potatoes were shipped from the New World and were adopted by Europeans. Sugar cane, bananas and mangoes from Asia, and European cereals such as wheat and barley, were amongst the introductions to the New World.

Christmas at Kew

This popular programme designed for family groups has been running since 1989. Visitors enjoy a range of activities, including special projects for schools, themed plant displays, carol concerts and rides on horse-drawn vintage buses. The main focus of the event is the Grotto, where Santa Claus interacts with children in a number of settings - from the rainforest, where children discover that brazil nuts are still harvested from the wild, to the desert where, through story-telling, they encounter frankincense and myrrh. The children can then see the plants growing in the adjacent glasshouse. Other themes such as the botanical ingredients of a Christmas pudding, and the plants' overwintering, which used the Narnia stories of C.S. Lewis as a setting, have been widely appreciated. Visitors love learning through fun.

Order, Order – taxonomy in action: interpreting the Order Beds at the Royal Botanic Gardens, Kew

Pat Griggs

Royal Botanic Gardens, Kew, UK

The topic – taxonomy

Identifying, naming and classifying the objects in our environments are all activities we undertake everyday without thinking twice. But lump them all together under the heading ‘taxonomy’, and the process seems to become more abstract – something that belongs in the domain of learned scientists.

Much of Kew’s research effort is directed towards a taxonomic survey of the plant kingdom. Its purpose is to provide the accurate identification, naming and classification of plants that are essential; not only for all other botanical research, but also for any other work involving plants, including agriculture, forestry and conservation.

The aim – to raise visitors’ awareness of taxonomy and Kew’s research

Most of Kew’s 1.3 million visitors each year are adults, who come simply for a day out. Just 7 per cent of them say that they visit the Gardens because they are interested in plants. Although 61 per cent feel that Kew is ‘scientific’, only 32 per cent think that Kew’s primary role is botanical research.

Accordingly, various interpretive projects have been initiated to explain the significance of the living plant collections and to highlight Kew’s research activities. One such project is in the Order Beds, where visitors can experience ‘taxonomy in action’.

The resource – the Order Beds

The Order Beds contain more than 3000 different types of herbaceous dicotyledonous plants, mostly from temperate regions of the world. The plants are grown in family groups; in general one family occupies one bed, although larger families are spread over a larger area. The Compositae, for example, fill 29 beds. Originally, the 126 beds were laid out according to the Bentham-Hooker system of classification, devised in the mid-nineteenth century, although this has been modified over time as research at Kew and other botanic gardens has clarified plant relationships further. By displaying plants in this way, the similarities and differences in form and flower structure between members of the same family can be seen at a glance.

The method – interpretation

To address the different levels of visitors’ interest in this topic, we have provided multi-layered information:

Panels

At each main entrance to the Order Beds, we have installed a large pillar bearing four panels. Two explanatory panels – ‘The Order Beds’ and ‘Taxonomy in Action’ – appear on both pillars. Panels on ‘Identification’ and ‘Naming’ are located on one pillar and on ‘Classification’ and ‘Taxonomy at Kew’ on the other pillar. These explain the elements of taxonomy and set Kew’s taxonomic research in context.

Family labels

Labels located on some of the family beds provide additional information, including the family characteristics and details of some of the particularly interesting members of the family.

Information sheets

Visitors who want further information can obtain an information sheet as part of a pack sold at Kew’s shops.

Supplementary information

The information available in the Order Beds is complemented by labels located close to each of the major gates and within the glasshouses; they describe the elements of the basic garden labels displayed by all plants. Additional information on Kew's research can be found on a panel attached to the wall of the Jodrell Laboratory adjacent to the Order Beds.

Conclusion

By encouraging visitors to investigate the diversity of the plant collections, we hope that they will discover for themselves the importance of accurate identification, naming and classification and realise that taxonomy provides a method of organising our knowledge about the plant kingdom so that it becomes more manageable.

Public education in the Shenzhen Fairy Lake Botanic Garden

Feng Huiling, Li Gang, Pan Xinliang

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The development of the Shenzhen Fairy Lake Botanic Garden

Shenzhen Fairy Lake Botanic Garden is situated in the eastern suburbs of Shenzhen City, in the Guangdong Province of China. The Garden is inlaid like a splendid green pearl on the western hillside of Mt. Wutong, the highest peak in the Shenzhen Special Economic Zone. The Garden was established in 1982, when 15 special plant sections were envisaged in the overall plan. Up to now (1996), the palm-grove and other eight planned collections have been completed, and more than 3000 species of plants have been conserved in the Garden, of which 2500 species have been introduced from China and abroad. As a new member of the family of botanic gardens, the Fairy Lake Botanic Garden is developing as one of the centres of public education on botanic gardens, conservation and research into plant resources in South China.

A variety of public education activities attracts thousands of people

Since the Garden was opened to the public in 1988 botanic garden education and environmental education has been one of the main tasks of the Garden.

In over ten special plant sections, galleries for science exhibitions have been established. In the Shade Plant section, a display gallery called 'Plant Evolution Show' has been set up in order to give citizens a knowledge of the history of plant evolution. More than 1000 species of shade-loving plants, including ferns and some ornamental plants in the *Crassulaceae*, *Begoniaceae*, *Marantaceae*, *Liliaceae*, *Araceae* and *Orchidaceae* families are arranged naturally in the area according to their ecological characteristics and their classification. Ferns and aroids are the two main groups: the former includes some ancient, relict and endangered plants such as *Psilotus nudum*, *Alsophila spinulosa* and *Platyoerium wallichii*, while the latter consists of some aroids from tropical America and tropical Asia, such as *Philodendron* and *Dieffenbachia*. This area attracts thousands of visitors every day, and it is also an important window for citizens to observe biodiversity.

In the Palm Collection, there is a gallery of popular science. While enjoying the tropical landscape of south China, visitors can learn more about plants. This section has become one of the important places for the visitors to have a rest after they have had a tour around the Garden.

'The Ex-situ Conservation Center of Cycads' was set up in 1994. During the past three years, not only all the species in China been collected, but also more than 130 species of cycads from Asia, Africa, America and Australia. This means that the Centre will be the largest conservation base of cycads in China. It will be something worth acquainting, cherishing, cultivating, and protecting.

The Gymnosperms Section is situated around the Fairy Lake. About 100 species of conifers in 10 families have been planted and arranged according to the classification system of Prof. Cheng Wan-chun. This section is just like a living textbook, providing students with a knowledge of the evolution of gymnosperms.

The Cacti and Succulents Section is formed by three greenhouses in different architectural styles. More than 1000 species (or cultivars) of cacti and succulents from Asia, Africa and America are collected in the three greenhouses and arranged according to ecological type. This section is expected to be the largest cacti house in China. Although it was only opened to the public last year, thousands of visitors have already come here to have a look. While visitors enjoy the special beauty of the cacti and succulents, they learn more about their evolution.

Since 1986, when the Garden began to introduce plants, research on the *ex situ* conservation of rare and endangered plants has been reckoned to be one of the most important tasks in the Garden, and a special section for such plants, covering an area of seven hectares, was set up in 1989. According to recent statistics, nearly 200 species of rare and endangered plants are being conserved in the Garden. Among them are: *Cathaya argyrophylla*, *Davidia involuocrata*, *Manglietiastrum sinicum* and *Tsoongiodendron odorum*; they are mostly growing well in the Garden.

Besides the popular scientific activities and tours inside the Garden, the potential of the Garden's resources for educational development for the public is being explored. This is being done as follows:

- a relationship has been established with the *Shenzhen Special Zone Daily*, *Shenzhen Economic Daily* and *Shenzhen Evening News*, and with the help of these newspapers staff often write articles about plants and then hold botany competitions. Photographs of the scenery of the Garden taken by the tourists are often selected and published in the newspapers
- each year a Spring Festival Flower Show is held during the period of the Chinese New Year. Different themes and varieties of flowers and posters are selected from year to year. From these shows and posters, citizens have learned a lot about such topics as the history of plant evolution and the plant kingdom
- the Garden has cooperated with the local television station to produce some education videos about plants and the environment, and has invited some famous botanists to explain the programmes. They were welcomed by the public after being broadcast by the Shenzhen Television Station
- there are 160 holidays for primary and middle-school students each year in Shenzhen. The Garden has therefore set up a "160 Education and Popular Scientific Projects" programme during these holidays. Plans have been made to play games related to plants with students of secondary and elementary schools
- Science population education courses are regularly organised for primary and middle-school teachers, to help them to develop environmental education programmes in school. This in turn encourages teachers to conduct activities with their students in the garden.

Future aims and objectives of garden education

The Garden is famous for its abundant and colourful plants, graceful landscape and beautiful natural scenery. It is becoming one of the important scenic spots and a place for people to relax after work. The population of Shenzhen City is about 4,000,000 now; if everyone were to visit the Garden once a year, not only would it be a good chance to develop our education programmes, but it would also provide a wonderful income for the Garden to support itself. Nevertheless, there have only been 700,000 visitors here so far; we still have a long way to go. In order to attract more tourists to the Garden, more and more interesting and colourful educational programmes need to be developed to attract more people to join in it. Not only to let them have a 'look' or 'visit', but also help them to understand the importance of the environment and the conservation of the flora in order to involve them in protecting activities. Furthermore, the Garden intends to improve its efforts in the follow ways:

- maintaining a good environment and developing more new layouts in the garden, and continuing to disseminate plant knowledge using different media, including newspapers, television, radio, poster and computer-based multimedia
- organizing citizens to take part in activities such as planting trees to commemorate marriages, friendships, and the founding of companies, holding special lectures on topics such as horticulture, the environment and biodiversity, and holding summer or winter camps for plant exploration
- opening the garden to students for practical gardening classes, or for use in biological experiments
- developing cooperative activities and exchanges with other botanic gardens at home and abroad on education, in order to gain the experience and information with which to improve our education programmes.

The installation of an interpretation trail about the rescue of endangered plants inside educational greenhouses

Loïc Ruellan

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Created in 1975, the National Botanic Conservatory of Brest (Conservatoire Botanique National de Brest), France was the first botanic garden in the world committed to the preservation of endangered plants. Since its origin, the Conservatory has worked at regional, national and international levels, cultivating threatened plants from Brittany, France and oceanic islands throughout the world. Depending on the particular circumstances, rescues are carried out as in situ or ex situ operations.

With more than 1,300 endangered species in cultivation (filed from X to I according to the UICN classification), Brest has one of the world's largest collection of threatened plants.

In addition to rescue operations, the Botanic Conservatory has always carried out a variety of activities to make the public aware of the importance of protecting our plant heritage. This is indispensable if we want to assure the survival of threatened species in the long-term.

Why create a learning trail?

Since 1986, groups (school children, adults, students or specialists) have been able to request a guided tour with an education officer to learn about the Conservatory.

Because it is not always possible to give guided tours to individuals, we have designed a system for receiving and informing them. As a result we have created a learning trail so that they can visit our new educational greenhouses independently. In this way, we hope to considerably increase the attendance in our greenhouses, and spread the message of the necessity to conserve endangered species.

The educational greenhouses

The Conservatory cultivates plants from all over the world, and consequently the greenhouses are an indispensable tool for maintaining these fragile plants. With the installation of scientific and educational greenhouses in 1990, we have improved our ability to propagate rare plants and to educate people about conservation.

In 1993, we enlarged our educational greenhouses. We took advantage of this opportunity to add an interpretation trail.

Today, these greenhouses, with an area of 1,000 sq m, display four different environments: high-altitude tropical forests, temperate islands, dry tropical zones, and tropical rainforests. Of the 300 species shown, 95% are threatened in their natural environments.

Organising the information

In order to provide good quality and well structured information, we have developed a new method: general information appears on panels, and specific information about species is included in a booklet. Thus information is found in two different places which complement each other and interact together.

The panels

Inside each greenhouse, the visitor always finds three panels:

- the first describes the natural environment
- the second explains the destructive influence of humans in this area
- the third presents a theme related to conservation.

The presentation of each conservation theme is divided into four parts:

- the rate of disappearance
- why should we save this species?
- ex situ conservation
- in situ conservation.

During their walk, visitors progressively acquire concepts and ideas to better understand the dangers that threaten biodiversity, the methods for rescuing endangered plants, and the necessity for botanic conservatories such as ours.

The panels are made of a new material called Comoral. Framed with anodised aluminium, the panels are not affected by light or humidity. We are one of the first organisations to use this revolutionary material invented by GIAT Industrie.

The booklet

When visitors arrive we give them a free booklet which presents 36 endangered species that are in culture inside the educational greenhouses. These plants have been selected because their individual histories illustrate the general notions described on the panels. The booklet, which the visitor keeps, is not only an informative guide but also a real tool to make people more aware of what is at stake.

The simultaneous use of the panels and booklets constitutes a very original method of education, and one which seems to suit visitors perfectly. During the summer of 1995, a survey was conducted which shows us that 87% of the public found this method useful.

The Conservatory's partners

The Brest Botanic Conservatory was created in 1975 by Jean Lesouëf, the first Curator, with the support of the Urban Community of Brest, the SEPNE environmental association, and the national Ministry of the Environment. Since 1990, the Ministry has awarded us national status, together with five other gardens (Bailleul, Gap-Charance, Mascarin, Nancy and Porquerolles).

The Garden is managed by a group of local communities, and the Conservatory currently (1996) employs eight people. Once a year a scientific council audits our activities and scientific programmes.

The Brest municipal council (Communauté Urbaine de Brest) is our most important partner. It gives us grants, but also finances 10 gardeners, grounds, buildings and the gardening equipment. We have received technical and financial support from the following organisations to equip the educational greenhouses:

- Brest Municipal Council (Communauté Urbaine de Brest)
- the national environment ministry (Ministère de l'Environnement)
- the Brittany regional council (Conseil Régional de Bretagne)
- the local departmental council (Conseil Général du Finistère)
- WWF France
- GIAT Industrie.
- the national education and research ministry (Ministère de l'Education Nationale de l'Enseignement Supérieur et de la Recherche).

The landscaping was designed and the interpretation managed entirely by the staff of gardeners and the members of the National Conservatory Garden of Brest.

This arrangement is an interesting experiment because it is certainly one of the rare examples of the provision of structured information about endangered species found in a botanic garden.

Medicinal plants for survival: FRLHT's educational programme for the conservation of medicinal plants in a biocultural perspective

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About the Foundation for Revitalisation of Local Health Traditions

The Foundation for Revitalisation of Local Health Traditions (FRLHT) is a non-governmental organisation which was established to save and build upon India's medical legacy. As a part of its efforts to save India's ethnomedicinal heritage, FRLHT has initiated a programme of conservation as well as for the sustainable utilisation of medicinal plants.

FRLHT's main areas of activity are:

- traditional medicine and primary health care
- in situ and ex situ conservation of the plant biodiversity used in traditional medicine
- multi-disciplinary databases on medicinal plants
- international cooperation in traditional medicine
- establishment of the theoretical foundations and epistemology of traditional medicine.

FRLHT is coordinating a Danish Aid supported and a Government of India-sponsored project for the conservation of medicinal plants in the southern Indian states of Karnataka, Tamil Nadu and Kerala. It is the most comprehensive programme in India for the in situ and ex situ conservation of medicinal plants. Under the in situ component of this project, a network of 30 Medicinal Plant Conservation Areas (MPCAs) and six Medicinal Plant Development Areas (MPDAs), covering a wide range of ecological diversity and altitude ranges, has been set up. The *ex situ* conservation programme comprises the establishment of a chain of 15 ethnomedicinal forest gardens called Medicinal Plant Conservation Parks (MPCPs). The MPCPs will conserve all the plant species traditionally used by the ethnic communities of southern India and will act as the live repositories of the natural and cultural history of the region in which they are located. They will also be the learning and documentation centres for the local folk practitioners.

Strong linkages with the local communities, and their close involvement with all conservation activities, is an important part of the project's agenda.

The chain of MPCAs, MPDAs and MPCPs is the foundation for the Indian Medicinal Plants Genetic Resources Network (INMEDGERN) which will encompass all in situ conservation areas, nurseries, herbariums, seedbanks, and botanic gardens that are engaged in the conservation and sustainable use of the medicinal plants of India.

Our educational perspective

Indian medicinal plants are a national and a global heritage, and the Government, private and social service sectors need to be made aware of the urgent need for conservation action. This is possible only through public cooperation.

There are strong and urgent reasons for conserving medicinal plants:

- in India, across 4635 ethnic communities and hundreds of ecosystems, people know about the uses of over 7500 species of medicinal plants
- India has also codified knowledge of medicinal plants, their properties, processes and products. Over 10,000 herbal formulations are fully documented in traditional medicine literature

- medicinal plants in the modern age have not only kept their healing qualities, but they can guarantee 'health security' to millions of rural households
- the medicinal plants of India can provide a range of useful herbal products for the whole world.

Beyond botanical gardens: the need for *in situ* conservation of medicinal plants

Even if medicinal plants species are cultivated on millions of hectares (this should happen!), and even if thousands of botanical gardens are created (this should be done!), medicinal plants can still become extinct if viable breeding populations are not protected and conserved in the wild. Thus *in situ* and *ex situ* conservation efforts play a complementary role in securing the plant genetic resource base.

The need for a network of ethnobotanical gardens

From the experience of setting up of the chain of Medicinal Plant Conservation Parks in southern India, it is felt that, apart from the core function of the ethnobotanical gardens as centres of *ex situ* conservation of plant genetic diversity, they also serve several concurrent and equally important functions:

- they can conserve a region's natural and cultural history, especially since plants are an important link between biodiversity and cultural diversity
- the ethnobotanical gardens can help disseminate local knowledge of plants. This knowledge may have several dimensions, namely, nomenclature, schemes of classification, ecological insights, traditional conservation practices, and multiplicity and diversity of uses.

Main target groups

Educational programmes are targeted at the communities, mainly rural, living in our project areas. These communities have a strong local stake in ensuring the long-term sustainability of the conservation programmes. It is expected that they will participate in the conservation programme through protection of the sites from fire, grazing, etc., cultivation and through the use of medicinal plants and maintenance of the local health traditions.

Within the local community, groups of special interest have been identified: folk-medicine practitioners, women and schoolchildren, and farmers. The Forest Service personnel responsible for implementing the *in situ* conservation programme in close cooperation with the local community are also an important group.

Wide public goodwill and support is also needed, in order to activate policy changes and programmes for the conservation, cultivation and use of medicinal plants and the revitalisation of health traditions.

Educational package

A wide range of methods is used to carry messages to communities that are predominantly rural and with limited exposure to formal education. The methods used are:

- written materials, including posters, brochures, manuals, signs and interpretation
- documentary video films
- state- and district-level folk-practitioners' conventions, in which awards for excellence in public health service are presented
- interactive folk-art puppets and folk-theatre
- nature camps for children.

The 'icon' that identifies the conservation sites is a signboard arch with a pair of statues of a *Rihi* (sage) showing the traditional method of making herbal medicine and recording his knowledge on leaf scroll. The icon symbolises the close linkage between the conservation of biodiversity and sustenance of the health traditions as integral parts of the cultural heritage of India. The visitors to the sites and the local public now have a great degree of reverence and appreciation for the conservation and cultural values that these sites epitomise.

***AMRUTH* – the Indian magazine for the conservation of medicinal plants**

FRLHT publishes *Amruth* (meaning ambrosia), a comprehensive bi-monthly, English-language magazine fully devoted to issues, news and features relating to all aspects of the conservation of medicinal plants.

The Green Health campaign

FRLHT is promoting, with the assistance and involvement of a number of NGOs and government agencies, a public campaign to popularise the use of commonly-found medicinal plants for primary health care on a self-help basis. Called 'Green Health', the campaign is basically a strategy to revive interest in the indigenous health-care systems. 35 common medicinal plants of southern India have been identified and illustrated manuals have been prepared on how to grow these plants in a nursery and how to use them for most household ailments.

Conclusion

FRLHT's educational activities, which are closely linked with in situ and ex situ conservation programmes, lay a special emphasis on the biocultural aspects of conservation. This is because medicinal plants, along with their associated cultures, are today under threat. While the reasons for loss of biodiversity are better understood, those for the loss of cultural diversity are hardly understood. Cultural diversity may be as important for Civilisation's evolution as biodiversity is for biological evolution.

The Jersey Orchid Recovery Programme – an opportunity for education?

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Introduction

The Living Collection Department at the Royal Botanic Gardens, Kew has responsibilities for:

- **conservation and cultivation** of its collection of plants
- **public education**, which is addressed through the dissemination of horticultural skills and knowledge both directly and indirectly.

Direct education is carried out by interpreting the diversity of the plant kingdom through displays of the living collections within the Gardens, in association with the Education Department at Kew. Indirect education is carried out by collaborating with in situ conservation projects for local vegetation, such as habitat restoration and species recovery projects, in order to encourage education at a local level. A recovery programme for a native orchid in Jersey is one example of a collaborative project in which Kew has been involved.

A recovery programme for *Orchis laxiflora* in Jersey

Orchis laxiflora, the lax-flowered or Jersey orchid, although relatively common in Europe, does not occur in mainland Britain. It is found, however, on a few sites in the Channel Islands. Its wild habitats, normally wet grassland and marshes, have been rapidly destroyed; many Jersey orchids have also disappeared because of serious pressure from modern farming practice and other local development.

Orchis laxiflora was one of the first orchid species to be raised symbiotically from seed by the Sainsbury Orchid Conservation Project at Kew. Following the success of ex situ conservation by propagation in the laboratory and planting trials in the Gardens, a recovery programme to raise plants from native seeds for re-establishment on a former site in Jersey was initiated by a request from the States of Jersey Planning and Environmental Committee.

Seed capsules were collected from the wild in 1992 and the seeds were sown symbiotically in the laboratory under sterile conditions. The vigorous plants raised were weaned in one of Kew's glasshouses. In March 1996, 39 dormant tubers were taken back to Jersey to plant out into the former site, next to a rural museum at Hamptonne. Jersey orchids had been observed there eight years previously, but had not been seen since. The planting was carried out by a member of staff from Kew, volunteers from a local naturalists group and a representative from the States of Jersey Planning and Environmental Committee. Since planting, these plants are growing well and are expected to flower in the near future.

Local activities and education

The local newspaper and radio in Jersey have reported on this project and its progress. The newly-built education centre on the site has been used for interpretation to give more information to the public. The children from a local school have also become involved in recording the orchid populations.

Local activities have just started. It is hoped that this venture will have a strong educational value through encouraging the interest of the local people in their native plants, and bringing their attention to the role of re-establishing and augmenting populations. In addition, it is also hoped that taking pressure off the main site for these orchids will allow the natural environment on the island to be sustained.

Conclusion

Biodiversity conservation can be addressed in many different ways and at a variety of levels. Botanic gardens are ideally placed to practise and promote biodiversity conservation both in situ and ex situ. One of the critical parts of a conservation strategy is the challenge for botanic gardens to educate people to have greater environmental concern as well as increased knowledge of how the natural world functions. These educational needs can be met by integrating knowledge, experience and techniques in the fields of horticulture, science, management and education; all important components of the mission of the Royal Botanic Gardens, Kew.

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The Bombay Natural History Society: India's pioneer institution in the field of nature education and conservation

Neelam Patil

Bombay Natural History Society, Bombay, India

The Bombay Natural History Society (BNHS), a well-known 114-year-old natural history organization, was started by eight residents of Bombay on 15 September 1883, to exchange notes on wildlife and hunting, to exhibit interesting specimens and encourage one another's interest in natural history.

Mr Phipson was the Honorary Secretary of the Society for 18 years. In 1886, BNHS started publishing a journal, the *Journal of the Bombay Natural History Society*, under the editorship of Mr Phipson. The *Journal*, now in its 94th volume, is required reading for any study on the fauna and flora of the Oriental region. Phipson's successor W S Millard was particularly interested in gardening, especially in the cultivation of flowering trees and shrubs. His bungalow at Bombay was famous for the collection of trees, shrubs and a large fernery full of foliage plants, orchids and other tropical flowers. The credit goes to Millard for introducing to India such trees as the Burmese cassia *Cassia renigera*, and the padauk *Pterocarpus indicus*, also a native of Burma.

Millard launched the mammal survey of India, Burma and Ceylon in 1911 before he left India in 1920. The survey lasted only till 1914 due to the outbreak of World War I. It was subsequently restarted in 1923.

In 1965 the collection was shifted to Hornbill House, a new building in the Museum compound, built by the Government of India to house the BNHS. The Society's association with the hornbill dates back to the arrival of 'William', a Great Indian Hornbill, in 1894. William lived in the Society's premises until 1920.

Dr Salim Ali's association with BNHS lasted for 79 years having first come to the BNHS as a child to get an unusual looking sparrow identified, which he had shot. To mark his 80th birthday, the Society started publishing a quarterly magazine called *Hornbill*. This magazine very soon became popular among members as it covered articles and happenings in the field of wildlife. *Hornbill* is now more than 20 years old.

Under Dr Salim Ali's guidance and presidency the Society started various projects such as:

- the study of bird migration
- the Gir Project in Gujarat
- an ecological study of bird hazards at Indian aerodromes
- the ecology of Keoladeo Ghana National Park, Rajasthan
- the ecology of endangered species and their habitats
- a study of the ecology of the grasslands of the Indian plains, with particular reference to their endangered fauna
- birds of prey.

The Conservation Education Centre

With the help of the UK Overseas Development Administration, a project was started to set up an educational centre to educate people and children about nature, to create an awareness amongst the younger generation with the help of talks, films, slide shows, guided tours and nature rambles in the wild. The Conservation Education Centre is fully functional and staffed with four education officers.

Short-term projects and field studies

To name a few, the following projects were carried out:

- rediscovery of Wroughton's free-tailed bat
- rediscovery of Finn's baya (*Ploceus megarhynchus*)
- rediscovery of Jerdon's courser
- wild buffalo in Peninsular India
- status survey of the Nilgiri langur and lion-tailed macaque in South India
- the Nilgiri tahr in the Eravikulam Sanctuary
- breeding colony of flamingoes in Kutch
- the estuarine crocodiles of Bhitarkanika
- nature reserve potential of Kinwat, Maharashtra
- Puddukotai Bird Sanctuary
- crocodile status survey for the Maharashtra Government
- Ladakh Wildlife Sanctuary
- the search for Blewitt's owl
- birds of Sriharikota Island
- ecology of the honeyguide
- Nilgiri Bird sanctuary
- Hark Lake, Punjab, as a waterfowl habitat
- Basra wild buffalo survey
- blackjacked crane survey.

In 1957, the University of Bombay recognized the BNHS as a research institute, to guide students in research leading to the M.Sc. and Ph.D. degrees. To date, many students have successfully completed M.Sc. and Ph.D. courses and are working at various places in important positions.

The Society's collection is very precious and is recognized by the Government of India as a National Heritage collection. The BNHS collection includes specimens of about 60,000 insects, 7,500 amphibians and reptiles, 17,000 mammals, 26,000 birds and 8,500 herbarium specimens. The entire collection is maintained with financial help from the State Government of Maharashtra. Many research students come to the Society to refer to the collection. The library has a collection of about 180 rare books. It also possesses a large number of books on wildlife such as mammals, insects, plants, bird's etc. Prominent journals and magazines are available to readers. About 4,000 people from different backgrounds such as school students, housewives, army and navy officers, doctors, engineers are members of the Society. The BNHS also organizes camps and nature outings for the members, schoolteachers and students to various National Parks and Sanctuaries in India. Programmes such as slide shows, talks, film shows, puppet shows and video films on wildlife are arranged. Mobile exhibitions on wildlife are arranged in the rural areas of India for those who can not reach BNHS in Bombay. To create awareness about nature and to conserve this heritage is the message given with the help of all these activities.

Botanical education in the *Horto medicinale* of Padua in the sixteenth century: perhaps the earliest example of teaching in a botanic garden

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The origin of the Padua Garden

In the sixteenth century, the problem of identifying plants described in classical writings on *materia medica* seems to have been the principal concern of botanists. Their opinions were often contradictory; the result was that sometimes very different plants were called by the same name and different names were given to the same species.

Chaotic botanical nomenclature was often the cause of errors in the identification of the plants ('simples') used in treatment, resulting in incorrect administration of plants, even of very poisonous ones, thus causing the deaths of patients, as pointed out by Palmer (1984, 1985). Moreover, uncertainty in plant identification led to fraudulent practices, to the adulteration of drugs, especially of the expensive exotic ones imported from the Indies and the Middle East (Palmer 1984; Cappelletti 1989).

This situation was the main reason for the foundation in 1545 at Padua of a *Horto medicinale* (later on called *Horto dei semplici*) for the cultivation of native and exotic medicinal plants, collected on field trips in Italy, Greece, the Middle East, Arabia, and on the coast of Africa. In the opinion of the Venetian Senate, the *Horto medicinale* would increase knowledge of simples and reduce errors and frauds, since the plants cultivated in the Garden would be useful reference materials for herbalists and apothecaries and enable easier detection of drug falsification. At a period when universities were in keen competition for students (Palmer 1985), the Garden would also improve the quality of medical teaching and therefore increase the prestige of the Paduan Studio.

University teaching in the *Horto medicinale*

The recent discoveries of several sixteenth-century manuscript ground-plans of the Padua Garden, in which the names of the plants cultivated in each bed are quoted, throws light on the educational methods of the time. During Guilandino's prefecture of the Garden (1561-1589), the medical students had to attend two courses on medicinal plants; *lectura simplicium*, a theoretical course of lectures on Dioscorides, and *ostensio simplicium*, a practical course held at the Botanic Garden, where each plant was shown to the students. The discoveries of several very similar manuscript ground-plans of the Garden (for instance, the variations among them are only due to freehand copying) suggest that each student received a handwritten map (or made their own copy of the design of the four compartments from a blank master copy), where they had to write the names of the plants observed in each bed.

In plans of the Garden, produced in 1571, a number is written next to nearly all of the plant names. This is the number of the page where the plant species is illustrated in the 1565 edition of the Commentaries to Dioscorides' *Materia Medica* compiled by the physician Pietro Andrea Mattioli (Mattioli, 1565). These page references to Mattioli's edition probably indicate that it was used as a reference book by some of the students, but it is very unlikely that it was adopted as an official textbook because of Guilandino's quarrel with Mattioli (Raimondi, 1906; De Toni, 1911).

Another feature of the Padua Garden which is revealed by the manuscript ground-plans, is that the same species occurred at more than one place in the Garden, perhaps in order to have enough seeds to reproduce the plant the following year, or to have specimens and seeds for exchange with other gardens and scholars. It is possible that students may have been given cuttings, which had to be dried like a herbarium specimen and kept for comparison with the descriptions and illustrations contained in printed treatises.

Printed maps, which can be regarded as an improvement on the handwritten ones, were used later on. The guide to the Garden published by Girolamo Porro in 1591 contains a ground plan of the whole Garden and the plans of each compartment, with beds being marked by numbers. The plan of each compartment is followed by several blank pages on which the students had to write the plant names. One copy of Porro's guide, partly filled in, is held at in Biblioteca Civica at Padua. A complete list of the plants cultivated in the Garden (with the plant species identified by

Cappelletti (1995)) is also given for comparative purposes. Thus Porro's guide can be regarded as a working exercise-book.

The example of the Padua Garden

Shortly afterwards, other botanic and ornamental gardens profited from the use of handwritten and printed plans in the Padua *Horto medicinale*.

A drawing (now at the Florence National Library) with four compartments very similar to the Padua ones, together with a list of herbs to be planted in the single beds, was prepared by Bartholomeus Memkins in 1579-1588 (Tongiorgi Tomasi, 1986).

The Florentine Dominican monk and keen botanist Del Riccio, in his manuscript treatise on experimental agriculture (containing observations made between 1565 and 1591) and now conserved at the Florence National Library, exhorted his readers to label each garden compartment with letters of the alphabet and to number the plant beds from one 'up to three hundred'. The numbers had to correspond to the plant names, transcribed in orderly lists. He said 'all this is done so that, with your book thus arranged in the same way as the garden, you can find which plants are in all the numbers of each letter... (as in) many other gardens and collections of simples, as for example, the fine Garden of Pisa recently made by the Fleming Giuseppe Benincasa, or the Padua Garden' (Del Riccio, 1981).

The seventeenth century handwritten map prepared for the 'secret garden' of Cardinal Antonio Barberini at Castelgandolfo (now the Pope's summer residence), is equipped with a list of plants to be cultivated in each numbered bed; and a colour drawing of each flower has been prepared and attached (Tongiorgi Tomasi, 1986).

Conclusions

The Padua Botanic Garden, over 450 years old, is regarded as the oldest botanic garden which has survived in the same location with an almost unchanged ground-plan and has kept its original role of research and university teaching.

It must also be stressed that shortly after its foundation the Garden became an important centre of study, where the experimental method was applied to both research and teaching. Besides giving full information on the living collections existing in the Padua Garden in the sixteenth century, as recently pointed out by Ubrizsy Savoia (1995), the completed manuscript garden plans are perhaps the earliest evidence of the teaching methods used in a botanic garden.

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