

The Evolving Role of Botanical Gardens

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Hedges against extinction, showcases for botany?

Botanical gardens, those islands of serenity amid society's increasing din, were defined early on as places "open to the public and in which the plants are labeled." Today, the purpose of these gardens has greatly expanded to include rescuing plant biodiversity, offering serious programs of research and education to citizens of all ages and instruction for skilled botanists, creating aesthetically pleasing refuges from modern life, and maintaining storage centers both on-site and off-site for the long-term preservation of plant species against the time when they will have vanished from their usual habitats. Even though the role of botanical gardens has expanded, they are faced with constant funding pressures.

From their early days (which go back many centuries), botanical gardens have existed to acquaint humans with the natural world around them. The first such places were physic gardens in which the importance of medicinal plants was recognized. Later, as the age of discovery brought seeds and fruits from distant lands, botanical gardens became vital components of trade. They have always been appreciated for the beauty they harbor. With such a history, then, it was little wonder that when the world's most famous present-day garden, the Royal Botanic Gar-

dens at Kew, blossomed into greatness, it was in part because of the desire of the Third Earl of Bute to produce for royalty a place that, as Kew's historians put it, would "contain all the plants known on Earth." Botanical gardens have tried to meet that ambitious goal since the mid-eighteenth century.

Inevitably, because the gardens must be fertilized with money from their visitors, they are also places of entertainment, whether that means toy

railroads or June weddings or music by Blondie and the Magnets (who appeared at Kew in 2011). Botanical gardens' schedule of events rarely fails to include annual occasions (Halloween is a big one) and events of home-grown interest, such as quilt shows and local ethnic festivals. Many dot their landscapes with statuary for their customers to admire.

The need to bring paying crowds through the turnstiles is a universal



The Palm House at the Royal Botanic Gardens, Kew, in London. Photo credit: Royal Botanic Gardens, Kew.

one. Botanical gardens, like many of society's cultural centers, are hurting for money as governmental funding evaporates. Traditionally, rich people gave money to botanical gardens, a practice that garden administrators hope will continue. "There are many different approaches to fundraising, but nothing exceeds private and foundation giving in terms of meeting specific needs," Patrick Griffith, the executive director of the Montgomery

Botanical Center in Miami, said in an interview. But philanthropy is clearly not enough. Most botanical gardens have added a gift shop (or two) and a marketing arm to entice the public.

Modern-day arks

There are few nations of the world without botanical gardens. Botanic Gardens Conservation International (BGCI), the London-based center of the gardens' global network, has more

than 700 members in 118 countries (see box 1 for a sampling). BGCI has documented over 150,000 plants in cultivation in botanical gardens, of which many thousands are threatened with extinction in the wild. The organization's membership is creating recovery plans for more than 500 of the threatened species. Guardianship of plant germplasm is the gardens' biggest responsibility, says Sara Oldfield, BGCI's secretary general and

Box 1. A stroll through global gardens.

The Arnold Arboretum, administered by Harvard University near Boston, is a blend of public place (it is one of the city's parks) and celebrated research center. Its living collections hold some 15,000 plants, representing almost 4000 taxa.

Quaid-i-Azam University, in Islamabad, Pakistan, is building a botanical garden from scratch, with the aim of researching commercial, medicinal, and ornamental plants. Ecofarming, a "rose boulevard," solar energy, and picnicking are in the garden's future, says an announcement from the university, "if it does not run into financial snags"—a phrase well known to garden administrators everywhere.

Kirstenbosch National Botanical Garden, near Cape Town, South Africa, celebrates the unique flora of the Cape Floristic Region, which is one of the world's six floral kingdoms (geographic zones in which plants grow) and a global hotspot of biodiversity. Botanic Garden Conservation International's (BGCI's) Oldfield recently visited botanical gardens throughout Africa and believes that they will become increasingly important. "In some countries," she said, "botanic gardens are at a crossroads because they are both combining their historical functions and increasingly being called upon to answer the world's biodiversity and climate change problems."

The Missouri Botanical Garden (MOBOT), founded in 1859, is a US National Historic Landmark. Its 79 acres in the heart of St. Louis contain a glass dome, the Climatron, full of tropical plants, and a premier collection of rare orchids. It offers myriad educational programs for adults and children and leaves few corners of the natural world uncelebrated. (This year the garden mounted an exhibition of tree houses in order to demonstrate "the significant role trees play in our lives and in the health of our planet.") Behind the scenes, MOBOT is a celebrated global research center, with staff working in every continent save Antarctica. It has its own publishing house, and its plant database, TROPICOS, contains Web-searchable records for more than 900,000 plant names and close to 2 million specimens. In 2010, the garden and the Royal Botanic Gardens, Kew, announced that they had completed The Plant List, a working list of all known land plant species—1.25 million scientific plant names (www.theplantlist.org).

The Arizona–Sonora Desert Museum, near Tucson, is dedicated to the appreciation and conservation of the Sonoran Desert, which straddles the US–Mexican border and is best known as the sole home of the saguaro cactus. The 21-acre outdoor museum is a network of paths winding through several micro-zones that house animals as well as plants—mountain lion and smaller cats, inquisitive prairie dogs, Mexican gray wolves, legions of lizards, and abundant bird life.

The Royal Botanic Gardens at Kew, in southwest London, is internationally famous both for its pleasing layout and architecture and its devotion to research. Kew has more than 30,000 kinds of living plants, more than a million preserved herb specimens, and a huge library and has added most recently its Millennium Seed Bank Project, which keeps germplasm frozen in long-term storage.

Semmozhi Poonga, a recently established garden in Chennai (formerly Madras), India, demonstrates that botanical gardens do not necessarily bloom from ancient roots. This one sprouted in 2010 on the land of the former Drive-In Woodlands Hotel. Its 22 acres already contain more than 500 plant species and 80 trees.



A favorite resting spot of birds is the saguaro cactus, which grows only in the Sonoran Desert. Photo credit: Fred Powledge.

author of *Botanic Gardens: Modern-Day Arks* (2010, MIT Press). “I think that’s the absolutely essential role of botanic gardens, as the pressures are mounting on wild plants,” she said. “And we have to take care of them wherever we can.”

Few botanical gardens today would fail to include in their mission statements a commitment to fighting extinction and the loss of biological diversity. Plant habitat and diversity are disappearing under an onslaught of development, agriculture, overcollecting, and trade. Climate change is affecting plant survival and causing some species to disappear or to try to migrate. Invasive and nonnative species often outcompete native species for habitat. The experts that botanical gardens need are becoming scarce, and university botany departments are shrinking. So too is funding by federal land management agencies. And then there is plant blindness.

Plant blindness is a term, big in plant conservation circles these days, that was coined by professor James Wandersee, of Louisiana State University, and Elizabeth Schussler, of the Ruth Patrick Science Education Center (www.aibs.org/eye-on-education/eye_on_education_2003_10.html). It refers to what Wandersee and Schussler describe as humans’ “inability to see or notice the plants in [their] environment,” “the inability to recognize the importance of plants in the biosphere and in human affairs,” and “the misguided anthropocentric ranking of plants as inferior to animals and, thus, as unworthy of consideration.” Wandersee and Renee M. Clary wrote that “most people in developed nations tend to see plants as merely a green, blurry backdrop for the animals and human-made objects that populate their visual field.” The cure for such blindness, the authors wrote, is “botanical education, plant mentorship, and direct experience” to make “plants become salient, meaningful, and valued.”

Botanical garden directors have been quick to take up the cause. Overcoming plant blindness is a challenge but one for which they are well

suited. The gardens have known and preached for years that the extinction dilemma is real and that the green blur beneath people’s feet or the canopy over their heads requires attention. The gardens, with their expert abilities with regard to plant conservation, can produce action plans to protect existing species and restore species at risk—and can do so without sacrificing their roles as centers of beauty and spiritual refreshment.

In addition to their *in situ* collections of germplasm—their attractively laid-out plots of local herbs, angiosperms, and indigenous trees, often supplemented by exotica from faraway parts of the world—botanical gardens are engaged in *ex situ* conservation. As in the zoological world, off-site cultivation and storage exist as a safeguard against real-world extinction. Although botanical gardens prefer *in situ* conservation to the artificial nature of *ex situ* conservation, the latter is a necessary evil. Peter Wyse Jackson, now director of the Missouri Botanical Garden, wrote in 2000, when he was secretary general of BGCI,

As a method of conservation, *ex situ* [conservation] is inherently deficient in that it is not usually possible to maintain more than a limited sample of the genetic diversity in cultivation or in storage. In addition, it may lead to unpredictable genetic change and can become in practice a form of domestication. It is often regarded as preservation rather than conservation. In contrast, *in situ* conservation, at least in theory, allows plant populations to develop and evolve in, and as part of, the ecosystem of their natural habitat.

But in the real world, Jackson concluded, both methods are necessary (see box 2).

The *ex situ* placement of plants brings up another question—one concerning the long-term effects of the “assisted migration” of species that must be moved because of global cli-

mate change. Sarah Reichard, a professor at the University of Washington and associate director of the university’s botanical garden, says that such migration, also called *managed relocation*, is controversial. What happens, she wonders, if moved species turn into invasive pests in their new habitats? Plants are creatures not only of their own germplasm but also of their genetically diverse populations and the ecosystems in which they grow. This is another reason, she feels, that “seed banking is one of the most valuable things we can do.” If a plant is to be restored, she said, “we want to preserve the evolutionary potential of the species by having lots of genotypes, in the hopes that some will survive varying conditions.”

The university’s garden has a state-of-the-art vault in which the seeds of more than 320 of Washington’s rare plant species have been identified and conserved (<http://courses.washington.edu/rarecare/SeedVault.htm>). Mindful of the potential need to use stored seed in the event of catastrophe, but also of its uncertainties, Reichard and her colleagues have done experimental reintroductions. They are also aware of the fact that, of the 9000 or so globally threatened species that are in botanical garden collections, around one-third are found in only one garden. “Putting all your eggs (or seeds) in one basket is always risky,” she said. “We have divided some of our seed collections and sent them to other vaults for storage.” The garden is similarly diligent in tracking and protecting the diversity of seeds in its *ex situ* collection.

Searching for resources and relevance

The discussion of how botanical gardens should maintain their collections—*in situ*, *ex situ*, or both—is pretty well settled. For gardens with the resources to do so, both methods are necessary tools in the battle against extinction. Gardens value and seek volunteer help to use these tools, and by and large, they get it. What they do not get is enough money.

There is another lively question confronting botanical gardens, however,

Box 2. Peril and progress.

The following is an interview with Kathryn L. Kennedy, president and executive director of the independent, nonprofit Center for Plant Conservation (CPC), a network of botanical institutions “dedicated solely to preventing the extinction of US native plants.” Kennedy, a plant scientist from Texas, oversees a network of collaborating institutions, such as gardens, arboretums, and natural history museums that have botanists on staff. These institutions collect live material from endangered plants, then maintain it as seed, rooted cuttings, or mature plants, all with the aim of someday returning it to its natural habitat.



Kathryn Kennedy, president and executive director of the Center for Plant Conservation. Photo credit: David Kennedy.

Has the center’s work blunted the extinction crisis?

Americans are impatient, want endpoint results, and generally think in terms of short-term problem solving—preferably [spanning] five years or less. But for species imminently on the brink, the situation is dire by definition, and there are seldom quick and dramatic results.... [Achieving and documenting recovery] is a long process, in most cases, easily [spanning] 25–30 years or more to alleviate threats, achieve the level of habitat protection and management that may be needed, reverse decline, achieve self-sustaining levels, and maintain them for a species across its range long enough to deduce with confidence the species is no longer inherently at risk.

I believe we are making progress in both stabilization and full recovery. The Holy Grail for preventing extinction would be removal from the list of endangered or threatened species [because of] stabilization...

Robbins’ cinquefoil (*Potentilla robbinsiana*) is the most notable example of a plant species delisted because [of] improved numbers and condition and threat management. That is a species that one of our participating institutions, the New England Wild Flower Society, worked hard with over 20 years.... This was a very successful partnership project involving our CPC institution, the US Forest Service, [the] US Fish and Wildlife Service, [the] Appalachian Mountain Club, and many other partners.... So we are beginning to see the fruits of efforts [that have been] underway for some time.

How does CPC view the balance between *in situ* and *ex situ* conservation and restoration of plant species?

The species we work with have reached critically low levels. Nearly 75 percent of federally listed species have fewer than 100 individuals remaining in the majority of wild sites left. For most species, this does not represent a viable population.... CPC has always worked in the restoration interface for imperiled plant recovery. We believe that *ex situ* actions and *in situ* actions for restoration are both important tools for recovery.

Our *ex situ* work... has been designed from inception to capture the wild traits necessary to support restoration in the wild and [to] provide the plant material that will be needed for population-level restoration.

Should reintroduction of plant species be considered a last-ditch effort?

Reintroduction is definitely intensive care for a species, and you would not undertake it if there was an expectation that habitat management and restoration alone would be sufficient for a species to... respond and recover. But for seriously impaired species and populations, direct work like reintroduction or augmentation may be necessary.... This is because by the time they are listed, plants are in worse shape than many animal populations, and they often suffer from very small populations that are not self-sustaining... and may be suffering genetic erosion, and also because sites have been lost and habitat is fragmented so that increasing the number of populations to fill critical gaps is also needed.

Every species is different, and we conduct every reintroduction we undertake in a well-documented context as an experiment we learn from, so we are still learning a great deal about the process, but we see increasing signs of success.... I just heard from an institution with a species where the reintroduction sites for the species are currently doing relatively better than the wild populations.

Has the status of imperiled plants improved in recent years?

We’ve made limited but promising progress. The imbalance in funding is problematic and is getting worse, to the extent [that] funding for all endangered species is under attack. It declined significantly in the last [federal] budget and drastically in the current proposed budget. Clearly... substantially more funding is needed if we really want to provide for endangered species recovery.... Plants encompass more than half the federally listed species, but they get less than five percent of federal agency expenditures for recovery action. By any standard, then, the endangered species budget is clearly less than half of what is needed.

and it concerns their social relevance (see box 3).

Despite efforts to attract more visitors by adding entertainment centers

and special event venues, many botanical gardens are still viewed as stand places, reflecting the conservatism of the wealthy people whose money

founded them. In a recent report on gardens in the United Kingdom, commissioned by BGCI, it was found that many of them were perceived as



*Carlos Magdalena (shown here), horticulturalist at Royal Botanic Gardens, Kew, in London, helped bring *Nymphaea thermarum* back from near extinction. The water lily, one of the smallest in the world, was rescued from a freshwater hot spring in Rwanda by German botanist Eberhard Fischer. Kew helped propagate the lily's seeds. Photo credit: Royal Botanic Gardens, Kew.*



The University of Washington's botanical garden maintains a seed vault in which the biodiversity of more than 320 of the state's rare plant species is conserved. Volunteer Sarah Bailey sorts tiny seeds to be added to the collection. Photo credit: Jennifer Youngman.

“exclusive and elite institutions.” What was needed, concluded the authors of the study, was a broadening of

audience appeal and an engagement “with community concerns and needs.” The result, the report said, could be a much-needed reconnection of the public with nature. Of course, greater turnover at the gardens’ turnstiles would be a nice byproduct, too.

Some of the efforts to reconnect may seem a far cry from how botanists once envisioned botanical

gardens. But gardens do what they must to keep their doors open in lean times. The New York Botanical Garden imports performers from Broadway shows to kick off some of its events. The Desert Botanical Garden in Phoenix, Arizona, put on a wedding contest said to be valued at \$85,000 in which the winning bride got a wedding dress, flowers, food, hair styling

Box 3. How do you go about growing botanical garden from the ground up?

Citizens of Charlottesville, Virginia, are in the process of finding out. Some of them, gathered beneath the moniker McIntire Botanical Garden, are hoping that the city will use a plot of centrally situated land as a newborn garden.

As is often the case with urban projects, this one evolved from competing ideas about how to use some land. Paul Goodloe McIntire gave the land to the city in 1926. Half the plot was put to passive recreational use; half was turned into a golf course. Then came a master plan and proposals that some of the land be used instead for a parkway. It was the parkway that ignited the McIntire fire. A coalition was formed to stop the road. Committees formed and legal actions ensued, and out of it all grew the proposal for a botanical garden.

Through the summer of 2011, a series of public hearings was focused on what the public might want in a botanical garden. A Web site was erected. Membership lists were drawn up. Proponents formed a partnership with Whole Foods. (“Our vision and goals align [with those of Whole Foods] to protect and preserve the environment, bring plants and people together, and enrich the community through education and enjoyment,” say the McIntire supporters.) The garden’s backers started an educational program to inform citizens of its benefits (it is close to the city center; ideal for community events and educational opportunities; a great destination for children, visitors, and researchers seeking “a place of serenity and beauty while creating opportunities for all to be informed about horticulture, sustainability, and climate change”). Money? Charlottesville has a long history of public–private partnerships. Political support? Three city council members are to be elected later this year, and all of the candidates are believed to support the project.

Helen Flamini, president of the fledgling garden effort, says that the first phase (after the hoped-for city approval) will be the drafting of a master horticultural plan that will extend 25 years into the future. At the base of it all is McIntire’s motto: “A garden for everyone!”

(“whimsically romantic”), makeup (“more fierce with rosy cheeks, smoky eyes flared out on sides to create that timeless ‘40s look”), a day at a spa, Swarovski earrings, and much more—all of it provided by a couple of dozen vendors, who were prominently named. The garden also runs a beer garden; for \$55, visitors can experience “a vintage urban lounge with a hint of Bavarian influence” among the cacti.

The Fairchild Tropical Botanic Gardens, in Coral Gables, Florida, is a respected tropical research institution, but it also throws “South Florida’s most decadent festival,” in which chocolate is the centerpiece. (Chocolate, after all, comes from a tropical tree.) For \$20,000, a vendor at the “Dark Chocolate” level in the 2009 festival got “exclusivity” at the event—prominent display of its logo, the right to use the festival in its promotion and advertising, 20 tickets to the Chocolate VIP party, and other perks. Sponsorship at the “Milk Chocolate (Platinum)” level cost \$10,000 and included 12 party tickets. For \$500, you got a “Hot Chocolate”—level sponsorship.

The BGCI report on social relevance paid special notice to one unusual garden: the Eden Project. Situated in

Cornwall, in the United Kingdom, Eden offers not the peace and quiet that characterize many botanical gardens, starting with its namesake, but, rather, education, “playfulness” (aimed specifically at children), and a clear focus on its “social role and relevance.” Eden, said the report, “is much more focused on community engagement and advocates for social change.” The result may confuse some fans of traditional botanical gardens; among Eden’s recent offerings were circus acts and a concert by Primal Scream and the Horrors. The business network “Bloomberg BusinessWeek” refers to Eden as “a theme park.”

The theme, thinks Sir Ghilleen Prance, is a worthy one. Prance is Eden’s scientific director, and he has impeccable credentials. He was director of research for the New York Botanic Garden; was a director of the Royal Botanic Gardens, Kew, and was a founder of its Millennium Seed Bank; and is a noted rainforest scholar.

“Eden was not set up as a botanic garden,” said Prance.

We have national botanic gardens in England, Scotland, and

Wales, so there was no need for another similar institution.... Eden is a showcase of botany, whose purpose is to show the importance of plants to people and to stimulate sustainable use of all plants. It is indeed a social enterprise organization.... Many things that originated at Eden are being copied and used in botanical gardens. We are quite happy about that, but Eden will not gravitate towards becoming a traditional botanic garden. Because we are a major tourist attraction, we get many visitors who would not normally go to botanic gardens, and so we are reaching a wider audience with the message of the importance of plants and the need to conserve them.

Prance sees no conflict between botanical gardens as places of both scientific research and trapeze acts. “If a garden has a research program, then the visiting public should know about it,” he said, adding that he had made sure that the Millennium Seed Bank at Kew had large windows so the visiting public could see seed researchers at work. “[Some] of the principal differences between a botanic garden and a park [are] that [the former] is involved in science, conservation, and educational activities,” he said. “All of these must be demonstrated to the visitor.”

Whatever botanical gardens’ future, the need for social relevance—however it is defined—will not go away. Nor will the need to raise the sums of money that are required for serious research. Some changes may be wrenching (rock music in botanical gardens may take some getting used to), but change is inevitable.

One major factor in the evolving role of gardens will be the ongoing effects of climate change. BGCI notes that, although some plant responses to climate changes are known, “we have only just begun to understand how the interaction of these changes impacts plants and their role in regulating the global climate.” Scientific



Botanical gardens play an important role in introducing children to the natural world and to science. Here, students visit the Kew gardens. Photo credit: Royal Botanic Gardens, Kew.

evidence is mounting that rising temperatures contribute to the migration of plant species—or at least to those plants capable of spreading their seeds into new territories. And, for people and their botanical gardens in Oceania, higher water levels brought on by warming may force migration of both plants and animals.

Defining *success* among botanical gardens is difficult, given the diversified constituencies of the gardens. “Every garden will have its own definition,” says Reichard of the University of Washington. Asked what a proper

definition of *success* might be, she replied:

I guess a general answer would be “if they are fulfilling their mission.” Ours is “sustaining ecosystems and the human spirit through plant research, display, and education.” Measuring that might be a little difficult, but if you went through each of the garden’s departments and found ways that they are supporting the mission, you could say we are successful.

She hastened to explain the “human spirit” part. “I thought that was a little touchy feely when we first added that, but I went along with it,” she said. “But in the few months right after September 11, 2001, gardens all reported a huge increase in visitors, and I got it. If we can provide people some relief from the problems of the world by sharing nature and the beauty of plants, I think that is a pretty nice goal.”

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