

The role of botanical gardens in plant conservation[©]

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INTRODUCTION

Botanical gardens are much about colourful display and arboreal grandeur. Until relatively recently, though, most botanical gardens were largely collections of exotic plants arranged for the pleasure of the public – not unlike the zoos of the past. In other words, exotic eye candy to entertain the customer and not so much about conservation. University-based botanical gardens have always provided special gardens and research collections for the education of experts, but these were mostly inaccessible. Essentially, the typical garden visitor would have no clue as to the value of the plants beyond any intrinsic beauty or other esthetic appeal they might have. It's worth noting that the earliest European botanical gardens were cloistered herb gardens administered by Latin-speaking monks. The walls and yew hedges surrounding them were meant to keep the knowledge in and the riff-raff out. Such academic traditions have been broken – although not always completely – the various kinds of interpretive signage common in modern botanical gardens being an indicator of the newfound willingness to communicate with the public.

(Getting back to our fixation with the exotic...) In many cases, botanical gardens ignored their own regional floras, in deference to the appeal of the foreign and unfamiliar in public displays. The collect-one-of-everything mentality (known in the botanical world as "stamp collecting"), is not in itself destructive, nor even without value on occasion, but it probably indicates the baser instinct to acquire for the sake of acquisition, and then to show off about it. Historically, greed among competing collectors and the imperialistic tendencies of governments sometimes resulted in what was essentially the opposite of conservation.

Nowadays, modern botanical gardens have a better understanding of the potential destructiveness of wholesale collecting and, indeed, of any kind of collecting. Seed collection, for example, which is generally seen as a relatively benign activity, can have serious impacts on the health of some plants in the wild, particularly where seed is the only means of reproduction and natural seed production is limited. This is easily illustrated with plants that require cross pollination to produce fruit: remove enough plants and viable seed numbers decline. Once seed is unavailable in the wild, reestablishment suffers. It is not, of course, appropriate or fair to blame only collecting for the loss in biodiversity that makes conservation so obviously important. Habitat loss through clearing for industrialization, forestry, and large-scale agriculture and over-grazing and over-cutting because of an ever-shrinking resource base, are the most significant factors in the reduction of biodiversity around the world.

CONSERVATION OF WILD PLANTS

The conservation of plants in the wild normally encompasses two broad categories: ex-situ conservation and in-situ (i.e., habitat) conservation. Habitat conservation is generally the purview of botanical gardens that have wild areas or that have the resources to be able to purchase or manage wild habitats. A slightly more arms-length approach to in-situ conservation includes education about and advocacy for threatened habitats. Like other botanical gardens, we have a garden feature at UBCBG – the Garry Oak Meadow and Woodland Garden that features plants from a local endangered ecosystem. This gives us a platform so we can inform the public not only about this important community, but also about biodiversity and conservation in general. Conserving biodiversity in-situ usually starts with documentation, followed by a conservation assessment. Such expertise is often found in botanical gardens. If the area is remote, the ability to train people on the ground in those regions, and thus, build capacity, is also an important aspect of conservation. The Flora of

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Nepal, which was undertaken by Royal Botanic Gardens Edinburgh, is a celebrated example of this approach. Most gardens cannot hope to initiate or maintain projects on that scale, but collaborations are always possible. Indeed, staff at UBC Botanical Garden was involved in biodiversity inventories and conservation assessments for a proposed park in the Hoang Lien Mountains of northern Vietnam in 2004.

Ex-situ conservation is another matter. In ex-situ conservation, propagules are collected and stored or grown out in plantings. Royal Botanic Gardens Kew's Millennium Seed Bank is a good example of ex-situ conservation, having currently banked 13% of the world's wild species. Botanical gardens often make a big deal out of ex-situ measures, but in many cases, these amount to little more than stamp collecting.

There are generally two goals in ex-situ conservation. The first is to perpetuate a species. In the best-case scenario, the entirety of a species' genetic makeup would be included in what's saved, so that it might have in its genome sufficient variation to survive the rigours of current and future environmental disturbance. Such a species will have a better chance of surviving repatriation, which is typically the second goal. Effective ex-situ conservation generally requires significant numbers of seedling plants from across the species' geographical, edaphic (soil-related), and elevational range. This is no easy task, either in collecting or having the space to grow the seedlings out. It becomes simpler and less problematic where populations are already reduced, but in these cases, there are often questions about whether it might not be worth the effort. Perhaps the largest ex-situ initiative is the International Conifer Conservation Program, administered by Royal Botanic Gardens Edinburgh, which encompasses surveys, assessments, propagation and taxonomic research and a network of in-situ and ex-situ planting sites. It goes without saying that some expertise in propagation is often required in plant conservation, as seed recalcitrance and the availability of materials from which to propagate are often contributing factors in conservation status.

EX-SITU CONSERVATION AT UBCBG

In 2010, UBCBG took part in a botanical expedition to the Hengduanshan Mountains of Sichuan Province in China to observe and collect wild *Acer pentaphyllum*. DNA collection for genetic fingerprinting was carried out on this trip and a good supply of seed was collected, as well. Wild populations of *A. pentaphyllum* are being reduced in number and its original distributional range contracted. Known as a "genetic bottleneck," such a diminishment in numbers notably decreases genetic diversity in the species. In other words, there is a lesser probability that offspring from the remaining populations will display the range of variability that the species once exhibited over its original range. This can mean that traits that confer cold hardiness, drought- or heat-tolerance, or resistance to a particular disease could be lost to the species, particularly if the remaining habitat does not bring those evolutionary pressures to bear. Actually, a number of traits may already be lost. It is, therefore, critically important (if saving the species is the goal) to collect seeds from as many individuals and as many populations as possible and plant them out in a variety of environments. Quarryhill Botanical Garden in California has already established a large ex-situ planting of *A. pentaphyllum* seedlings from two previous expeditions.

UBC Botanical Garden's plants are derived from 12 different seed collections from the populations of *A. pentaphyllum* that remained in 2010. More than one hundred seedlings have been planted out in various sites and in a field trials area at UBCBG since that time. We certainly don't expect all or even most of our seedlings to survive the vagaries of Vancouver's climate, but if a few thrive, they will represent genetic expression that may not be represented by surviving collections elsewhere (such as in California, Belgium, Pennsylvania, or Sichuan). Ultimately, when plants are returned to the wild, they would represent the widest possible genetic complement.

CONSERVATION OF CULTIVATED PLANTS

Botanical gardens have a role in conserving diversity, whether that diversity is embedded in historical cultivars that speak to regionally or locally significant plant breeding

efforts, the rich First Nations legacy of plant selections or the diversity represented in collections of ornamentals. Botanical gardens are first and foremost “gardens” and gardens are places of beauty. Even food gardens have a certain appeal (who isn't fond of eating?) and it's worth pointing out that there is plenty of genetic diversity in cultivated plants. However, as various grass-roots seed-saver organizations have shown us, heritage food varieties, like their wild relatives, are under threat. Botanical gardens are stepping up to demonstrate and explain the value of conservation of food crops, even facilitating seed-sharing events such as “Seedy Saturdays”, which help to preserve and proliferate historically and regionally important open-pollinated taxa.

Ornamental plants represent through their cultivated ranks an enormous diversity. Together with the Plant Collections Network (PCN, an initiative of the American Public Gardens Association), North American botanical gardens have gotten together to identify and assess “national collections” of many such plant groups. The value here is that modern botanical gardens are generally committed to both record-keeping and the dissemination of information about the plants they grow. UBCBG is part of two multi-institutional PCN plant collections: maples and magnolias.

Independently, UBCBG has embarked on a propagation project to conserve the rare ornamental cherries of Vancouver. The goals of the program are to maintain the diversity of cherry trees in the Vancouver area and to identify propagation protocols that facilitate improvements to the health and longevity of the cultivars. There is some evidence that the various incompatibilities and differential rates of growth inherent in grafted plants are contributing to disease susceptibility. Cherries are well adapted to conditions in the Vancouver area and make excellent small-to-medium sized urban trees. However, brown rot and bacterial canker are serious diseases that limit the effective lifespan of these trees. More seriously, older rare cultivars are being lost and, because of stringent plant protection legislation (e.g., limited importations of stone fruits), these plants cannot easily be replaced. Working with the Vancouver Park Board, the Biotechnology Program at the British Columbia Institute of Technology and UBC Botanical Garden Nursery, we now have 35 cultivars, many of them the rarest cherry cultivars, growing on their own roots at the Nursery and in the Garden.

Botanical gardens have come a long way since the days of the monks' cloistered garden. Conservation initiatives require the broadest engagement and highest level of communication for success. Whether through ex-situ collections, surveys and assessments, propagation research, education about biodiversity and habitat protection or the cultivation of heritage plants, botanical gardens are making a difference.

