

Cacti flowering at the National Botanic Garden of Belgium, Meise



Doreen Groom (Meise)

# How useful are botanic gardens for conservation?

Conservation collections are highly valued by some botanic gardens: DAVE APLIN suggests they should be critically evaluated

SINCE THE AGE of ten I have been enchanted by plants. I recall vividly my father teaching me to tend dahlias on a small plot of land in Dorset. Since then my interest has extended beyond that manicured patch to plants occurring naturally across the fields of Britain and internationally. I soon became aware of the threats facing many of them, although the first wide-ranging evidence of this has only recently emerged.

In 1997, the International Union for Conservation of Nature (IUCN) declared that around 35,000 plant species, about 10% of the known total, to be threatened by extinction (Walter & Gillett 1998). Today this percentage is believed, by some, to be closer to 40%. In response, the Convention on Biological Diversity adopted the Global Strategy for Plant Conservation (GSPC) in 2002, which outlined targets to safeguard plants and their environments by 2010.

This strategy, composed by leading scientists, is marked in time as it provided no reference to climate change. This was no oversight – it merely demonstrates that global warming has only been taken seriously in the last few years. It is now considered one of the greatest threats to biodiversity, as highlighted in a study by the European Native Seed Conservation Network (ENSCONET). In 2007, the Network announced that 3,000 European alpine species were endangered, mainly due to rising temperatures (Rossi *et al.* 2007). This new threat coupled with perhaps the single most destructive force, habitat loss, is accelerating the urgency for conservation action.

## **Integrating *in situ* and *ex situ***

Essentially, there are two main approaches to safeguarding plant species. By far the best is protection

in the natural habitat (*in situ* conservation) where populations have evolved over millennia and can continue to adapt. Dramatic changes to a plant's environment, such as in temperature or land clearance, however, may render even this form of protection futile.

The alternative approach, known as off-site or *ex situ* conservation, requires the collection of viable plant parts (ie seeds, spores, tissue or whole plants) from the wild for storage or cultivation. The aim of this approach is to provide a vital safety net, temporarily conserving plant diversity, until a time and place is designated for reintroduction (Aplin *et al.* 2007).

While the concept of *in situ* conservation is rarely questioned, *ex situ* methodologies often come under fire. At one extreme some ask, 'Why bother, especially if the plant's habitat is destroyed?' More moderately, others state, 'We cannot sit back and watch plants and their genetic diversity disappear forever' and therefore accept intervention is sometimes (increasingly) necessary.

Contrasting views have led to strained relations between *in situ* and *ex situ* protagonists. In Europe at least, these are beginning to heal, as witnessed at a recent Planta Europa

Conference in Romania, aimed at preparing a new European Strategy for Plant Conservation. Here, individuals from both parties spoke of 'integrated conservation', acknowledging the growing necessity for each other's methods.

Botanic gardens are currently the greatest contributors of *ex situ* conservation, utilising methods such as seed banking, cryopreservation, tissue culture and the cultivation of plants. Additionally, many specialist plant societies have an excellent track record in plant protection, in the case of the British Cactus and Succulent Society spanning a quarter of a century. In order for botanic gardens to become active conservation partners we need to be aware of the limitations to our methods. If these methods do not contribute directly or indirectly to a species' survival in the wild then it is not conservation.

### Do plant collections aid conservation?

In my role as a Curator at the National Botanic Garden of Belgium (Meise) I have been eager to discover the extent to which living collections can legitimately aid conservation. Having been fortunate to visit a large number of gardens over the past few

years, I have become aware that, like at Meise, large numbers of plants are held behind the scenes. These are normally termed 'conservation' or 'research' collections, often regardless of their scientific merit for these purposes. Around the same time I have also become conscious of the financial constraints many botanic gardens face, and to this end anticipate the future necessity to justify the presence of every plant on our benches.

### The dominance of *Cactaceae*

In my experience, one of the most common collections given the 'conservation' label is *Cactaceae*. This is not difficult to understand. Habitat destruction, or simply its modification by industry, has placed many species under ever increasing threat. Meanwhile the frenzied poaching of some fashionable rarities, such as *Ariocarpus* species, have helped justify the family's international protection under the Convention on International Trade in Endangered Species (CITES). Yet this legislation is all too often ignored or has arrived too late to save many populations. In 2006, conservation assessments published in the *New Cactus Lexicon* (Hunt *et al.* 2006), provided the sober news that over 30% of all taxa required conservation action. Therefore, I started to question whether botanic gardens were really cultivating these plants for conservation, or simply growing them under our own misguided label.

The *Cactaceae* collection at Meise represents our largest living plant family comprising about 5,000 plants from 1,642 taxa. Despite this apparent diversity only 10% have collection data. This information is extremely important if plants are to be utilised for conservation (and research). It normally details the



*Opuntia stenarthra* was unearthed in the collection at Meise. It had not knowingly been seen as a living plant for over 100 years



Rene Marrens (Meise)



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*Epithelantha bokei* (above left) is now known in the wild from an area less than 20km sq, according to the *New Cactus Lexicon*, and there are fewer than 1,000 individuals of *Turbincarpus pseudopectinatus* (above right) remaining in the wild

location where the plant or seed was originally collected thus making it possible to differentiate between different populations and possible genetic variation. The remaining 90% had no data. These comprised plants that had, presumably, been repeatedly cultivated in gardens and some were of hybrid nature. Insufficient data has been shown to compromise conservation (eg Maunder *et al.* 2001, Aplin *et al.* 2007), therefore, except for exceptional circumstances, these plants should be confined to education and display purposes.

It would have been a simple, but unpopular, exercise to remove 90% of our plants. We were certainly going to reduce our collection substantially, but in order to make an informed choice we needed to have an indication of their scientific value by specialists. We were fortunate to be able to deploy the services of two internationally renowned experts, Dr David Hunt, Secretary of the International Organisation for Succulent Plant Study, and Dr Nigel Taylor, Head of Horticulture at the Royal Botanic Gardens, Kew. Over two long days in July 2007 they

meticulously studied each of our plants. At the end of their evaluation they provided the honest, but blunt assessment that two-thirds of our collection could be thrown away with no implications to research or conservation.

On hearing this I was asked if I felt depressed. Actually, the feelings were more of relief because for the first time ever we had an accurate picture of reality and can concentrate space and time more wisely. Furthermore, the exercise unearthed plants that we had not realised were important, such as a specimen of *Weberbauerocereus cuzcoensis* from its original collection and the jewel in our collection, *Opuntia stenarthra*, a scruffy-looking Paraguayan species, which has not been observed as a living plant for over 100 years! We also discovered that our collections of *Matucana* and *Oreocereus* were important, not so much for their data, but for the fact that they are rather uncommon in botanic garden collections.

The evaluation of plants in botanic gardens, in my opinion, is one of the most important directions

a curator can take, the quality of the collections at Meise are no better or worse than those in other botanic gardens, but we have at least initiated a proactive approach to improve quality that will gradually spread to other plant groups.

The urgency to evaluate *ex situ* collections has been recognised in the forthcoming European Strategy for Plant Conservation, which will hopefully persuade reluctant curators to strive for quality rather than quantity. The latter should be left to garden centres, or as a tool for bulking-up rare taxa for enthusiasts to reduce the pressures of illegal collecting, as the mass propagation of *Yavia cryptocarpa* by members of the British Cactus and Succulent Society clearly highlights (Maddens & Miller 2006).

### Seeds of hope

Moving away from cultivated plants, seed banking is currently considered to be the most important off-site conservation activity. It enables many wild-collected seed lots to be stored in a relatively small area, thus safeguarding a greater genetic diver-

sity than could ever be, realistically, maintained by living plants. Modern techniques carefully dry, then freeze samples at  $-20^{\circ}\text{C}$ . Under these conditions some taxa may retain their viability for hundreds, if not thousands, of years.

One of the largest seed banks in the world, the Royal Botanic Gardens Kew Millennium Seed Bank (MSB) demonstrated its commitment to conservation by banking its billionth seed in April 2007. Its holdings of *Cactaceae*, however, are represented by less than 5% of known taxa. This is not surprising as this family has not yet been a focus of activity. More worrying is that there seems to be no extensive collections of banked cacti seed designated solely to conservation. In order to address this imbalance Kew has initiated a project aimed at collecting seeds from its wild-sourced plants from their living collections. This procedure is carefully controlled to ensure that cross pollination is carried out with other plants of known origin.

Naturally, the gene pool of a particular taxon from an *ex situ* collection will be limited. However, a larger pool could be made available if we started to utilise a number of off-site holdings collectively. In this

scenario, pollen (for example) could be transferred between institutes or private collections to pollinate specific accessions, in a similar way currently carried out for cycads.

Pollen storage is currently an under-utilised conservation tool (Towill 2004) needing further research, yet one that has huge conservation potential. Some taxa however are only known from a single site, or even extinct in the wild, eg *Rhipsalis pentaptera*. In these cases any seeds, as long as they are not hybrids, are valuable especially if they are placed in long-term storage to aid future conservation effort.

Currently, communication and collaborative effort between *ex situ* collections is relatively uncommon. However, the International Organisation of Succulent Plant Study's 'Reference Collections Initiative' aims to make this its focus. The initiative will bring together important cactus collections under one umbrella with obvious benefits such as knowing who maintains internationally important collections of particular taxa, where to seek advice on the identification and cultivation of species and a platform for allowing the transfer of plants or their derivatives. In this way the true

strength of *ex situ* conservation can be realised, avoiding the pressure of institutes trying to do everything independently on impossible budgets.

### Conclusion

Undoubtedly, the art of curating living plant collections is changing. If we want to continue to legitimately place the appellation botanic to our institutions we need to focus on data quality and not strive to represent as many of the world's species at a single place. Future generations will judge us on the route we take.

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The Millennium Seed Bank run by Royal Botanic Gardens, Kew, is adding to its cactus seed collections