
Generating collaborations to utilize *ex-situ* living collections to achieve Target 8 of the GSPC: a symposium discussion

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Abstract

Target 8 of the GSPC calls for at least 75% of threatened plant species to be in *ex-situ* collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs by 2020.

Target 8 is directly applicable to the botanic garden community, which is uniquely placed to support the Target with a combination of horticulture, conservation and research skills. Furthermore, these skills are often coupled with a long history and experience of building and maintaining large living collections. Collectively, botanic gardens hold an estimated 6,130,900 accessions of living plant material (BGCI, 2001). This puts botanic gardens in a primary position to provide leadership for achieving success. As with any large complex endeavour, there are certainly many challenges. The symposium discussion sought to identify these and solicit collective ideas on solutions.

Key words

Capacity Building, Conservation, Databases Ex-situ, Genetic Analysis, Living Collections, Seed Banking

Can we achieve Target 8?

The ambitious nature of the Target is designed to drive achievements. The first question to ask is: can the botanic garden community achieve the Target by 2020? The answer to this is both “yes” and “no”, depending on how we look at Target 8. On a global level, collecting 75% of all threatened species is a daunting task, with an estimated 10,065 taxa in the IUCN categories of Extinct, Extinct in the Wild, Critical, Endangered and Vulnerable (IUCN, 2013). Implementing Target 8 at a more local level helps; however, the concentration of plant diversity and distribution of resources across the globe poses challenges.

In areas with low plant diversity, achieving the Target can be relatively easy. For example, the Royal Botanic Gardens Edinburgh has 170 taxa selected as priority based on the ability to grow them, and 130 have been successfully collected (RBGE, 2013). In mega-diverse areas or hot spots, the numbers of threatened plants can be staggeringly high. South Africa has a flora containing approximately 24,000 species (SANBI, 2013a) with almost 25% of taxa threatened or of conservation concern (SANBI, 2013b). The Target is unlikely to be met by 2020 in diversity hotspots like South Africa. The global distribution and coverage of botanic gardens also poses limitations at the local level. In the following images, note the disparity in the concentration of the world’s botanic gardens (Image 1) in comparison to the world’s biodiversity hot spots (Image 2).

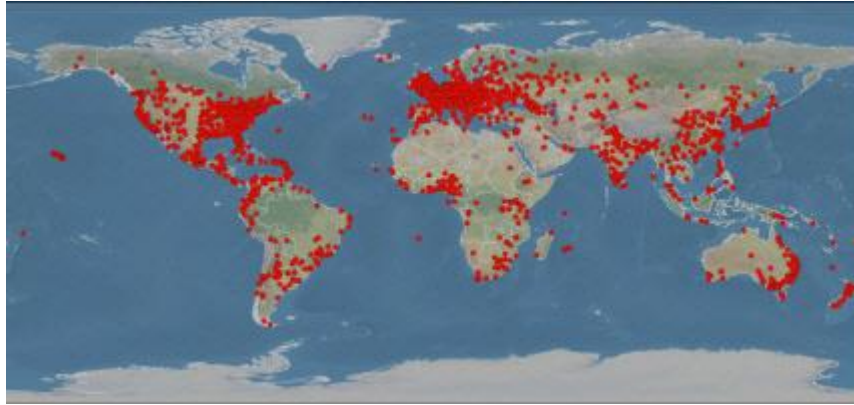


Figure 1: Global Distribution of the World's Botanical Gardens (BGCI, 2013)

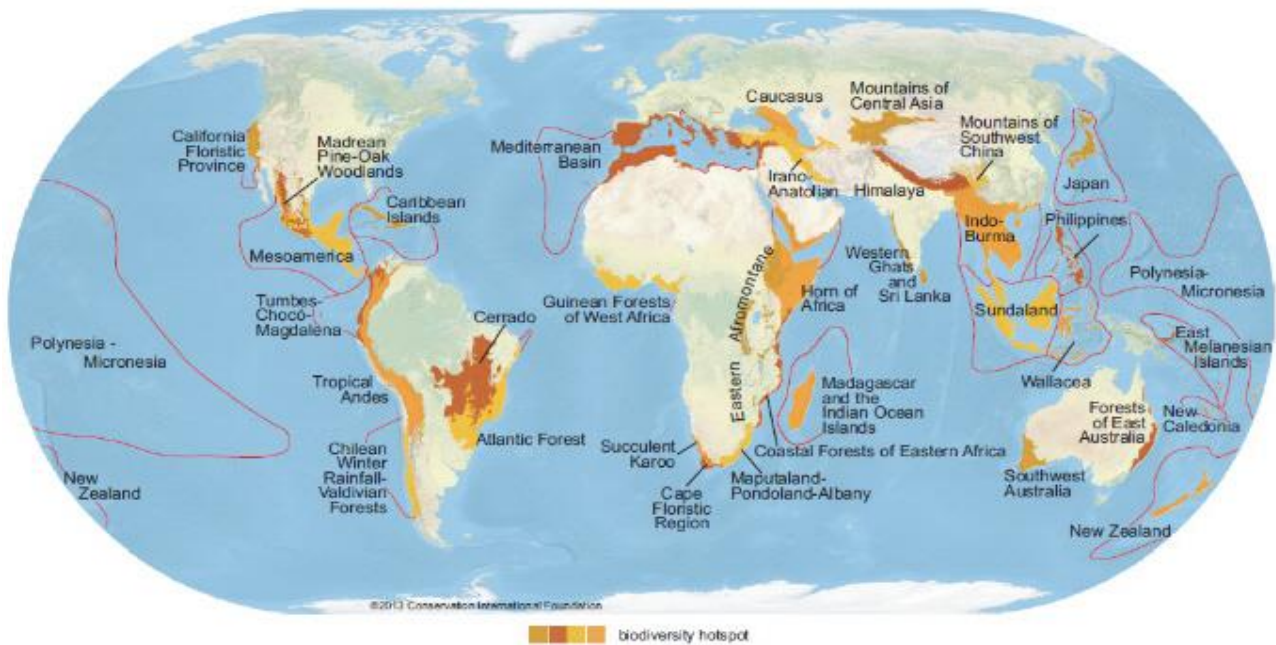


Figure 2: World's Biodiversity Hot Spots (Conservation International, 2013)

Further complications exist for floras that are more difficult to store in seed banks, such as much of the tropical flora. In the case of living collections, groups that are a horticultural challenge are alpine plants and taxa from cold, dry habitats. Particularly problematic are taxa that are a challenge to store in seed banks and which require specialized growing environments or large amounts of space.

So what are we to do? Reduce the Target percentage required for areas of high diversity, with low coverage of botanic gardens, or those areas that have lower resources? Rather than reducing Targets, we could see this as a challenge, and focus on areas for international collaboration and on capacity-building programmes to address the shortfall. For example, Missouri Botanic Garden's Madagascar programme has been working collaboratively for 25 years to document and conserve the Malagasy flora (Missouri Botanic Garden, 2013). The knowledge of areas of shortfall will become increasingly useful in strategic planning for conservation, as Targets in "easier" low plant diversity areas are met.

An increasing quandary is dealing with taxa that are difficult to grow; in some cases these are groups associated with specific habitats. Seed banks go a long way to help us safeguard genetic diversity in these cases; however, the problem still remains as to how we recover these plants from storage, develop cultivation protocols, and support restoration activities. We will need to identify these groups and support capacity in the regions they occur. Continual honing of our horticulture skill and developing adequate growing facilities will also be required.

The ability of gardens to focus on a global scale is dependent to a large degree on their size and funding level. But even the smallest gardens can have a significant impact at the local level by focusing on a few species. This means that the 2187 botanic gardens globally (BGCI, 2013) acting together can have a significant impact on Target 8. Larger gardens with more resources have a responsibility to aid with capacity building to address the areas with significant challenges. So the answer in some ways is the old adage “think globally, act locally”. In the case of larger gardens working internationally, continuing to increase collaboration and placing greater emphasis on long-term sustainable projects will ensure success.

Quantity / Quality of living collections

Gone are the days of indiscriminately developing living collections containing every plant that could be procured. The process of targeting collections and setting priorities has been recognized by most as essential to ensuring meaningful outcomes associated with *ex-situ* conservation. As we work towards achieving Target 8, there will be an increasing need to intensify planning activities for collections, allowing us to make use of genetic analysis of collections and wild populations. The need for more planning is not just at the institutional level, but also across the entire botanic garden community. With new sets of data, we will be able to make much more targeted decisions for collections development and for generating collaborations. As living collections continue to be honed to support conservation, there are several key areas we need to examine:

- Gaining a better understanding of what areas and plant groups each garden is working on with respect to living collections. This will help in discovering gaps and in highlighting potential collaborations. This information could be shared more actively as part of BGCI’s GardenSearch database.
- How we go about exchanging material will become more critical. Specific exchanges based on individual requests are most useful. However, perhaps opportunities may exist to review what material we exchange as part of the *Index Seminum*, ensuring maximum conservation value. There are several inherent challenges with *Index Seminum*, including the large amount of garden origin material exchanged. When we do share wild origin material it is of limited conservation value because multiple gardens end up with a narrow genetic representation of a species, often from a single collection site. It is vitally important for botanic gardens to maintain material exchange programmes like *Index Seminum*, but perhaps in the future one option could be that material requests are built directly into BGCI’s PlantSearch database, thus enabling the exchange of material to be more targeted. Material could then be requested to fulfill a specific goal.
- When we exchange plant material, we must ensure that we are sharing the full associated collections data, and that we can track plants back to their original collection locations. Without this, exchanged plant material becomes useless for *ex-situ* conservation.

The process of tailoring living collections for conservation and incorporating new genetic diversity information represents a renaissance for living collections. However we utilize this opportunity, we must continue to strive for excellence in collections management and curation activities. We must look much more at quality of our collections from the genetic diversity standpoint and not purely at numbers of species. The progress towards Target 8 in North America indicates that 39% of

threatened plant species are in collections (Kramer, A *et al.*, 2011), in Europe 42% (Sharrock and Jones, 2009). However, many of these collections are represented by a single collection in one botanic garden and do not adequately support the necessary genetic diversity. It will be necessary to evaluate current collections for genetic diversity, bolstering them as necessary with additions. We must also ensure that new collections are conducted in a manner ensuring necessary diversity is taken into consideration. To add complexity, understanding the effects that climate change will have on the ability for us to grow a given taxon in our living collections will become increasingly necessary. Being able to grow the number of taxa we collectively do today and enlarging conservation collections will require collaborative work on both a regional and global level to determine the best gardens to hold *ex-situ* collections of certain species (Gewin, 2013).

Databases and Information Sharing

For most of their history, collections in botanic gardens have been developed in isolation according to the priorities of the individual institutions. More recently, with increased ability to share digital data, botanic gardens have been able to work together more efficiently. Comparing collections held in multiple institutions quickly using databases is now possible. This is a great leap forward; however, as a community there is more work to do in order to fully utilize the wealth of existing collections data. Supporting *ex-situ* conservation fully will require us to evaluate and expand the data we are storing and sharing.

The open sharing of data and expertise will help drive success in achieving Target 8. The types of data that are most critical include:

- Species represented in collections
- Full information associated to collections, including wild-source locations
- Genetic analysis data for collections and associated wild populations
- Seed storage protocols, propagation and cultivation information
- Experiences of species recovery efforts.

We must strive for full and open sharing of data. Only then can the process of assessing and targeting collections at a regional or global level for conservation be efficient. The opening of data resources, including collections information, contained at individual gardens and in BGCI's Plant Search database will have profoundly positive impacts on achieving Target 8, and in developing wider collaborations between gardens in support of the GSPC Targets.

In addition, consideration must be given to enhancing data availability to more actively support conservation. This will entail gardens intensifying efforts to record data in some areas, including seed storage methods, propagation, cultivation protocols and displaying the results of genetic analysis of collections. These types of data have not been traditionally available, and for the most part only on special request. Perhaps, most gardens do not even record them as part of collections records. Adding the ability to record this data and then building methods of sharing it will bring the advantage of increased support for conservation with horticultural knowledge. It will also prevent gardens from repeating work trying to grow difficult species that has already taken place elsewhere, thus allowing us to build on previous knowledge. Concerns have been expressed by some about openly sharing collections data in relation to the Convention on Biological Diversity and Nagoya protocol. However, with the ability to specifically block collections information, it should be possible to openly share data to support conservation without compromising compliance with the Convention.

Collectively supporting the expansion of data recording and sharing is essential. Sharing data across the many different databases used in botanic gardens, even with the International Transfer Format, which makes data transfer easier through standardized database fields (Wyse Jackson *et al.*, 1997) is less efficient due to incompatibility between different databases. Looking at a variety of ways to solve compatibility issues should be considered. In addition there are still gaps in the recording of collections in data bases, particularly in developing countries. Many of the world's hotspots of plant diversity are located in these regions. Fewer botanic gardens, along with less ability to database collections, necessitates examining the possibility of sharing database resources and providing increased training in collections curation. The need to help botanic gardens and staff skills development in collecting and maintaining database records is a critically needed focus area. This could include offering greater access to database resources and supporting collections recording through training opportunities.

Tracking compliance in collections CBD issues

As a community we are all becoming more experienced with working within the Convention on Biological Diversity (CBD) for the exchange of plant material; this is essential for gardens that work internationally or exchange wild-origin plant material. Although still challenging, obtaining the knowledge necessary to gain permissions will get easier as the Nagoya protocol is implemented. There is great need to make the process of permitting as efficient as possible, so that less time can be spent on the paperwork processes necessary to obtain and track compliance. This is particularly problematic for smaller gardens with limited staff that find it difficult to build permitting processes into staff responsibility. It can also be complicated to continue to track permissions associated with a given accession, both within a garden's own collections and for purposes of exchange.

There are two key areas that would help in achieving Target 8 with regard to CBD:

- Collaboration between gardens: developing and implementing permit programs to obtain living plant material can be complex and time consuming. Many gardens already share templates for material transfer agreements. Continuing to do so, and the wider sharing of success in developing key relationships, will be needed to help foster the exchange of plant material. Working collaboratively together as groups to obtain permission for material exchange could be a way of reducing the burden on many gardens. The continued expansion and implementation of the International Plant Exchange Network is also a great way of reducing work load and ensuring CBD compliance.
- Integration of permit tracking into database systems: Once material has been obtained under necessary agreements, gardens are beholden to ensure that the agreement terms by which the plant material was collected are maintained through the life of the plant. The only effective way to do this is to track specific permissions for a given accession and then ensure that when material is exchanged. It should be done so that others will continue to abide by the original agreements. Tracking permissions for potentially thousands of accessions is almost impossible, or at least prohibitive from a staff time perspective, unless we utilize technology. Gardens should incorporate digital permit tracking into the databasing process in order to be successful. At the Missouri Botanical Garden, this consists of scanning, uploading and attaching the permits directly to an accession, in addition any material exchange documents. Information about the permit or agreement is also logged, enabling efficient compliance with CBD. IPEN (International Plant Exchange Network) accession numbers (BGCI, no date) have also been created for exchanged plant material and are recorded in the Garden's plant records database. Integrating these processes into the Garden's database has led to greater accuracy and efficiency in tracking of permissions.

Supporting staff skills

We are all aware of a reduced number of students that are now entering the fields of botany, taxonomy and horticulture. This is an extremely disturbing trend which has led to these areas being defined by some as dying art forms. This effect is often magnified for our work in botanic gardens because we are often looking for staff with specific combination of skills. For example, in botanic gardens, we are looking both at the traditional horticulture skills of landscape maintenance and design, but also at the more specific skill-sets of curating collections. Furthermore, the administrative burden on horticulture staff is also increasing as we are requiring ever more accurate tracking of collections, recording of horticulture research and the completion of plant exchange documentation. The staff in botanical gardens working in applied areas such as horticulture are pivotal in achieving success with Target 8. As a community, we cannot afford to allow the skills necessary to perform the core functions of collections care and *ex-situ* conservation to be affected. This will have a long-term negative effect on achieving success in Target 8. The following is a set of recommendations to help support staff capacity:

- Develop in-house training programs utilizing staff expertise
- Set up formal education and training courses
- Internship and apprenticeship programs
- BS, MS and PhD programs
- Engage in formal and informal capacity-building programs
- Create opportunities to engage young people:
 - Partner with schools to develop education programs
 - Provide tours
 - Offer internship opportunities
 - Participate in career days.

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