



# BGCI Technical Review

Defining the botanic garden, and how to measure performance and success



**BGCI**

*Plants for the Planet*



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Defining the botanic garden, and how  
to measure performance and success

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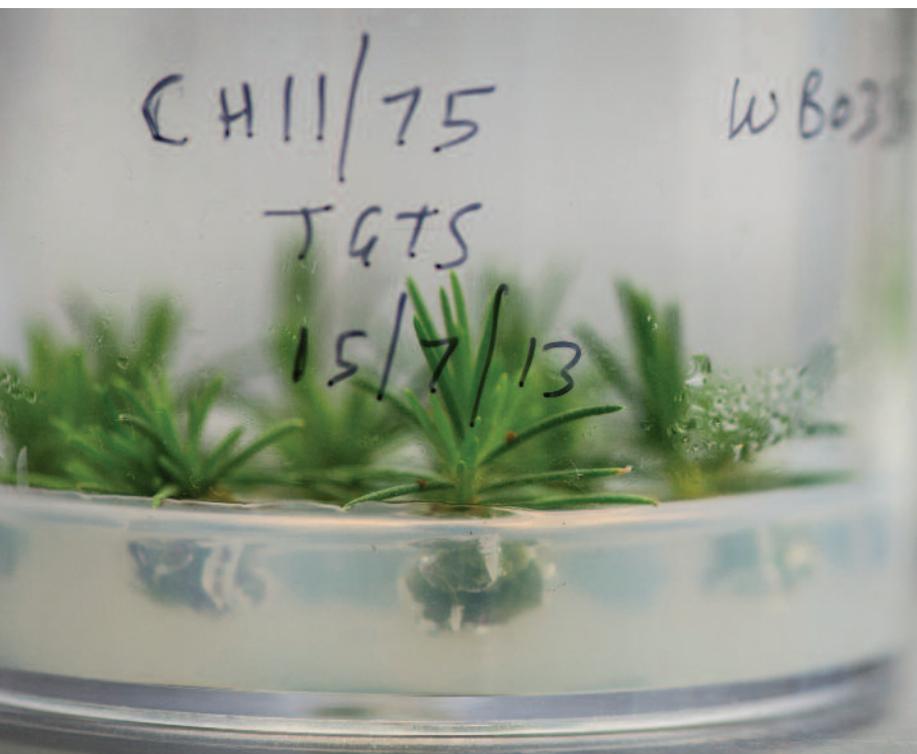
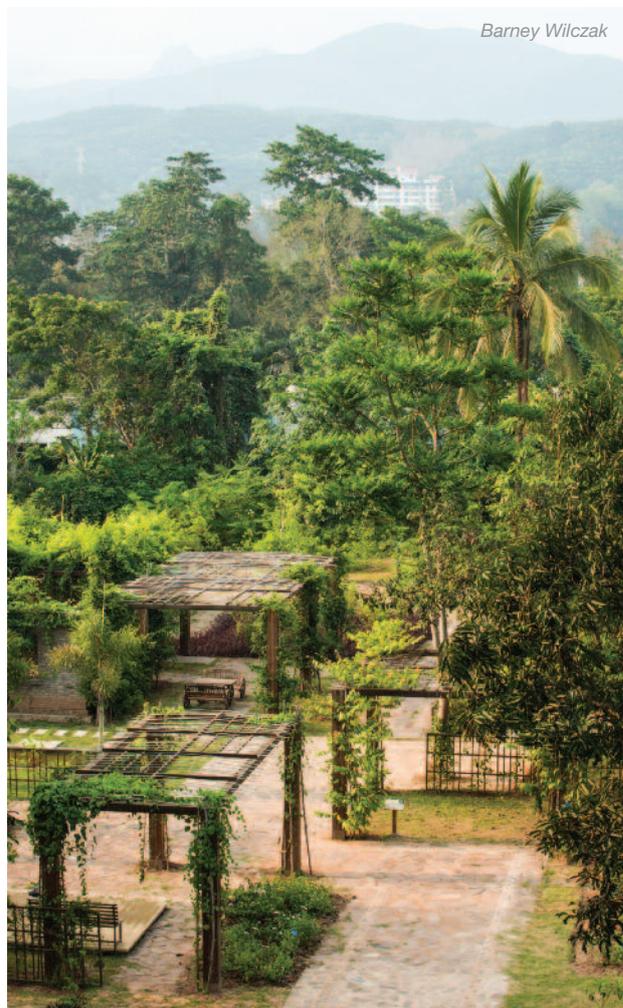
Barney Wilczak

# 1. INTRODUCTION

**There is some evidence that the activities that botanic gardens do uniquely well – particularly to do with documenting, understanding, growing and conserving plant diversity across the taxonomic array – are not sufficiently recognised by policymakers and funders, leading to the erosion of the values and activities that define a botanic garden.**

Some countries have legislation, charters or other legal instruments that formally define and recognise the role of 'botanic gardens' and differentiate them from public parks, historic gardens and other horticultural attractions. However, most do not, and even within our professional community, botanic gardens are established and managed for many different purposes, including visitor attraction, public education, science and conservation. Given their multi-functional role, gardens can easily neglect some of their most important functions in favour of other, more immediate priorities.

Recognising that the botanic garden community encompasses many different kinds of gardens but also has a set of clear, defining characteristics, in May 2016 the Botanic Gardens Conservation International (BGCI) International Advisory Council requested that BGCI carry out a technical review looking at (a) how botanic gardens define themselves, and (b) how botanic gardens measure success. This Technical Review is based on the results of an online survey that BGCI carried out early in 2017 entitled 'Defining botanic gardens and key performance indicators'. In addition, a literature survey of botanic garden annual reports was undertaken to gather further data on how gardens measure success. In total, this review incorporates data from over **200 botanic gardens in more than 50 countries.**





Recognising the unique role of botanic gardens in the conservation of plant diversity, the first *Botanic Gardens Conservation Strategy* was published in 1989 by IUCN and WWF (Heywood 1989). This document played an important part in guiding the developing role of botanic gardens in conservation throughout the 1990s. In 1998, it was felt that a fundamental revision of this document was required, involving input from many partners around the world. BGCI therefore launched an international consultation process to review and update the Strategy, taking into account the national and international policy framework in which botanic gardens were now operating, especially the Convention on Biological Diversity. The consultation and review process led to the publication of the *International Agenda for Botanic Gardens in Conservation* (Wyse Jackson & Sutherland 2000). Coinciding with the publication of the *International Agenda*, a group of specialists issued the *Gran Canaria Declaration* calling for a Global Plant Conservation Strategy. After consultation across the botanical community, the Convention on Biological Diversity's (CBD) Conference of the Parties, through decision VI/9, adopted the *Global Strategy for Plant Conservation* (GSPC).

The *Botanic Gardens Conservation Strategy* defines a botanic garden as possessing the following characteristics:

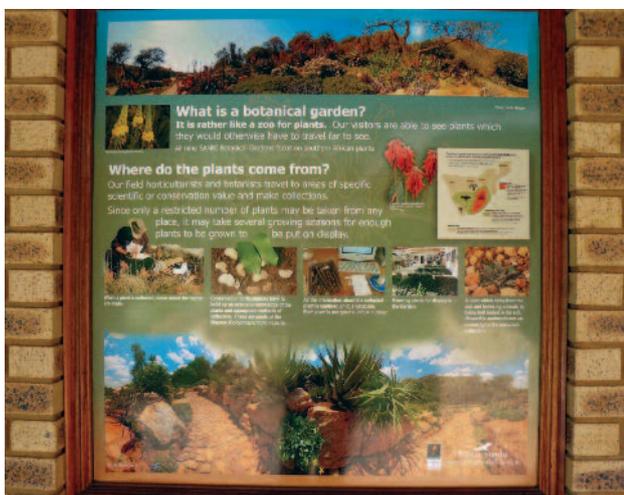
- A reasonable degree of permanence
- An underlying scientific basis for the collections
- Proper documentation of the collections, including wild origin
- Monitoring of plants in the collections
- Adequate labelling of plants
- Open to the public
- Communication of information to other gardens, institutions and the public
- Exchange of seed or other materials with other botanic gardens, arboreta or research institutions (within the guidelines of international conventions national laws and customs regulations)
- Undertaking scientific or technical research on plants in the collections
- Maintenance of research programmes in plant taxonomy in associated herbaria
- Long term commitment to, and responsibility for, the maintenance of plant collections
- Promoting conservation through extension and environmental education activities



Interestingly, conservation actions don't feature strongly amongst these criteria although many of the activities outlined above support conservation. A large proportion of respondents to the BGCI survey (75.4%) said that their institutions use 'plant species conserved' as an institutional measure. Other important institutional measures not explicit in the criteria above include compliance with international policies (56.5%) and sustainability initiatives such as water conservation, renewable energy and recycling (53.6%). In addition, our survey of annual reports clearly indicates that scientific research in botanic gardens is far broader than just taxonomy, encompassing disciplines such as molecular biology, biochemistry, ecology and biodiversity conservation. Finally, ethical policies related to visitors and staff, knowledge and data-sharing, procurement and retail are also important in many gardens. Taking these trends into account, a more complete and updated list of criteria that define a botanic garden is presented in Box 2, below.

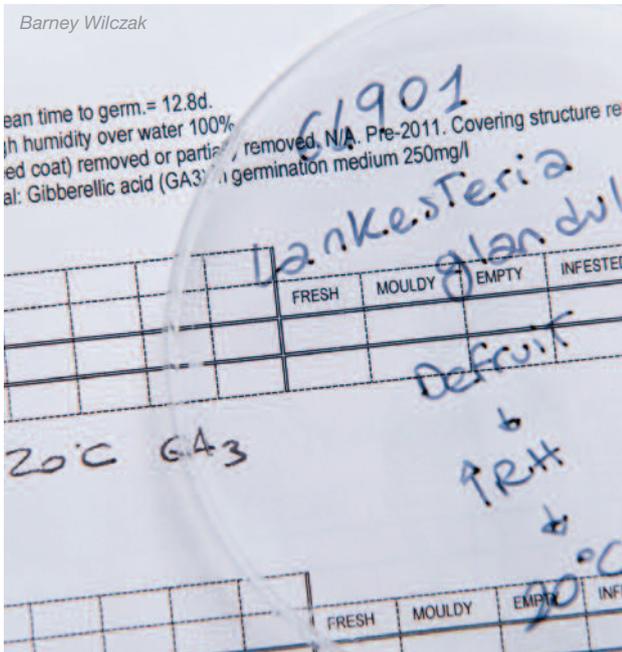
#### Box 2: Updated criteria useful in defining a botanic garden

- A reasonable degree of permanence
- An underlying scientific basis for the collections
- Proper documentation of the collections, including wild origin
- Monitoring and long term maintenance of plants in the collections
- Adequate labelling of plants
- Open to the public
- Communication of information to other gardens, institutions and the public
- Promoting conservation through extension and environmental education activities
- Exchange of seed or other materials with other botanic gardens, arboreta or research institutions
- Undertaking of scientific or technical research on plants in the collections including taxonomy, molecular biology, biochemistry, ecology, biodiversity conservation and other disciplines
- Conserving rare and threatened plants in *ex situ* collections (e.g. in the garden, seed banks etc.) and, wherever possible, in their natural habitats
- Compliance with international and national regulatory frameworks (e.g. the CBD, CITES, plant health, invasive species etc.)
- Adoption and promotion of sustainable practices such as renewable energy, water conservation and waste recycling
- Adoption and promotion of ethical standards related to knowledge, data sharing, procurement, commercialisation and employment.



Visitor sign, Walter Sisulu National Botanical Garden, South Africa

### 3. STRATEGIC PLANNING



Our survey revealed that 77.9% of the gardens that responded to our questionnaire (n = 113) produce a strategic or annual planning document. The fact that 22.1% of gardens don't do this is surprising given that planning documents are essential management tools for running any organisation, large or small. A closer analysis of the gardens that don't have strategic plans reveals that they include very small gardens or, more commonly, are parts of larger institutions and departments, and don't have their own strategic plans.

Intriguingly, although nearly 80% of organisations have a strategic plan, only 65% use organisation-wide performance measures and only 61% use personal performance measures for their staff, indicating that some institutions have plans but don't measure whether they are achieving their goals. There is little point in having a strategic plan unless it is used as a management tool for assessing progress and adaptive management.

#### RECOMMENDATION

**All gardens, big or small, should have strategic plans. Such documents are important for informing people what you do, and are essential management tools for any organisation.**



## 4. OVERALL TRENDS IN MEASURES OF SUCCESS

The online survey offered respondents a multiple choice check box of common activities and outcomes that they measure institutionally. Respondents were also encouraged to indicate additional measures employed by their organisations. Table 1 sets out the institutional measures people indicated that their institutions use in order of popularity.



Ranking	Measure	% of respondents using measure	Area of activity
1	Number of visitors	87%	Visitors & public education
2	Number of events held	80%	Visitors & public education
3	Income (public)	77%	Funding
4	Number of plant species conserved	75%	Conservation
5	Number of social media followers	68%	Visitors & public education
6	Attendance of events	67%	Visitors & public education
7	Number of volunteers	64%	Staff & volunteers
8	Income (philanthropic)	61%	Funding
9	Number of traditional media publications (including TV, radio and newspaper coverage)	59%	Visitors & public education
10	Use of collections by third parties for research, conservation etc.	59%	Science & collections
11	Visitor satisfaction	58%	Visitors & public education
12	Compliance with international policy (e.g. CBD, CITES, Nagoya, statutory obligations, plant health and invasive species)	57%	Business management & governance
13	Income (competitive grants)	57%	Funding
14	Number of people using your institution's collections	55%	Science & collections
15	Staff satisfaction/retention	55%	Staff & volunteers
16	Number of successful project proposals	54%	Science & collections
17	Sustainability measures (e.g. energy, water, recycling etc.)	54%	Sustainability and ethics
18	Number of adults attending courses offered	52%	Visitors & public education
19	Number of members	51%	Visitors & public education
20	Visitors' attitude or behavioural changes	51%	Visitors & public education
21	Number of partnerships built	49%	Business management & governance
22	Number of social media posts	46%	Visitors & public education
23	Number of project proposals submitted	43%	Funding
24	Number of specimens distributed	43%	Science & collections
25	Sales of commercial products (e.g. horticultural cultivars & institution branded products)	43%	Funding
26	Capital project delivery	41%	Business management & governance
27	Number of online resource users	38%	Visitors & public education
28	Board member attendance	33%	Business management & governance
29	Quantitative impact of media coverage	28%	Visitors & public education

Table 1: Institutional measures employed by botanic garden survey respondents in order of popularity



Measures associated with visitors and public education feature most strongly in the top 10 institutional measures employed by botanic gardens, followed by funding measures and then measures related to the more technical scientific and conservation areas of activity. The fact that species conservation is measured institutionally by three quarters of the gardens that responded to this survey is encouraging.

The technical aspects of botanic gardens' work to do with science, collections, education and conservation feature much more strongly in the performance measures applied to individual staff members (see Table 2).

Additional institutional and individual measures not covered in our survey are listed in **Section 5** below, and more detailed analysis is presented.



Bian Tan

Ranking	Measure	% of respondents using measure	Area of activity
1	Monitoring and curation of collections	76%	Science & collections
2	Number of school children educated	76%	Visitors & public education
3	Number of people trained	67%	Science & collections
4	Number of species conserved	67%	Conservation
5	Number or proportion of collections databased/documentated	67%	Science & collections
6	Projects completed successfully	61%	Business management & governance
7	Number of public communications (e.g. blogs, social media posts and press releases)	59%	Visitors & public education
8	Number of successful project proposals	59%	Science & collections
9	Number of other (non-peer reviewed) publications	56%	Science & collections
10	Number of specimens identified	56%	Science & collections
11	Number of peer reviewed publications	52%	Science & collections
12	Number of project proposals submitted	48%	Science & collections
13	Number of specimens accessioned into herbarium	43%	Science & collections
14	Number of seeds banked	41%	Conservation
15	Sales of commercial products	41%	Funding
16	Number of germination/ propagation protocols developed	37%	Conservation/ horticulture
17	Publication citation indices	31%	Science & collections
18	Number of new species described	28%	Science & collections
19	Number of samples accessioned into DNA bank	15%	Science & collections

Table 2: Individual performance measures employed by botanic garden survey respondents in order of popularity

Many gardens use a score board approach to monitoring and managing their performance, and often the key numbers are reported in the institution's Annual Report.

## BY THE NUMBERS

January through December 2015

### Visitors

Total Annual Attendance: 1,042,763

### Membership

Total Member Households: 42,551

### Community Garden

Rented Plots: 89

Registered Gardeners: 160

Produce donated to SAME Cafe: 658 pounds

### Horticulture Therapy Program

Participants per category

Winter Green and Summer Sensory Programs: 652

Chatfield Farms Veterans Farm Program: 18

### Community Supporting Agriculture

Pounds of produce grown at Chatfield Farms: 58,300

Pounds of produce sold through CSA: 51,800

Pounds of produce donated to community: 3,500

### Public Programs

School Children Visitors: 30,107

Youth and Family Program Attendance: 13,575

Adult Class and Workshop Attendance: 14,925

Adult Class and Workshops: 813

### Helen Fowler Library

Circulation:

items checked out: 2,183

items used in house: 879

periodicals used in house: 637

Patrons:

new patrons added

to the library: 19,911

Catalog:

new items/records added to the library collection: 545

library records edited/corrected: 2,062

InterLibrary Loan:

items lent to other libraries: 137 items

borrowed for staff and members: 112

Gardening Help questions answered: 1,012

### Living Plant Collection

New Plant Accessions: 2,773

Plant Families: 244

Genera: 2,205

Species: 9,685

Taxa: 16,673

Accessioned Plants: 26,780

### Plant Propagation & Production

Plants produced for displays: 34,780

Plants produced for CSA: 34,426

In-house propagated plants

    sold at the Shop at the Gardens: 2,113

In-house propagated plants

    sold at Spring Plant Sale: 5,713

In-house propagated plants

    sold at Fall Plant & Bulb Sale: 1,723

### Plant Distributions

Boyce Thompson Arboretum:

    13 species for collections

Tucson Botanical Garden:

    18 species for collections

University of Arizona Campus Arboretum:

    1 species for collections

Researcher from Midwestern University:

    4 species for phylogenetic research

Researcher from Smithsonian:

    77 species for the Global Legume Genome Initiative

Researcher from University of Wyoming:

    3 species for molecular research

### Index Seminum Seed Program

Institutions that ordered seeds: 63

Countries that participated: 21

Distributed seed packets: 742

### Herbarium

Sam Mitchel Herbarium of Fungi: 17,681

Collections that represent newly documented fungi in

Colorado: 9

Kathryn Kalmbach Herbarium: 56,674

### Research and Conservation

Collections that represent new county records: 17

New Funding awarded/received: \$150,984

Phenology visits: 649 total

People reached through scientific outreach participants: 7100

### Staff

Full-Time, Part-Time and Seasonal Staff: 224

Reference: [https://www.botanicgardens.org/sites/default/files/blog-photos/2015\\_annualreport\\_2.pdf](https://www.botanicgardens.org/sites/default/files/blog-photos/2015_annualreport_2.pdf)

An extract from Denver Botanic Garden's 2015 annual report

## 5. MEASURING SUCCESS IN DIFFERENT AREAS OF BOTANIC GARDEN BUSINESS

As indicated in the sections above, the business of botanic gardens is multifaceted and for this reason there are many ways in which to measure performance and success. In this section, we list the measures recorded in our survey and additional measures that our literature survey found were used in botanic garden annual reports. Although these measures are not comprehensive, they are a useful indication of the range of measures available to botanic garden managers.

### 5.1. Plant conservation

#### Key findings

More than 75% of the botanic gardens that responded to our survey measure 'plant species conserved' at the institutional level, and two thirds measure it at the staff performance level. This is an indication that plant species conservation is a valued activity at all levels in most botanic gardens. For a detailed survey of conservation activities carried out by botanic gardens see Havens *et al.* (2006). Other than seed collecting (see 5.3. Collections) and development of germination/ propagation protocols (see 5.4. Horticulture), conservation-related activities such as red listing, species reintroductions and ecological restoration are not often measured at the institutional level.

#### RECOMMENDATION

**Specific conservation activities and outputs that a garden specialises in, for example, working on specific taxonomic groups, geographical areas or conservation disciplines, should be measured at the institutional level. Institutional measures indicate to staff that their work is valued, and send a clear message to external audiences that particular activities are important to the organisation.**

#### Box 3: Examples of plant conservation performance and success measures (percentage of positive survey responses)

- Number of plant species conserved (76%)

#### Additional Measures

- Global Strategy for Plant Conservation (GSPC) targets (see Case Study 4)
- Number of IUCN red lists or species conservation assessments compiled at local, national or global levels
- Number of plant conservation research publications for policymakers, researchers, or practitioners
- Number of staff with formal affiliations with IUCN SSC specialist groups, or other conservation organisations
- Number of propagation and germination protocols published on native or threatened taxa
- Number of native or threatened species conserved in seed bank
- Exchange or supply of wild species material with other conservation practitioners or gardens
- Field gene banks or *ex situ* collections managed for conservation purposes
- Number or percentage of native or rare and threatened species cultivated and interpreted as part of the living collection display
- Number of different provenance accessions of native species (genetic diversity measure)
- Area of natural areas restored or managed within garden
- Number of native plant taxa in natural areas managed by the garden
- Conservation collections policy implemented
- Plant health collections policy implemented
- Invasive species policy implemented
- Number of field-based scientific studies carried out on native habitats or species
- Number of species reintroductions
- Number of species recovered
- Area of natural habitat owned, managed or restored (see Case Study 3)
- Number of native species populations monitored and managed *in situ*
- Land and habitat protection (through policy and government engagement)
- Public events and displays designed to raise awareness of plant conservation and environment
- Training courses on plant conservation attended by staff
- Training courses on plant conservation policy, practice or communication offered
- School programmes with plant conservation/environmental education component
- Conservation volunteer programme in place/number of volunteers
- Percentage of operating budget spent on plant conservation

## CASE STUDY 2:

## Conservation assessments: The Morton Arboretum, United States of America

Many botanic gardens are involved in global, regional or national red listing initiatives, contributing information towards conservation assessments for plants. These evaluations help the botanical community to prioritise *in situ* as well as *ex situ* conservation actions.

Despite their importance for prioritising conservation action, few gardens measure the number of conservation assessments published as a key performance indicator. Botanic gardens are ideally placed to carry out red list conservation assessments by utilising their extensive collections (e.g. living collections and herbarium specimens) and the expertise of their staff.

In addition to measuring the number of red list assessments (published on the IUCN Red List or national initiatives), it is also advisable to measure the impact of this work, for example the number of conservation assessments that have resulted in conservation action, such as new *ex situ* collections of threatened species.

Reference: <http://perennialreport.mortonarb.org/>



### IDENTIFYING CONSERVATION PRIORITIES

As part of the Global Trees Campaign to conserve trees around the world, Arboretum experts assessed all 91 U.S. native oak species and found that about a quarter of them are endangered or vulnerable.

*An extract from the Morton Arboretum's 2016 perennial report*



## CASE STUDY 3:

## Ecological restoration: Kings Park and Botanic Garden, Australia

The success of restoration initiatives can often be difficult to determine. Kings Park and Botanic Garden uses two indicators to ascertain their effectiveness in restoring degraded bushland in Western Australia.

### 1. Number of common native plant species in areas with high levels of management compared to areas with low levels of management.

The indicator is calculated by dividing the average number of common species present in high management zones (i.e. degraded areas prioritised for restoration activities, some of which are currently in progress) by the average number of common species present in low management zones (no active restoration activities), as determined through annual monitoring of representative quadrants within each zone. This indicator has enabled Kings Park and Botanic Garden to track their restoration progress, as it is expected that the number of native species present will increase until ecological stability is reached, and the restoration objective has been achieved.

### 2. Weed cover in high intensity management areas compared to low intensity management areas.

This indicator is derived by annually recording percentage weed cover within two dominant community types and comparing results for the two types of management intervention. Weed cover is expected to decrease over time and then stabilise once ecological stability and the restoration objective have been attained.

The number of native plants grown and planted within restoration sites is also carefully recorded.

Reference: [http://www.bgpa.wa.gov.au/images/pdf/about\\_us/ar\\_bgpa\\_2015\\_16.pdf](http://www.bgpa.wa.gov.au/images/pdf/about_us/ar_bgpa_2015_16.pdf)

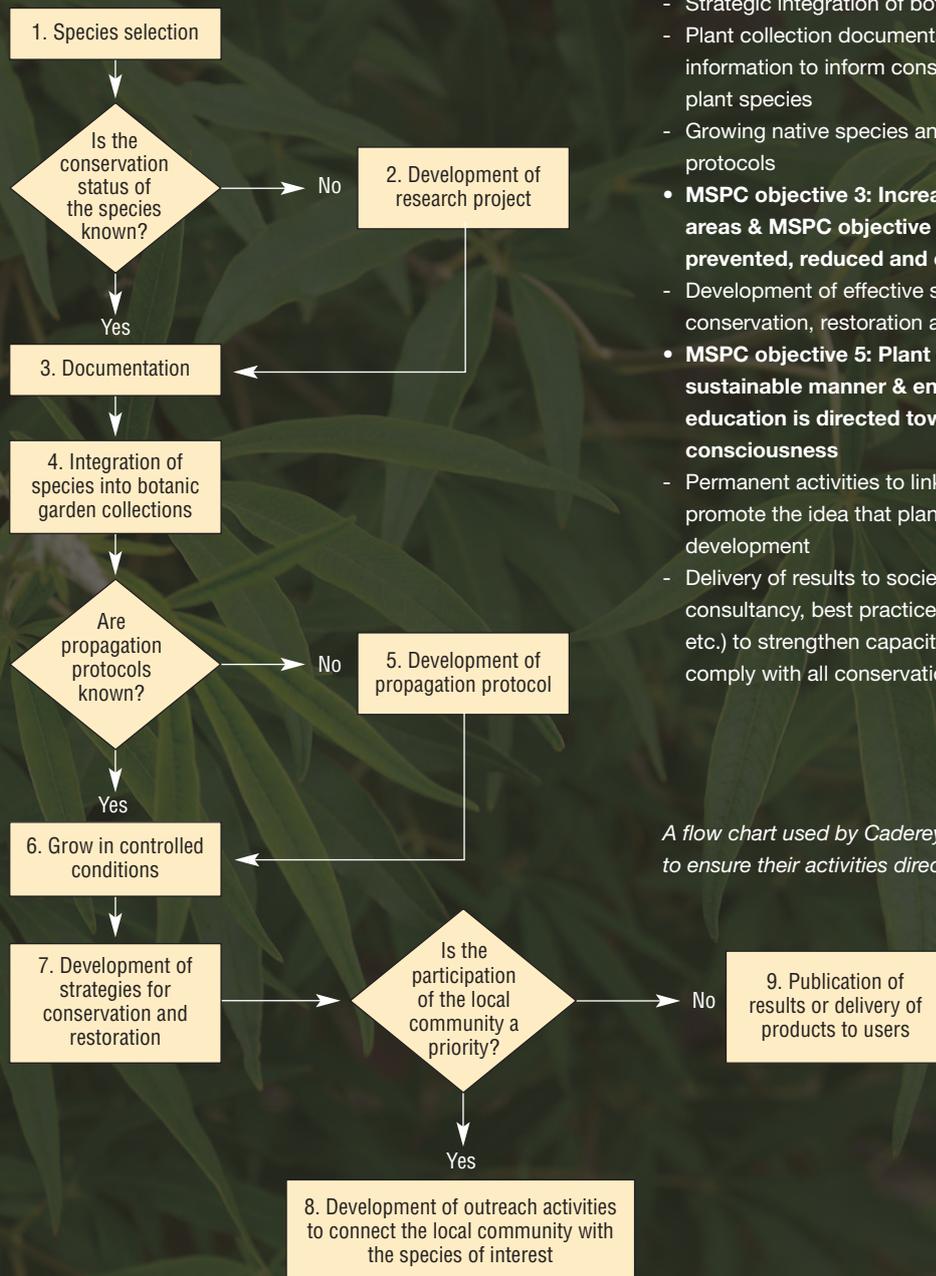


**CASE STUDY 4:**

**Measuring progress towards achieving the targets of the Global Strategy for Plant Conservation: Cadereyta Regional Botanical Garden, Mexico**

Mexico is one of several countries that have developed national responses to the Global Strategy for Plant Conservation with quantifiable, time bound targets. Cadereyta Regional Botanical Garden has established objectives within their strategic plan that directly and clearly contribute to the Mexican Strategy for Plant Conservation (MSPC). For example:

- **MSPC objective 1: Knowledge and information that enables conservation of plant diversity is generated and transmitted.**
  - Determine priority species for conservation
  - Develop projects that generate knowledge to facilitate plant conservation
- **MSPC objective 2: The conservation status of plant diversity is improved.**
  - Strategic integration of botanical collections
  - Plant collection documentation including practical information to inform conservation and management of plant species
  - Growing native species and developing propagation protocols
- **MSPC objective 3: Increased restoration of degraded areas & MSPC objective 4: Threats to plant diversity are prevented, reduced and controlled.**
  - Development of effective strategies and activities for the conservation, restoration and utilisation of native flora
- **MSPC objective 5: Plant diversity is used in a sustainable manner & environmental and cultural education is directed towards responsible social consciousness**
  - Permanent activities to link native plants with people and promote the idea that plant diversity serves human development
  - Delivery of results to society (publications, models, consultancy, best practice examples, propagated plants etc.) to strengthen capacity and public commitment to comply with all conservation goals.



*A flow chart used by Cadereyta Regional Botanical Garden to ensure their activities directly contribute to the MSPC*

## 5.2. Scientific research

### Box 4: Examples of scientific research performance and success measures (percentage of positive survey responses)

- Number of people trained (65%)
- Number of publications (56%)
- Number of peer reviewed publications (53%)
- Number of adults attending courses offered (52%)
- Publication citation indices (31%)
- Number of new species described (27%)

#### Additional Measures

- Grant submissions, grant award successes, grant income and grant overhead income
- Volume of taxonomic output in inventories, floristic accounts and monographs
- Data gathered and recorded on specialist online databases (e.g. trait data)
- Number of users of online science resources
- Participation in field work and expeditions
- Data gathering for long term monitoring and evaluation
- New or improved scientific protocols developed
- Contribution to food security, water, energy, health etc.
- Participation in national or international workshops, meetings or congresses, invited lectures, participation in committees
- Number of researchers who occupy strategic positions in the international/national scientific community
- Number of undergraduate/postgraduate students supervised

### Key findings

Non-peer reviewed publications are valued as much as peer reviewed publications by botanic gardens, in fact slightly higher at 56% versus 52%. Citation indices are measured by only 31% of gardens. This is encouraging in that gardens don't (yet) have the drivers and pressure to publish in widely cited journals in the same way as universities. This is important because much of what botanic gardens publish is aimed at the practitioner rather than the researcher.

New species described are only measured by 28% of the respondents, indicating perhaps the decline of plant taxonomy in botanic gardens but more likely indicating that botanic gardens carry out a wide range of plant-related research, most of which is not recorded at institutional levels by individual discipline or output.

The danger with recording publications as a surrogate for all research activity is that not all data gathered and recorded is publishable in journals or books. It is extremely important that botanic gardens publish information that is useful to practitioners trying to conserve and manage plant diversity. Online databases that record trait information, such as plant uses, active ingredients, genetic markers, seed storage behavior, reproductive mechanisms, morphology etc. often include information that botanic gardens are uniquely placed to provide thanks to their collections. The gathering and dissemination of such data should be recognised and valued.

Two thirds of respondents give the number of people trained as a staff performance measure, indicating that vocational training of third parties is an important activity for many gardens. In some cases, the kind of training (e.g. postgraduate supervision) is specified.

### RECOMMENDATION

**Botanic gardens should ideally act as conduits for data and expertise between researchers and practitioners. It is important, therefore, that information published by botanic gardens reaches a wide range of users – in particular practitioners conserving or managing plant diversity in broader society (e.g. foresters, farmers, conservationists etc.), and wherever possible, gardens should measure impact not just outputs. Measures such as number of users of online science resources are particularly important.**

### CASE STUDY 5:

#### Building botanical expertise:

#### Royal Botanic Garden Edinburgh, United Kingdom

The Royal Botanic Garden Edinburgh (RBGE) harnesses its extensive botanical collections and scientific and horticultural expertise to deliver programmes on conservation, horticulture, botany, ecology, wellbeing and art. In addition to providing a vital source of revenue for RBGE, passionate alumni are now equipped with the botanical expertise to make a real conservation impact.

RBGE measures annually the number of course participants for the range of courses offered by the institution (see below), as well as income generated from student fees. The latter is a particularly important measure as it demonstrates the value of investing in education resources such as RBGE's new online learning platform PropaGate (<https://onlinecourses.rbge.ac.uk/>).

Reference: [http://www.rbge.org.uk/assets/files/about\\_us/Corporate\\_Info/Annual%20Report%20and\\_Accounts\\_2015-16\(1\).pdf](http://www.rbge.org.uk/assets/files/about_us/Corporate_Info/Annual%20Report%20and_Accounts_2015-16(1).pdf)

#### Our Key Results for FY 15/16 are shown below:

Impacts	Measure	Actual
HND/BSc/MSc	Course participants	85
RBGE Diploma	Course participants	48
RHS	Course participants (taught and distance)	243
School groups & Teacher CPD	Course participants	9,304

#### Our Key Results for FY 15/16 are shown below:

Impacts	Measure	Actual
Adult Short Course	Course participants	1,107
Adult Certificate	Course participants	108

*An extract from Royal Botanic Garden Edinburgh's 2015-2016 annual report*

## CASE STUDY 6:

### Use of online scientific databases

#### Royal Botanic Gardens, Kew, United Kingdom

Making its collections and plant and fungal-related data widely accessible is a key strategic priority for the Royal Botanic Gardens, Kew.

Key Performance Measure 6: Use of online science resources (number of site visits to):

- International Plant Names Index (IPNI): <http://www.ipni.org/ipni/plantnamesearchpage.do>
- World Checklist: <http://apps.kew.org/wcsp/prepareChecklist.do>
- The Plant List: <http://www.theplantlist.org/>
- Kew Herbarium Catalogue (Herbcat): <http://apps.kew.org/herbcat/navigator.do>
- Seed information Database: <http://data.kew.org/sid/>

Reference: <http://www.kew.org/sites/default/files/annual-report-accounts-1516.pdf>

#### Royal Tasmanian Botanical Gardens, Australia

The Royal Tasmanian Botanical Gardens records its germination data on an open-access online database. Each report provides data on:

- Genus and species
- Time and place seeds were harvested
- Accession number
- Germination test start date
- Germination test result (% of viable seed germinated)
- Germination rate (number of days it took for half of the final germination result to be achieved)
- Test conditions
- Who carried out the germination test.

Reference: <http://gardens.rtbg.tas.gov.au/tscc-germination-database/>



### 5.3. Collections

#### Box 5: Examples of collection performance and success measures (percentage of positive survey responses)

- Monitoring and curation of collections (76%)
- Number or proportion of collections databased/documented (65%)
- Use of collections by third parties for research, conservation etc. (59%)
- Number of species identified (55%)
- Number of people using institution's collections (55%)
- Number of specimens distributed (42%)
- Number of specimens accessioned into Herbarium (42%)
- Number of seed collections (40%)
- Number of samples accessioned into DNA bank (15%)

#### Additional Measures

- Number of living collection accessions, % of wild origin and/or % verified
- Herbarium specimens databased, digitised and/or available online
- Number or % of library collections borrowed, consulted and/or digitised and available online
- Number of "gold standard collections"
- Number of rare or threatened species
- Number of crop wild relatives or economically important collections
- Number of unique collections
- Number of national collections or collections of horticultural importance
- Number of collections representing new records
- % of collections lost

### Key findings

Over 75% of gardens that responded to the survey measure the monitoring and curation of their collections, reflecting the high value gardens place on their collections. The proportion of gardens that measure collections being databased or documented is also high (66%). This may reflect the increasing trend in gardens to make more specimen information available digitally, which is very welcome. The number of gardens measuring DNA collections (14.8%) is relatively small, which is perhaps surprising given the importance of phylogenetic approaches to plant taxonomy and the emerging discipline of functional trait genomics in botanic gardens.

40% of respondents measure numbers of seeds banked, an indication of the increasing number of gardens that are establishing seed banks, and over half (55%) measure the number of specimens identified by staff – an important service provided by botanic gardens.

Fewer than 60% of institutions measure the use of their collections; 59% measure use of their collections by third parties and only 43% measure specimens sent out to users.

Collections are expensive to build and maintain, and the value of documented collections is primarily their use for research, conservation and education. The utility of collections for these purposes is also an important element of what constitutes a botanic garden. These are very important measures for funders, especially governments, who need to show that collections are a 'public good'.

#### RECOMMENDATIONS

**The use of collections should be a key measure for most botanic gardens, including use by third parties in research, conservation and education.**

**The percentage of collections lost should be a key measure as an indication of curation standards for both living collections and botanical specimens.**

#### CASE STUDY 7:

#### Collection distribution: National Tropical Botanical Garden, Hawaii, United States of America

The Breadfruit Institute at the National Tropical Botanical Garden (NTBG) in Hawaii manages the largest and most extensive breadfruit collection in the world. Recognising the importance of this collection NTBG incorporated into their institutional strategic plan the strategic priority to "demonstrate the value of breadfruit as a global resource for alleviating malnutrition and contributing to the UN Sustainable Development Goals". A key performance indicator (KPI) for this priority was to distribute 100,000 breadfruit trees internationally by 2016. NTBG used a monthly KPI slide to track the number of breadfruits being shipped overseas. This method enabled problems to be identified early on and allowed enough time for the necessary steps to be taken to address them and ensure the strategic goal was met.

Reference: [http://ntbg.org/about/annual\\_report/2015/NTBG\\_AnnualReport2015.pdf](http://ntbg.org/about/annual_report/2015/NTBG_AnnualReport2015.pdf)



By the end of 2015, the Global Hunger Initiative, part of NTBG's Breadfruit Institute, provided more than 65,000 breadfruit trees to 37 countries around the world in an effort to address food insecurity.

*An extract from the National Tropical Botanical Garden's 2015 annual report*



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**CASE STUDY 8:**

**Improving collections**

**Missouri Botanical Garden, United States of America**

Striving to improve the quality of botanic collections should be a major objective for the majority of botanic gardens. One of Missouri Botanical Garden's (MBG) key performance indicators for collection development is to measure the percentage of accessions that are from a wild source, which can be used as a proxy for genetic diversity. This KPI is measured through the following system:

- Provenance of incoming plant material is determined and entered into MBG's Living Collections Management System (LCMS) which is a custom web-based SQL database.
- Within the LCMS a data dash board produces snapshot reports and graphs in real time for a wide range of collection data including the percentage of wild source accessions and other important collection development KPIs such as the number of native species and the number of rare and threatened taxa in collections.
- The data dashboard is checked regularly to ensure that KPI targets are on track.

Reference: <http://www.missouribotanicalgarden.org/gardens-gardening/our-garden/plant-records/lcms-documentation.aspx>

**Royal Botanic Garden Edinburgh, United Kingdom**

A key KPI for the Royal Botanic Garden Edinburgh's collections development is to increase the total number of 'gold standard' samples in their DNA bank. Annual targets for this KPI have been set by the botanic garden.

The requirement to meet the gold standard is for the DNA sample to be associated with:

- A herbarium specimen.
- Standardised high quality collecting data such as GIS spatial data and vegetation type which is fed into a centralised database.
- A photograph of the herbarium specimen or of the living plant.

Reference: [http://www.rbge.org.uk/assets/files/about\\_us/Corporate\\_Info/Annual%20Report%20and\\_Accounts\\_2015-16\(1\).pdf](http://www.rbge.org.uk/assets/files/about_us/Corporate_Info/Annual%20Report%20and_Accounts_2015-16(1).pdf)

## CASE STUDY 9:

### Measuring the use of collections by third party researchers: Cambridge University Botanic Garden, United Kingdom

Cambridge University Botanic Garden (CUBG) is positioned at the centre of the largest concentration of plant scientists in the UK, and supporting third party research is central to their mission and identity. Researchers can request a range of support including material transfers from the garden's documented living collections. All requests are centrally monitored to ensure that CUBG can: 1) deal with research requests in a timely manner; 2) meet legal obligations controlling collections use; 3) respond strategically to collection use, and; 4) collect information to communicate to internal and external stakeholders, and funders.

All requests, including named species and accessions are entered into CUBG's collections database regardless of whether the request is then met. This is vital because there are many valid reasons why research requests cannot be fulfilled, yet it is important to record interest, as testament to a collection's perceived research value. If a request can be fulfilled, a "Research Description Form" is sent out that asks the user to provide a description of the intended use. Research requests are not fulfilled unless this information is received in advance.

CUBG reports on research use in several ways. Every six months a report on collections use is prepared recording number of requests, number of research visits, number of material transfers, amount of material transferred, and number of publications supported. In the garden's annual report, all the researchers that have made use of the garden, including a brief description of their research, and associated

publications are cited. Publications can be tracked by annually surveying users to find out how their research is progressing and whether their work has been published.

In addition, CUBG is able to use search engines like Google Scholar (<http://scholar.google.co.uk/>) to search for names of researchers, names of taxa consulted and the name of the botanic garden to retrospectively track publications and acknowledgements from researchers who have consulted CUBG's collections.

Reference:

<http://www.botanic.cam.ac.uk/CMSShared/Document.aspx?p=27&ix=420&pid=2711&prcid=4&ppid=2711>

#### Plant Material provided to other Gardens

##### **Alpnegium**

Eight accessions through the Index Seminum

##### **Antwerp Botanic Gardens**

Ten accessions through the Index Seminum

##### **Botanic Garden of the University of Latvia**

*Onopordum acanthium*

##### **Botanic Garden, Tartu University, Estonia**

Eight accessions through the Index Seminum

##### **Botanic Garden Institute, Vladivostok, Russia**

Two accessions through the Index Seminum

##### **Botanischer Garten der Philipps-Universität**

Six accessions through the Index Seminum

##### **Botanischer Garten der Universität Ulm**

*Ratibida columnifera*

##### **Chelsea Physic Garden, London**

Twelve accessions for display

##### **Giardino Botanico, Milan, Italy**

Sixteen accessions through the Index Seminum

##### **Hortus Botanicus Universitatis, Dumbrava, Romania**

Three accessions through the Index Seminum

##### **Jade Garden, Chuncheon, Korea**

Three accessions through the Index Seminum

##### **Jardin Botanique de Luniversite Pasteur, Strasbourg, France**

Two accessions through the Index Seminum

##### **Jardin Botanique de la Ville et de l'Universite, Bescanson, France**

Eight accessions through the Index Seminum

##### **RHS Wisley**

Forty accessions mostly *Lavandula*

##### **RHS Hyde Hall**

Nine accessions for cultivation



An extract from Cambridge University Botanic Garden's 2015-2016 annual report

## 5.4. Horticulture

### Box 6: Examples of horticulture performance and success measures (percentage of positive survey responses)

- Number of germination/ propagation protocols developed (36%)

#### Additional Measures

- Numbers of plant families, genera and species in the living collection
- Number of plants added to the living collection through specialist expeditions and collecting
- Acquisition and exchange of plant material with other gardens (e.g. Index Seminum)
- Developing improved methodologies and techniques for optimum growth and sustainable plant health
- Planting, design, installation and maintenance of horticultural collections, exhibits and displays
- Area under cultivation
- Number of plants produced for displays
- Number of plants propagated to be sold in the garden shop, and plant sales
- Weight of produce harvested in vegetable gardens for restaurant
- Weight of produce donated to local community
- Number of international and national show medals and awards (e.g. Chelsea, Shanghai etc.)
- Number of special collections of plants (e.g. national collections, unique collections)
- Interpretation and dissemination of expert knowledge to visitors
- Record keeping and updating of living collections databases
- Control of pests and diseases
- Weed cover or occurrence
- Developing landscapes that can adapt to global warming
- Cultivars and number of patents produced

### Key findings

Only 37% of gardens measure the number of germination or propagation protocols developed by their staff at the institutional or personal performance levels. Given that botanic gardens conserve and manage a far greater range of plant diversity than any other professional sector, knowing how to grow a wide range of plants is a key skill set amongst horticulturist and seed bank staff. It is even more important that protocols are recorded and shared. Surrogates such as visitor numbers and visitor satisfaction are often used to measure the quality of horticulture but capture only a small fraction of the skills, activities and

outputs associated with growing botanic garden collections. This is a major omission. Unless we value these skills in staff, preferably through institutional measures, they will be lost.

#### RECOMMENDATION

**Gardens should value and measure their horticultural specialisms at the institutional level. These may be associated with certain taxonomic groups (e.g. orchids, succulents etc.), particularly valuable collections (e.g. unique, rare or threatened taxa in cultivation) or specific biomes/habitats (e.g. alpine species). The unique plants and plant assemblages that a garden grows define that botanic garden.**



**CASE STUDY 10:****Measuring specialist horticultural skills:  
United States Botanic Garden, Washington DC., United States of America**

The United States Botanic Garden (USBG), recognising the fundamental importance of retaining staff of horticultural excellence, has developed a four tier career progression system. Employees can move through four levels of career development (with commensurate pay increases) as skill levels improve through employment but without requiring additional formal education.

If an employee is hired in tiers one or two, they can progress through to tier three without competition as long as all the skills and other requirements are met. When there is an opening at a tier four position there is an internal competition for all eligible tier three employees.

High achieving employees holding unskilled positions at lower levels, such as labourers and motor vehicle operators, are eligible for a 'mobility programme' which is a two year programme to build horticultural skills. It is highly organised with check-ins with their supervisory facilitator every two weeks and frequent milestones that must be reached to advance through the programme. Upon successful completion, the employee is placed at the entry level position within the horticulturist series, with the same ability to move up through the ranks based on skill acquisition. Measures include:



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**Skills and knowledge**

- Thorough knowledge of landscape maintenance
- Able to initiate and improve development of designated plant group
- Record keeping ability, including mapping and record forms
- Knowledge of procurement of plant specimens
- High level technical skills
- Able to create appropriate aesthetic displays of the collection
- Expert in complex individual taxa & specialised group of plants
- Knowledgeable about plant anatomy and taxonomy
- Authority on the conservation of a plant group
- Specialised historical knowledge of a plant group
- Understands and adheres to international laws concerning plant conservation
- Skilled in plant propagation
- Thorough knowledge of plant insects, diseases and growing media
- Capable of generating accession and display labels in accordance with the Collection Policy

**Competencies/activities**

- Schedules propagation of existing plants to maintain the integrity of the collection
- Expands, develops, selects and leads maintenance of the accessioned collection
- Performs collections studies including the exchange of materials, ideas, and information with other conservatories, museums, and botanic gardens.
- Regularly works with all botanic garden divisions and sections including horticulturists, designers, public programmes and operations staff, landscape architects, and estimators in planning and creating exhibits, projects, repairs, and public events.
- Serves as plant specialist for designated species responsible for developing the most improved methods and techniques for promoting optimum growth and sustainable health.
- Serves as de facto curator for specific collection or group of plants
- Instructs docents, volunteers, students & interns
- Assists with public outreach programs

## 5.5. Public engagement and education

### Box 7: Examples of public engagement performance and success measures (percentage of positive survey responses)

- Number of visitors (87%)
- Number of events/exhibitions held (80%)
- Number of school children educated (76%)
- Attendance at events/exhibitions (67%)
- Number of social media followers (67%)
- Number of traditional media publications (including TV, radio and newspaper coverage) (60%)
- Number of public communications (e.g. blogs, social media posts, press releases) (59%)
- Visitor satisfaction (57%)
- Visitor attitude or behavioural changes (51%)
- Number of members (50%)
- Number of social media posts (46%)
- Number of online resources users (39%)
- Quantitative impact of media coverage (29%)

#### Additional Measures

- Number of cultural events held
- Number of adult classes and workshops
- Adult class/workshop attendance
- Youth and family programme attendance
- Number of guided tours, and number of people on tours
- Number of science communication events and people attending
- Response times for information requests from the public
- Accessibility of garden facilities
- Impact on community

## Key findings

Nearly all gardens (87%) measure visitor numbers, but interestingly only 57% measure visitor satisfaction and only 51% measure visitor attitude or behavioural changes. Given that the mission of botanic gardens includes engaging, informing and educating visitors, these are important measures that shouldn't be neglected.

80% of gardens measure the number of events they hold, and 67% measure attendance of those events. Two thirds of gardens monitor their followers on social media and 46% measure the number of social media posts they publish. Surprisingly, only 60% of gardens measure traditional media publications meaning that this is not a consideration for 40% of gardens. This is possibly because social media is becoming a more important way to engage with the public. Most striking is how few gardens measure the impact of their communications and engagement. Only 29% of gardens try to quantitatively measure the impact of their media coverage and only one garden reported measuring community impact.

### RECOMMENDATION

**All gardens should measure visitor satisfaction, and ideally visitor attitude or behavioural changes should be measured too if gardens are to be effective communicators about the importance of plants and environment. Such surveys are useful management tools in striking the right balance between recreation and education. In addition, changes in attitude are a measure of impact, not just activity.**

### CASE STUDY 11:

#### Media impact: Longwood Gardens, United States of America

Longwood Gardens utilises the media analytics tool Cision (<http://www.cision.com/us/>) to measure the effectiveness of their PR campaigns. Analytic tools can save considerable time and resources by completing data mining and analyses for you. Longwood Gardens is able to use Cision to produce custom reports on the following categories:

- **Stories** are the number of articles run about your organisation. For example if the BBC wrote an article about your botanic garden in 2016 that would show up as one story.
- **Advertisement value** is the amount that you would have to spend to get the coverage you received in the stories that were run. For example, in 2016 Longwood Gardens had 2,121 stories picked up through their PR efforts. To pay for those stories in those publications would have cost them over \$3 million.

- **Unique visits** is how many people actually see the stories.
- **News Circulation** is the total number of people who are subscribed to the publications (both in print and online) where you have stories printed.

Other popular media analytic tools include:

- Prezly (<https://www.prezly.com/pr-software>)
- Newsbox (<http://newsbox.com/>)
- BusinessWire (<http://www.businesswire.com/portal/site/home/>)

Year	Stories	Advertisement value	Unique Visits	News Circulation
2014	2,525	\$1,433,974	1,264,891,355	70,451,960
2015	1,326	\$2,897,251	2,382,268,333	28,540,004
2016	2,121	\$3,033,817	2,110,245,754	18,566,318

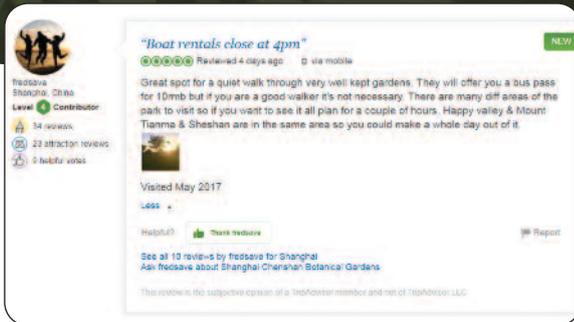
*A custom report produced by Longwood Garden using the media analytics tool Cision*

## CASE STUDY 12:

### Visitor satisfaction: Shanghai Chenshan Botanical Garden, China

Studies have found that destinations with high levels of visitor satisfaction also have high visitor return rates, whereas an unsatisfactory visitor experience can result in negative publicity and considerably reduce the appeal of your garden. It is therefore important to understand the level of satisfaction among visitors. This key performance indicator is measured by Shanghai Chenshan Botanical Garden, through traditional methods such as surveys but also through harnessing the

*A review left by a visitor of Shanghai Chenshan Botanical Garden on TripAdvisor*



wealth of information posted online. Social media and review sites enable visitors to voice their opinions, good or bad, at the click of a button and with high visibility. If not monitored and dealt with appropriately such sites can seriously damage an organisation's reputation. Shanghai Chenshan Botanical Garden carefully monitors and responds to China's most popular social media and reviewing sites including:

- Dianping, the Chinese equivalent to TripAdvisor, is an app that enables visitors to give the garden a score out of five.
- Weibo and Wechat, which are similar in function to Twitter and Facebook, provide a platform to provide feedback and ask questions.

## 5.6. Sustainability and ethics

### Box 8: Examples of sustainability performance and success measures (% of positive survey responses)

- Sustainability measures (e.g. energy, water, recycling etc.) (53%)

#### Additional Measures

- Number of members visiting the botanic garden by public transport
- Number of staff using carpool or public transport
- Waste reduction/recycling schemes in place and on display to the public with appropriate interpretation
- Tons of organic material composted and/or waste recycled
- Renewable energy as a proportion of the garden's energy portfolio
- kW energy generated from renewable sources and/or saved
- Tons of CO<sub>2</sub> emissions produced or saved (including from travel)
- Water saving or recycling schemes in place and on display to the public with appropriate interpretation
- Gallons/litres of water used or saved
- ISO14001 or other recognised sustainability accreditation gained (e.g. Green Tourism awards)
- Responsible sourcing of commodities and products sold in retail outlets
- Responsible sourcing of materials and plants used by the organization
- Ethical funding policy in place
- Sustainability plan/documentation in place
- Leadership commitment to staff and visitor diversity and inclusion demonstrated in policy and practice

## CASE STUDY 13:

### Surveying and influencing visitor beliefs and attitudes: Phipps Conservatory and Botanical Gardens, United States of America

In order to effectively engage with its visitors about climate change, Phipps Conservatory and Botanical Gardens first sought to better understand visitor beliefs and attitudes regarding the topic. A survey, where a series of questions intended to identify participants' attitudes, behaviours and policy preferences about climate change, was carried out. Of 1,000 participants, 90% of visitors believed in climate change; however only 8% felt that it is an urgent issue that needs to be dealt with immediately.

This survey indicated that the most effective use of resources was not to convince guests that climate change is real, but to help them take the next step: action. The botanic garden partnered with a green energy provider in January 2017 that is able to help visitors switch to green power on site. This significantly reduced the barriers to switching. As an added incentive, every visitor to Phipps that switches to renewable energy during their visit gets a free family membership to the botanic garden for one year. Existing members that switch get a six-month extension of their membership. In the first four months of the program, more than 750 households have switched, which will save 6,000 tons of CO<sub>2</sub> emissions by the end of the year.

Reference: <https://phipps.conservatory.org/green-innovation/for-the-world/climate-change/>

### Key findings

Sustainability is clearly gathering momentum with more than half of the respondents saying that elements of sustainability are institutional measures.

## RECOMMENDATION

Botanic gardens have a responsibility to practice what they preach, and if care for the environment is one of the key messages to the general public, then demonstrating environmentally sustainable practices in the way the organisation is run is essential. This can be something as simple as recycling for compost and, in most cases, will make economic sense too.

### CASE STUDY 14:

#### Energy management performance: Kew's Millennium Seed Bank, United Kingdom



Both of Kew's sites are ISO14001 accredited, and the rigour of this recognised international standard assists Kew to improve its environmental sustainability performance.

Fundamental to managing utilities is the establishment of baseline data. As a minimum, taking manual readings from the master meters of electricity, oil/gas and water on the first of each month will enable an annual usage baseline to be created. Monthly figures enable an understanding of seasonal usage and provide evidence for successful intervention. The use of smart meters, Building Management Systems (BMS) and sub-meters can provide significant extra information and value. Having established baseline data it is important to communicate successes and define savings in terms of finance, energy (kWh) and carbon dioxide (CO<sub>2</sub>) equivalence.

Kew's Millennium Seed Bank (MSB) uses its annual figures to produce regular updates for energy, water and waste. This communication highlights the agreed objectives, shows results graphically and details successes and future work in a simple and easily digestible format for all stakeholders including senior management, staff, auditors and visitors.

Fundamental to the efficient control of the MSB building is the effective use of a BMS. The BMS controls and monitors most of the engineering assets within the building in particular, it regulates temperature throughout the building ensuring that a suitable minimum temperature (20°C) is provided during working hours but reduces this temperature (15°C) out of working hours. This saves considerable heating related energy which makes up 50% of the MSB's energy usage.

#### Examples of Millennium Seed Bank Energy Projects

Each of the following projects had a brief but factual business case highlighting the costs, benefits and likely payback period for management to consider and approve.

##### 1) Photovoltaic panels (PV's)

The MSB negotiated a 50 kW photovoltaic project with an energy company partner. This project was cost beneficial



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to the installer utilising tariffs, was cost neutral to the MSB (including maintenance) and provides circa. 8% of the MSB's electricity requirement annually.

##### 2) Replacement of cold room refrigeration

The -20°C cold rooms at the heart of the MSB were designed to a very high standard including exceptional insulation properties and efficient control of chilling by the Building Management System (BMS). The energy efficiency was significantly enhanced when the standard refrigeration chilling units were replaced by a state of the art scrolling pack compressor system which allows each -20°C room to be run on just 1 kWh per hour.

##### 3) Voltage optimisation

Installation of a voltage optimisation system allows the MSB's voltage to be reduced to 220V (from 240V) saving circa. 11% of the MSB's energy.

##### 4) LED lighting project

The MSB is currently embarking on a complete replacement of existing lights with far more energy efficient and reliable LED lights. Typically savings in energy and maintenance allow for a financial pay back of less than 2 years.

Implementing the above projects has helped reduce the MSB electrical energy consumption between 2008 and 2016 by 23%. During this period staff and visitor numbers were increasing as was business activity. These savings are delivered year on year with no additional financial input. The cumulative financial and environmental savings when compared with taking no action are extremely significant.

Reference: <https://www.iso.org/iso-14001-environmental-management.html>

## 5.7. Business management and governance

### Box 9: Examples of business management performance and success measures (percentage of positive survey responses)

- Income (public) (77%)
- Income (philanthropic) (60%)
- Income (competitive grants) (56%)
- Sales of commercial products (e.g. Horticultural cultivars & branded products) (43%)
- Number of project proposals submitted (43%)
- Number of successful project proposals (53%)
- Projects completed successfully (61%)
- Capital project delivery (41%)
- Compliance with international policy (e.g. CBD, CITES, SDGs, Nagoya, statutory obligations, plant health and invasive species) (57%)
- Number of partnerships built (49%)
- Board member attendance (33%)
- Documented career ladders for scientists (69%), horticulturalists (65%), education staff (50%), managers (56%), other staff (40%)
- Number of volunteers and/or volunteer hours (64%)
- Staff satisfaction/retention (54%)

#### Additional Measures

- Staff numbers, attendance/absence
- Salary parity and retention of business critical skills
- Number of interns, apprentices etc.
- Diversity of staff members
- Gender and racial equality/equal opportunities
- Succession plan in place for critical management and board positions
- Number of policy briefs/ recommendations made to and accepted by government
- Satisfaction from government

## Key findings

At the institutional level, public funding is the most widely measured income source, reflecting the fact that most gardens rely on public funding for at least part of their income stream. Interestingly >40% of gardens don't measure competitive funding or philanthropic giving, suggesting that many gardens continue to rely solely or largely on public funding.

The measurement of sales of commercial products is surprisingly low at 43%. Most gardens have shops and catering outlets. However, many of these are outsourced and/or represent relatively small sources of income for gardens. This is an area with great potential for growth. Many Chinese gardens, for example, are actively producing cultivars for sale as potentially large sources of income.

Only 57% of respondents include compliance with international policies as an institutional measure. In the updated definition of a botanic garden, compliance with international and national

regulations is one of the key criteria. International policies and regulations won't apply to all gardens, but national policies on plant health, invasive species and other statutory obligations are relevant to all.

Although not included in our survey, influencing policy-makers and governments was a key measure for many botanic gardens.

Most gardens have documented career ladders for their scientists (69%), horticulturalists (65%) and managers (56%). Only 50% have career ladders for education staff, probably indicating that many smaller gardens don't have education staff. Only around half of gardens (54%) measure staff satisfaction and retention at the institutional level.

Few gardens appear to measure pay parity between disciplines in spite of that fact that a range of disciplines (all with highly specialised knowledge and skills) are required to run a botanic garden. Salary analysis from the BGCI survey shows large discrepancies between the disciplines. Almost universally, there is a distinct career hierarchy with managers and scientists at the top and educators and horticulturalists a long way behind (see Figure 2). This discrepancy is found even in gardens without a scientific focus where education and horticulture are the main objectives.

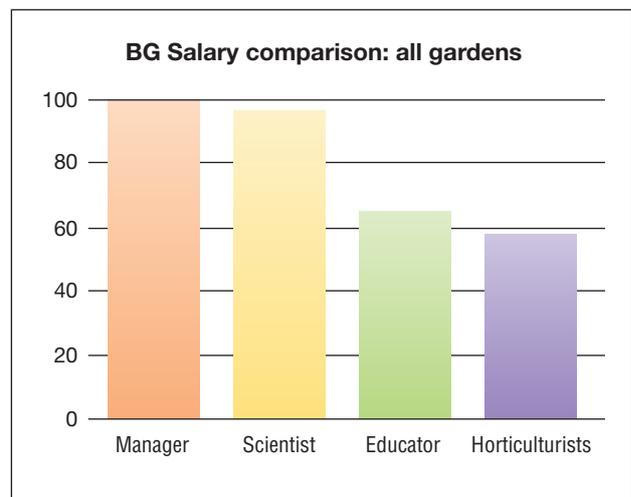


Figure 2: Salary comparisons across botanic garden disciplines. In our survey the average (mean) top of range salary was compared between four disciplines (n =42; 29 countries). Top managers were paid the most (set at 100%); scientists came a close second (94%); then educators (66%); and finally horticulturalists whose top of range pay is, on average, 56% of what equivalent managers are paid. These discrepancies were not significantly different in gardens without science programmes.

### RECOMMENDATION

**All gardens should have documented, aspirational career ladders for specialised staff. Furthermore, salary parity should be based on business criticality rather than just formal qualifications if staff shortages, poor morale and recruitment problems are to be avoided. This is especially the case for specialist horticulturalists in botanic gardens where currently there is a global skills shortage.**

## CASE STUDY 15:

### Career ladder for specialist horticulturalists: South African National Biodiversity Institute, South Africa

Despite horticulture being a specialised and core profession at the South African Biodiversity Institute's (SANBI) botanic gardens, its growth has been limited by a lack of career development. A career ladder for horticulturists was launched by the institute in 2015/16 to recognise, attract, retain and develop horticulture and horticulturists in SANBI's botanic gardens. The career ladder has eight rungs, inputs and outputs together describe and measure the skills and experience required to fulfill different rungs.

- Input: quantifiable measure of capability based on qualification, experience and leadership
- Output: quantifiable measure of productivity identified as relevant to a specific profession

The inputs for evaluation are:

- Input 1: Required Qualifications
- Input 2: Relevant Working Experience
- Input 3: Strategic Horticultural Leadership

The outputs for evaluation are:

- Output 1: Horticultural Research and Development
- Output 2: Human Capital Development
- Output 3: Curation of Living Collections
- Output 4: Horticultural Maintenance and Development
- Output 5: Plant Conservation and Collaboration

Each input and output is weighted and contributes to an overall score. A horticulturist's position on the ladder is established by determining the weighted sum of levels of competency for each of the three inputs and five outputs. Horticulturists are required to develop personal profiles that present evidence of their outputs and are assessed by a SANBI Moderation Panel. Since implementation, SANBI has seen an increase in the uptake of bursaries towards Master's and Doctoral degrees from employees on the career ladder.

Reference:

<https://www.sanbi.org/sites/default/files/documents/documents/k-13308-sanbi-annual-report-2016dev34-lr.pdf>



## CASE STUDY 16:

### Influencing plant conservation and environmental policy

#### Vilnius University Botanical Garden, Lithuania

A key objective of Vilnius University Botanical Garden's first strategic plan was to build relationships with different stakeholders, including governmental bodies. The aim of this activity was to raise the profile of the botanic garden and to generate additional sources of income.

Implementation of this strategic objective has resulted in considerably increased financial support from the Lithuanian government and opportunities to prepare national laws (e.g. on plant genetic resources) and to sit on national councils.

#### Purwodadi Botanic Garden, Indonesia

Purwodadi Botanic Garden in Indonesia has included developing policy briefs as a key performance indicator since 2013. Policy briefs include a concise summary of a particular issue, potential policy options to tackle it and recommendations. This information is then widely disseminated by the botanic garden to relevant stakeholders, through reports, presentations and in-person discussions.

Each year a target for this indicator is set based on the Purwodadi Botanic Garden's current research priorities. For example in 2015, the botanic garden worked with mining companies to reduce their impact on biodiversity. The botanic garden conducted a botanical inventory and compiled a list of recommended plants to be grown in the post-mining reclamation site and identified a 37 ha area of forest to be designated as a conservation area. As a result of this work, the mining company has begun propagation of the recommended species and established the candidate forest site into a conservation arboretum.



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