

National Strategy and Action Plan for the Role of Australia's Botanic Gardens in Adapting to Climate Change

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Council of Heads of Australian Botanic Gardens

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The challenge

This *National Strategy and Action Plan for the Role of Australia's Botanic Gardens in Adapting to Climate Change* (referred to here as the Action Plan) sets out overall strategies and specific actions necessary to promote and resource Australia's botanic gardens in their vital role as facilitators of climate change preparedness and adaptation. It provides a framework for the Council of Heads of Australia's Botanic Gardens (CHABG) to report to the Natural Resource Management Ministerial Council.

Impact of climate change

Climate change is a major new challenge for botanic gardens, as it is for many other communities and institutions around Australia. It will have major impacts on our species, natural ecosystems and landscapes. Montane rainforests, alpine regions, wet tropics, coastal and freshwater wetlands, heathlands and coral reefs will be among the most vulnerable systems. A warming of 1°C is sufficient to move Southern Hemisphere climate belts about 125 km south or 100 metres uphill. A regional change of temperature of that order is likely to significantly impact on biota with narrow distributional ranges. However, the extent and nature of the effects at regional and local levels are poorly understood (AGO 2005).

The early impacts of climate change are already having a significant impact on where plant species can live. As temperatures and rainfall change, many species may not be able to survive and breed because the environment will change faster than the plants' ability to adapt.

Survival will depend on a species' ability to tolerate changed conditions — to adapt, to evolve or to move to new habitats. Depending partly on the rate and extent of climate change, and partly on adaptive management measures, some species will become extinct and the range of others will be severely depleted.

Australia's 20 000 vascular plant species are the centrepiece of Australia's landscapes. They represent 10% of the world's plant species and 90% are unique to Australia (Chapman 2005). Of Australia's known plant species, 7% are currently considered threatened or vulnerable and represent 15% of the world's threatened plant species (Chapman 2005). Plants provide the living structure and the primary productivity of Australia's ecosystems, which support Australia's vast array of life. Their multiple uses and functions provide diverse and invaluable services for the wellbeing of society, including uptake of atmospheric carbon, oxygenation of air and water, and production of food, building materials and medicinal products.

Australia faces the important challenge of ensuring that the diversity of our plant species is managed and protected in the face of this threat.

Role of botanic gardens

For four centuries, botanic gardens have led research and generated much of our knowledge about plants and how to grow them (botany and horticulture). They are important sites of plant conservation because they maintain plants away from their natural habitat (ex situ conservation) and have a significant role in education.

The *Convention on biological diversity* (UNEP 1993), the *International agenda for botanic gardens in conservation* (Wyse-Jackson and Sutherland 2000) and the *Global strategy for plant conservation* (UNEP 2002) have helped to define and clarify the roles of botanic gardens internationally. A key role among the many that have been identified for botanic gardens in a 21st century context is plant conservation.

Plant conservation is achieved in partnership with herbaria through a range of activities (Table 1), including:

- ∞ providing a safety net through
 - living plant collections
 - seed banks, germplasm collections
- ∞ providing knowledge and expertise through
 - horticultural and field-based research (**how** they grow, **what** they need to survive)
 - information about plant species distribution (**where** they are)
 - information about plant taxonomy (**what** they are)
- ∞ providing opportunities for community awareness and education.
- ∞ Table 1 shows an overview of plant conservation activities. Some more details about the collections, research focus and expertise of Australia's major botanic gardens are provided in Appendix A.

A safety net for plant species through ex situ conservation

Australia's botanic gardens have significant seed banks, gene banks and living collections that are essential for managing the risk of species loss in the wild. These collections are vitally important for the preservation of species (e.g. by holding taxa that are extinct in the wild), as well as for maintaining species in the wild and assisting recovery after loss (e.g. by the reintroduction of species into the wild). Cultivated populations of plants in botanic gardens (ex situ conservation) also provide a resource for further study into areas such as the physiological tolerances of plants and to inform approaches and priorities for in situ conservation (e.g. priorities for reserve acquisition and design). In addition, there is great potential for these collections to be used for research on the impacts of climate change and adaptation of our native plants. These uses mean that the collections have significant future economic value.

The value of ex situ collections is increased when they operate as part of an integrated conservation strategy to reduce plant diversity loss (Guerrant et al 2004) such as identifying a strategy involving conservation in situ (likely to involve moving the plant to another location) and ensuring preservation in a living collection.

Australia's botanic gardens have the potential to contribute much more to conserving plant species and ecosystems than they are able to do with current funding.

Knowledge and expertise to support climate change research

Australia's urban and regional botanic gardens have unparalleled and unique knowledge about where plants grow in the wild, how to propagate and grow them outside their natural ranges, and how to interpret this knowledge for scientists and the community. In a number of the larger botanic gardens, a herbarium is either part of the garden or part of another institution associated with the garden. Some capital city gardens and most associated herbaria also include considerable research expertise and facilities for molecular (e.g. DNA) analysis for population and evolutionary studies, as well as seed biology, plant disease and related research.

A key opportunity for community awareness about climate change

Botanic gardens are where people, plants and biodiversity come together. They are the second most visited places in Australia after cinemas (ABS 2002); 41% (13 million) of Australian adults visit a botanic garden every year, many more visit gardens' web sites for information.

Botanic gardens already have excellent interaction with the public through their education activities, displays and garden tours, which place them in an ideal position to:

- ∞ develop new learning opportunities for the public aimed at expanding awareness and understanding of climate change and how it affects plants and biodiversity
- ∞ emphasise the relationships between biodiversity conservation, climate change adaptation and sustainable living practices
- ∞ inform individuals about how they can assist efforts to respond to climate change
- ∞ demonstrate how plants can be used to monitor climate change.

New programs such as these would increase the level of public awareness and understanding of plants, their importance and the factors that affect their survival.

Table 1 Botanic gardens and herbaria in plant conservation

Supporting in situ conservation	Ex situ conservation programs
<p>Understanding and cataloguing our plant biodiversity in the wild, including identifying:</p> <ul style="list-style-type: none"> ∞ how many plant species there are ∞ what they are called ∞ how rare they are ∞ where they occur ∞ where they are likely to occur ∞ how common they are in reserves. 	<p>Establishing ex situ collections of native plants at risk from climate change based on assessments of:</p> <ul style="list-style-type: none"> ∞ how many species are at risk ∞ how well these species are secured in our living collections, seed banks and gene banks ∞ what the emerging priorities are for living collection management in botanic gardens.
<p>Ensuring understanding and expertise for translocation and ecological restoration programs, including addressing key questions such as:</p> <ul style="list-style-type: none"> ∞ is it feasible to move species at risk? ∞ if so, what should the priorities for moving species be in a changing climate? ∞ what are the ecological and economic risks of moving species? 	<p>Ensuring necessary horticulture research and development to maintain living collections in the context of:</p> <ul style="list-style-type: none"> ∞ the likely impacts of climate change on different species ∞ the vast array of plant propagation, establishment and maintenance requirements.
<p>Identifying species, processes, biosecurity risks and management strategies for plant diseases and pests emerging as a result of climate change.</p>	<p>Ensuring necessary plant pathology research, disease control, and biosecurity assessment to manage the risks to ex situ collections from disease under a changing climate.</p>
<p>Identifying risks and management strategies for native species that may emerge as potential invasive species.</p>	<p>Ready material for species reintroductions and restoration.</p>

Strategic context

Current Australian Government biodiversity conservation strategies provide a compelling context for the national coordination and engagement of Australia's botanic gardens' conservation programs in light of a changing climate.

The *National Biodiversity and Climate Change Action Plan 2004–2007* endorsed by the Natural Resource Management Ministerial Council (NRMMC) in 2004, outlines actions to conserve threatened species that have the potential to become extinct as a result of climate change impacts, including ensuring *that terrestrial species at highest risk of extinction in the wild as a result of climate change are preserved in ... botanical gardens, and germplasm/seed banks* (Action 5.3.2) (NRMMC 2004). Recovery plans for species and ecological communities threatened by climate change are to consist of appropriate actions, including conservation actions outside of their natural habitat (ex situ) (Action 7.3.2).

The *National Climate Change Adaptation Framework*, endorsed by the Council of Australian Governments in 2007, sets a context for Australia's botanic gardens to contribute to risk management by reducing the vulnerability of plant biodiversity to climate change (COAG 2007). The framework's action areas are directly addressed by botanic gardens and herbaria through research and analysis of changing distribution and phenology of terrestrial ecosystems and increasing resilience of natural ecosystems to the impacts of climate change.

The *National Strategy for the Conservation of Australia's Biological Diversity* (DEST 1996) sets objectives to establish and maintain facilities for ex situ research into plants and the conservation of plants (Objective 1.9), to strengthen ex situ conservation, including the provision of adequate resources to relevant institutions and organisations, and to integrate ex situ and other measures with in situ (in their natural habitat) measures for the conservation of threatened species. It also aims to increase public awareness of, and involvement in, the conservation of biological diversity. The strategy is currently being revised and is likely to include priority areas to which botanic gardens can directly contribute including mainstreaming biodiversity, knowledge for all, making choices, effective delivery and building resilience to threats to biodiversity.

Several organisations within Australia have an interest in plant conservation, research and education (see Appendix B). Australia's capital city botanic gardens operate as independent institutions within the national framework of the Council of Heads of Australian Botanic Gardens (CHABG). The gardens already promote national coordination and collaboration in relation to policy, and their effectiveness and efficiency could be significantly improved if they were regarded as the premier system for ex situ conservation of Australia's plant diversity. This would be similar to the National Reserve System, which provides the national focus on effective in situ conservation management. CHABG links to botanic gardens regionally through Botanic Gardens Australia and New Zealand and internationally through Botanic Gardens Conservation International, and is involved in developing international guidelines for ex situ plant conservation in relation to climate change.

The Council of Heads of Australasian Herbaria (CHAH) works closely with CHABG. CHAH is regarded as the peak body for herbarium collections and plant systematics research. There has been a long history of close working relationships between herbaria and botanic gardens in Australia, and about half the herbaria and botanic gardens are part of the same institution. These linkages and collaborations mean that relevant skills and capability in the herbarium community are available to contribute to various aspects of this climate change adaptation strategy.

Herbarium resources, data and bioinformatics expertise will be integral to achieve some of the goals of this strategy.

The Australian Network for Plant Conservation Inc (ANPC), a national nongovernment organisation established to promote plant conservation in Australia, has close links with the Australian National Botanic Gardens and other botanic gardens and herbaria, with representatives of several on its National Committee. The ANPC contributes to efforts to increase community awareness of climate change and to determine effective responses.

National coordination and prioritisation with respect to activities such as research, education and the maintenance of seedbanks and living collections are needed to maximise the joint contribution of Australia's botanic gardens to plant and ecosystem conservation.

Action plan

As a response to the significant global challenge that climate change presents for plant conservation, the heads of Australia's botanic gardens and herbaria from all states and territories have endorsed an outcome-oriented strategy and Action Plan based on the following four goals.

- ∞ Coordinate a national safety net for Australia's plant species through ex situ conservation
- ∞ Deliver integrated and easily accessible information about Australia's plant species
- ∞ Establish a long-term monitoring program of plant responses to environmental change
- ∞ Increase community awareness of climate change and facilitate effective responses.

An objective of the national strategy and Action Plan is to effectively coordinate the efforts of organisations working to conserve Australia's flora by prioritising conservation objectives and pooling resources. The Action Plan also forms the basis for coordination of action and the reporting framework. By addressing issues of capacity and infrastructure and coordinating their ex situ conservation programs, Australia's botanic gardens can increase the value and understanding of their role in integrated plant and ecosystem conservation.

The endorsement of this Action Plan by governments is critical to its success in attracting strategic partners. For the goals to be achieved, additional investment is required and will be sought from governments and strategic partners.

The sections below provide background on each goal followed by a table listing and prioritising strategies and actions for that goal. Each action has been assigned a priority and a timeframe within which the outcome could be achieved once the action has commenced.

Goal 1: Coordinate a national safety net for Australia's plant species through ex situ conservation

To represent plant species in danger of extinction from climate change in a seed bank, living collection, or gene bank and make them available for use in species recovery programs.

Background statement

The living plants, seed banks and gene banks of Australia's botanic gardens serve as long-term collections of plant genetic resources and diversity. They are currently an ad hoc safety net for the conservation of Australian plant species.

These ex situ collections support the retention and future restoration of wild plant diversity and also provide a potential future economic resource. Most of the ex situ conservation work is done within individual state and territory botanic gardens and other seed banks associated with species recovery, with limited national coordination, no integrated database of collection information and no nationally agreed priorities.

Ex situ conservation of species and genetic diversity requires significant investment in infrastructure, collection and ongoing maintenance. Application of ex situ conservation techniques needs to be coordinated, done to agreed standards and targeted to priority species identified as at risk from climate change.

There is a close link between seed banks and herbaria due to the need for adequate documentation of collections. A number of seed banks are not located within botanic gardens and some of these have strong ties to recovery and translocation programs.

Currently, most state and territory botanic gardens participate in the international conservation effort, the Millennium Seed Bank, with a fledgling Australian nationally coordinated effort, Australian Seed Conservation and Research, funded by Kew Gardens and state agencies. Funding for this project ends in 2010.

A nationally coordinated distributed seed bank, building on AUSCAR and incorporating further work in botanic gardens, is a critical component of a more formal National Safety Net for Australian Plant Species and an essential part of an integrated national response to the impacts of climate change. It will provide an opportunity to jointly prioritise conservation objectives, develop an integrated national infrastructure, develop standards for representative genetic collecting, and ensure coordination of efforts after 2010.

The ANPC has published nationally accepted guidelines for conserving seed, *Germplasm conservation guidelines for Australia* (Touchell et al 1997), which is also supported by the Australian and New Zealand Environment and Conservation Ministerial Council. A revised edition of these guidelines, prepared in conjunction with the Millennium Seed Bank partners and other experts from a range of institutions across Australia, reflects extensive increases in knowledge and will be published by ANPC in 2009.

The ANPC's *Guidelines for the translocation of threatened plants in Australia* (Vallee et al 2004), which has been accepted by the NRMCC for national application, identify principles and practice for proposed ex situ and in situ planting of species.

Both ANPC guidelines provide the basis for the integration of ex situ and in situ conservation activity for threatened species, usually in context of a recovery plan.

Strategy 1.1 Develop an integrated national infrastructure for plant genetic resource banks			
Actions	Priority	Lead	Timeframe
1.1.1 Develop national priorities for ex situ conservation to guide future collection of plant material	1	CHABG	2008–09
1.1.2 Implement best practice standards and guidelines for ex situ conservation in collaboration with existing standards development	1	CHABG	2008–09 and ongoing
1.1.3 Align botanic gardens collection policies with climate change priorities	1	CHABG	Review collection policy priorities – 3 months (2008) Ongoing
1.1.4 Improve the diversity and utility of existing collections of plant genetic resources	2	BGPA	Develop in first year (2009) Ongoing
Strategy 1.2 Ensure every priority plant species is represented in a seed bank or other long-term collection facility			
Actions	Priority	Lead	Timeframe
1.2.1 Coordinate a distributed National Seedbank Network to ensure efficiency of seed collection efforts and to input into global efforts after 2010	1	BGPA and ANBG	Initial development phase over 3 years (2008–11) Ongoing
1.2.2 Develop strategic partnerships with user groups of seed banks (e.g. species recovery programs)	2	BGPA and ANBG	Initial development phase of 1 year (2008–09) Ongoing

ANBG = Australian National Botanic Gardens; BGPA = Botanic Gardens and Parks Authority; CHABG = Council of Heads of Australia's Botanic Gardens

Goal 2: Deliver integrated and easily accessible information about Australian plant species

To provide information to scientists and the community including species environmental tolerance; known and potential climate change vulnerability; species-specific horticulture; and weed and disease risk assessments, linking with biodiversity information in the Australian Virtual Herbarium.

The combined knowledge and expertise held by botanic gardens, in partnership with herbaria, will make a substantial contribution to the understanding of plant adaptation to climate change, and support plant conservation in the wild and in gardens. Botanic gardens are an authoritative long-term, reliable source of knowledge on the horticulture of Australian and non-Australian plants. Herbaria, through CHAH, provide the information systems, knowledge and expertise to deliver complex distributed information.

The botanical expertise in plant diversity and taxonomy held in botanic gardens and herbaria underpins the current state of knowledge about plant biodiversity. Some botanic gardens and herbaria also have considerable research expertise and facilities for molecular (e.g. DNA) analysis for population and evolutionary studies, as well as seed biology, plant disease and other research strengths.

National coordination of data, data standards, and the integration of biodiversity and horticultural information are required to increase the useability and accessibility of plant data, and reduce duplication of effort. Integrated data will help address plant conservation research needs emerging from impacts of climate change. A web-based interface such as the existing Australia's Virtual Herbarium, integrated within the Atlas of Living Australia, could efficiently deliver this plant information to scientists and the community.

Strategy 2.1 Phased development of a coordinated National Plant Information System to deliver integrated information from Australia's botanic gardens to scientists and the community

Actions	Priority	Lead	Timeframe
2.1.1 Inventory existing collections and infrastructure, including regional botanic gardens	1	CHABG	3 months (2008–09)
2.1.2 Develop and document a project plan to implement a coordinated National Plant Information System	1	ANBG	Project plan development – 6 months (2008–09) optionally concurrent with Action 2.1.1
2.1.3 Implement the project plan for a coordinated National Plant Information System	1	ANBG, CHABG and CHAH	Initial development phase – 2 years (2009–10) Ongoing maintenance managed by CHABG

ANBG = Australian National Botanic Gardens; CHABG = Council of Heads of Australia's Botanic Gardens; CHAH = Council of Heads of Australasian Herbaria

Goal 3: Establish a long-term monitoring program of plant responses to environmental change

To monitor the effect of climate change across Australia's wide variety of ecosystems using the established network of botanic gardens throughout Australia.

Australia's botanic gardens have some historical long-term monitoring data on plant flowering times, which is a key indicator of response to environmental changes. These data have global significance as little data are available about the Southern Hemisphere.

In addition, botanic gardens have significant expertise and knowledge of plant flowering and seasonality studies. They are well placed to develop methodologies for monitoring the impact of climate change on plants for botanic gardens and conservation agencies in Australia. They provide a network of city and regional gardens all over Australia through which to develop a comprehensive long-term monitoring program.

Such a program can be used to raise community awareness of climate change through citizen-based science. The public can participate in the collection of baseline information on plant populations in the wild while they learn about how climate change affects plants and biodiversity.

Strategy 3.1 Lead the research agenda in Australia for long-term monitoring of plant responses to environmental change

Actions	Priority	Lead	Timeframe
3.1.1 Develop a national phenology program that integrates science and the community (citizen-based science linked with Action 4.1.1) to serve as an education and monitoring tool	1	Sydney Botanic Gardens Trust	Project scoping (2008) Project development (2008–09)
3.1.2 Implement a national phenology program	1	Sydney Botanic Gardens Trust	2009 and ongoing

Goal 4: Increase national community awareness of climate change and facilitate effective response

To increase engagement of the 13 million visitors to Australia's botanic gardens in understanding climate change and what can be done to mitigate and adapt to it.

Australia's 8 capital city and 150 regional botanic gardens attract 13 million visitors a year. This gives them significant collective capacity to engage urban and regional communities and deliver messages about climate change impacts on plants and ecosystems, and how communities can help governments to respond to climate change.

Botanic gardens have already established effective patterns of community engagement and already conduct a broad range of education, botanical information, interpretation and community awareness activities.

Development of a national climate change community awareness agenda to focus collaboration will increase the power and impact of current programs. National coordination will also facilitate sharing of resources and expertise between capital cities and regional gardens. Consistent programs and messages that are national in scope can be more effectively applied at major and regional botanic gardens.

Botanic gardens also represent a significant opportunity for all levels of government to showcase relevant climate change programs occurring in their regions and involve communities in action.

Strategy 4.1 Develop a coordinated National Climate Change Community Awareness Agenda for Australian botanic gardens			
Actions	Priority	Lead	Timeframe
4.1.1 Lead a national forum of botanic gardens to develop effective collaboration to:	1	ANBG	Common key messages identified at the forum and will now be implemented across Australia's major botanic gardens
∞ Develop a pilot or demonstration citizen-based science project linked with the phenology program (Action 3.1.1) as a focus to facilitate collaborative action			Project identification at forum Project scoping and development 2008–09 and ongoing
∞ Develop key climate change and biodiversity messages and marketing approach for use by all botanic gardens in conjunction with the Department of Climate Change			2008–09
∞ Identify mechanisms to coordinate marketing and promotion action			2008–09
4.1.2 Develop botanic gardens as a shopfront known to deliver biodiversity conservation and climate change messages		CHABG	2008–09

Strategy 4.2 Establish new and strengthen existing strategic partnerships to assist delivery of outreach programs			
Actions	Priority	Lead	Timeframe
4.2.1 Seek new strategic partnerships (both public and private) to assist delivery of the national climate change community awareness agenda	2	ANBG	Current and 2008–09
4.2.2 Develop a training and capacity building program for education and interpretation in regional botanic gardens (through BGANZ), community groups, schools, volunteers, etc.	2	ANBG	2009–10
4.2.3 Strengthen and extend the existing relationship between the ANPC and botanic gardens and herbaria, to ensure effective skills and knowledge transfer to plant conservation practitioners throughout Australia, particularly to regional and community-based groups	2	ANBG, CHABG, CHAH	Current and ongoing

ANBG = Australian National Botanic Gardens; ANPC = Australian Network for Plant Conservation; BGANZ = Botanic Gardens Australia and New Zealand; CHABG = Council of Heads of Australia's Botanic Gardens; CHAH = Council of Heads of Australasian Herbaria

Australia's botanic gardens system comprises 8 major botanic gardens based in the state and territory capital cities, together with over 150 regional botanic gardens. Most have mission statements that include elements of 'know, grow and show' (i.e. botanical research, horticulture and living collections, information provision and community engagement).

Living collections in botanic gardens usually include a component of Australian flora that generally relates to a geographical jurisdiction (see Table A1). Australia's capital city botanic gardens contain a combined total of about 24 000 Australian plant species, with some overlap in species represented within the collections.

Approximately 3800 Australian species have been collected in seed banks, including 1281 threatened species. Most gardens use guidelines developed by the Missouri Centre for Plant Conservation and Kew Botanic Gardens, UK and adapted by the Australian Network for Plant Conservation (ANPC) for seed and gene bank collections.

Most major botanic gardens use information databases to store information about their collections, but the format and accessibility of these systems varies.

Many of the capital city gardens' living collections are managed to support priority conservation activities such as threatened species recovery planning. Collectively, Australia's botanic gardens are involved in 130 national and regional threatened species recovery projects, including propagation, seed collection and studies, re-introduction biology and strategies to reduce the likelihood of species extinction.

Research generally focuses on ecosystems in respective jurisdictions, seed biology and storage, taxonomy and systematics, ecosystem restoration, horticulture and/or threatened species. Priorities for ex situ conservation are determined variously through state planning processes, opportunistically, or based on staff interests and funding availability.

Table A1 Major Australian botanic gardens

Botanic garden	Visitor numbers (per year)	Collection focus	Australian plant species in collection	Herbarium	Research focus and expertise
Australian National Botanic Gardens	500 000	Sample of Australian flora	6500	Yes	Orchids, seed bank germination, storage
Kings Park (Perth)	5 million	Sample of Australian flora	3000 in Living Collection	Research herbarium	Species and ecosystem restoration, ex situ conservation, ecophysiology, conservation of endemic and endangered taxa, systematics, species adaptation
Adelaide	1 024 299 (Adelaide), 168 250 (Mt Lofty), 40 535 (Wittunga)	Sample of Australian flora ^a	Adelaide 1000, Mt Lofty 900, Wittunga 900, Total: 2800	State herbarium	Partnership with Millenium Seed Bank, horticultural research on arid and semi-arid land flora from SA, seed bank and germplasm, germination, storage and cryogenics, smoke and water germination, taxonomy
Melbourne	1.8 million (includes Cranbourne)	Royal Botanic Gardens Melbourne — sample of Australian flora Cranbourne – Australian flora	Royal Botanic Gardens Melbourne 1630, Royal Botanic Gardens Cranbourne c1100	Yes	Balanced worldwide research focus: Myrtaceae, fungi and cryptogams, Mimosaceae, conservation genetics, urban ecology, horticultural botany, weed identification and assessment
Brisbane	700 000	50% Australian native rainforest (by area), 50% exotic	1500	State Herbarium	Australian native rainforest trees (ex situ), umbrella orgainsation for 33 regional QLD botanic gardens

Botanic garden	Visitor numbers (per year)	Collection focus	Australian plant species in collection	Herbarium	Research focus and expertise
Sydney Botanic Gardens Trust, Mount Annan Botanic Garden and Mount Tomah Botanic Garden	3 750 000	Subtropical and heritage Australian native plants, Southern Hemisphere cool climate plants	7469	Yes	Plant life in Australia, with a particular focus on New South Wales
Darwin	162 000	Sample of exotic tropical and northern Australian flora	1000 in Living Collection	Yes (in Palmerston, part of NRETA)	Cycads, boabs, zingiberales, palms, tropical trees, northern Australian flora
Tasmania (Hobart)	338 730	Southern Hemisphere cool climate plants with a focus on Tasmanian natives and subantarctic plants and the maintenance of the heritage tree and cool temperate plant collection	> 600 species	Herbarium: 3500 specimens	Horticultural research on the propagation of Tasmanian native species through seed germination research at the Tasmanian Seed Conservation Centre, vegetative propagation at the RTBG Nursery and tissue culture research of selected rare and threatened species in collaboration with the University of Tasmania

NRETA = Department of National Resources, Environment and the Arts; RTBG = Royal Tasmanian Botanical Gardens
a Adelaide — South Australian indigenous flora, Australian forest (east coast wet sclerophyll). Mt Lofty — mallee and arid lands. Wittunga — Fleurieu Peninsula and Kangaroo Island indigenous flora, tall forests of SW Australia, flora of Australia and South Africa

Together, Australia's botanic gardens can plan more effective communication and develop core messages about climate change and biodiversity. A national-level botanic gardens climate change and biodiversity education initiative will provide a leadership role in environmental education while promoting greater public involvement and participation in measures to conserve biological diversity. This appendix describes the current arrangements for collaboration and coordination of conservation efforts among Australia's botanic gardens and herbaria.

Council of Heads of Australian Botanic Gardens

Collaboration and coordination between the major botanic gardens is achieved through the Council of Heads of Australian Botanic Gardens (CHABG), which consists of the directors of the Australian capital city botanic gardens:

- ∞ Australian National Botanic Gardens, Canberra, Australian Capital Territory
- ∞ Botanic Gardens of Adelaide, Adelaide, South Australia
- ∞ George Brown Darwin Botanic Gardens, Darwin, Northern Territory
- ∞ Kings Park and Botanic Garden, Perth, Western Australia
- ∞ Brisbane Botanic Gardens, Mt Coot-tha, Queensland
- ∞ Royal Botanic Gardens Melbourne, Victoria
- ∞ Royal Botanic Gardens Sydney, New South Wales
- ∞ Royal Tasmanian Botanical Gardens, Hobart, Tasmania

CHABG aims to:

- ∞ provide a national forum for information exchange and coordinated planning, and to foster best-practice standards among Australian botanic gardens
- ∞ be an advocate for the interests of Australian botanic gardens and influence policy and legislation affecting botanic gardens nationally and internationally
- ∞ identify funding opportunities and seek increased resources for botanic gardens
- ∞ advocate plant conservation, and foster botanical and horticultural science
- ∞ facilitate career opportunities for, and provide grants to, botanic gardens' professionals to improve their skills and benefit their gardens
- ∞ coordinate national conferences, exhibitions and visitor programs related to public gardens, plant conservation and botanical science
- ∞ build and maintain links with relevant national bodies.

Council of Heads of Australian Herbaria

The Council of Heads of Australian Herbaria (CHAH)¹ is widely recognised as a peak body for promoting the nation's knowledge and information on plant, algal and fungal biodiversity.

¹ <http://www.CHAH.gov.au>

About half of the major botanic gardens are within the same institution as their associated herbarium. Other botanic gardens work in partnership with the herbaria community through CHAH. Herbaria contain collections of documented dried plants, which form a significant dataset of our plant biodiversity, past and present, and are an important scientific resource for ecology as well as taxonomy and systematics. They contain information about past and present plant distributions and so are repositories of bioclimatic information about plant distribution. This is important for assessing the extinction risk and the mismatch between potential and realised niches which govern whether a taxon may be pushed to extinction. Equally, the botanic gardens have expertise in plant growth requirements that address questions around potential niches. The critical expertise that herbaria provide is the expertise and knowledge around biological building information systems — the systematic framework to making conservation assessments.

The objectives of CHAH relate to:

- ∞ relevance of herbaria to biodiversity knowledge
- ∞ importance of national cooperative effort
- ∞ management and dissemination of information
- ∞ promotion of taxonomic research
- ∞ training in taxonomic research to maintain and enhance national levels of expertise
- ∞ cooperation on collections management, development and utilisation
- ∞ links with relevant organisations.

Botanic Gardens Australia and New Zealand

Botanic Gardens Australia and New Zealand (BGANZ) is a wider affiliation including regional botanic gardens. The objectives of BGANZ are to:

- ∞ provide a forum for information exchange and coordinated planning, and foster best-practice standards amongst Australian and New Zealand botanic gardens and other botanic gardens internationally
- ∞ advocate for the interests of Australian and New Zealand botanic gardens and provide policy and legislative advice affecting botanic gardens, including internationally
- ∞ identify funding opportunities and seek increased resources for botanic gardens
- ∞ advocate plant conservation and foster the plant sciences and social and cultural heritage programs
- ∞ facilitate development and grant opportunities to botanic gardens' employees (staff, contractors and volunteers) for the benefit of the employee, organisation or industry
- ∞ facilitate accreditation of plant collections and botanic gardens
- ∞ coordinate national conferences, exhibitions and visitor programs related to botanic gardens, plant conservation and plant sciences
- ∞ build and maintain links with relevant national and international bodies
- ∞ provide regular communication throughout the botanic gardens and broader community about the programs and activities of the member organisations and employees.

Australian Network for Plant Conservation

The Australian Network for Plant Conservation (ANPC) is recognised, acknowledged and valued as a leading organisation that facilitates the delivery and exchange of scientific knowledge and on-ground experience for achieving plant conservation. The objectives of the ANPC are:

- ∞ knowledge transfer — to facilitate the exchange of high-quality plant conservation information between scientists and on-ground practitioners
- ∞ international work — to contribute to international plant conservation
- ∞ corporate governance — to sustain ANPC's viability through well-managed financial and human resources and growth in membership and involvement
- ∞ partnerships — to underpin ANPC activities with strategic partnerships that facilitate on-ground plant conservation
- ∞ profile and standing — to improve ANPC's profile and professional standing amongst the plant conservation community.

This Action Plan provides a framework and focus for national coordination of efforts among the partnerships between botanic gardens and herbaria, the networks between regional and major botanic gardens, and networks with on-ground management through the ANPC.

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