Managing weeds in Australian botanical gardens

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Summary  Botanical gardens must play their part in the global attempt to reduce the impacts of invasive plants. The challenge is to minimise the importation, cultivation and promotion of known or potential weeds. An Australian Botanic Gardens Weed Network (ABGWN) has been formed to combine information and expertise in a united approach to weed policy and weed management. The ABGWN is also working with the Cooperative Research Centre for Australian Weed Management to produce a weed risk assessment procedure that can be used by Australian botanic gardens. This paper outlines the context of botanic gardens in relation to weeds, the tension between botanic garden values and environmental values, and current progress of the ABGWN.

Keywords  Botanic gardens, weeds, weed management, weed risk assessment.

BOTANIC GARDENS AND WEEDS
The role of botanic gardens has changed over the years according to the demands and interests of the day. One major aspect of botanic gardens has been the fascination with plant diversity, especially plants from distant lands. From the sixteenth century European colonial expansion and exploration gathered momentum and the early European botanic gardens became the repositories for the beautiful, curious and new plant trophies that were being brought triumphantly home. In the late sixteenth and early seventeenth centuries the plants came from Eastern Europe and nearby Asia and gardens competed with one-another to have the most exciting collections. In the eighteenth century novelties came from the Cape of South Africa and the East Indies and plants from warm climates initiated a boom in glasshouse collections. Scientific endeavour, mainly taxonomy, was stimulated by the many newly-discovered organisms needing description and classification. Botanic gardens began to display systems gardens or ‘order beds’ demonstrating the new plant classification schemes of the day. But the demands of economic botany and ornamental horticulture were not to be distracted as, during the late eighteenth and early nineteenth century, the influx of plant treasures continued. Collection sources included Western North America, South America, the Himalayas, China, East Asia and, of course, the tropics and Oceania, especially Australia, Tasmania and New Zealand. It was not long before these countries and regions were setting up their own botanic gardens.

In retrospect we can see clearly how botanic gardens were a significant part of the era of Romanticism. There was the intrepid individualism of the botanical explorers in far-off lands and tales of vast rivers, jungles, strange and fascinating foreign cultures and customs and the breathtaking wonders of the natural world to be seen on distant parts of the globe. The plant kingdom was an exciting and unrestricted palette of colours and textures with seemingly infinite variety to be harnessed for commerce and garden decoration.

Botanic gardens nowadays are multifaceted. There is still an interest in rare, attractive and curious plants from around the world so horticultural display is high on the agenda. There is still the process of documentation and ordering to be done by classification botanists in Herbaria, but now there is greater emphasis on the less obvious groups - fungi, algae, lichens and mosses. The public, as always, is eager for new excitement and entertainment so there are the major events, new structures and garden displays, shops, cafes, art exhibitions, sculpture, theatre, music, educational activities and so on.

Conservation issues came to the fore as the environmental movement gathered pace in the 1960s and ‘70s. Conservation collections of rare or threatened plants were established and botanic gardens became plant havens. But the agenda has changed. As the natural world staggers under the pressures of an ever-increasing human population, efforts to slow the process of environmental degradation have galvanised around the notion of sustainability, the attempt to leave the biological world in as good a state as possible for future generations.

The recent Millennium Ecosystem Assessment paints the broad picture:

The structure of the world’s ecosystems has changed more rapidly in the second half of the twentieth century than at any time in recorded history, and virtually all the Earth’s ecosystems have now been significantly transformed through human actions.

Over the past few hundred years, humans have increased the species extinction rate by as much as 1000 times background rates typical over the planet’s history (medium certainty).
Botanic gardens not only display the plant world in all its glory, but also, consciously or not, help mould public perceptions and attitudes towards plants and the natural world. We can both enjoy and protect plants and that must be part of the botanic gardens message. High on the agenda must be public education about the environmental and agricultural damage caused by invasive plants.

To date botanic gardens have played a relatively small role in the effort to stem invasive plants. Regulating their own activities in relation to weeds has been largely informal using individual botanical expertise. It is a difficult and controversial area. Outcomes are likely to be regulatory or prohibitive and the process will involve time, labour and money, factors that discourage enthusiastic action. However, the association of botanic gardens with ornamental horticulture and plant introduction demands attention. Some concerning figures are:

- 60–70% of the naturalised plants in Australia have escaped from gardens;
- Of the 20 Weeds of National Significance announced in 1999, 14 (70%) were garden escapes; and
- About 40% of Australia’s current declared weeds are invasive garden plants.

Table 1 presents summary data of number of naturalised plants in Australia. Present-day figures indicate that there is still much work to be done:

- Between 1971 and 1995 about 200 of the 300 newly naturalised plants in Australia were introduced to the country as ornamentals;
- About 54% of the currently recognised 720 naturalised invasive garden plants were on sale in nurseries in 2002; and
- Current estimates suggest that the cost to Australia’s primary industries in lost production and weed control now exceeds $4 billion p.a.

For many years botanic gardens were part of an international network exchanging seed lists (Index Semina), which was the main means of plant acquisition, especially the rare and unusual species. Seed exchange is now restricted. Firstly, there is the legally binding Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Secondly, under Article 8 of the 1993 Convention on Biological Diversity (CBD) national governments are called on ‘to prevent the introduction of’ and ‘control or eradicate those alien species which threaten ecosystems, habitats or species’. The Global Invasive Species Program (GISP) was established in 1997 to address the global threat and support the implementation of Article 8 of the CBD. As a result of these international initiatives there is now a common agreement among many botanic gardens to carefully monitor the acquisition and use of genetic resources, one aspect of which is obtaining consent from the country and/or organisation of origin to ensure potential benefit sharing (including non-monetary benefits). The major Australian botanic gardens have not produced Index Semina for many years and seed acquisition from overseas is dealt with by special request and supervised with caution.

TRADITIONAL ROLE OF BOTANICAL GARDENS AND RESPONSIBLE ENVIRONMENTAL MANAGEMENT

Australian botanic gardens have a poor reputation in relation to weeds, with blackberry (Rubus spp.) supposedly dispersed from the Royal Botanic Gardens, Melbourne, and *Mimosa pigra* L. from the Darwin Botanic Gardens.

The difficulties confronting botanic gardens will no doubt focus on the tension between environmental values (including biological invasions) and botanic gardens values such as heritage, education, science and scientific research, conservation, and public landscape. The following areas require careful management in relation to weeds.

**Table 1.** Exotic plants, garden plants, and weeds – the numbers.

<table>
<thead>
<tr>
<th>Kind of weed</th>
<th>Number</th>
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<tbody>
<tr>
<td>Number of alien species in Australia</td>
<td>c. 27,000 (Groves <em>et al.</em> 2005)</td>
</tr>
<tr>
<td>Taxa in major urban botanic gardens (inc. hybrids and cultivars)</td>
<td>c. 33,400 (Anon. 2006a)</td>
</tr>
<tr>
<td>Naturalised</td>
<td>3244 (J. Hosking pers. comm.)</td>
</tr>
<tr>
<td>Declared</td>
<td>429 (Anon. 2006b)</td>
</tr>
<tr>
<td>Estimate of no. taxa in nursery industry (inc. hybrids and cultivars)</td>
<td>c.35,000 (Hibbert 2004)</td>
</tr>
<tr>
<td>Garden thugs</td>
<td>958 (Randall 2001)</td>
</tr>
<tr>
<td>Naturalised invasive/potentially invasive garden plants</td>
<td>1036 (Randall and Kessal 2004)</td>
</tr>
</tbody>
</table>
Plant diversity Botanic gardens have traditionally explored plant diversity. This not only serves science and a natural human curiosity about the plant kingdom but also has a valuable educational function.

Heritage Several of the major botanic gardens are cultural landscapes of such significance that they have been placed on the National Register and are therefore subject to heritage planning legislation. These landscapes contain trees of historical significance within an overall landscape style exemplified by few other sites. They are therefore sites of great cultural, educational and scientific value and are managed according to recommendations outlined in their Conservation Analyses.

Education What plants are to be displayed in special collections like kitchen gardens? Wheat and carrots are widely naturalised plants. Should they be displayed and if so, what about widely naturalised plants. Should they be displayed and collections like kitchen gardens? Wheat and carrots are Education

Science The horsetail, Equisetum, is extremely distinctive and botanically important as it is the only genus in the family Equisetaceae, which, in turn, is the only family within the broader horsetail group Sphenopsida. This unusual plant genus exemplifies the kinds of plants that thrived on the Earth in the Carboniferous period over 350 million years ago. It is valuable for botany students to study the botanical structures of such an important plant group, while its form and history make this a very interesting curiosity for the general public and visiting students. However, Equisetum is also a highly destructive weed with underground spreading rhizomes that can penetrate to a depth of 1 m or so and, once established, is extremely difficult to eradicate. It is undoubtedly an environmental threat when it escapes from gardens, whether public or private. If grown it would need to be carefully contained.

Weed monitoring Botanic gardens are noted for their introduction and cultivation of rare and unusual plants. These are especially difficult to assess for their weed potential because their cultivation history is non-existent or negligible. These need to be carefully monitored.

Supervising affiliated organisations Affiliated organisations include Friends of Botanic Gardens, retail outlets that might unwittingly supply the public with invasive plants or seeds, education units, plant craft groups, commercial arrangements with the nursery industry, and plants going to staff.

TACKLING WEED INVASIONS

Australian Botanic Gardens Weed Network In October 2004 the Council of Heads of Australian Botanic Gardens (CHABG) approved a proposal for a cooperative effort to deal with the problem of environmental and agricultural weeds. This issue had emerged clearly at the Botanic Gardens of Australia and New Zealand (BGANZ) Conference in Geelong in 2003. CHABG supported the development of common policies, procedures and a weed risk assessment methodology for Australian botanic gardens, committing staff to the process. I was appointed facilitator for the establishment of a Working Group to coordinate a clear statement of objectives and a possible time-line to meet these objectives. The task was to be carried out with the assistance of the Cooperative Research Centre for Australian Weed Management (Weed CRC).

A working group of representatives has been established, called the Australian Botanic Gardens Weed Network (ABGWN). To date the ABGWN has a membership of 75 organisations with representatives from the major city botanic gardens, the regional botanic gardens of Victoria and New South Wales, and also representation from zoos.

The following targets were established:
1. Development of a common Weed Policy statement;
2. Establishment of an initial cooperative sharing of policies, weed procedures, lists, and information resources and approaches to weed risk assessment and weed risk management; and
3. Development of an effective strategy for the detection and management of weeds in botanic gardens through the use of agreed Weed Risk Assessment and Weed Risk Management Procedures

To date the ABGWN has operated well, establishing the network and exchanging weed information.

In July 2005 a workshop was held at the Royal Botanic Gardens Melbourne where members of ABGWN combined with staff of the Weeds CRC. Here the structure of a weed risk assessment that could be introduced to botanic gardens was explored. Through consultation a number of scored questions and methodology was developed and this is currently being finalised (as at May, 2006). The Australian Botanic Gardens Weed Policy was accepted by CHABG at the BGANZ conference in Hobart in October 2005.

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AUSTRALIAN BOTANIC GARDENS WEED POLICY

The major Botanic Gardens of Australia, in collaboration with regional botanic gardens and kindred organisations, are committed to the conservation and enhancement of Australia’s natural, economic and cultural biological resources. They will therefore encourage and demonstrate environmentally responsible horticulture and other sustainable management practices by striving to:

- Restrict the development of new weed problems in Australia by preventing the introduction to botanic gardens of species known or thought to have weed potential;
- Prevent the dissemination of known weed species from botanic gardens collections;
- Reduce the impact of existing weeds by identifying and managing existing problem species and monitoring plants entering and leaving sites;
- Develop a framework for continuing weed management through the cooperative exchange of information and the development of agreed policies, procedures and a weed risk assessment methodology; and
- Develop programs to educate and inform the horticultural community and general public on weeds and weed issues.

With the formation of the ABGWN it is hoped that botanic gardens can help stem the tide of invasive plants by: sharing the weed monitoring workload; keeping records of plant performance in particular geographic areas; building up weed profiles of particular species and genera; and performing weed trials to help the process of risk analysis. Above all ABGWN can contribute by raising public awareness of the environmental and agricultural damage caused by invasive plants.

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REFERENCES