

THE BOTANIC GARDEN

A Newsletter for the Botanic Gardens of Australia
and New Zealand www.bganz.org.au



Students participating in Erosion Model school program, ANBG

Issue 21 - July 2008

Editorial Committee:

- Dr Philip Moors Director and Chief Executive, Royal Botanic Gardens
Melbourne and BGANZ President
- Dr Tim Entwisle Executive Director, Botanic Gardens Trust, Sydney
- Mr Mark Fountain Manager, Botanical & Public Programs, Royal Tasmanian
Botanical Gardens and BGANZ Council member
- Ms Helen Paulsen Curator, Mackay Regional Botanic Gardens and BGANZ
Vice-President (Australia)

Managing Editor: Virginia Berger

Graphic Designer: Kerryn Gourlay

CONTENTS

Meetings and Conferences:

- BGANZ Biennial Congress 2009 – advance notice 3
- BGANZ (NSW) Regional Conference 3
- Second East Asian Botanic Garden Network Meeting, Korea..... 4
- 2008 American Public Garden Association Annual Conference..... 4

Items of Interest:

- From Seed to Cyber Space: RBG Melbourne wins award for online
plant census project..... 4
- National Forum on Climate Change Education and Awareness
Rachel Sanderson, Australian National Botanic Gardens..... 5
- Association of Friends of Botanic Gardens Conference Orange
Janet Thompson, President, Friends of RBG Melbourne..... 6

Articles:

- Managing Trees in a changing environment
*G.M. Moore, School of Resource Management,
Burnley College, University of Melbourne*..... 7

Feature Garden:

- Australian National Botanic Gardens, Canberra
*Stephen Speer, Program Manager,
Communications & Visitors Services, ANBG*..... 15

Profiles:

- Trevor Christensen, Manager of Scientific Services,
Botanic Gardens of Adelaide..... 21
- Mark Fountain, Manager, Botanical & Public Programs,
Royal Tasmanian Botanical Gardens..... 22

Email addresses – note from the Managing Editor

I thought it was just me, but I have now read that anyone maintaining an electronic mail distribution list can expect to have one third of each mail-out come back as 'returned mail'. People change their e-mail addresses, positions change, staff move on, and the source of the mailing list is left uninformed. I have attempted on numerous occasions to track down new addresses, but it is a very time consuming (and frequently unsuccessful) task.

If you know of anyone who does not receive the newsletter and who would like to, please let me know. If you change your e-mail address, please let me have the new one. Such advice would be greatly appreciated.

Virginia Berger
Managing Editor

MEETINGS AND CONFERENCES

- **Advance notice**

The next **BGANZ Biennial Congress** will be hosted by the Mackay Regional Botanic Gardens, Queensland from **Thursday 8 October – Sunday 11 October, 2009.**

- **BGANZ (NSW) Regional Conference**

Saturday 6 – Tuesday 9 September, 2008
Eurobodalla Regional Botanic Gardens, Batemans Bay

Theme: *Accentuate the Positive* – chosen to illustrate the aim of encouraging Botanic Gardens staff to share the secrets of their successes with the audience. Conference will include:

- presentations, workshops and seminars
- an optional river cruise
- a welcome reception
- two full days of plenary sessions and workshops
- farewell lunch

Program and further information available at:
www.esc.nsw.gov.au/community/gardens

If you would like to be on the mailing list please email Heather Haughton, Hon Secretary: **heather@melbpc.org.au**

- Second East Asian Botanic Garden Network Meeting
9-11 June, 2008
Seoul, Korea

The East Asian Botanic Gardens Network (EAGBN) Meeting is held every other year and is recognized as the primary regional cooperative event for the botanic gardens and arboreta in Eastern Asia.

During the 2nd EAGBN meeting, discussions will be focussed on cooperation among the botanic gardens and arboreta in the East Asia Region for the implementation of the Global Strategy for Plant Conservation and promotion of public education programs at botanic gardens and arboreta.

Contact: www.eabgn.com

- 2008 American Public Garden Association Annual Conference
22-26 June, 2008
Pasadena, California

Theme: **'The Big Picture'** – covering topics such as climate change, biodiversity, conservation, energy policy, sustainability and survivability.

For more information or to register online: www.publicgardens.org

ITEMS OF INTEREST

FROM SEED TO CYBER SPACE – RBG WINS AWARD FOR ONLINE PLANT CENSUS PROJECT

An ambitious project that has digitised records on over 50,000 individual plants representing 10,000 species held in 19 collections in the Royal Botanic Gardens Melbourne's living collection has won a major Victorian award.

The Online Plant Census has taken out the Sir Rupert Hamer Records Management Awards 2007 for Innovation and Excellence in Records Management in the Outer Budget Agency category.

Dr Philip Moors, Director of the Royal Botanic Gardens, said: "Yet again the Royal Botanic Gardens is setting the pace: no other botanic garden in Australia has a similar online tool to locate plants in their collections."

Dr Moors said that over the past ten years, the public's desire for information about plants has increased enormously.

"The Online Plant Census will support this continuing interest in the plants - many of them irreplaceable, some even endangered or extinct in the wild - held in the living collections at RBG Melbourne."

"We are literally taking the public's search for seed and plant information into cyber space so anyone around the world will be able to explore our historic and extensive collections."

The online census allows the public and virtual visitors to search against Scientific or Common names, Genus or Family names only or specific beds or locations to identify plants found across the 38-hectare site.

Dr Moors said the online census was live and updated daily, with links into other sites such as the International and Australian Plant Name Indices (IPNI and APNI) and the Google image link to get to image information.

Included in the census are many commemorative and therefore historically significant trees, such as the Separation tree under which the founding of Victoria was declared in 1850.

There are also plants that no longer exist in the wild and only survive in Botanic Gardens, for example, the *Sophora toromiro*, which is now extinct on Easter Island, but has survived in a handful of Botanic Gardens around the world.

The delivery of well-documented and accurate plant information in research and reference collections is one of the core roles of a public botanic garden that distinguishes it from that of a public park.

Dr Moors paid tribute to the Gardens staff who have been painstakingly mapping the Gardens over the past thirty years.

“Without their endeavours, the online census would just not have happened,” he said.

www.rbg.vic.gov.au/dbpages/rbgcensus/index.php

National Forum on Climate Change Education and Awareness

Key education and public program representatives from capital city botanic gardens around Australia met at the Australian National Botanic Gardens in April 2008 to begin developing a national approach to climate change education. The forum aimed to tap into the collective potential of botanic gardens to make a difference by increasing awareness of the importance of biodiversity and sustainable living in responding to climate change.

Participants agreed to four key messages for botanic gardens on climate change, messages broad enough to be adapted to suit a range of contexts and audiences:

1. Plants are central to the cycles of the planet (including the carbon, water and nitrogen cycles).
2. People and plants will determine the future of climate change. Plants do, and people can, reduce the impact of climate change and adapt to changes that occur.
3. Botanic Gardens are special places for people to research, learn about and debate climate change.
4. People need to protect biodiversity (plant diversity and diversity of ecosystems), because biodiversity will help reduce the impacts of climate change.

During the day, participants shared information on what their gardens are already doing, and developed common objectives for a joint national climate change education/awareness initiative. ‘It’s exciting to be part of a national discussion,’ commented Mick Robertson from the Royal Botanic Gardens Cranbourne. ‘The whole approach to climate change has to be global.’

'Developing the key climate change messages crystallised thinking for me,' reflected Mark Fountain from the Royal Tasmanian Botanical Gardens. 'Thinking strategically, we can take those messages back and make sure we're pushing them. We've just finished an interpretation plan, now we can make sure we're plugged into the messages. That's the most valuable thing. It's been very interesting to listen to educators talk about education. It's certainly been a very valuable day.'

A number of gardens have already begun implementing the climate change key messages within their programs and communication materials. A working group has been formed to develop a national pilot program for Australian botanic gardens on climate change and biodiversity education and awareness. 'This is a great opportunity to collaborate' said Sabrina Sonntag from the Australian National Botanic Gardens. 'Together we can achieve some really powerful outcomes.'

Rachel Sanderson, Australian National Botanic Gardens

ASSOCIATION OF FRIENDS OF BOTANIC GARDENS CONFERENCE

Seventeen Botanic Gardens and Arboreta were represented at the Association conference hosted by the Friends of the Orange Botanic Gardens early in April. Glorious weather and exotic trees dressed in their beautiful autumn clothes were an added bonus to the beautifully organized conference.

Stimulating speakers included Steve Corbett, Director and Chief Executive of the Centennial Parklands, Moore Park in Sydney, who spoke of the significance of volunteers both internationally and in Australia and the way in which they enrich the communities they serve. The New South Wales Government has acknowledged this by appointing a Minister for Volunteerism. Steve concluded with a quote "Volunteers are not paid, not because they are worthless, but because they are priceless".

Janelle Hatherly, Manager, Public Programs, Botanic Gardens Trust, Sydney, addressed the challenges facing our botanic gardens – how to ensure that they remain relevant to a society that is becoming increasingly urbanized and disconnected from nature and the need to nurture the next generation of stewards of botanic estates and help 'sow seeds' for a greener future. She suggested that programs may have to be created which invite the curiosity of children and reach them through their technology – these days many children are more familiar with a computer screen than a garden bed let alone a vegetable patch.

An excellent pre-conference tour which included a visit to the historic town of Carcoar, the restored Athol gardens near Blayney and a truffle farm, a most enjoyable conference dinner plus an early morning bird walk in the Orange Botanic Gardens all contributed to the success of conference.

Not only does the content of these conferences inspire and inform but they also provide the opportunity for Friends and others from botanic gardens around Australia to get together, make friends and share experiences and knowledge. Such contact is of enormous benefit to everyone involved.

The next Association conference will be held by the Friends of the Australian Inland Botanic Garden, Mildura in 2010 on a date to be advised.

*Janet Thomson
Melbourne Friends' delegate*

ARTICLES

Managing Trees in a Changing Environment

“Humanity is conducting an unintentional, uncontrolled, globally pervasive experiment, whose ultimate consequences could be second only to a global nuclear war...It is imperative to act now!” (World Conference on the Changing Atmosphere, 1988)

This statement from an international conference nearly twenty years ago emphasizes the significance of global warming, and associated climate change on the planet's environment. The debate today is about the extent of change and how it might be managed. Gases produced by human activity have changed the composition of the Earth's atmosphere and reduced the amount of radiation that is reflected from the Earth's surface. This extra radiation warms up the atmosphere.

The major gases responsible for these changes and global warming - the greenhouse gases - are carbon dioxide, methane, the oxides of nitrogen, and other gases in smaller amounts that are included under the Kyoto protocols (Table1). In the Australian context, the greatest contributor to the greenhouse gases is carbon dioxide. This is due to a complex of factors including such things as transport infrastructure, methods of energy generation and the fact that there is a relatively small population occupying a large continent. In Victoria, the significance of carbon dioxide as a greenhouse gas is due to the use of brown coal to generate electricity.

Greenhouse gases included under the Kyoto Protocols, and their contributions to the overall Greenhouse Effect (as a %) for the State of Victoria (Anon 2001):

GREENHOUSE GAS	SYMBOL	CONTRIBUTION (%)
Carbon dioxide	CO ₂	68.4
Methane	CH ₄	25.0
Nitrous Oxide	N ₂ O	6.4
Hydrofluorocarbons	HFCs	Negligible or 0
Perfluorocarbons	PFCs	0.2
Sulphur hexafluoride	SF ₆	Negligible or 0

These data are useful as they explain, or perhaps justify, the current emphasis by scientists, politicians and environmentalists on dealing with carbon dioxide as a greenhouse gas and climate change priority. If something can be done about reducing carbon dioxide emissions then it will have a significant impact, however this is not to say that other gases are unimportant.

There are terms used under the Kyoto Protocol, which are not always clearly understood (Anon 2000, Anon 2001). A SOURCE is any process or activity which involves releasing any of the greenhouse gases, while a SINK is any reservoir or process that stores carbon, thus lowering the amount of carbon dioxide in the atmosphere. SEQUESTRATION is any removal of greenhouse gases from the atmosphere by plants or technological measures over time. Thus carbon sequestration is the absorption of carbon, usually by biomass, such as trees, soils and crops.

Under the Kyoto Protocols, urban vegetation cannot be included in calculations of greenhouse gas emissions as either sinks or for purposes of sequestration, primarily because of difficulties that relate to verification of data, and the relatively small scale of urban plantings. It should also be remembered that the term of the Kyoto Protocol ends in 2012, and that prior to that date a successor protocol (post-Kyoto protocol) needs to be developed. It is expected that such a protocol would be more demanding on nations that agree to it than the current arrangements. While Australia has not signed the Kyoto protocol, it is actively taking part in the preparatory discussions for the post-Kyoto protocols.

MANAGING TREES UNDER THESE CHANGING CONDITIONS

Although the Kyoto Protocol does not apply to urban vegetation, it will alter the political environment surrounding urban vegetation, and see the value of urban vegetation increase. It is possible that the post-Kyoto protocol will include urban vegetation. Either way, there will be an opportunity to increase the public awareness of trees in cities, an opportunity to have the real value of urban vegetation calculated and recognized, and the potential to significantly affect decision making processes.

While the values of large trees are recognised by some people others perceive trees as nuisances (Spirn 1984, Moore 1997). The costs associated with trees in urban landscapes are often well known but their real direct and indirect benefits are rarely fully valued. Economists driven by the huge real costs of damage to the environment, and the costs of attempting environmental amelioration and rehabilitation, are only now starting to redress this problem and put balance back into the economic models. The impact of trees on the urban microclimate and city infrastructure are being recognized.

Climate and environmental values associated with mature trees (After Grey and Deneke, 1978: Anon, 1989: Harris, 1992: Finnigan, 1994, Moore 1997)

Climate related values:	Environmental values:
Shade	Production of Oxygen
Shelter from the wind	Fixing of Carbon Dioxide
Thermal insulation	Reduced soil erosion
Temperature modification	Edaphic environment
Reduction in Glare	Protecting watersheds
Humidification of the air	Ameliorating wind flow
Filtration of polluted air	Improved air quality
Interception of rainfall	Altering ambient temperature
Reduced water runoff	Noise abatement
Reduced stream turbidity	Wildlife habitat
Altered effective precipitation	Create ecosystems

The role of trees as filters for pollutants, improving the quality of air, reducing wind speed and influencing water infiltration and absorption are the subject of research (Finnigan 1994). The presence of shady trees can increase the useful life of asphalt pavement by 30% (Killicoat, Puzio and Stringer, 2002).

Mature trees are significant assets to our environment and our society regardless of where they occur or whether they are native or exotic.

A great deal of effort has gone into managing and conserving and preserving the trees. In the urban context, considerable human effort and time has been expended on the trees as well as a great deal of real energy in the form of fossil fuels that has underpinned their maintenance. There has also been significant water resource allocated to their growth and development. They are community assets in every sense of the word – society has invested resources in their establishment and management, and they have matured as assets and are now returning great and diverse benefits (Moore 1997) to society in return.

These mature trees are significant sinks of carbon and sequester this atmospheric carbon dioxide for very long periods of time. Should the trees die the carbon which is the major element of their structure would be released to the atmosphere making matters significantly worse. Consider what this could mean in a city like Melbourne, using rounded estimates to calculate the masses involved. There are at least 100,000 mature trees in the inner city area alone, and each weighs approximately 100t. Of this weight about 80% is water, leaving about 20t of structural mass, of which about 50% or 10t is carbon. Thus there is about a million tonnes of carbon sequestered in these inner city trees alone, not to mention that sequestered by associated organisms.

Carbon fixed in urban trees in inner Melbourne:

Approximations used	Value
Estimated number of trees in private and public open space in inner Melbourne	100,000
Average weight of whole tree, including above and below ground components (t)	100
Water content (%) of tree (approximation)	80
Dry matter mass of trees (%) (varies, so conservative estimate)	20
Carbon content of dry matter (%) (varies, so conservative estimate)	50
Amount of carbon sequestered in each tree (t)	10
Total carbon sequestered in urban trees of inner Melbourne (t)	1,000,000

If we take these calculations further, it can be calculated what effect pruning such mature trees for construction, or installation of utility services such as powerlines or communication cables, might have in terms of Carbon. Different pruning regimes remove different proportions of the canopy, and so data for 30, 20 and 10% canopy reductions are shown.

Carbon lost in pruning mature urban tree canopies:

Approximations used	Value
Average weight of whole tree, including above and below ground components (t)	100
Amount of carbon sequestered in each tree (t)	10
Amount of carbon sequestered in the canopy of each tree (t)	5
Amount of carbon lost if 30% of canopy pruned from each tree (t)	1.5
Amount of carbon lost if 20% of canopy pruned from each tree (t)	1
Amount of carbon lost if 10% of canopy pruned from each tree (t)	0.5

Given that pruning contracts and operations managed by local governments usually involve hundreds or perhaps even thousands of trees, it is worth estimating overall carbon losses for 100 trees. Furthermore, if you value carbon at AUD\$10.00 per tonne, the significance of the losses becomes clearer. When these values are considered it becomes apparent that they could affect the economic value of pruning as a management tool, and could see the rapid move to underground services. This is especially so when costs for 3 and 5 year pruning cycles are calculated.

Carbon lost and its value for pruning 100 mature urban tree canopies:

Approximations used	Value
Amount of carbon lost if 30% of canopy pruned for 100 trees (t)	150
Amount of carbon lost if 20% of canopy pruned for 100 tree (t)	100
Amount of carbon lost if 10% of canopy pruned for 100 tree (t)	50
Value of 1 tonne of carbon \$AUD	10
Value of carbon pruned from 100 trees when 30% pruned (AUD\$)	1500.00
Value of carbon pruned from 100 trees when 20% pruned (AUD\$)	1000.00
Value of carbon pruned from 100 trees when 10% pruned (AUD\$)	500.00

It should be noted that similar calculations can be applied to root damage and loss when roots are severed for construction and utility installation. Clearly, installation of underground services must be done in a way that does not damage or remove root mass. Similarly, research could reveal the extent of root loss due to compaction and water logging and the loss of carbon that results. Its economic impact could then be calculated.

The calculations above have involved the deliberate use of conservative estimates so that there can be no accusations of inflating values to serve the arguments in favour of urban trees. There are many algorithms that can be used for carbon calculations, including those available from the Australian Greenhouse Office, and most of these will give a higher carbon value than the calculations above. It should also be noted that there is growing evidence that there has been a general and significant undervaluation of carbon fixed below ground by mycorrhizae and the other microbes associated with plant root systems. In short, values for tree related carbon are likely to be considerably higher than any of the algorithms currently in use have so far revealed.

DROUGHT AND CHANGED WEATHER PATTERNS

The current drought that has affected Victoria, and more generally the south eastern part of Australia is now well into its ninth year. There has not been a dry period like it in the State's recorded recent history, and the duration of the drought is unprecedented over the period, for which we have data. The current drought has not been of the type described as acute, like that of 1983, but has been a chronic drought with below average rainfall month after month, and year after year.

It is not known whether this drought is a part of a regular natural pattern that occurs over a longer period of time. It might be the one in five hundred year or perhaps the once in a millennium drought for example, but current meteorological data are too recent to reveal such patterns.

However the current dry period may be a result of global warming and may indicate the changes that are to come, and which could be a more permanent part of our environmental conditions.

Regardless of how things eventually pan out, there is no doubt that chronic drought and the possibility of more permanent global climate change are changing the environments within which trees are growing. Such changes are also resulting in the rapid change of the political, economic and social environments within which tree managers operate, and the decision making processes that ensue. There is no doubt that they are managing trees in a changing environment.

There has been huge public interest in efficient and effective water use and conservation. Restrictions to water use have been applied to urban gardens, parks and streetscapes and these have placed the vegetation under considerable stress. There have been debates about whether trees –native or exotic - should be irrigated over the summer, and suggestions that perhaps the drought should take its course and consequently trees could be left to die. This is neither asset nor environmental management! Our knowledge of trees and particularly their root biology can be applied to effective and efficient management practices (see below).

Tree management imperatives at times of drought and climate change

- Since absorbing roots are near the soil surface, use this in management
- Plant trees in large mulched beds
- Mulch of any type is beneficial, but organic mulches have much to offer
- Large old trees must use significant amounts of water
- A few irrigations over summer will see trees through the driest periods of the year
- Focus on younger trees so that there are new generations of trees for the future
- Select trees wisely for the particular landscape role that is intended.

Consider water efficiency as part of any urban tree management program

Mature trees will have a significant place in urban landscapes of the future and they must be managed to ensure that they remain healthy and fulfil the full potential of their lifespan. Through recognizing tree structure, appropriate space must be provided for their canopies and root systems. This will reduce human interference with root systems in particular, leading to healthier, longer lived trees and lowered maintenance costs. Larger spaces to accommodate trees must be a part of sustainable urban design. Use of mulch cannot be an afterthought, which often leads to an eyesore, but rather must be an integral part of proper design. The needs of trees will be provided for in a way which is incorporated into the design of urban landscapes, so that the right mulch will be used and it will be integral to the ambience of the landscape. Already, there is a change in people's appreciation of the appropriateness of mulch, and their perceptions of trees growing in a green turf have changed.

Similarly, recognizing that the absorbing roots of most trees growing in urban locations are shallow and spreading should dictate the proper use of mulch material. Mulches should be organic wherever possible, of mixed particle size and between 75-100mm in depth. Irrigation systems such as drippers or leaky pipe should be located under the mulch to deliver water effectively and with a minimum of loss to where it is needed most by tree root systems

Characteristics and benefits of mulch for urban trees:

- **Mixed particle size – coarse and fine matter**
 - Facilitates aeration
 - Prolongs the life of mulch in urban sites
 - Creates habitat for edaphic organisms
- **Depth of 75-100mm (3-4 inches)**
- **Benefits include:**
 - Better water infiltration
 - Lower evaporation
 - Improved aeration
 - Better soil structure

As climate changes, the impact of vegetation on stormwater runoff could save billions of dollars in infrastructure costs to Australia's cities. It is not economically possible to retrofit larger drains and alter the levels at which they enter waterways, but trees not only hold rainwater on their canopies, but through transpirational water use reduce water entering drains significantly. Estimates suggest that trees may hold up to 40% of the rain water that impacts on them, and that as little as 40% of water striking trees may enter drains. Furthermore, the root systems may act as effective biofilters in improving the quality of the storm water before it enters water tables or river systems (Denman 2006).

Given that carbon dioxide is the most significant of the greenhouse gases, especially for the states of South Eastern Australia, its sources, sinks and sequestration will be particularly politically sensitive. Sources of carbon dioxide from the use of fossil fuels are often obvious, but many citizens fail to associate electricity with greenhouse gas emissions. However, in Australia, considerable electricity is derived from coal powered generators, and as people become more aware of climate change, the focus on green issues associated with power generation will increase. This could have a profound impact on current power line clearing practices in the eastern states.

The Kyoto protocol recognizes the value of carbon sequestration by trees, as a means of locking up carbon for significant periods of time. While the protocol does not recognize urban trees, the public will soon be aware that power generation is producing large volumes of greenhouse emissions and that the clearing of trees for powerlines and general tree pruning is reducing the level of carbon sequestered in the canopy structures of urban trees. Thus the power generating and distribution companies and authorities are compounding their contributions to the greenhouse effect and global warming. On the one hand they are major greenhouse gas emitters, and on the other they are causing significant carbon losses by their line clearing activities. These circumstances see citizens demanding an end to line clearing to protect the carbon sequestered

in urban trees. Under such a scenario, the Kyoto protocol has no legal impact on urban tree management but a changed political environment could provide an opportunity to press for under-grounding of services and the end to power line clearing. Once again this would see a rise in the real economic value of urban trees and landscapes.

A CASE STUDY FOR LANDSCAPE DESIGNERS:

By way of concluding this paper, a short hypothetical case study is presented. A local school has recently briefed a well-known firm of architects for the construction of its new school buildings. The school has a very strong environmental ethos, and employed the architects who are known for their environmental and energy expertise. The design has been presented and the architects have done a fine job in taking into account climate, energy use and recycling. The building and its landscape have been integrated, and the architects are relying on the proper choice of trees to shade buildings in Summer, but allow sunlight to warm the school in Winter. Their calculations show that this could save between 12-15% of the building's heating/cooling and lighting energy budget.

The architects have thus sought horticultural advice on which species of deciduous trees they can consider for planting to meet their design requirements, but at the same time meeting the school's policy of planting only indigenous trees. The school has planted Australian native plants in the past and may consider native plants, if appropriate local indigenous trees are not available, and so the architects have alerted horticulturists that this may be an acceptable option.

The architects have already had *Brachychiton* species, *Melia azedarach* and perhaps some *Nothofagus* species suggested as possibilities. However, they have considered the list to be too short; the *Nothofagus* seems inappropriate because of its slow growth rate, the *Melia* problematic because of its hard fruits in a school environment and they have heard reports that *Brachychiton* often has uneven canopy development. A number of other species tend to be summer deciduous which is far from desirable under these circumstances. So they want a wider range from which to choose.

Here the issues of native versus exotic, efficient energy use in urban design and the role of trees in urban landscapes under changing climatic conditions collide.

CONCLUSION

This is the century of the environment and the value of trees and vegetation will inevitably rise as people become more aware of the elements of a sustainable urban environment. There have been major changes in attitudes to water, climate change and the need for sustainability in a short period of time, but they will be permanent. They herald the development of a truly Australian urban landscape which values trees, but recognizes the dryness of the Australian continent.

REFERENCES:

Anon (2001) *Understanding Climate Change*, State Government of Victoria, department of natural resources and Environment, ISBN 07311 4832 0.

Anon (2000) *Greenhouse Sinks and the Kyoto Protocol*, Australian Greenhouse Office, Commonwealth of Australia, ISBN 1 876536 67 5.

Denman L (2006), *Are Street Trees and Their Soils an Effective Stormwater Treatment Measure?* Proceedings of the Seventh National Street Tree Symposium, 10pp, University of Adelaide, Adelaide, ISBN 09775084-6-3.

Finnigan J.J. (1994), *Improving the Physical Urban Environment with Trees*, in *Urban Trees: the Challenge for Australian Cities and Towns*, RAIPR, Canberra, 1-22.

Grey, G.W. and Deneke, F.J. (1978), *Urban Forestry*, John Wiley, New York.

Harris, R. (1992), *Arboriculture: The Care of Trees, Shrubs and Vines in the Urban Landscape*, Prentice Hall, New Jersey.

Killicoat, P, Puzio, E, and Stringer, R (2002), *The Economic Value of Trees in Urban Areas: Estimating the Benefits of Adelaide's Street Trees*. Proceedings Treenet Symposium, 94-106, University of Adelaide.

Moore G M (2006) *Urban Trees and the Global Greenhouse*, Proceedings of the Seventh National Street Tree Symposium, 23-28, University of Adelaide, Adelaide, ISBN 09775084-6-3.

Moore G M (1997) *Benefits of Street Trees*, *Arbor Age*, 3-8.

Spirn, A.W. (1984), *The Granite Garden: Urban Nature and Human Design*, Harper Collins, New York.

G.M. Moore

Former Principal of Burnley

Associate of the School of Resource Management and Geography

University of Melbourne

FEATURE GARDEN

The Australian National Botanic Gardens, Canberra, ACT

More than a national tourist attraction, the Australian National Botanic Gardens (ANBG) are a scientific storehouse of plant resources, a role model for waterwise management in Australia's drying climate, and a guiding force behind building effective networks between our national, state and regional botanic gardens.

Botanical beginnings

From the very beginning, the ANBG was designed and established to be more than just an ornamental garden. It was to be developed with scientific research in mind, purposely located near Canberra's two main research institutions, the Australian National University (ANU) and the CSIRO — known at that time (the 1930s) as CSIR, the Council for Scientific and Industrial Research.



Opening of ANBG
by Prime Minister John Gorton

As soon as World War II ended, construction of the ANBG site began on the lower slopes of Black Mountain — the site of the future Telecom Tower, now Telstra Tower, which overlooks the city, lake and parliamentary circle. Despite the site's poor-to-average soil, the area was chosen because of its sheltered position, protected from strong westerly winds.

Four years later, in 1949, the first ceremonial tree planting signified the 'official' establishment of Canberra's botanic gardens, though it wasn't open to the public until almost 20 years later, in 1967. In 1970, 25 years after the first eucalypts were planted, Prime Minister John Gorton officially opened the ANBG. By the end of the decade, the Gardens had become a national attraction.

The Visitor's Centre opened in 1985 and housed a range of exhibitions, a botanical bookshop and a public reference herbarium, where visitors can bring plant specimens for identification. During the 1990s, the community-based Friends of the Botanic Gardens and Growing Friends plant propagation group came into being, and volunteers began giving free daily guided tours and working in the Herbarium. Since 2000, a growing awareness of climate change has seen the ANBG focus on intensive waterwise management and to take a leading role in public education about the future of gardens in our changing climate.

Armchair tour of the ANBG

Don Beer, volunteer guide at the ANBG since 2005, takes us on a virtual tour along the gardens' Main Path, and reveals some little-known facts along the way.



'We first wander along Banks Walk, a show area named for the 'father' of Australian botany, Sir Joseph Banks. The many flowering plants make this walk particularly spectacular during spring. Over the rainforest bridge and past the café is the Ellis Rowan garden — a horticultural section containing plants that can be purchased from Canberra's commercial nurseries. It's a good spot for keen home gardeners.

left to right Hakea, (2 & 3)
Feature Garden, Along the
main path - (All ANBG)

'The family Myrtaceae is next. Eucalypts, the iconic tree of Australia, are the key element here. We can also see callistemons, tea-trees and paperbarks, among other groups. Then, in the monocotyledon section, we find grasses, lilies, irises and rushes. Xanthorrhoea (grasstrees) are a feature here — did you know their gum can be used to produce picric acid, which is the basis of an explosive still used in detonators?

'The Aboriginal Plant Use Walk is nearby — this walk highlights plant species used by aborigines for food, weapons, medicines, musical instruments, bowls, firesticks, baskets, mats, nets, jewellery, paint, glue and canoes.

'Next, we arrive at the family Proteaceae, which includes grevilleas, banksias and hakeas. This family derives its name from the Greek god Proteus, who was famous for being able to change his appearance at will. It's an extremely diverse and varied family — the grevilleas in particular demonstrate many different forms of inflorescences and leaves.

'Leaving behind the Proteaceae we walk through the flora of the Sydney region. There is a tremendous diversity of plants — rainforest, coastal and heath, three thousand species in all — found in the area from Newcastle in the north to Jervis Bay in the south, and over to the Great Dividing Range.

'Just up from the Sydney region is the Display Glasshouse, which contains plants that can't be grown outdoors in Canberra. We'll see epiphytes, ferns, orchids, palms and other tropical and subtropical species, collected from the wild by ANBG staff and research associates.



Glasshouse - ANBG

'We now cross the Eucalypt Lawn, a popular picnic spot. About three years ago the grass was very green and used to come up to the base of the tree trunks. But in the last year or so, with limited watering, it's developed big bare patches, and looks more natural. Saturday night concerts are held here in the summer; it's great to sit back and listen to 'Annie and the Armadillos', while looking up at the beautiful foliage and seeing the magnificent vista of greens and blues in the distance.



Summer concert - ANBG

'Wandering through the Acacia Section, we can see the famous Mulga tree. Although acacias dominate the Australian environment where rainfall is less than 300 mm, the Mulga is said to synchronise the production and germination of its seed with La Nina – so it does need a little bit of water.

'The Rock Garden, with its little waterfall and rock pool, is our next stop. In the warmer weather, Eastern Water Dragons (lizards) often sun themselves on the rocks. You can sometimes see them fighting, and one guide saw two dragons having it out on top of the waterfall, and falling together into the pool!

'A group of native conifers is our second-last stop. Here you can take a good look at a Wollemi Pine growing next to path. The Hoop Pine is one tree that nearly everyone has made use of, without realising: it's one of the few woods that can be used in contact with food, and is used to make paddlepop and icecream sticks.



Students visiting the rainforest gully - ANBG

'Finally we come to one of the Garden's major attractions — the Rainforest Gully, with its maze of boardwalks taking us through the rainforests of the east coast of Australia. Fine-misting sprays and fast-growing shelter trees have transformed this dry eucalypt gully into a cool, dark and lush environment. The Tasmanian Section, with its Huon Pines, soft tree ferns, Tasmanian Myrtle and Southern Sassafras, is my favourite spot of all — it's very leafy, cool and refreshing.'

Thanks for the tour, Don!

Rainforest refuge

Don Beer isn't the only one who favours the ANBG's rainforest gully. It's also the favourite haunt of the Garden's Director, Anne Duncan, whose background in rainforest management has given her a soft spot for tree ferns.

'It's so peaceful in the Rainforest Gully, and so different from the vegetation around it — it's like a refuge,' she says.

The education groups that make a daily pilgrimage to the ANBG — about 12,000 students from kindergarten to Year 12 — also love the rainforest, according to Education Officer Molly Henson.

'The kids love it because it feels like they are in a natural environment, a real rainforest. It's dark and shady, and they like to explore the boardwalks,' says Molly. 'It's also my favourite, because it has lots of diversity, and it's such a contrast to Canberra's grassy woodlands.'



Sydney basin - ANBG

Partnering for research

Although the ANBG was established with scientific research collaborations in mind, few partnerships developed until more than 40 years after the Gardens were first established. The Centre for Plant Biodiversity Research, established in 1993, combined the herbarium collections of the ANBG and its neighbour, CSIRO Plant Industry. The resulting Australian National Herbarium, the largest of its kind in Australia, houses more than 1.4 million botanical specimens.

The Centre was a key player in developing the six-million-specimen Australia's Virtual Herbarium (AVH). 'The AVH gives state-of-the-art access to botanical information over the web,' explains Anne. 'It pools information from all over Australia and presents it through one accessible portal, linking the databases of all the state herbaria. People can access the "live" version all the time, instead of working with outdated information.'

Anne also describes an exciting new project that expands on the concept of the AVH, called the Atlas of Living Australia. 'The Atlas will provide access to all available information about Australia's living heritage — plants and animals,' says Anne. The project involves the ANBG, CSIRO and other partners.

Adapting to climate change

The ANBG is recognised as having a leadership role in Australia's botanic gardens' response to climate change.

'Our initiative with the Council of Heads of Australia's Botanic Gardens has led to a national climate change adaptation strategy,' Anne explains. 'It identifies four key roles we see for botanic gardens in their adaptation to climate change. One of these is education: all botanic gardens will put together a national approach to increase community awareness of climate change.'

'Australian and New Zealand botanic gardens receive around 14 million visitors — so we have huge potential to educate the community and raise awareness. Our botanic gardens can work together to drive a contribution to climate change adaptation.'

Key climate change education messages:

- Plants are central to the cycles of the planet (including the carbon, water and nitrogen cycles).
- People and plants will determine the future of climate change. Plants do, and people can, reduce the impact of climate change and adapt to changes that occur.
- Botanic gardens are special places for people to research, learn about and debate climate change.
- People need to protect biodiversity (plant diversity and diversity of ecosystems), because biodiversity will help reduce the impacts of climate change.

Being waterwise in a drying climate

Anne says that climate change is already impacting on the ANBG in an operational sense — especially when it comes to water usage.

'We need to set an example in waterwise management,' she explains. 'We keep within Canberra's general water restrictions, and we manage to keep plants alive — but not necessarily thriving.'

The ANBG's water usage is managed in great detail by the use of a computerised irrigation system, and by as much recycling as possible.

'The rainforest gully, for example, has a dam (or ornamental pool) at the bottom for runoff,' says Anne. 'The water is recycled and used to irrigate other parts of the gardens. We also recycle our nursery water, and have installed some rain tanks to collect rainwater. Plus, we are looking at using non-potable water (ie recycled stormwater) for irrigation instead of high-quality water.'

'We've also been trialling some soil moisture sensors to understand whether our water application is effective,' she explains. 'This sort of technology used to be prohibitively expensive, but it's now affordable, and places like golf courses use them as part of normal irrigation practice. By finding out what's happening within the soil, we can save a lot of water. It's been trialled on the café lawns, and we've discovered we can reduce the water usage there quite a bit.'

The garden of the people

The ANBG is about to develop a strategic plan to shape its future, and plans to involve the community as much as possible.

'We are the garden of the people of the nation,' says Anne proudly. 'Community support is needed for anything we do. For example, the community needs to decide whether to support our decisions about water use. If certain plants or gardens need lots of water, should they be grown here? Our strategic plan will be an opportunity for people to say "yes, that's important, or no, that's not."

'Botanic gardens all over the world are doing lots of thinking about sustainability. We are about to revise our collection, and plan to document the plants we have now, and their values (research, display, threatened species etc). Then we'll ask which are the ones we need for the future, given that our climate is drying? We'll present this to the community in a formal consultation process over the next 12–18 months and see what they think, and decide where to go from there.'

Decentralising the national collection

Apart from focusing on climate change, Anne says that a key aspect of the ANBG's future will be its changing status as a national collection.

'Rather than look at the ANBG as a national collection [of plants], we could be looking at a national collection that is distributed around the state and regional botanic gardens,' she explains. 'For instance, a lot of regional botanic gardens are now growing native plants that were previously only grown here in Canberra.'

'We could coordinate the collection, and facilitate the construction of a species database,' Anne says. 'So to go to see a rainforest garden, for example, you would go to a garden in North Queensland, and so on. Tropical species can be grown much more easily in Queensland than in Canberra – it's just not efficient for us to do it here.'

Anne says that this specialisation would give regional gardens a drawcard as being part of Australia's national collection. 'Once the database was completed, it would be a bit like the virtual herbarium, and will naturally have public access,' she says.

According to Anne, creating this network could have other advantages too. 'The network [of state and regional botanic gardens] has great potential for delivering our climate change community awareness strategy,' she says.

For more information about Australian National Botanic Gardens:

www.anbg.gov.au

*Stephen Speer
Program Manager
Communications & Visitors Services
Australian National Botanic Gardens*

Photos: Barry Brown

PROFILES

Over the last few issues of *The Botanic Garden*, readers have been introduced to members of the BGANZ Council. Trevor Christensen and Mark Fountain are the representatives of Adelaide and Tasmania respectively.



Trevor Christensen

Trevor Christensen is Manager Collections and Learning at the Botanic Gardens of Adelaide. In this position he has responsibility for a number of different areas including education and interpretation programs, Library and information resources, ex situ conservation research (specifically the Seed Conservation Centre and its activities), policy, partnership projects such as the public / private funded Sustainable Landscapes project as well as plant records and documentation.

Trevor was born and raised in Queensland where he completed tertiary studies in horticulture and botany. After a short time of working for local government in Queensland he moved to South Australia and has held a number of roles within the Botanic Gardens of Adelaide and Department for Environment and Heritage, including a number of years as Horticultural Botanist.

He has specialist knowledge in the area of harmful plants, working closely with hospitals, doctors and emergency staff in provision of advice and lectures. In recent years he has had close involvement with development of the site Master Plan for the Adelaide and Mt Lofty Botanic Gardens.



Mark Fountain

Nothing is totally random, in my case it's not too difficult to deduce that the directions I have taken in life were influenced by my forebears. My Grandfather on my father's side was almost the archetypal English farmer (we have footage of him as the talking head for a very early documentary film about British farming dressed in a hounds tooth jacket, jodpurs and gumboots with pipe in hand). My dad was an agronomist and a 'ten pound pom' who emigrated to Tasmania in his mid twenties. He was instrumental in establishing the

Tasmanian potato industry and was recognised as a bit of a world authority on spuds. He retired many years later as the Secretary of Tasmania's Department of Agriculture and Fisheries.

To add one random element, my maternal grandfather worked for the instrument maker Boosey and Hawkes and supposedly invented a mute for the cornet. I love music but am unfortunately completely devoid of any talent. On the other hand my Mum was interested in the visual arts and arguing with her four sons (in the most positive 'debating with attitude' sense of the word). Amongst the great many things I learnt from my Mum I rate an appreciation of art and the capacity to postulate the alternative view very highly.

My first foray into 'higher' education was to go to Art School where I had far too much fun before deciding I wasn't taking it seriously and beginning to feel guilty about wasting my parents' money and eventually 'dropping out' (a very early seventies thing to do). Dropping out for me meant about two and a bit years of infrequent, itinerant work and a several-books-a-day world literature habit.

The culmination of this 'period of odd jobs' was a year or so working in the local library after which I decided that I did not want to work indoors ever again, and driven perhaps by my agrarian background, my parents involvement in gardening, a childhood fascination with dreaming my way into Sung dynasty landscape paintings and a love of the bush I resolved to become a horticulturist.

To do this, I canvassed the local nurseries until one gave me a job and I very quickly became immersed in every aspect of horticulture. At work I was lucky enough to experience different facets of this industry from propagation through to a role as the Production Manager and everything in between. Outside work I taught Horticulture sometimes two nights a week, covering, over the course of a number years a surprisingly diverse range of subjects. (This was surprising because I was often struggling to be ahead of my very engaged, mostly mature-age students) During the growing season Saturday was usually devoted to contract potting to supplement my modest Nursery persons wage, At differing times I also took on the occasional design and construct landscape job and ran a backyard nursery specialising in Tasmanian and Australian flora.

For a hobby I spent many of my spare weekends in the bush studying field botany with a couple of fellow horticulture student friends (one of whom researched and wrote the definitive book on Tasmanian Ferns). I was also an active committee member of the then Society for Growing Australian Plants (SGAP) convening a number of their biennial Flower Shows, even becoming President for a period.

Two things led me into the Botanic Gardens world, the first was a back injury (fortunately short lived) that unsubtly let me know I might not be able to sustain the physical aspects of nursery work forever, the other was a personal approach from the Garden's Director at the time to apply for a position looking after the RTBG nursery with a brief to expand the Tasmanian flora program. Since then I've worked in many roles at the Gardens including most of the management positions and been lucky enough to be given a range of challenging project management roles from the Subantarctic plant house, through to infrastructure projects (roads and paths), renovation / adaptive re-use (Conservatory, Seed Bank) and currently the development of the RTBG's 20 year Strategic Master Plan.

I've also been lucky to have been offered a few very special botanical and horticultural experiences including standing in fields of mega-herbs on the New Zealand Subantarctic Islands and Macquarie Islands, being alone in the green depths of Japan's Saiho-ji garden, the famous Moss temple, reconstructed in 1339 and now a world heritage site. (see my Flickr site <http://www.flickr.com/photos/markfountain/> for a few recent shots of other Japanese gardens). Closer to home I have been awed in the presence of Tasmania's oldest living entities *Lomatia tasmanica* and the Mount Read Huon Pine.

I have learnt after 13 years or so working in the Botanic gardens that we are privileged to work in such extraordinarily complex and rich places, not only for the work we do with plants (and I'm sure we'll have to work even harder to make people aware of the critical importance of plants in our changing world) but also for the heritage we manage and for our unheralded position as vital nodes for social and community wellbeing and education.

Mark Fountain