Annual Report 2006 2007

Scientific Report of the Science and Public Programs Branch

Inspiring the appreciation and conservation of plants through exciting, innovative and relevant research

Botanic Gardens Trust
SYDNEY

www.rbgsyd.nsw.gov.au/publications

Access Directory

Science and Public Programs Branch
Botanic Gardens Trust
Royal Botanic Gardens & Domain
Mrs Macquaries Road, Sydney NSW 2000
Tel (02) 9231 8111 Fax (02) 9251 4403
Gardens Offices hours:
8.30 am to 5 pm, Monday to Friday

Mount Annan Botanic Garden
Mount Annan Drive, Mount Annan NSW 2567
Tel (02) 4648 2477 Fax (02) 4648 2465
The Garden is open all year except Christmas Day.
10 am-4 pm, April to September;
10 am-6 pm, October to March.

Mount Tomah Botanic Garden
Bells Line of Road via Bilpin NSW 2758
Tel (02) 4567 2154 Fax (02) 4567 2037
The Garden is open all year except Christmas Day.
10 am-4 pm, March to September;
10 am-6 pm, October to February.

National Herbarium of NSW
Mrs Macquaries Road, Sydney NSW 2000
Tel (02) 9231 8111 Fax (02) 9251 4403

Copies of this report can be found on the Trust website:
www.rbgsyd.nsw.gov.au

Cover photographs: ‘Coprinus’ (named ‘Coprinus Troup’); Gibsmithia (named ‘Alga in outer space’)

Photograph by: (top) Lotte von Richter, (bottom) Dr Alan Millar

Contents

Highlights of the Year

- Opening of exhibition to celebrate the tercentenary of the birth of Carl Linnaeus, the 'Father of Systematics': *Carl Linnaeus: 18th century scientist, 21st century legacy*
- Six botanists were part of the UNE Biosystematics teaching team (with staff from UNE and the Ausralian Museum) that received a Citation for Outstanding Contribution to Student Learning from the Carrick Institute for Learning and Teaching in Higher Education 'For inspiring students' learning and appreciation of systematics through a unique integrated research-driven program devised and delivered by researchers from three premier Australian research institutions'.
- Staff members taught part of the Biosystematics degree course at the University of New England. The residential school for the second unit was held at the Gardens in July 2006.
- Plant pathology staff were instrumental in the diagnosis and control of Phytophthora root rot at the Wollemi Pine site in Wollemi National Park.
- New webpages were added to our website covering the plants around Botany Bay and the Cumberland Woodland at Mt Annan
- Internship Program: Jordan Bailey, Iain Goodrick, Peta Hinton, Margaret Morgan, Megan Muir, Philip Pritchard, Daniel Robinson, Christine Rockley and Lucas Shuttleworth participated in the first 7 week Internship Program offered by the Herbarium which ran from 8 January – 23 February. This program offers undergraduates and recent graduates in the plant sciences advanced working experience in a leading scientific institution. Specific training is given in skills for job-seeking and higher study. The team running

this program consisted of Bob Makinson, Louisa Murray, Barry Conn, Mary Stewart and Kathi Downs.

- Co-supervision of 43 students from 11 universities including 15 students based fulltime at the Trust, and a continuing commitment to tertiary teaching at several universities, including the University of New England Biosystematics Course.
- Grant and enhancement funding of $1.0 million to the Trust for 20 projects.
- Maintenance of diverse and high quality research programs, with 84 publications for scientific audiences.
- Publication of 20 taxonomic papers in *Telopea* volumes issues 11(3)) and 11(4) and continued growth in the number of manuscripts submitted to and published in *Cunninghamia*.
- Successful series of exhibitions in the Red Box Gallery, with exhibitions on botanical art and the Margaret Flockton Prize in botanical illustration.
- Continued growth in the requests for information from the Botanical Information Service and the Plant Disease Diagnostic Unit.

Part 1: Introduction

The BGT Science Annual Report is structured around the *Three Year Vision for Plant Sciences Branch (2000–2003)*, prepared in response to the 1999 review of Plant Sciences. The Branch was reviewed again in March 2004. The following introductory material is taken from the Vision document.

Our Environment

The Science Program of the Royal Botanic Gardens and Domain Trust is:

- Obligated first and foremost to the Trust through the relevant Acts and corporate planning.
- Funded primarily by the State Government of NSW and its programs must contribute to that government's policies and goals.
- Obligated under all treaties and strategies to which the State and Federal governments are signatories (e.g. NSW Biodiversity Strategy, National Strategy for the Conservation of Australia's Biological Diversity, Convention for Biological Diversity).
- The oldest and one of the most highly respected scientific units in Australia. (Science in Australia began at the Trust and has always been a strong focus for the discovery, documentation and study of Australian plants).
- Recognised and valued internationally, nationally and within the State for its science programs (with different programs relevant at different levels).
- A critical component for the Trust is to remain one of the worlds leading botanic gardens.
- Accepted as a leading organisation in the conservation and management of NSW's plant biodiversity.

- Part of a national and international collection of herbaria and botanic gardens (and other organisations) contributing to the understanding, appreciation and conservation of Australia's flora.

Vision for Science at the Botanic Gardens Trust

The Botanic Gardens Trust will have exciting, innovative and relevant scientific research programs. It will be recognised throughout New South Wales, Australia and the world as making a major contribution to the discovery and conservation of biodiversity. It will work with the horticultural industry and botanic gardens in plant development and disease diagnosis. Research results and biodiversity data will be communicated using the best available means. The Trust will work in partnership with government agencies, universities, botanic gardens and herbaria to achieve these aims.

All scientific programs will be widely recognised within New South Wales as important and appropriate, with no reduction in the Gardens' international reputation for high quality, progressive science.

Objectives for Science at the Botanic Gardens Trust

- To undertake original research on the plants of New South Wales and neighbouring areas.
- To effectively disseminate the results of research through publications, products and services.
- To play a leading role in the conservation of biodiversity in New South Wales and neighbouring areas.
- To be the primary source of plant diversity information in New South Wales.

- To lead and contribute to the understanding and appreciation of plant diversity.
- To assist in the sustainable management of the botanic gardens and the horticultural industry.
- To contribute to the development of State, national and international policies and legislation.

Priority-setting Criteria

All new programs and projects must be evaluated against the following criteria. Some criteria are deliberately open to interpretation and should be used as a starting point for discussion about a particular program/project. The geographical focus for any program will usually be New South Wales or 'neighbouring' region (in a scientific, geographic or economic-political sense).

The program or project should:

1. Be consistent with the implicit and explicit directions and policies of the State Government of New South Wales
2. Be of scientific merit: i.e. methodologically sound and scientific in approach. The research should 'change the way we do or think about things'
3. Contribute to a sense of wonder and excitement about plants and their biology
4. Be innovative and/or use the best available methodology
5. Result in better conservation and management of biodiversity
6. Provide a service or knowledge not readily available elsewhere (may be part of a coordinated interagency program)
7. Make best use of our resources, including people, facilities, and preserved and living collections
8. Contribute to, complement, or initiate other programs in the Trust

9. Effectively communicate outcomes to the appropriate audience
10. Raise or maintain the profile of the Trust
11. Preferably attract external funding or result in income to the Trust
12. If consistent with the above criteria, be targeted to meet the greatest needs of the identified stakeholders.

Science Promotion

The Trust's sciences program continued to receive excellent media coverage and staff publicised their work in print, radio and television wherever the opportunities arose.

Other publications and presentations for general audiences are included in the detailed reports for each section, and in the reference list at the end.

Teaching

The number of Honours and higher degree students supervised was 43 this year**.** Staff also delivered guest lectures at various universities, sometimes presenting blocks of key lectures (e.g. Dr Brett Summerell and Dr Alan Millar at The University of Sydney). Dr Maurizio Rossetto has continued his involvement in the Biological Conservation course at the School of Rural Sciences and Natural Resources (University of New England), coordinated by Associate Professor Caroline Gross. Various staff members have adjunct appointments at a number of universities.

Plant Science Internship Program

2007 saw the first 7 week Internship Program offered by the Herbarium, running from 8 January to 23 February. This program offers undergraduates and recent graduates in the plant sciences advanced full-time working experience, with training in a broad suite of science and workforce skills. In return the Interns assist staff, particularly in the Herbarium curation area, yielding a significant nett gain for us. The program helps with BGT profile on university and TAFE campuses, and yields some media opportunities.

The Friends of the RBG provided crucial financial support for this pilot version of the program. Nine interns were recruited: Jordan Bailey (UTS), Iain Goodrick (UTS), Peta Hinton (not enrolled), Margaret Morgan (Ryde TAFE), Megan Muir (UTS), Philip Pritchard (Ryde TAFE), Daniel Robinson (UTS), Christine Rockley Uni of Newcastle), and Lucas Shuttleworth (Uni of Sydney).

Work performed included 2595 specimens incorporated, 3060 specimen storage boxes moved and/or relabelled, 3097 field maps ordered and annotated, and elements of processing for over 3000 collections.

Core staff of the program were Bob Makinson, Louisa Murray, Kathi Downs, Barry Conn, Doug Benson, Doug Benson, and Mary Stewart. Many staff from other parts of BGT, DECC and beyond volunteered time in task preparation and teaching.

Biosystematics course

The Trust continued its strong involvement in the Biosystematics units for tertiary students run in conjunction with the University of New England and the Australian Museum. It has been decided to run the course-specific subjects every second year, and 2006 has been one of those years. The residential school for the second unit was held at the Gardens in July 2006.

In August the Biosystematics teaching team received a Citation for Outstanding Contribution to Student Learning from the Carrick Institute for Learning and Teaching in Higher Education 'For inspiring students' learning and appreciation of systematics through a unique integrated research-driven program devised and delivered by researchers from three premier Australian research institutions'.

Honorary research associates

The Honorary Research Associates continued to be major contributors to our research program and their key research achievements are included within the relevant programs below.

Scientific Committee of the Trust

The external members of the committee are the chair, Professor Sue Serjeantson (Australian Academy of Science), and Associate Professor Jeremy Bruhl (University of New England), Dr Dan Faith (Australian Museum), Dr Jane Tarran (University of Technology, Sydney) and Dr Klaus Koop (Policy and Science Division, Department of Environment and Conservation).

The committee met three times during 2006/07, usually coinciding with the Trust meetings. Through the provision of general advice and feedback, and the review of scientific projects and programs, the committee continued to have an important role in the management of the Science Program.

Part 2: Conservation & Horticultural Research Section

This Section brings together the Trust's broad expertise in ecology, conservation biology, research horticulture, population genetics and plant pathology, creating opportunities for multidisciplinary projects and collaboration.

The New South Wales Vegetation Theme includes the survey, mapping and classification of plant communities in the State, as well as long-term research into particular communities and the dynamics of species, populations and vegetation assemblages. It also includes publications on the vegetation of New South Wales for general audiences, and the scientific journal *Cunninghamia*.

The Horticultural Research and Development Theme encompass innovative horticultural research to assist the cultivation of Australian plants, with reference to goals of both the horticultural industry and the conservation sector.

The Fungi and Plant Theme has as its major focus plant health. The research focuses on the nature, classification and control of fungi, both disease-causing and beneficial, and in cultivated and wild situations. The Plant Disease Diagnostic Unit complements services provided by the Department of Agriculture by focussing on pests and diseases of plants in natural ecosystems and amenity horticulture. It also plays an important role in the Gardens' integrated pest management programs.

New South Wales Vegetation Theme

Aquatic vascular plants

A program of Wetland Assessments continues under Surrey Jacobs. Jo Green (Southern Cross University) continues her PhD study on assessing saltmarsh rehabilitation. Jo Ling received a PhD for her investigation and comparison of techniques for wetland assessment using microphyte and macroinvertebrate assemblages.

Classification and status assessment of the vegetation of NSW

The year saw the publication of the first section – for the Western Plains – of John Benson's *NSW Native Vegetation Classification and Assessment* project. This comprehensive review and typology of the ecological vegetation communities recognised across the State is a major contribution to a systematic understanding of our native vegetation, and will become a standard reference for conservation planning in this State. The plant communities described so far are incorporated in the decision-making tools in the Property Vegetation Planning process under the NSW Native Vegetation Act.

It involved a complete review of literature and survey data, and 25,000 km of field checking over 6 years. The project mirrors similar work in the United States and Europe. A database with 89 fields has been established to store information on each listed plant community including scientific name, common name, characteristic species, distribution by various regional boundaries, physiography, estimated or measured areas for pre-European and current extents, threat codes based on IUCN-like threat criteria developed for the project, reservation adequacy codes, photographs and a general description. 213 plant communities are described and listed in the published work covering the arid and semi-arid NSW Western Plains.

Senior Technical Officer Chris Allen and former Project Officer Jedda Lemmon assisted on the project (GIS, figures, statistics, maps, file and database structure). Separate funding was secured from the Natural Heritage Trust for extension of the NVCA project to the South-West Slopes Bioregion, and this component was brought to an advanced level during the reporting period with another 100 plant communities incorporated into the NSWVCA database. To date, the project covers 53 million hectares or 65% of NSW.

Conservation committees

The Trust is represented on a number of inter-agency standing committees and *ad hoc* working groups in the conservation area. Membership on government conservation committees includes:

- NSW Scientific Committee: Bob Makinson.
- NSW Fisheries Scientific Committee: Alan Millar
- Interagency Technical Working Group on Native Vegetation: John Benson

- NSW Cut-flower Advisory committee: Cathy Offord
- Wollemi Pine Management and Recovery Committee: The Trust was represented by Patricia Meagher, Cathy Offord, John Benson, Brett Summerell, Rusty Worsman, Edward Liew and Bob Makinson.
- Border Ranges Multi Species Recovery committee: the Trust was represented by Maurizio Rossetto and Robert Kooyman.
- North Head Sanctuary Scientific Committee: Doug Benson.
- Goobarragandra Valley Reserves Trust: Bob Makinson.
- Continuing membership on non-government conservation committees includes:
- Australian Network for Plant Conservation (National Management Committee): Bob Makinson (Vice-President).

Internationally, John Benson is a member of the IUCN (World Conservation Union) Commission on Ecosystem Management, and the Species Survival Commission Red-List Committee; and Maurizio Rossetto is a member of the IUCN Species Survival Commission Reintroduction Specialist Group.

Ecology of Cumberland Plain Woodland Plants Web Pages

The **Ecology of Cumberland Plain Woodland Plants Web Pages** was commenced to bring together ecological data from a number of projects and make it accessible to a wide audience, from students and the general public to bushland managers and professional researchers. The project is an extension of the format applied in the earlier **Ecology of Sydney Plant Species project** (1990-2005) but developed for web access rather than the printed format of the earlier project.

Cumberland Plain Woodland is a listed Endangered Ecological Community under the NSW Threatened Species Conservation Act. The project involves data from the long-term monitoring program in the woodland sites at Mount Annan Botanic Garden, seed dispersal and germination results from other research programs, as well as data on vertebrate and invertebrate interaction with the woodland ecology. As well as images of flowers, fruits and seeds of nearly 300 Cumberland Plain Woodland plant species, image galleries include seed, seedling, and rootstocks images as well as mosses, lichens, fungi and invertebrates recorded in the Annan woodlands.

Ecological interactions are highlighted to integrate and communicate the diversity of organisms present in a typical woodland remnant.

The pages went live on the net in January 2007 and are being periodically updated. It has been one of the most highly visited pages of the BGT website. The **Ecology of Cumberland Plain Woodland Plants Web Pages** is available at… http://www.rbgsyd.nsw.gov.au/science/hot_science_topics/Ecology_of_Cumberland_Plain_Woodland

Ecological monitoring

Ecological scientists continue to contribute to long-term monitoring projects, providing information of importance to vegetation management and conservation. The long-term monitoring program of Cumberland Plain Woodland vegetation started in 1988 is being continued by Doug Benson and Lotte von Richter. The monitoring component, based in the Conservation Woodland areas at Mount Annan Botanic Garden, includes monthly assessments of plant species abundance as they respond to seasonal changes, and an overall annual assessment of sites annually.

This year sites in grassland adjacent to the woodland areas were treated to promote natural regeneration. The program involves an ecological burn, followed by spot weed spraying or hand removal of major weed grasses. Recruitment of native species is dependent on adequate rainfall; the wet seasonal conditions in early 2007 have been the best for many years and good flowering and seeding of natives was recorded in Autumn 2007. With the extra rain in June 2007 expansive growth of natives is anticipated for Spring.

Data from the ecological monitoring is being included in the **Ecology of Cumberland Plain Woodland Web Pages** project**.**

Cumberland Plain seed biology

Cumberland Plain Woodland is one of a number of Endangered Ecological Communities occurring in the Sydney region. Many of these communities are degraded and further threatened by proximity to and further expansion of urban Sydney. To achieve success, recovery plans for Cumberland Plain species need information on the seed germination, dormancy and longevity and other ecological characteristics of the species. Lotte von Richter and Doug Benson have been focussing on *in situ* seed ecology, working with students and staff collecting, germinating seeds from the conserved bushland area at Mount Annan and setting up

ongoing field experiments. More than 150 species have been studied and the results are being summarized for publications, as well as being made available through the Ecology of Cumberland Plain Woodland Web Pages project.

Sydney Region vegetation studies – Kurnell

Ecologist Doug Benson continued a series of observational studies on vegetation dynamics at various sites in the Sydney Basin Bioregion. These include wetland and riparian communities on the Hawkesbury-Nepean floodplain and Kurnell Dune Forest at Kurnell.

Kurnell has particular scientific and historical significance as the site of the first plant collections on the east coast of Australia by Banks and Solander in 1770. Threats to the site by the invasion of native sclerophyll woodland and heath by naturalising Tallowwood trees (*Eucalyptus microcorys*) have been documented and published. To assist management and interpretation of the Historic Landing Site site, a detailed description of the original vegetation of the site, and a list of species collected at Botany Bay by Banks and Solander, based on collections held in the British Museum of Natural History and the National Herbarium of NSW, has been prepared. This includes an assessment of Cook and Banks' exploration of different parts of Botany Bay, based on specimens collected, and their ecological distribution and habitat.

The work was published in *Cunninghamia* in 2007 as well as being used in the **Botany of Botany Bay Web Pages** prepared by Plant Sciences and Public Programs Division in 2006. These pages are available at …

http://www.rbgsyd.nsw.gov.au/science/hot_science_topics/Botany_of_Botany_Bay

Aquatic Plants and Flows

Lucy Nairn continued work on a postdoctoral position funded by Land and Water Australia as part of a large grant awarded to herself, Dr Tim Entwisle and Associate Professors Barbara Downes and Ian Rutherford from the University of Melbourne. The project examined changes in in-stream vegetation with regard to flow regimes and is utilising historic data from herbarium records as well as field-based studies tied in with environmental flow allocations in Victoria and NSW.

Liverpool Plains native grassland survey

Chris Allen and John Benson continued a project to survey the native grasslands of the Liverpool Plains. These grasslands are listed as an endangered ecological community under the NSW Threatened Species Conservation Act and less than 3% of the community remains – most of having been ploughed for crops and improved pasture. GIS layers on soils, woody vegetation, salinity, cadastre, soils, slope and travelling stock routes have been obtained and a stratified sampling program based on soils, slope, and distribution has been developed. Six monthly sampling commenced in spring 2002 providing insights into the effects of drought and "normal" conditions on the distribution of plant species. In the meantime mapping of the current and pre-European extents of the grasslands is underway and a set of 82 permanent plots for sampling and monitoring have been placed across the remnant and derived grasslands.

Conservation Ecology and Genetic research

This area of research is essential to the long term conservation and management of rare flora and biodiversity in general, and its effectiveness relies on the use of appropriate approaches and techniques. Its strengths are in its innovativeness and in the ability to disseminate the findings directly to the agencies / community groups interested. Dr Maurizio Rossetto's studies in conservation ecology and genetics fulfil two main objectives: i) provide useful information for rare species management; and ii) understand the evolutionary and environmental processes leading to rarity (or endemism) by identifying the main factors influencing species survival.

Collaborative studies (with R. Kooyman, Dr W. Sherwin, J. Hunter, R. Jones) combined molecular, ecological and environmental data from rare paleo-endemic rainforest trees (*Eidothea hardeniana* and *Elaeocarpus sedentarius*) to show that the lack of efficient fruit dispersal mechanisms was an important factor for explaining their limited distribution. Interestingly, these species have survived in small effective populations sizes for a long time as suggested by the fact that they are now at mutation-drift equilibrium. In a broad life-history trait analysis of over 250 rainforest species from northern NSW, we showed that dispersal- and persistence-related factors are important in explaining their differential distribution.

Following these findings a collaboration with R. Kooyman described an approach identifying trait-based plant functional groups as the basis for developing threat / risk assessments for rare, threatened and 'of concern' species to be used in multi-

species recovery plans. Multi-variate methods were used to extract and test emergent groups from a rare species list from the Border Ranges, and additional information fields related to species life history and distributional data were used to develop a species-level information assessment matrix. Functional groups based on life-history characters have the potential to bring together taxa that are likely to respond to selective processes, environmental threats and potential management actions in similar ways. The approach suggested offers a balance between the need for urgent action, and the requirement for a sound scientific background on which to base biodiversity management and recovery planning. It is also potentially applicable to a broader range of plant communities.

A number of rare species we are researching are extensively clonal. A study on *Wilsonia backhousei* (K. Sommerville, submitted PhD project in collaboration with A. Pulkownick), an important member of the Sydney salt-marsh ecological communities, is also showing that an understanding of the implications of clonality is essential for re-habilitation and re-introduction projects. Excessive clonality within planted propagules can result in population sterility, and prevent the re-establishment of self-sustaining populations. These concepts are being carefully considered in current reintroduction plans for two rainforest species from Northern NSW with very low levels of genetic variability: *Fontainea oraria* and *Elaeocarpus williamsianus*.

Evolutionary Ecology research

The research of Dr Maurizio Rossetto and his collaborators focus on a range of ecological and evolutionary issues that aim at exploring how a range of environmental, ecological and morphological factor are driving evolutionary and adaptational patterns. One of the objectives is to use genetic and genomic approaches to investigate the historical sources of the different ecological adaptations, and how these affect the current distribution of biodiversity. The integration of functional genomics, population genetics and comparative ecology is an exciting emerging field of research that is evolving rapidly with the development of novel technological and theoretical approaches.

For example, we now recognize that drastic environmental modifications linked to impending climate change threaten the integrity and long-term sustainability of rainforest ecosystems. Because of the susceptibility of some rainforest taxa to a changing environment, conservation and management faces challenges at two temporal levels: the contemporary, dealing with current threatened species lists and

habitat fragmentation, and the future, dealing with the predicted decline of already small habitat remnants. Understanding likely responses to future threats is crucial to conservation planning, and one of the main challenges for conservation biology will be to anticipate environmental change and adjust management approaches accordingly. By appreciating how past climatic cycles have affected selective biotic and abiotic pressures and consequently the survival and distribution of species and ecological communities, we will be able to develop predictive models that determine vulnerability to future change. A recent study by Dr M Rossetto et al. sampling the entire distribution of two related and co-distributed rainforest trees, documented substantial discrepancies in genetic differentiation across biogeographic barriers such as the Black Mountain Corridor (a recognised biogeographic barrier in Qld WT). While *Elaeocarpus largiflorens* revealed an abrupt genetic front between two morphologically distinct subspecies separated by the BMC, the same barrier was inconsequential to *E. angustifolius* (which showed lower genetic differentiation across a much wider geographic gap). We are currently analysing SSRs and sequence data in a broader study comparing genetic disjunctions across twelve tropical *Elaeocarpus* species representing a range of habitat preferences and life-history traits combinations in order to identify the location of refugia, the factors affecting expansion patterns and the adaptive potential of these taxa.

Wollemi Pine ecological studies

John Benson submitted papers on the field ecology of the Wollemi Pine, covering correlated flora, stem growth and regeneration dynamics, and seedling recruitment (the last two topics in collaboration with Tony Auld of DEC).

Horticultural Research and Development Theme

Horticultural improvement of waratahs

The Waratah (*Telopea speciosissima*, family Proteaceae) is grown as a cut flower crop, and has been a research focus at Mount Annan for some years. Current work is aimed at improving flower quality, especially the browning of the floral bracts prior to harvest. Dr Amelia Martyn published two papers on the bract browning disorder in the journal Scientia Horticulturae in 2007. The first paper describes the physiology of the disorder and its amelioration under shade cloth, and the second outlines experimental data showing that localised calcium deficiency is not the cause of bract browning. A third paper has been submitted for publication, and shows that bract browning is linked to photoinhibition and pigment damage.

Flannel flower development

A project commenced, funded by the Rural Industries Research and Development Corporation, which aims to improve the cultivation of Flannel flower (*Actinotus helianthi*, Apiaceae). It continues from previous research led by Cathy Offord and Lotte von Richter that established the potential of this species as a cut flower, garden and pot plant, and now focuses on the development of intensive cultivation and breeding of vigorous, disease resistant, high yielding varieties. The work is in collaboration with NSW Agriculture and contributing cut flower growers.

Seed biology

Research for the SeedQuest NSW collaborative project between the NSW Seedbank, Horticultural Research at Mount Annan Botanic Garden and the Millennium Seedbank of
the Royal Botanic Gardens, Kew (UK) continued in 2006-07. The research aims to:

- improve the quality of seed collections to ensure optimal long term storage;
- determine the best methods to germinate seed by mimicking environmental cues experienced by seed in the field, including breaking dormancy in some species;
- estimate how long seeds are likely to survive in storage and in the field.

Germination data has been collated for more than 600 species since the SeedQuest NSW project began. Dormancy studies in 2006-07 have focused on the family Rutaceae, which has been notoriously difficult to propagate, with the aim of

overcoming seed dormancy and providing information for threatened species management. Collaborative studies with Dr Tony Auld and Mark Ooi (Department of Environment and Climate Change) have revealed that dormancy in *Boronia anemonifolia* is broken by warm, alternating temperatures along with smoke cues and gibberellic acid. This research will be presented at the International Seed Ecology II conference in Perth in September 2007, and results are being prepared for publication. The successful combination of dormancy breaking cues is being applied to a wide range of NSW Rutaceae held at the NSW Seedbank, with promising early results.

Seed longevity (rapid ageing) studies continue in collaboration with scientists at the Millennium Seed Bank in the UK, Kings Park and Botanic Gardens in Western Australia and the South Australian Seed Conservation Centre. Seed longevity has been tested for more than 30 species at the NSW Seedbank, bringing the total number of Australian species tested to more than 100. The data will be prepared for publication in the coming year.

Desiccation tolerance studies have also been conducted for a small number of NSW species, as the basis for a larger collaborative project with the Millennium Seed Bank and Griffith University in the future. Experiments on the endangered fleshy-fruited species *Myrsine richmondensis* (Myrsinaceae) have shown that the species is desiccation tolerant, so seeds have been dried and stored as part of the recovery plan. A paper on seed storage in *Myrsine richmondensis* has been accepted for publication in the journal Seed Science and Technology.

Horticultural research staff hosted a two day workshop for Australian research partners of the Millennium Seed Bank in February 2006, followed by a one day workshop implementing a review of the Australian Germplasm Conservation Guidelines.

Orchid research

The year saw the publication of the first section – for the Western Plains – of John Benson's *NSW Native Vegetation Classification and Assessment* project. This comprehensive review and typology of the ecological vegetation communities recognised across the State is a major contribution to a systematic understanding of our native vegetation, and will become a standard reference for conservation planning in this State. The plant communities described so far are incorporated in the

decision-making tools in the Property Vegetation Planning process under the NSW Native Vegetation Act.

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Volunteer programs

The volunteer program continued strongly in Horticultural Research at Mount Annan Botanic Garden. Several small teams are assisting with tissue culture of a variety of species, mainly for use in other horticultural areas of the BGT and Friends activities, as well as two other volunteers involved in archiving.

Automatic Weather Station

On Tuesday 14 November a new Bureau of Meteorology Standard Automatic Weather Station (AWS) was commissioned at Mount Annan Botanic Garden. The AWS is a joint collaborative project between Mount Annan Botanic Garden (MABG), Campbelltown City Council (CCC) and the Bureau of Meteorology (BoM) and demonstrates all three levels of government working together. The Campbelltown (Mount Annan) AWS will join the BoM fleet of 500 AWS's operating 24/7. Mount Annan staff will use the data to improve our horticultural practices in the Garden helping to reduce water use. Understanding climate change will help us manage our extensive botanical collection. In addition our Horticultural Research and Ecology

staff will use the climate data to better understand the triggers that make seed germinate. In particular it will benefit our studies on soil seed banks in the endangered Cumberland Plain Woodland and improve our understanding of environmental weed species. The AWS will be entirely green-powered by sustainable solar power and will communicate to the BoM wirelessly. This is the first independent facility in the Botanic Gardens Trust entirely powered by solar power and reinforces our commitment to sustainability. This project was managed by John Siemon and the AWS was jointly funded by Campbelltown City Council and the Friends of the Botanic Garden at a total cost of $40,000. CCC & MABG have a long-term commitment to this project.

Centre for Plant Conservation and Research

With accelerating loss of biological diversity and climate change impacting upon ecosystem survival, our work is seen as critical by government and the scientific community. Our scientists need to look ahead for solutions that help threatened species, aid in identifying climate change impacts and possible adaptation strategies and tap into the wealth of knowledge held by indigenous Australians about native plant life. The opportunity has arisen where the viability and scoping of a proposed Centre for Plant Conservation and Research at Mount Annan appears appropriate. BGT's Towards 2016 program has identified this Research Centre as a high priority project. A Project Initiation Planning Workshop was held in June 2007 to bring together key stakeholders to discuss the proposed Centre and gain some clarity as to its purpose, function, advantages, etc. The Workshop participants agreed there was a strong enough case to take the next step and submit a Preparatory Funding Bid to Treasury. Further development of this concept will be undertaken over the next 12 months.

Fungi and Plants Theme

Fungi causing leaf-spot diseases of the Myrtaceae and Proteaceae

Work continued on a major study documenting and describing the species of fungi causing leaf spot diseases on plants in the families Proteaceae and Myrtaceae in collaboration with Professor Pedro Crous, of the Centraalbureau voor Schimmelcultures, The Netherlands. Studies on fungi associated with leaf spots of *Eucalyptus* have resulted in the discovery of a wide diversity of species previously unknown to science. In the first paper resulting from these studies three new genera of fungi, *Alysidiella, Fusculina* and *Phlogicylindrium* were described, as well as another 7 species of fungi in already known genera. A second paper documenting new species of *Mycosphaerella* included another 6 species that were previously unknown. Work currently underway using molecular and conventional methods has highlighted a range of new species for description.

Fusarium

Brett Summerell assisted in the teaching of a workshop on the identification of *Fusarium* at Kansas State University, Manhattan, Kansas, USA with over 40 participants from all parts of the world involved in training on identification of all major species of *Fusarium.*

A few recently initiated projects focus on various formae speciales of *F. oxysporum*. The wilt pathogen of peas and snow peas, *F. oxysporum* f.sp. *pisi*, and the stem rot pathogen of vanilla, *F. oxysporum* f.sp. *vanillae*, are both being investigated in terms of their population genetics and disease management. Disease surveys for snow pea wilt throughout eastern Australia were conducted with more than 300 isolates of *F. oxysporum* f.sp. *pisi* collected. Preliminary DNA fingerprinting data confirmed that the pea and snowpea pathogen is the same as there was no genetic differentiation between the two groups. Furthermore, there was no geographic differentiation of this pathogen in eastern Australia as sub-populations from Queensland, NSW and Victoria were shown to be genetically similar. Some clonal groups were found in all three growing regions. Surveys for vanilla stem rot throughout the main growing provinces of Indonesia were completed. The disease was found in all vanilla growing regions surveyed at high incidences. More than 400 isolates were collected, purified and DNA extracted for genetic analyses. Some isolates were also obtained from east Africa for phylogenetic comparison. Non-host associated strains of *F. oxysporum*

from non-agricultural soils throughout Australia are also being investigated to determine the evolutionary potential of this group of *Fusarium* in Australia. Sample collecting trips were conducted in the Northern territory, Western Australia, Victoria and NSW. A large collection of over 350 isolates of *F. oxysporum* were collected. Morphological data so far revealed high levels of diversity among the isolates. Fingerprinting and phylogenetic analyses will be conducted to further understand the evolution and diversity of this species of *Fusarium*.

Phytophthora

Phytophthora cinnamomi causes root rot and dieback of many native plant species found in natural ecosystems throughout New South Wales. Efforts were initiated to conduct surveys for pathogen incidence throughout the Sydney Metropolitan and the Hawkesbury Nepean catchment areas, funded by the respective Catchment Management Authorities. An education workshop on the pathogen and disease management was held to promote the awareness of the disease and the need to conduct disease surveys. Susceptibility of many native species to *P. cinnamomi* will also be tested as part of upcoming activities.

Following the discovery of *Phytophthora cinnamomi* at the Wollemi Pine grove in the Wollemi National Park, an investigation on the efficacy of phosphonate and metalaxyl in controlling Phytophthora root rot on Wollemi pines was conducted. Post-infection control of the disease was demonstrated by phosphonate treatment. The optimum concentrations and mode of application were also determined. On-going soil surveys at the Wollemi National Park are being conducted to determine the spread of *P. cinnamomi*.

Other Phytophthora diseases investigated are pineapple heart rot (*P. nicotianae* and *P. cinnamomi*) and black pepper wilt (*P. capsici*). Both of these studies are based in Vietnam as part of an international collaborative project funded by the Australian Centre for International Agricultural Research (ACIAR). Both diseases were found to be widespread and severe throughout all growing areas in Vietnam. The main species causing pineapple heart rot is *P. nicotianae* and the presence of *P. cinnamomi* was only detected in one province. Only one mating type of either species has been detected. Disease control experiments so far showed that all commercial cultivars were susceptible to the disease, and the application of phosphonate as a soil drench gave effective control of the disease on young plants. On the other hand, both mating types of *P. capsici* were found in Vietnam. Moreover, isolates from chilli

plants were also found to be highly pathogenic on back pepper. Control experiments showed phosphonate applied as a soil drench to be effective. Another recently initiated project involves investigating into the population genetics of *P. palmivora* which causes cocoa pod rot in PNG.

Diseases in North Sulawesi, Indonesia

The second phase of the ACIAR-funded project is still on-going. Research into diseases of vanilla and clove has has progressed to investigating management strategies of vanilla stem and root rot and clove decline. Vanilla and clove are two of the main cash-crops in North Sulawesi, Indonesia, and increased production by alleviating disease damage would contribute to economic stability in this region. The vanilla pathogen *Fusarium oxysporum* f.sp. *vanillae* was shown to have an endophytic phase in healthy vanilla vines. Some of these endophytic isolates were shown to be pathogenic on vanilla in glasshouse trials. An important implication in the management of this disease is the possibility of transmitting this pathogen to new vines as vanilla is vegetatively propagated from visually “healthy” vines. Particular caution is recommended in the selection of planting material. *F. oxysporum* f.sp. *vanillae* is a soilborne pathogen. Both glasshouse and field trials demonstrated that the inclusion of shredded clove leaves (abundantly found throughout North Sulawesi) as a soil amendment reduced the inoculum potential of *F. oxysporum* f.sp. *vanillae.* Clove leaves contain the chemical compound eugenol which is known to have antimicrobial properties. The fungal pathogen associated with clove decline, *Ceratocystis polychroma*, is associated with the galleries of the trunk borer insect, *Hexamitodera semivelutina*. However, it was shown that many other insects inhabiting the insect galleries have the potential of spreading the disease. *C. polychroma* spores trapped on the surface of insect cuticle were shown to be viable and pathogenic on healthy clove seedlings. Field trials on the management of insects associated with borer galleries are currently being conducted. Extension workshops for farmers have also been planned.

Communication and Services

Cunninghamia.

Cunninghamia: a journal of plant ecology for eastern Australia is a leading scientific journal for the publication of original research papers on all aspects of plant ecology with particular emphasis on the vegetation and flora of eastern Australia. Descriptive, experimental and historical studies of plant communities, populations, individuals, their interactions with other organisms and their management are published. All papers are peer-reviewed.

Cunninghamia volumes 9(4) and 10(1) were published in 2006/07.

Highlights include:

- A major study of the treeless vegetation of the Australian Alps.
- Papers on the ecology of Endangered Ecological communities including *Sphagnum*-dominated peatland communities, montane bogs in New England and Wallum-heath on the NSW North Coast
- An extensive historical paper on the botany of the Ludwig Leichhardt expedition from Moreton Bay to Port Essington, 1844-45
- A paper on the 1770 landscape of Botany Bay, focussing on the plants collected by Banks and Solander and the rehabilitation of the natural vegetation at Kurnell

Plant Disease Diagnostic Unit

The Plant Disease Diagnostic Unit, as part of the Plant Pathology section, offers a commercial service for the detection, diagnosis and control of plant diseases. It is used by both external clients and the sites of the Botanic Gardens Trust, to promote plant health and appropriate horticultural practices and to minimise pathogen spread through environmentally safe treatments.

This year has seen an overall increase in the number of samples processed to 270 from that of last year's 253. Of these, 208 were from external clients (208 last year) and 45 were from within the Trust. The majority of the enquiries (38%) came from commercial consultancy companies (soil-testing laboratories, arborists and horticultural advisors). Private gardeners in the Sydney region were the next most frequent users of the service (29%), while other Government Departments and Local

Councils made up 15% of enquiries. The latter, however, tended to be large surveys requiring a greater percentage of time and effort. The remaining 18% were internal BGT enquiries.

The majority (39%) of enquiries from external clients and BGT staff involved soil-testing for major soil-borne fugal pathogens, in particular *Phytophthora cinnamomi*, the cause of die-back disease. Eleven large-scale surveys to identify the presence and spread of *P. cinnamomi* were carried out for a number of National Parks in NSW and Local Councils in the Sydney region. As public awareness of the problems caused by this pathogen increases, and the need for its management becomes more important, it is necessary to map its occurrence and distribution. Our Unit is now recognised as the leading laboratory in Sydney capable of performing such surveys.

The Unit is also recognised as a centre for the identification of *Armillaria* (16% of enquiries), a serious fungal pathogen of many woody plant species. This pathogen can be detected with a molecular assay, providing an invaluable identification tool in the absence of the fungal fruiting bodies. The spread of this disease through Sydney, including Hyde Park, has been mapped largely using our services.

Of the total enquiries, 28% were for foliar diseases, while the remaining enquiries consisted of mushroom identification, *Fusarium* species identification and butt rots.

Centre for Plant Conservation

The Centre has continued to facillitate linkages between the Trust's activities and external clients, comprising other sections of DECC, other State and Federal Departments, a range of non-governmental organisations, and a wider community constituency interested in plant conservation issues.

During the year, input has been made to relevant DECC units on draft threatened species survey guidelines, on the Priority Action Statement for threatened species, on the draft Biodiversity Strategy. The Trust CPC Coordinator is one of two BGT representatives who attend meetings of the DECC Biodiversity Conservation Managers group, which focuses on threatened species and ecosystems. Input was also made to the Council of Heads of Australian Botranic Gardens (CHABG) draft document on responses to Climate Change.

During the year, contributions were also made to DECC and interagency discussions aimed at developing more momentum towards unified systems of ecosystem classification and data management for NSW.

Collaboration has been maintained with the Australian Association of Bush Regenerators, with a number of events hosted.

Close involvement has been maintained with the Australian Network for Plant Conservation (ANPC) Inc., a national organisation of plant conservation scientists and practitioners from government, industry, and community sectors. The CPC Coordinator Bob Makinson is a member in individual capacity of the ANPC national committee.

The CPC Coordinator led a successful process by the ANPC and The Millenium Seed Bank Australian Partners group (including the NSW Seedbank and associated research staff at Mount Annan), to initiate a national working group for revision of the Germplasm Conservation Guidelines, a former national standard of the 1990s. A successful national expert workshop was held at Mount Annan BG in February 2007, to map out the content and allocate drafting responsibilities for the revised Guidelines, with publication due in 2008. $5,000 in seed funding was secured (through ANPC) from the Exchange Incentives Program of Greening Australia and Land & Water Australia, for this and up to two subsequent expert workshops.

The CPC Coordinator also initiated, through ANPC, a project for publication (probably in 2009) of a magazine-style publication on plant conservation practice for owners of small rural properties, with the working title 'The Blockies' Guide'.

The Coordinator initiated and coordinated the inaugural Plant Science Internship Program, held in January and February 2007.

Work was started towards a conspectus of threatened flora legislation in all Australian jurisdictions, to be published as a special issue of the ANPC bulletin Australasian Plant Conservation in 2008.

Planning commenced for the 2008 ANPC national conference, to be held in western Sydney and for which Mount Annan BG will be a local partner.

Discussion continued on the usefulness of the CPC concept, given that this has been a 'virtual' centre playing a largely facilitating role for cross-sectional initiatives. With preparation underway for a new axis of conservation-related activity, including a proposed new facility and unit reorganisation at Mount Annan BG, it is expected that the CPC will be discontinued in 2007-8, but with the roles continued under other badging.

Conservation Information Systems

Progress in the digital capture of scientific data, and in the development of our database structures and tools, is leading to an increasing focus on conservation-related information systems. These include records of historic and current mapping of vegetation cover, species distributions, survey records, living collections, habitat physical and biological features and Geographical Information Systems (GIS). GIS includes any electronic data and data layers that have a spatial component. Whilst many consider a GIS to be a specialised area for ecologists, mathematicians and IT specialists, it forms integral part of conservation management and also of many taxonomic studies, field surveys, and the maintenance of living collections of conservation significance. Increasingly our information outputs in the taxonomic and specimen records areas must be informed by and compatible with GIS tools (e.g. *the Australia's Virtual Herbarium* project).

We currently maintain data on location of origin of plant voucher specimens, plants identified in surveys and plants kept as living specimens in the BGT gardens. However, we also display and analyse these data in relation to other species to help describe taxonomic distributions and characterise ecological communities. We further

use these data in conjunction with abiotic data like rainfall, temperature, soil type, rock type, topography, salinity, fire history, etc. to detect correlations and information gaps.

Whilst we produce much of our own data, we also source much (e.g. legal boundary, survey, other state and abiotic data) from other agencies and NGOs, to enhance the variables available to us, for analyses and the production of maps and figures for publication and on the web. The capture, cataloguing and use of plant images is another on-going task.

These data are constantly changing and is currently being exchanged, sourced, maintained and updated by Chris Allen. Many new data layers are becoming available and can make decision-making less arbitrary. For example electronic copies of aerial photography of the Trust's estate, accurate to 15cm, will allow horticultural staff to plan beds and know exactly where specific plants or infrastructure can be found. Combined with new differential Geographical Positioning Systems (GPS), a staff member could walk directly to a specific plant and look up its history on the spot.

There are and will be many new sets of data for us to obtain, and to integrate with our own systems. Demand for integrated products is also rising rapidly. Key factors affecting this demand include:

- the rapid evolution of the State's departmental arrangements for Natural Resource Management
- the implementation of catchment management plans
- changes to the Threatened Species Act
- the loss of vegetation mapping in NSW

The Trust frequently exchanges data with other work-units within the DEC, other State agencies, and with some NGOs. Data exchange requires ongoing discussions on custodianship protocols, and the necessary data formats to enable efficient and safe transfers, storage and archiving of data. We now have enhanced GIS software and new printing capabilities, to streamline analysis and production of outputs in more timely and economic ways.

Part 3: Plant Diversity Section

This Section includes research on the diversity, classification and relationships of plants, and the management and application of our botanical collections and the data associated with these collections. The custodianship of collections in the National Herbarium of New South Wales and the provision of systematics research and information are two core legislative drivers for the Trust. Three key research themes have been established, and ready access to data has been identified as the major communication objective.

The **Flora of Australia Theme** focuses on discovering and documenting the plants and related biota in Australia. Plant systematists throughout Australia and overseas, work together to document our flora. The Trust is part of this collaborative effort, with a long-standing expertise in flowering plant groups such as eucalypts, grasses, sedges and wattles, but also a wide range of expertise in other important groups that are well represented in New South Wales.

The **Origins and Evolution Theme** focuses on the study of plant relationships, as part of international efforts to unravel the history of Australia's biota. Fossils give us tantalising glimpses of the past but the full story of plant evolution is contained within the morphology and genes of current day species. We are focusing our research on key questions in the history of Australia, before and after the splitting of Gondwana over 80 million years ago.

The **Asia Pacific Biodiversity Initiative** is a theme that builds on the Trust's long-term contribution to the discovery and documentation of plants in our local region outside Australia. As part of our national responsibilities under the Convention for Biological Diversity, we are assisting neighbouring countries to gain the knowledge to manage and conserve their vegetation. Sydney, as Australia's 'gateway to the Pacific', has always looked outward to the Asia-Pacific region. Many countries in this region have been identified as lacking the most fundamental biodiversity information. The Trust is one of the region's chief providers of the expertise and experience needed to address this gap. The emphasis is on training, knowledge exchange and collaborative projects with the host countries.

The **National Herbarium of New South Wales** holds the State of New South Wales' reference collection of approximately 1.2 million preserved plant specimens. The

herbarium collection represents a comprehensive and accurate biodiversity record through time (as the flora changes) and space (representing the variation and distribution of species). The maintenance and use of this vital scientific heritage requires expert scientific and technical curation skills. A key objective over recent years has been to unlock the rich store of information in the herbarium through data processing the collection information as part of the national “Australia’s Virtual Herbarium” project.

The Plant Diversity Section also provides a Botanical Information Service. This Service now includes electronic delivery of information, through the internet site *PlantNET*, as well as a plant identification service and self-help reference collection. The scientific systematics journal *Telopea* is published by the Plant Diversity Section.

Workshops

Dr Alan Millar was invited to help teach at a workshop on macroalgae in Kobe, Japan, (July 2006) attended by students from all over Japan. Dr Millar’s involvement was to bring global biodiversity of macroalgae to the student’s attention.

In November 2006, Dr Millar was invited to open the Italian Phycological Conference in Catania, Sicily, then talk to researchers about collaboration on studies of the red algal genus Laurencia in the Mediterranean and Australian regions. The possibility of anthropogenic introductions was the premise behind much of these species distributions.

Dr Maurizio Rossetto took part in a workshop funded by the Environmental Futures ARC Network entitled "A multidisciplinary workshop for defining plant extinctions from island Oceania" (October 11-13 2006 at the ANU in Canberra). The workshop brought together a number of participants with various expertises ranging from molecular biology, palynology to field botany (from Australia, USA, Tahiti, Fiji). The theory and practice of extinction processes within islands was discussed, and new collaborations were developed resulting in the initiation of a new project combining palynological and molecular data on selected species.

Dr Peter Weston took part in a workshop on the assembling of southern hemisphere floras, in Adelaide in January organised by the ARC-New Zealand Research Network for Vegetation Function.

Flora of Australia Theme

Aquatic Plants

Lucy Nairn continued work on a postdoctoral position funded by Land and Water Australia as part of a large grant awarded to herself, Dr Tim Entwisle and Associate Professors Barbara Downes and Ian Rutherford from the University of Melbourne. Data on changes to in-stream vegetation due to flow regimes were collected, from herbarium records as well as field-based studies tied in with environmental flow allocations in Victoria. Data analysis has commenced.

Dr Surrey Jacobs continued studies on aquatic plants with publications on *Aponogeton* and *Nymphaea,* and studies continuing on *Vallisneria* and *Nymphaea.* A treatment of the genus *Nymphaea* for the *Flora of Australia* was published.

Bryophytes

Dr Elizabeth Brown and Margaret Heslewood continued work on phylogenetic analyses of the Lepidoziaceae (Hepaticae), based on chloroplast and ribosomal DNA data. The first in a series of papers was published. The research is partially funded by the Hermon Slade Foundation. Dr Brown undertook fieldwork in Vanuatu and Lamington, Queensland, as part of an international team studying biodiversity (ISBISCA). Together with students Matt Renner and Endymion Cooper she attended the bryological workshop in New Zealand in January and gave a short presentation on the work in the Lepidoziaceae.

Matt Renner, a PhD student at the University of Sydney, has continued investigating speciation in the Lejeuneaceae. In June he presented a paper to Evolution 2007: Joint meeting of the Society for the Study of Evolution, American Society of Naturalists and the Society of Systematic Biologists entitled "Skating on thinly veiled prejudice: Do continuous overlapping characters bias cladistic datasets?"

Endymion Cooper started work for his Honours year studying speciation in the Telaranea centipes group (Lepidoziaceae). He is using a combination of molecular and morphological techniques to investigate current concepts in the group of four species.

Honorary Research Associate Dr Helen Ramsay has completed and published studies on the chromosomes of Papua New Guinea mosses. Her work on the chromosomes of New Zelaand and Australian mosses is being prepared for

publication. Manuscripts for the families Pylasiadelphaceae and Sematophyllaceae are being finalised for the next volume of the *Flora of Australia- Mosses 2.*

Cycadaceae

Honorary Research Associate Ken Hill and Leonie Stanberg began a systematic study of the Cycas series Cairnsianosae group in Australia where the relationships of the currently recognised eight taxa are not clear. Field study was undertaken for 5 weeks in Central Queensland by Leonie Stanberg accompanied by Dr Surrey Jacobs and volunteer Jane Dalby. Taxa were examined in detail, accumulating morphological data sets and DNA samples necessary to help elucidate relationships within this group. Analysis began of the morphological data collected.

Cyperaceae

Karen Wilson continued studies of various genera in the family Cyperaceae, largely in collaboration with Assoc. Prof. Jeremy Bruhl (University of New England) and students whom they jointly supervise. Kerri Clarke (under the supervision of Jeremy Bruhl and N. Prakash, UNE Armidale, and Karen Wilson) was awarded her PhD thesis for her study of morphology and anatomy of the tribe Abildgaardieae (Cyperaceae). A paper was published on the study of *Lepidosperma laterale* (Cyperaceae) by John Hodgon as his BSc (Hons) project, supervised by Jeremy Bruhl and Karen Wilson, and another paper has been submitted. A paper was published on the detailed inflorescence structure of *Exocarya*, with Dr Jenny Richards (Florida) and Jeremy Bruhl.

DNA Barcoding the Australian Flora

Dr Darren Crayn has initiated a pilot project to investigate the utility of a cutting edge technique, DNA barcoding, for identifying Australian plants. DNA barcoding uses short sequences of selected DNA regions as an identification tool, and has been hailed as a panacea for the identification of difficult plant material such as juveniles, poorly known taxa and fragmentary specimens. This pilot project is on the Kurnell Peninsula flora, a rich, diverse flora of c. 340 native vascular species (193 genera, 81 families) located within metropolitan Sydney. The flora of Kurnell's c. 450 hectares of coastal dune scrub, heath, wetland, rainforest and sclerophyll woodland is well-known, of manageable size for barcoding and well represented in herbaria (for assessing preserved versus fresh material). Furthermore, Kurnell is historically

significant being the first Australian flora studied scientifically by Europeans, namely Joseph Banks and Daniel Solander, botanists on Cook's first voyage (in 1770). To date, c. 100 vascular species have been provisionally barcoded for 3 DNA regions (*accD*, *rpoB*, *rpoC1*), with another 60+ barcoded for one or two of these regions. Another four candidate regions (*trnH-psbA* spacer, *matK*, *ycf5* and *ndhJ*), showed relatively poor amplification success in early, limited trials. These problems are probably related to PCR optimisation and primer specificity.

Elaeocarpaceae and Cunoniaceae

Building on molecular phylogenetic research by Drs Darren Crayn and Maurizio Rossetto which has resolved the phylogeny of all extant genera in Elaeocarpaceae sensu lato (including Tremandraceae), PhD student Hannah McPherson is investigating the phylogeny and population genetics of *Tetratheca*. These small, dry-adapted shrubs exhibit starkly different ecological preferences and vegetative morphology to most other members of Elaeocarpaceae, which are rainforest trees. A phylogeny of almost all species of *Tetratheca* is now in hand, and population genetic work is progressing toward identifying the processes underlying evolutionary radiations of this interesting lineage into and within the xeric biomes. A *Flora of Australia* treatment of *Tetratheca*, *Tremandra* and *Platytheca* is a planned output of this study.

Rossetto and Crayn are continuing research into the relationships among species of *Elaeocarpus*, with much focus now on the phylogeography of key species. A paper in Australian Journal of Botany analysing patterns of genetic variation in several species from northern NSW to north Queensland has been published. A second paper describing a new species from northeastern NSW, *Elaeocarpus sedentarius*, has been submitted for publication.

Work on Cunoniaceae has just begun, and is being carried out by PhD student Margaret Heslewood. She aims to resolve the phylogenetic relationships of Australian Cunoniaceae and investigate the population genetics of species of *Ceratopetalum*, including coachwood and Christmas bush.

Ericaceae: Styphelioideae

A collaboration involving Honorary Research Associate Dr Chris Quinn and BGT scientists Dr Elizabeth Brown and Dr Darren Crayn has continued revision of the systematics of subfamily Styphelioideae. Combined molecular and morphological

analyses of *Epacris* and *Monotoca* are nearly complete and results of a morphometric analysis of variation in *Leucopogon lanceolatus* are currently being prepared for publication. Furthermore, several putative new taxa of *Leucopogon* from northeastern NSW and southeastern Queensland are under study with papers describing these to be completed in the near future.

Dr Crayn and Dr Sophie Bickford (CSIRO Plant Industry) are continuing investigations into the distribution of phylogenetic diversity in Styphelioideae across the landscape although progress has been slow due to other commitments.

Dr Crayn is participating in research on the origins and diversification of the genus Dracophyllum and allies, led by Dr Steve Wagstaff (Landcare Research New Zealand). Initial phylogenetic analyses of molecular data with fossil-based calibration of evolutionary rates show that the Western Australian genus *Sphenotoma* forms a distinct lineage that diverged from *Dracophyllum* and *Richea* during the Miocene. *Richea* is nested within *Dracophyllum*. Genetic diversity is very high among the Australian species, which are far fewer in number than the closely related New Zealand species. The New Zealand and New Caledonian radiations both trace their origins to dispersals from eastern Australia.

Fabaceae

Indigofera: Dr Peter Wilson and Dr Aniuska Kazandjian, formerly a PhD student at James Cook University, Townsville, published a paper clarifying the position of two varietal taxa in the *Indigofera pratensis* species complex. One variety was dismissed as a minor variant of the typical form of the species but the other was recognised as a new species.

Freshwater Algae

Two volumes of the *Algae of Australia* included major contributions by Trust scientists. A volume on the freshwater red and green algal groups Batrachospermales, Thoreales, Oedogoniales and Zygnemaceae was authored by Dr Tim Entwisle and Dr Stephen Skinner, along with Simon Lewis and Dr Helen Foard. The 726 page *Introduction* volume includes chapters by Drs Entwisle and Skinner. These contributions represent many years of research and will provide much needed information on the taxonomy, and to some extent ecology, of the freshwater macroalgae in Australia.

The work of Master of Science student at Ohio University (USA), Sarah Stewart – using molecular and morphological analyses to resolve two species complexes occurring in Australia and New Zealand – still requires further sequencing and morphological studies before it can be prepared for publication. Drs Entwisle and Vis will complete this work in the next year.

Dr Stephen Skinner, part-funded by Australian Biological Resources Study, and Dr Entwisle completed the draft of a guide on the non-planktonic freshwater (and soil) *Cyanobacteria in Australia*. Intended as a aid to initial identification to the genus, as well as a record of common species, this work complements the already available guides to coccoid and filamentous planktonic freshwater Cyanobacteria prepared by Baker, Fabbro and McGregor. The manuscript has been submitted for publication.

Dr Skinner identified and accessioned freshwater macroalgae from New South Wales and elsewhere in Australia, from collections by himself, other staff and contacts around the country. These collections include many new species and almost all are new distribution records for this poorly studied group of organisms.

Lamiaceae

Trevor Wilson (University of Sydney) began a PhD thesis on the phylogeny and pollination syndromes of *Prostanthera* (Lamiaceae). He is supervised by Drs Barry Conn and Murray Henwood (University of Sydney).

Lichens

Dr Alan Archer, Honorary Research Associate has continued work on the Australian Graphidaceae, with the publication of new species and new reports (based on material collected by Prof. J.A. Elix, (Australian National University), and the preparation of a preliminary draft for the Flora of Australia (with assistance from Dr. R. Lücking, Field Museum, Chicago).

Marine Algae

Dr Millar took on the office of Editor-in-chief for the International Phycological Society's journal *Phycologia* and has expanded the stable of Associate Editors to 28 to ensure coverage of all possible disciplines. Over the last 12 months, 125 manuscripts have been submitted and about 75 have been accepted for publication. *Phycologia* publishes only 725 pages per year. The journal's Impact Factor (IF) has

risen from 1.2 to 1.8 since Dr Millar has taken the EIC office. *Phycologia* is now considered to be the second leading international journal, after *Journal of Phycology*, which is the voice of the Phycological Society of America and publishes 1400 pages per year.

Dr Alan Millar and Dr George Wilson (Australian Museum) have expanded their collaborative study of marine algae and their associated invertebrates to include Dr Dan Faith, who will help analyse the raw data for identifying possible surrogates for predicting biodiversity hot spots along the coastal regions. This project was initially funded by the Hermon Slade Foundation and the first papers should appear in 2008, intended for the journals *Science* and *Nature*.

Mr Nick Yee's PhD research on the molecular phylogeny of the brown algal order, Sporochnales (supervised by Dr Millar) is near completion and he plans to submit his thesis in July 2007. Mrs Yola Metti (also supervised by Dr Millar) converted her MSc research on the molecular phylogeny of the red algal genus *Laurencia* to a PhD project in July 2006. This project has been so successful that the Taiwanese and Japanese have asked Mrs Metti and Dr Millar to collaborate with them on completing their respective generic floras. The South Africans and Brazilians are also keen to be involved with their floras.

Myrtaceae

Babingtonia: Dr Peter Wilson, Dr Chris Quinn and Margaret Heslewood submitted a paper on the Eastern Australian species currently referred to the genus *Babingtonia*. In this project, funded by an earlier ABRS grant, both DNA sequence data and morphological information were analysed and showed conclusively that *Babingtonia* species from the eastern states are not closely related to the type species from Western Australia and that these species actually fall into at least three distinct groups. The paper, presenting these results and describing two new genera, is now in press.

Poaceae

Joy Everett, Dr Surrey Jacobs and Elizabeth Norris have continued their research into the morphology of the Australian native species of *Austrostipa* and all other genera in the grass tribe Stipeae. Further data using Scanning Electron Microscopy have also been recorded and tested on selected material to estimate variation and establish scoring systems to enhance the molecular analyses. Dr Trevor Hodkinson

(Trinity College, Dublin, here for six months sabbatical last year) worked with Surrey Jacobs to produce a book chapter as part of an ongoing study to assemble 'super trees' using a range of genes to study grass phylogeny.Surrey also produced treatments of *Austrostipa* and *Amphibromus* for the *Flora of North America* grass volume edited by Dr Mary Barkworth (Utah).

Proteaceae

Grevillea intercative system

Contract funding from ABRS enabled continuation of work by Bob Makinson (jointly with the Centre for Plant Biodiversity Research, Canberra) on development of an interactive LucID identification and information system for *Grevillea*.

Asia-Pacific Biodiversity Initiative Theme

Cycadaceae

Work by Honorary Research Associate Ken Hill and Leonie Stanberg continued on the classification and phylogeny of the Asian cycads. In May 2006 Mr Anders Lindstrom, the Curator of Cycads at Nong Nooch Tropical Botanical Gardens (NNTBG) in Thailand visited the BGT to work with Ken Hill and Leonie Stanberg to complete three scientific papers describing new species in India, Indonesia and the Philippines. Papers were submitted to *Telopea* in August 2006. The Indian paper was published in June 2007. Anders Lindstrom also donated a large number of his wild-collected herbarium specimens to our Herbarium, mainly from India, the Philippines and Indonesia.

Leonie Stanberg visited Thailand in December at Mr Lindstrom's invitation to participate in field study of a species of Thai cycad that is critically endangered. Fieldwork in Central Thailand found two new populations of *Cycas chamaoensis* (now found to be extinct at the previously known single locality). DNA and herbarium voucher cycad collections were made at NNTBG from 102 of their wild-collected plants, to enhance the herbarium collections held at BGT and also the molecular dataset required to help elucidate species relationships within the genus. A donation of Australian cycad seed was made to NNTBG to enhance their collection of ex situ plants.

A fourth paper on *Cycas* in China was also submitted to T*elopea*. A popular book *Cycads of Vietnam* was published in June 2007, describing in detail the 27 species that occur in the country, along with line drawings, maps and photographs.

Elaeocarpaceae and Cunoniaceae

Drs Darren Crayn and Maurizio Rossetto are investigating phylogeny, biogeography and evolution in the families Elaeocarpaceae and Cunoniaceae as part of collaborative ARC-funded research into the role of distance dispersal in the evolution of SW Pacific floras with Andrew Lowe (University of Adelaide), Mike Pole (University of Queensland) and others. Also involved are Dr. Mark Coode at RBG Kew (a world authority on Elaeocarpaceae) and Johan Pillon (IRD, New Caledonia). Considerable insight has been already gained into the phylogenetic relationships and evolutionary origins of Elaeocarpaceae, and work is now underway on a similar study in

Cunoniaceae, being undertaken by PhD student Margaret Heslewood. We are working on maximising sampling Asia–Pacific taxa to explore historical biogeography and patterns of diversification in this region. A collaboration with Steve Wagstaff (Landcare Research, New Zealand) has been initiated to study the evolution of the genus *Aristotelia* in Australia, New Zealand and South America.

Juncaceae

John Hodgon was awarded a PhD for his thesis on sectional and species limits, as well as hybridization, within the rush genus *Juncus*. This research was supervised by Associate Professor Jeremy Bruhl (UNE), Dr Adam Marchant and Mrs Karen Wilson.

Myrtaceae

Xanthostemon: Dr Peter Wilson and Mr Fred Pitisopa of the Solomon Islands Forestry Department published a paper describing the rare and threatened species *Xanthostemon melanoxylon.* This species is found only on ultramafic substrates, which occur in only a few places in the Solomon Islands. The species has a distinctive ebony-like dark wood that is much sought-after. One of the best sites has been identified as having substantial nickel reserves, so the species is threatened by both unsustainable logging and the possibility of future mining. Dr Wilson has been liaising with scientists from the SPRIG (South Pacific Regional Initiative on Forest Genetic Resources) Project, which is managed by CSIRO Forestry and Forest Products, who are involved in cooperative projects in the Solomons.

Urticaceae

Julisasi Tri Hadiah (Kebun Raya Bogor, Indonesia) submitted her PhD thesis on the phylogeny of *Elatostema* (Urticaceae) to the University of New South Wales. She was supervised by Drs Barry Conn and Paul Adams (University of New South Wales). Research into the phylogeny of the Urticales based on chloroplast DNA data was continued by Julisasi Hadiah, Barry Conn and Dr Christopher Quinn.

Management of Plant Diversity Information

The Trust has established high level contact with the Global Taxonomy Initiative of the Conference of the Parties to the Convention, on Biological Diversity and other international groups, to further the Asia-Pacific objectives.

The Trust continued its contribution to national and international committees related to the management and dissemination of plant diversity data. The Trust is a member of the IUBS *International Working Group on Taxonomic Databases* and the Australian *Herbarium Information Committee* (HISCOM), and is represented on the Executive Committees of key international database groups (particularly, members of staff are the Chair of the *Global Plant Checklist Committee* of *International Organization for Plant Information*; member of *GBIF Electronic Catalogue of Names Subcommittee* and chair of the project team of *Species 2000*). Karen Wilson was one of the editors of the Species 2000/ITIS Catalogue of Life Annual Checklist 2005 on CD-ROM, and Helen Stevenson (Graphic Designer) designed the booklet to accompany the CDs.

The Trust is also a member of the *Species 2000 Asia-Oceania* group and the *Pacific Biodiversity Information Forum*. These groups encourage international and national biodiversity activities in the broad region.

Guide to the Trees of Papua New Guinea

The first phase of the 'Guide to trees of Papua New Guinea' project was completed as part of a collaborative research initiative between the National Herbarium of New South Wales and the Papua New Guinea National Herbarium, The aim of this project was to develop a simple, structured method of documenting the tree flora of that country. More than 400 species have been completed and are available via the Internet at http://www.pngplants.org. It is also being prepared for publication as a book. Dr Barry Conn is program leader of this project, with the first phase co-authored by Kipiro Damas (Papua New Guinea National Herbarium). This project was partially supported by *The Australia & Pacific Biological Foundation*.

Origins and Evolution Theme

Basal Angiosperms – Calycanthaceae

Dr Peter Weston has continued to develop international collaborations with North American and European botanists investigating the floral and reproductive biology of relictual basal angiosperms, with the aim of contributing to the reconstruction of ancestral character states of the flowering plants. Australia is home to several

lineages of this disparate assemblage, including endemic genera of Austrobaileyales, Laurales, Magnoliales and Canellales. Most recently, he has teamed up with Swiss postgraduate research student, Yannick Staedler and his supervisor, Professor Peter Endress (Institute of Systematic Botany, University of Zurich) to investigate floral phyllotaxis, architecture and development in the Calycanthaceae, a family represented in the southern hemisphere by just one Australian species, *Idiospermum australiense*. *I. australiense* is a rare, large, canopy tree restricted in the wild to a few pockets of lowland tropical rainforest between Innisfail and Cape Tribulation. Fortunately, two healthy young trees of *Idiospermum* are growing in the Royal Botanic Gardens Sydney and one of these has been flowering annually since the late 1980's, making it a more convenient source of material for floral developmental study than wild trees. Staedler, Weston and Endress were able to show that all genera of the Calycanthaceae are characterised by flowers with spiral phyllotaxis and a gradual transition between floral organ classes, features that are found in many other basal-relictual angiosperms. A paper describing these results has been accepted for publication in the *International Journal of Plant Sciences*.

Basal Angiosperms--Hydatellaceae

Studies of the Hydatellaceae, which was previously referred to Poales, led to cooperation by Dr Adam Marchant and Honorary Research Associate Dr Barbara Briggs with Dr J. Saarela and Prof S.W. Graham of the University of British Columbia, Vancouver, Canada, and other botanists in England and Switzerland. DNA sequencing has shown most unexpected and interesting relationships for this family, as the sister group of the Nymphaeales. This places Hydatellaceae among the basal Angiosperms, as part of an ancient lineage, neither a monocot nor a eu-dicot. The findings were published in the prestigious journal *Nature*. Hydatellaceae are a small family of diminutive aquatic plants, most of them native in Australia.

Dr Briggs collected specimens of *Hydatella* in Tasmania, these are being used in studies by botanists elsewhere on the anatomy and molecular genetics of the family.

Elaeocarpaceae and Cunoniaceae

Drs Darren Crayn and Maurizio Rossetto have continued to investigate the phylogeny, biogeography and within-species diversity of the plant family Elaeocarpaceae (including Tremandraceae) in order to understand some of the evolutionary mechanisms that have influenced speciation and distribution patterns

within the Australian flora. ‘Relaxed clock’ molecular methods have allowed a conservative estimate of the time of origin and rate of evolution of the major clades within Elaeocarpaceae. Of particular interest was the inferred Paleocene origin of the *Tetratheca* lineage with a major radiation during the Miocene in Australia, a period in which the general Tertiary aridification of the continent underwent a major intensification. Within the phylogenetic framework, analyses of population-level genetic diversity are being undertaken for selected species of *Elaeocarpus* (by Rossetto and others) and *Tetratheca* (by PhD student Hannah McPherson) to provide insights into comparative evolutionary responses and speciation mechanisms in closely related rainforest tree species and dry-adapted shrubs.

A similar project on Cunoniaceae is now being undertaken by PhD student Margaret Heslewood. This project will provide comparative data for this close relative of Elaeocarpaceae that shows many similarities in its distribution and ecology. This work is being carried out as part of collaborative ARC-funded research into the role of long distance dispersal in the evolution of SW Pacific floras being led by Andrew Lowe (University of Adelaide).

Freshwater red algae

Dr Tim Entwisle, with Dr Morgan Vis, Wayne Chiasson and Dr Alison Sherwood (USA), and Dr Olando Necchi Jr (Brazil) completed collection and DNA extractions for a synthesis paper on freshwater red algae worldwide. Analysis commenced and a draft manuscript for submission to *Phycologia* is in preparation. To minimize paraphyly and taxonomic change, a number of strategic taxonomic changes will be proposed while retaining the familiar taxonomic architecture of the Batrachospermales.

Lord Howe Island Speciation

Recently, Vincent Savolainen (Kew Gardens) and colleagues provided complete evidence for sympatric speciation in a case study of two species of palm on an oceanic island. A large dated phylogenetic tree showed that the two species of *Howea*, *H. belmoreana* and *H. forsteriana*, endemic to the remote Lord Howe Island (LHI), are sister taxa and diverged from each other well after the island was formed 6.9 million years ago. During extensive fieldwork, they found a substantial disjunction in flowering time that is correlated with soil preference. In addition, a genome scan indicated that only few genetic loci are more divergent between the two species than

expected under neutrality, a finding consistent with sympatric speciation involving disruptive/divergent selection. Both palms are diploid and therefore polyploid speciation was excluded. Not only is this case study one of a very small number of convincing examples of sympatric speciation, it is also – as far as we know - the first comprehensive case study from the plant kingdom. This work is now being broadened considerably in collaboration with Dr D. Crayn (BGT) to investigate whether other cases of sypatric speciation exist in the vascular flora of LHI and whether this evolutionary phenomenon is more common than previously thought. Pairs of putative sister species showing ecological diversification have been selected for study and a PhD student (base at Kew) appointed to the project.

Myrtaceae

Dr Peter Wilson and collaborators Dr Jim Basinger (University of Saskatchewan), Dr David Greenwood (Brandon University, Manitoba) and Dr David Christophel (University of Denver, Colorado) completed a paper describing a new genus of fossil Myrtaceae based on coalified flowers and capsular fruit. Specimens of this taxon were recovered from a clay deposit in South Australia dating from the Middle Eocene and were able to be examined by Scanning Electron Microscopy. Fossil flowers and fruits of Myrtaceae are rare, and these fossils establish a record of the tribe Kanieae within what is likely to have been Eocene coastal rainforest vegetation at a paleolatitude of 55–58°S during a time of global warmth. The paper describing and illustrating these fossils and naming this plant has now been published.

Dr Peter Wilson, Dr Chris Quinn and Margaret Heslewood continued work investigating the generic position of *Leptospermum* species with non-persistentfruits. This study is building on an earlier student project on the genus *Leptospermum* and related genera that found evidence that the species of this genus that have non-persistentfruits may not be closely related to those species with woody, persistent fruits. For this project, funded by a two year ABRS grant, over 30 species have been sequenced for both chloroplast and nuclear regions. These data are now being augmented by study of morphological characters. The goal of this research is to reassess generic limits in *Leptospermum* sens. lat. and to reconsider relationships with other genera in the tribe Leptospermeae, particularly *Kunzea* and *Neofabricia*.

Orchidaceae

The majority of orchid species are deceptively pollinated by animals that are lured to the orchids' flowers by "false advertising" – the promise, but not delivery, of food, brood sites or sex. For example, most species of the genus *Diuris* seem to mimic various kinds of pea flowers, but unlike them, they offer neither nectar nor edible pollen. Postgraduate student James Indsto and his co-supervisors, including Principal Research Scientist Dr Peter Weston, have been investigating the evolution of this relationship by phylogenetically analysing *Diuris* and determining the pollinators of several Sydney species. Indsto and his colleagues have shown that nectarless *Diuris maculata* is pollinated in Scheyville National Park, Western Sydney, by *Trichocolletes venustus*, a bee that also gathers pollen and nectar from co-blooming pees, *Daviesia ulicifolia* subsp. *ulicifolia* and *Hardenbergia violacea*. *Diuris maculata* closely resembles the "egg and bacon" flowers of the *Daviesia* in both the human visible range and in UV, part of the spectrum that is visible to bees but not to humans. A paper describing these results has been accepted for publication in *Australian Journal of Botany*. At Lake Munmorah, Indsto and his colleagues have also investigated the pollination of *Diuris alba*, a species that produces small quantities of nectar and does not closely resemble flowers of any co-blooming plants. Here *D. alba* is pollinated primarily by female *Exoneura* bees, which are generalized foragers of nectar and pollen. Phylogenetic analysis of *Diuris*, based on both molecular and morphological characters, suggests that this genus was ancestrally specialized as a pea-mimic and that lineages with more generalized pollination systems evolved from such specialized ancestors.

Plantaginaceae

Dr Barbara Briggs collaborated with Professor Emeritus Friedrich Ehrendorfer of Vienna in papers reporting chromosome number records of *Veronica* and describing three new species from New South Wales and one from Tasmania. These were published in our journal *Telopea*. She also collaborated with Professor Philip Garnock-Jones (New Zealand) and Dr Dirk Albach (Germany) in a major reclassification of the *Hebe*, *Detzneria* and *Labiatoides* sections of an enlarged genus *Veronica* which was published in *Taxon*.

Poales

Continuing from their studies on Restionaceae, Dr Marchant and Dr Barbara Briggs studied families related to Poaceae and Restionaceae. Sequence data on chloroplast DNA was obtained from further taxa. There is robust support for the small Western Australian family Ecdeiocoleaceae, with Joinvilleaceae of the Old World tropics, as the closest living relatives of Poaceae. A paper reporting these findings and presenting additional sequence data has been published in Telopea.

During fieldwork in Western Australia, Dr Briggs and Patricia Meagher confirmed the presence of an undescribed species of *Ecdeiocolea* with a distinctive growth habit. This is only the second species of that genus and the third in Ecdeiocoleaceae. They also continued observations on the reproductive biology of Ecdeiocoleaceae, which has an unusual pattern of the development of male and female flowers.

Proteaceae

Principal Research Scientist Dr Peter Weston has been working since 1979 on the phylogeny and historical biogeography of various groups in the Gondwanic family Proteaceae, establishing an international reputation as a taxonomic authority on the family. In 1998 Professor Klaus Kubitzki, editor of the encyclopedic *Families and Genera of Vascular Plants*, invited Dr Weston to write an account of the Proteaceae for this series and this was published in volume 9 of this series in 2006. In addition to descriptions of all infrafamilial taxa down to genus and a key to genera, he also wrote an introductory essay on diverse topics from morphology, anatomy and phytochemistry to reproductive biology and cytology – almost “Everything you ever wanted to know about the Proteaceae but were too afraid to ask”.

The treatment for *Families and Genera of Vascular Plants* required a classification and molecular phylogenetic analyses had indicated that the intrafamilial classification of Johnson and Briggs, published in 1975, needed revision. Dr Weston and his colleague Associate Professor Nigel Barker (Rhodes University, Grahamstown, South Africa) synthesized the results of available published and unpublished phylogenetic analyses in the form of a supertree, produced using matrix representation and parsimony (an “MRP supertree”). They revised the classification of the Proteaceae above generic level on the basis of this supertree, ensuring that only putatively monophyletic groups were recognized as higher taxa (Weston & Barker 2006).

Dr Hervé Sauquet is a Marie Curie Outgoing International Postdoctoral Fellow, funded by the European Union, who arrived in Sydney in May 2006 to work with Dr Weston for 12 months on the Proteaceae. He is now working on this project for a further 12 months, based in the Jodrell Laboratory, Royal Botanic Gardens, Kew, with Dr Vincent Savolainen. Their collaborative project, titled "Evolutionary origin of biodiversity hotspots with a Mediterranean climate (HOTMED)" involves the integration of morphological and molecular characters in a phylogenetic analysis of the Proteaceae. This is allowing them to identify the clades to which proteaceous fossils belong, with estimates of precision.

The availability of robust phylogenetic trees based partly or wholly on molecular data has allowed the empirical testing of a wide range of evolutionary hypotheses that previously were regarded as testable only in principle. For example, relaxed molecular clock methods, when combined with rigorously identified fossils, are allowing scientists to convert these phylogenetic trees into chronograms – trees with a time dimension. Drs Weston and Sauquet, and their colleagues Associate Professor Nigel Barker (Rhodes University, South Africa) and Dr Frank Rutschmann (University of Zurich) have completed the first study of molecular dating of major groups in the family Proteaceae, based on *rbc*L and *atp*B cpDNA sequences, which will be published shortly in *Journal of Biogeography*. Their results suggest that all of the taxa of Proteaceae that show African-Australian disjunctions are too young to have dispersed between these continents over land. It suggests instead that the African Proteaceae have descended from four ancestors, three of which independently dispersed across the Indian Ocean between Africa and Australia, and one of which dispersed across the Atlantic Ocean to Africa from South America. These suggestions conflict with the accepted wisdom that the Proteaceae are a Gondwanic group that has undergone minimal long distance dispersal.

Dr Weston also continued his collaboration with Dr Austin Mast (Florida State University, USA) and various other colleagues and students on phylogeny within the family and particularly on the subfamily Grevilleoideae, emphasising several biogeographically interesting clades. The tribe Macadamieae, for instance, includes endemic taxa in Australia, South and Central America, Africa, Madagascar, New Caledonia, New Guinea, SE Asia, Fiji and Vanuatu. Drs Weston and Mast, together with Trust Technical Officer Kathi Downs and Florida State University honours student Crystal Wallis have phylogenetically analysed the Macadamieae and shown that eight subclades cross wide, deep-water gaps. Moreover, all of these disjunctions

are estimated to be younger than the gaps that they cross. This implies either that long distance dispersal has been much more prevalent in the history of the Proteaceae than previously thought or that there are enormous gaps in the fossil record.

Drs Weston and Mast, together with Trust Botanist Mr Bob Makinson, Trust Research Associate Mr Peter Olde and Florida State University honours student Amanda Kubes have also been phylogenetically analysing the large tribe Grevilleeae (*Grevillea*, *Hakea*, *Finschia*). This work has shown that *Finschia* and *Hakea* are probably both nested within *Grevillea*, which will require major nomenclatural changes if confirmed. *Hakea* is such a large and diverse clade that it warranted a study in its own right and Drs Weston and Mast, have collaborated with Drs Bill and Robyn Barker of the State Herbarium of South Australia and Florida State honours student in analysing this group in detail. The genus is split into two major groups, one of which is primitively broad-leaved, the other primitively terete-leaved. Terete leaves may have facilitated the invasion of arid habitats by the latter group.

Mr Makinson continues non-molecular taxonomic wortk on the group, with new species and species relationships under investigation, mainly in the *G. linearifolia* and *G. juniperina* alliances.

Vitaceae

This collaboration between Dr Rossetto, Dr Crayn and Dr B. Jackes (JCU) is still producing new and exciting findings. Previous work showed that *Cissus*, the most species rich genus of Vitaceae, is not monophyletic in Australia and after the sampling of a larger number of taxa and DNA regions we have shown that the genus is not monophyletic worldwide, with some close links between South American and Australian taxa. We have also developed a molecular clock using available fossil and molecular evidence, and interestingly the resulting chronograms show that the radiation of the endemic Australian genera took place around 25 Mya (i.e. after the detachment from Antarctica and the onset of aridification). Finally, we have described a new species of *Clematicissus* (a previously monospecific genus) from eastern Australia and are in the process of naming a new Australian genus.

Management of the Preserved Collection

Australia's Virtual Herbarium

The herbaria of Australia – held in botanic gardens, environment agencies and CSIRO – hold a vast source of largely untapped information about the plants of this country. In particular, only half of the more than 6 million preserved plant collections are databased, and there is no 'one-stop shop' for accessing the nation's plant information. During 2001-2002, the Council of Heads of Australian Herbaria, supported by Commonwealth and State environment ministers, unanimously agreed to database the remaining half of the collections and make them available across the Internet with extensive funding from the Commonwealth and State governments and private donors. All new plant species and scientific discoveries will then be posted directly onto the Australia's Virtual Herbarium site (mirrored on all herbarium websites), the specimens themselves remaining under the custodianship of each regional herbarium. In the National Herbarium of New South Wales (NSW), the total number of specimens data-processed is about 635,000 (about 370,000 databased by AVH temporary staff), representing about 54% of the total collections. Although it will prove difficult for the Branch to fully data-process the Australian material held by our herbarium, the gaining of a second round of funding from the Commonwealth Government ($400,000 for NSW) will enable more AVH staff to be employed. The painfully slow process of appointing new AVH staff was nearly complete at the end of the financial year. Once these data are fully available to the broader community, access to all these collections' records will increase efficiency and accuracy in handling data within the Trust, as well as open up new opportunities for delivering plant information to the wider community. Access to these data continues to be made available via the PlantNET website, e.g. providing more detailed spot maps for taxa in the *NSW Flora Online*.

In addition to data-processing thousands of specimens the AVH project has resulted in many curatorial benefits to the collections. In particular, identifications of thousands of specimens have been checked, and numerous nomenclatural changes from the literature have been incorporated. There have also been improvements in the physical curation of many specimens, including correct annotation, allocation of geocode information (such as, botanical divisions), and securing of the material to archival papers for long-term preservation. Type specimens have been singled out

for special treatment, including conservation treatments and digital photography. The images of types are available on the PlantNET website.

NSW Collections Management System

Gary Chapple, Chris Ward and other members of staff continued to work with KE Software to enhance the *NSW Collections* database for the Gardens. This incorporates herbarium, horticultural, and floristic survey data into a single database system. Images of plants, including herbarium collections are being included in the database. Plans for a 5-7 year review of the system were developed, with the first fact-finding workshop in August 2006. Further steps were put on hold for the rest of the year owing to the disruptions and time involved for key staff members in the migration of the whole Department of Environment and Conservation to a new software platform.

Communication and Services

Botanical Information Service

PlantNET

The electronic version of the *Flora of New South Wales*, *Flora Online,* was developed by Ken Hill as part of the Trust's *PlantNET* website:

(http//:plantnet.rbgsyd.nsw.gov.au).

It provides nomenclatural information, botanical descriptions, illustrations, distribution maps, images of herbarium specimens and other plant images. These data are managed by the Trust's *NSW Collections* database. *PlantNET* continues to be enhanced so that plant information, identification keys and images from any region of New South Wales will be available, as well as information on other groups of plants. Updating of entries is slow, owing to staff shortage of time.

Botany of Botany Bay Web Pages

Web pages about the plants and botanical history of the Botany Bay area were prepared by Plant Sciences and Public Programs Division. This project was funded by the Friends of the Gardens. See:
http://www.rbgsyd.nsw.gov.au/science/hot_science_topics/Botany_of_Botany_Bay

Aussie Alga*e*

Dr Alan Millar and Ms Linn Linn Lee set up the *Aussie Algae* webpage, a subset of *PlantNet,* to deliver information on Australian marine algae. The William Harvey collection of Australian marine algae on semi-permanent loan from the Mitchell Library (SLNSW), along with the 1800 Harvey specimens already in the NSW National Herbarium collection and all the type specimens in NSW, are now searchable via *Aussie Algae*. Linking the databases from Ireland, Belgium and the United States, *Aussie Algae* also gives historical, nomenclatural and in situ photographs where available of many species in the NSW collection.

PNGplants

The *PNGplants Collections* has continued to expand with the addition of herbarium specimen information as held at the National Herbarium of New South Wales, with new collections being added to the database by Papua New Guinea staff via a web-interface. This database is linked to *PlantNET* via the *PNGplants website*.

Forensic Identification

Government analysts identified forensic material (*Cannabis*) in 13 cases for the Police Service.

Public Reference Collection

Environmental consultants, students, government agencies, and the general community spent more than 260 hours using the Public Reference Collection to identify plants that they had collected.

Telopea

Telopea is New South Wales' leading scientific journal for the publication of plant diversity information. The focus of the journal is the discovery and documentation of plant species, and the study of their origins and relationships. The geographical focus is New South Wales, but papers cover other Australian States as well as neighbouring regions of the world. *Telopea* is an internationally recognised journal and all papers are peer-reviewed.

After serving as editor for 5 years Joy Everett handed on the job to Elizabeth Brown with the completion of issue 11(1). Elizabeth Brown continued as scientific editor.

Telopea issues 11(3) and 11(4) were published: 20 papers in total. Highlights include:

- The description of two new species of *Prostanthera*.
- Descriptions of new species of *Boronia, Dianella, Veronica and Trochocarpa*
- A suprageneric classification of the Proteaceae.
- Pollen morphology of rainforest taxa in the Illawarra.

Part 4: Resources Section

The Resources Section provides infrastructure and support for the Plant Sciences Branch. The section comprises the Library, Botanical Illustration Service, Herbarium Specimen Preparation Facility, Volunteer Program, and Electron Microscopy and Molecular Systematics Laboratories. The section is also responsible for the management of the Branch's vehicles and field-work equipment and in collaboration with the Gardens' Property Coordinator, for issues relating to the Brown Building, which houses the National Herbarium of New South Wales. The Resources Manager also oversights Branch occupational and general health and safety issues, provides agency wide services in managing various capital and other projects.

Library

The Botanic Gardens Library continues to be engaged in a range of projects related to its long-term redevelopment and to the preservation and growth of its world-class collection.

The rehousing of the Library's extensive heritage collections has been a major focus of the Library's volunteers. Fund raising for the conservation of items most in need is an ongoing quest.

Major space and storage issues continue to be addressed as funds and time allow.

Work on contemporary collections is ongoing.

Developments

- The Friends of the Gardens provided funding for the digitising of selected collection items. This enabled the Library to contract the scanning of 1,988 images in TIFF format and make jpg copies (J.H. Maiden's unpublished centennial manuscript, Playfair's algal drawings, a collection of borrowed historic Gardens postcards and the Library's collection of historic photographs). This pilot project has established the groundwork for further digitising projects.
- Volunteers have prepared the text for photographic records and made progress in bar coding images. Once secure permanent server space is made available, Library staff can quickly prepare imaged catalogue records for the scanned collections.

- The Oral History Project, undertaken by Volunteer John Pearce and Honorary Research Associate Barbara Briggs, has made enormous progress, with 20 interviews already completed. A list of over 45 potential interviewees has beendrawn up (which grows by another 2 or 3 after each interview).

  Preservation digital copies have been made of the interviews and photos made available by interviewees have been scanned into the digital collection. Funding is needed to prepare transcripts. The Oral History Project is capturing the memories of many people involved with the Gardens in many different ways over the years. The project will provide material for the 2016 Bicentenary, as well as recording aspects of the Garden's unwritten history.

- John Slade made an extraordinary donation of books from Hermon Slade's private collection held by the Hermon Slade Raiatea Foundation. They comprised orchid and other botanical works valued at over $90,000.

- The Australian Garden History Society funded the conservation of Thompson's Gardener's Assistant.

- The conservation of a signed copy of Darwin's *Origin of the Species* was completed, funded by the Friends.

- Funds were made available from Plant Sciences to buy $10,000 of scientific books, above and beyond the annual budget of $19,000. This year's book budget covered a significant purchase of books for Mt Annan's Library. A similar purchase of books for Mt Tomah will be delayed until they have a proper Library facility. Some funds were also allocated for further developing the Central Depot Collection for Horticultural staff.

- A Library Book Acquisitions working group has been established to assist Library staff in prioritising book puchases, maintain strategic directions and fill gaps in the library's coverage (members: Bob Makinson convenor; Peter Weston, Steve Bartlett, Judy Blood).

Library staff were unable to catalogue for 9 months due to very slow network speeds. In recent months headway was made in catching up on the accumulating backlog. Negotiations continue with DECC IT for finding a means of accessing the BGT's online serials. Access was lost 2 years ago when a common IP address was introduced.

The dedication and hard work of the Library's volunteers have enabled much of the progress achieved in recent years. Their contribution has been invaluable.

Exhibitions, Talks and Tours

Library staff has been involved throughout the year in writing articles, assisting in exhibitions and displays of heritage materials in the Red Box Gallery, staff inductions, student tours and presenting public lectures.

Botanical Illustration

Major taxonomic projects

Ongoing taxonomic work has been completed for publication primarily in *Telopea,* but also in the *Australian Journal of Botany,* the *Canadian Journal of Botany* and for as yet unpublished papers for botanists, honorary research associates and students.

Major projects completed include –

- 11 more *Cycas* illustrations were completed for *Telopea* and a monograph on the genus by Ken Hill and Leonie Stanberg.
- Other illustrations completed for publication include the genera *Dicranoloma, Amoranthus, Pterostylis, Procris, Craspedia, Acacia, Laurencia, Blechnum* plus *Urticaceae* leaf diagrams, and bracken hydathode drawings.
- $814 (incl. GST) was raised through the electronic outsourcing of scientific illustrations from the Illustration Archive. Primarily, images sought were from the *Flora of NSW* collection with a few full-plate illustrations also required for use in books, identification guides and signage. Requests came from organisations as varied as the Natural Resources Unit of Pittwater Council, The Dept. of Primary Industries, Sydney Airport Corporation, The Dept. of Sustainability and the Environment (Vic) and a yet-to-be-named publication by Peter Bernhardt, Rutgers Press, Missouri USA.
- The 3 large landscape drawings and paintings for signage at Mt Tomah were finally completed and are yet to be installed.
- Throughout the year Design and Editorial also requested images for scanning or for drawings to be done for Education brochures and Annual Reports. Flockton images were provided for the BGT website.

- Illustrations were sourced and scanned for BGT Education Unit.
- Copies of Margaret Flockton's coloured illustrations were also employed once again on behalf of the Gardens for a retirement gift for Tony Martin. All scanning and designing was undertaken by Illustration. The designs are retained in the hope of commercial printing of stationery packages one day.

Digital Imaging Project

In November/ December 2006 the Illustration Archive was organised, categorised and labelled for easier access, and 3 entire boxes of Flockton *Eucalyptus* images were digitised and added to EMu Multimedia and Taxonomy modules. Recently more scanning has been made on the modern collection and also the archived works of Flockton, Maiden etc. housed in the Library Annex. We are prioritising the documentation of all the artworks and aim to complete all historical scanning before July 2008.

Endangered and Vulnerable Plants

The current focus of this project is to illustrate New South Wales species being listed as endangered nationally. This project was 'dormant' whilst Lesley Elkan was absent.

Volunteers and training

- Regular assistance is given to the staff frequently requiring help when scanning images on the computer located just outside the Illustration Room. We often complete scan images for those staff.
- A student enrolled in the Natural History Degree at the University of Newcastle, Christine Rockley, was a volunteer in Illustration July–Sept 2006, one day per week. She completed a plate of the rare *Acacia terminalis* as well as doing some volunteer work with Education.
- Catherine Wardrop gave impromptu talks and demonstrations in the Illustration Room to students from Universities and TAFE as well as BGT volunteers and visiting scientists, about the role and processes of scientific illustration and the Illustration Archive.

Scanning

- Scanning of black and white illustrations for publication in external journals and PhD theses continues to be undertaken by the illustrators to help ease the workload in the Design and Editorial section.

Exhibitions and Awards

- The illustrators once again assisted with the Artist in Residence Programs 2006 and 2007. Gaye Chapman ended her residency with a much praised exhibition in the Palm House (Jan 07) and the Red Box Gallery (Jan, Feb, March 07). Catherine Wardrop assisted with invitations and mail-outs as well as looking after the *Botanomancy* exhibition.
- Catherine Wardrop assisted with the interviews and selection for the BGT Artist in Residence 2007. AnA Wojak was the successful applicant and has been given space to work in Victoria Lodge. Her temporary sculptures and installations around the Gardens have been documented through the Gardens and are available for viewing on her website and the Botanic Gardens website.
- The illustrators assisted once again in the hanging then dismounting and repackaging of the Margaret Flockton Award for Botanical Illustration. Presented by the Friends of the Gardens, its fourth year was again a great success with 29 entries from around the world (numbers slightly down from last year as the lead time was only 6 months). The exhibition was mounted in the Red Box Gallery for hundreds of visitors. Lesley Randall from California won First Prize and Juan Luis Castello from Spain was awarded Second Prize.
- Catherine Wardrop was awarded an Outstanding Merit.
- Catherine Wardrop assistedwith the installation of the current exhibition in the Red Box Gallery - *Carl Linnaeus. 18th Century Scientist, 21st Century Legacy.*

Herbarium Specimen Preparation Facility

All plant specimens coming into the Herbarium are processed and prepared in the Preparation Room before being incorporated into the collection. As part of our Integrated Pest Management Program (IPM) specimens collected in the field are pressed, dried and frozen (at < -18°C) prior to mounting. This ensures specimens are free from pests before they are incorporated into the collection. In-coming and out-

going loans and exchange are also frozen to ensure that pests are not transmitted between herbaria.

The Preparation Facility is a checkpoint where all specimens entering and leaving the Herbarium are recorded. The Herbarium again received accreditation as an approved Quarantine Approved Premise through the Australian Quarantine and Inspection Service. This enables us to process specimens received from overseas, and provide a quarantine service for other Australian herbaria.

Volunteer Programs

The mounting program has as its central goal to have the pressed plant specimens securely mounted on archival quality materials, clearly and correctly labelled, and catalogued in the collection database. A major priority is to ensure that all out-going loan material is mounted before being sent out. The program relies on a group of dedicated volunteers, who each give one day per week.

Although most volunteers assist in the mounting program, some work with specific research or curation projects, including scanning and data checking type specimens, and curation of the algae and lichen collections.

This year has been very active with the training of 15 new Scientific Volunteers who are now settled happily into the mounting program in the Herbarium. Particular training has been given to the volunteers to fix some of the more vulnerable specimens in the collection that are in desperate need of curatorial attention.

Specimen mounting program

Volunteers mounted approximately 20,000 specimens on archival paper. Outgoing loans, incoming exchange and parts of the existing collection.

Scanning Electron Microscope Laboratory

The Electron Microscopy Laboratory provides facilities for Scanning Electron Microscopy (SEM) including freeze and critical point drying. These techniques are used in research and plant identification. Equipment includes a Cambridge S360 Scanning Electron microscope (SEM) and associated preparation equipment.

The Cambridge S360 SEM encountered more faults this year due to reaching the end of its useful life and is no longer supported by the manufacturer. The cost of technical engineers to perform fault finding was prohibitive given they could not guarantee that a spare part could be sourced. The future of the old S360 SEM will be addressed in late 2007 when a review of functions and usage of Level 1 in the Brown Building is undertaken.

The Australian Museum was approached for access to their well equipped and managed Electron Microscopy Lab. Access to such an important tool for taxonomic research is of paramount importance. Scientific staff and honoraries are once again producing fantastic images for their research work. A Memorandum of Understanding between the two organisations is being investigated. The current arrangement with the Australian Museum provides beam time with samples prepared using existing BGT equipment.

SEM Projects

Honorary Research Associate Christopher Quinn is continuing his SEM studies within the family Ericaceae. Elizabeth Norris together with Joy Everett and Surrey Jacobs has been continuing studies of the tribe Stipeae.

Molecular Systematics Laboratory

The Molecular Systematics Laboratory provides facilities for DNA-based studies of plant relationships, to supplement whole plant and anatomical comparisons. Laboratory staff collaborated with students and researchers on various projects, provided technical support and trained staff and students in laboratory procedures.

Laboratory Occupational Health and Safety

Due to the increase in research work toward population genotyping, which requires pipetting multiple samples per locus, some users were experiencing lower arm fatigue. A report from the DECC Occupational Health and Safety Officer recommended purchasing new ergonomic pipettes to reduce wrist and finger strain. A selection of three manual and four electronic multichannel Finnpipettes were purchased for the laboratory. In addition a new system of loading pre-racked pipette tips was introduced for the high throughput users (Pagoda tip loading system) to further reduce wrist and finger strain.

Equipment and Laboratory Services

In 2006/7, the Laboratory and staff again underwent a significant period of multiple disruptions. Due to the Central Depot Redevelopment in early 2007, staff and laboratory equipment from Plant Pathology Unit needed accommodation within the Brown Building. Laboratory staff was required to relocate to other office space within the Herbarium to make room for Plant Pathology staff. Space was also made available within the Molecular and SEM labs and Level 1 generally for working space and equipment.

Late 2006 saw a review of BGT's Laboratories, staff and functions.The review was managed by by the Manager Resources Tony Martin and included Peter Wilson, Edward Liew and John Siemon from the Science and Public Programs Branch and Rebecca Johnson from the Australian Museum. Submissions were received and interviews with staff and key stakeholders were conducted. A review document was produced and circulated to all staff with short and long-term action items. These actions are progressively being implemented, with the support of staff, by John Siemon following the retirement of Tony Martin.

The Resources Manager, Tony Martin, retired in April after 16 years with the BGT. Louisa Murray and John Siemon are currently jointly acting Resources Manager while a restructure of the Science part of the branch is undertaken.

Students

Graduate students utilising the laboratory included: Yola Metti (*Laurencia*, Rhodophyta – the "coral plant"); Hannah McPherson (Tetratheca, Tremandraceae) and Nicholas Yee (Sporochnales, Phaeophyta).

Completed: Karen Sommerville (*Wilsonia*, Convolvulaceae) PhD.

Commencing: Margaret Heslewood (Ceratopetalum, Cunoniaceae) and Trevor Wilson, (Prostanthera, Lamiaceae) who underwent plant molecular techniques training prior to joining the Plant Systematics Laboratory at University of Sydney for PhD studies.

In May, two visiting scientists came to assist Maurizio Rossetto with research on Elaeocarpus. They are Marilena Meloni from Italy and Rohan Mellick.

Staff and Honorary Research Projects

Dr Adam Marchant continued molecular systematics studies on Australian Solanaceae and *Ipomoea costata* together with colleagues in Broome and Japan. Adam is continuing work on Restionaceae with Dr Barbara Briggs and is also working on the DNA fingerprinting of *Camellia* in conjunction with George Orel and Tony Curry, University of Western Sydney.

Carolyn Porter developed a microsatellite library for *Ceratopetalum apetalum* (Cunoniaceae). Primer testing had commenced prior to the project being taken up by a PhD candidate. Assisted with sequencing 2 loci for an international project studying Bromeliads.

Dr Andrew Perkins is continuing molecular studies of Apiaceae in collaboration with DrMurray Henwood, University of Sydney, with the majority of the work now being conducted at the Plant Systematics Laboratory, USYD.

Red Box Gallery

The Red Box Gallery aims to promote the Trust's scientific work by mounting exhibitions that promote the Trust's scientific work and enable the Trust to display the many historic and educational items from its Library and Herbarium collections.

The gallery has had a very busy and successful year with an extensive exhibition program. Visitation to exhibitions in the gallery during 2005/06 exceeded 3,000 whilst visitation to the gallery since its opening in 2003 has passed 10,000.

Exhibition Program

2006 Margaret Flockton Award 06/07/06 to 129/09/06

An exhibition of selected works from The Margaret Flockton Award.

Botanic Gardens Treasures. 18/09/06 to 24/11/06

An exhibition showing many of the historic books, equipment and specimens including the Banks and Solander specimens from 1770 and the prints from *Banks Florilegium* housed in the Herbarium collections.

Our Hidden Talents - BGT Staff exhibition 04/12/06 to 22/12/06

Art works produced by Botanic Gardens Trust staff.

Artist in Residence Exhibition 06/01/07 to11/03/07

Gaye Chapman *The Secret Garden* (in Palm House and then Red Box Gallery)

2007 Margaret Flockton Award 12/03/07 to 25/6/07

Opening 15 March

Linnaeus exhibition 25/06/07 to 04/10/07

Celebrating the 300th birthday of Carl Linnaeus - The father of the binomial system of classifying living thing

Artist in Residence Program

The Artist in Residence program (AIR) provides practising artists the opportunity to work at the Royal Botanic Gardens, Sydney for a year and culminates with an exhibition of the artist's work held in the Red Box Gallery or other suitable venue at the Royal Botanic Gardens, Sydney for a period of about ten weeks.

The 2006 Artist In Residence was Gaye Chapman, who worked in her studio and produced an exciting series of paintings where she had chosen native and exotic plants in the collection that were associated with childhood, as revealed by research into their associated folklore, fables, legends, myths and history.

The paintings which were all the same size were hung by Gaye and her partner in an impressive series of strings of paintings, suspended from the ceiling. The overall effect was a work of art in itself.

Critical Incident Planning and Implementation.

The Resources Manager was responsible for the updating and implementation of the Critical Incident Plan (CIP) at the Sydney site. Tony Martin has retired and Brad Horan (Manager Domain and Infrastructure) took over the role of Chief Emergency Officer from June 2007.

During the year, there were 13 major incidents in the Sydney Gardens. Each incident was subsequently investigated and remedial action taken as required addressing any issues.

Achievements throughout the year include:

- Up-date of evacuation procedures on the Sydney site
- Liaison with the Sydney Emergency Management Committee (SEMC) in regards to the Domain being used as a Sydney Safety Site
- Two 'walk through drills' with SEMC staff and Building Wardens to trail the procedures should the Sydney Safety Site need to be mobilised.

Part 5: Appendices

Appendix A: STAFF, HONORARY ASSOCIATES, VOLUNTEERS AND STUDENTS IN PLANT SCIENCES BRANCH

Director Science and Public Programs
Brett Summerell BScAgr(Hons), PhD(Syd)

Executive Assistant
Sheryl Saban (part-time)

Administrative Assistant
Kristina McColl BSc(Hons)(NSW), BushRegenCert (part-time)
Ifeanna Tooth BSc(Syd), AdvCertUrbHort (OTEN) (temp, part-time)

CENTRE FOR PLANT CONSERVATION

Coordinator
Bob Makinson BA (Biology)(Macqu)

CONSERVATION AND HORTICULTURAL RESEARCH

Manager
Vacant

NSW Vegetation

Special Botanists
Doug Benson BSc(Hons)(NSW)
John Benson BSc(Macq)

Research Scientist
Maurizio Rossetto BSc(Hons)(La Trobe), MSc, PhD (UWA)

Senior Technical Officers
Chris Allen BEng, BSc(Biology)(Syd), PhD(Syd)

Technical Officer
Lotte von Richter BScAgr(Syd), MScAgr(Syd)
Lucy Nairn BSc(Hons) (Monash)(temp) (LDD 11.4.07)

Fungi and Plants

Plant Pathologist/Mycologist
Edward Liew BSC(Hons), PhD(Qld)

Scientific Officer
Rosalie Daniel BScAgr(Mel); PhD(Deakin) (temp) (commenced 2.07)

Senior Technical Officer
Suzanne Bullock NZCS, MSc (NSW)

Technical Officers
Julie Bates, AssDipAppSc (Ultimo TAFE)

Karen Sommerville BSc(Hons), PhD[in progress](UTS); CertHortOperations(Padstow TAFE) temp (4.07 – 5.07)

Horticulturist

Veronica Kuziow, Hort Cert III (temp) (commenced 6.07)

Horticultural Research and Development

Senior Research Scientist

Catherine Offord BScAgr(Syd), MScAgr(Syd), PhD(Syd)

Scientific Officer

Amelia Martyn BScAgr(Hons), PhD(Syd)

Senior Technical Officer

John Siemon, BHortSc(Hons)(Qld)

Technical Officers

Leahwyn Seed BSc(Hons)(UNE) (temp)

Karen Sommerville BSc(Hons), PhD[in progress](UTS); CertHortOperations(Padstow TAFE) temp (commenced 08.06)

Technical Assistant

Andrew Orme Hort TradeCert (temp)

PLANT DIVERSITY

Manager

Karen Wilson BScAgr(Syd), MSc(NSW) (Special Botanist) (acting)

Research and Curation

Principal Research Scientist

Surrey Jacobs BscAgr, PhD(Syd)

Peter Weston BSc(Hons), PhD(Syd)

Alan Millar BSc(Hons), PhD(Melb)
Peter Weston BSc(Hons), PhD(Syd)

Senior Research Scientist

Barry Conn BScEd, MSc(Melb), MBA(CSturt), PhD(UAdel)

Peter Wilson BSc(Hons), PhD(NSW)

Research Scientist

Darren Crayn BSc(Hons), PhD (NSW)

Senior Systematic Botanist

Joy Everett BioTechCert (Syd TAFE), BSc(Hons), MSc(Syd)

Botanists

Elizabeth Brown BSc, MSc(Hons), PhD(Auk)

Stephen Skinner BSc(Hons), MSc, PhD(Adel), GradDipEd(Sec.) (temp)

Senior Technical Officer

Louisa Murray BAppSc(CCAE)

Technical Officers

Wayne Cherry BScAgr(Syd), GradDipBioSc (NSW)

Katherine Downs, BA (NSW), BSc(Hons) (Syd)

Clare Herscovitch BSc(Hons)(Syd) (part-time)

Margaret Heslewood BSc(Hons)(Syd) (temp, part-time)

Phillip Kodela BSc(Hons), PhD(UNSW) (commenced 4.6.07) (temp, part-time)

Hannah McPherson BSc(Hons)(NSW) (part-time)

Liz Norris BSc(Hons)(Macqu) (temp, part-time)

Karen Sommerville BSc(Hons), PhD[in progress](UTS); CertHortOperations(Padstow TAFE) temp (1.7.06-08.06)

Leonie Stanberg BSc(Syd), DipEd(SCAE)

Gillian Towler BSc(Macq), AssDipAppSc(HortParkMgt), TreeSurgCert

Michael Whitehead BSc(Hons)(NSW) (temp) (26.3.07 – 11.6.07)

Herbarium Assistant

Zonda Erskine AssDip in FAP(Sydney TAFE)

Botanical Information Service

Botanist

Barbara Wiecek BSc(Syd)

Senior Technical Officers

Seanna McCune BAppSc(Hawkes), BushRegenCert

Technical Officers

Gary Chapple BSc(Syd), DipAg(Hawkes)

Robert Coveny HortCert

PlantNET Officer

Peter Hind HortCert

RESOURCES

Manager

Anthony Martin, BioTechCert, BioTechHigherCert, BAppSc(Riverina)

Technical Officer

Alex Newman CertAmenHort(SA), AdvCertHort(SA), BScAg(Hons)(Adel), BMus(Adel), PhD(Macq)

Laboratories

Senior Technical Officer

Adam Marchant BSc(Hons), PhD(ANU)

Technical Officer

Carolyn Porter BAppSc(Hons)(UTS)

Library

Senior Librarian

Judy Blood BA, Dip Ed (LaT) DipLib (RMIT) BushRegenCert, ArboricultureCert, Multimedia Cert IV

Library Technician

Miguel Garcia AssocDipLibPrac(STC)

Botanical Illustration

Illustrators

Lesley Elkan BSc(UTS), PostGradDipIllus(Newc) (resumed from MatLeave 4.06.07, part-time)

Catherine Wardrop BA(Vis)(ANU), PostGradDipIllus(Newc) (part-time)

Volunteer Program

Volunteer Program Supervisor

Mary Stewart BSc(Syd)

Peta Hinton DipFine Arts(Meadowbank TAFE) + 3 AdvCerts(Meadowbank TAFE, St George TAFE); BushRegenCert(National Trust); 2007 BGT Internship (temp, part-time) (commenced 21.5.07)

HONORARY RESEARCH ASSOCIATES

Alan Archer PhD(City Lond), CChem, FRSC

Peter Bernhardt BA, MA(SUNY), PhD(Melb) (withdrawn Nov 2006)

Don Blaxell BSc(NSW), DipAgr(Vic) (withdrawn Nov 2006)

Barbara Briggs BSc(Hons), PhD(Syd), PSM

Carrick Chambers AM, MSc(NZ & Melb), PhD(Syd), Hon.LLD(Melb), Hon DSc(NSW), AHRIH

Mike Dingley BioTechCert (STC) (withdrawn Nov 2006)

Lionel Gilbert, OAM, BA (Hons) PhD(UNE), LCP(Lond)

Gwen Harden MSc(UNE)

Ken Hill BSc(Hons), MSc(UNE)

Jocelyn Howell BPharm(Syd), BSc(Macq)

Robert Kooyman

Erich Lassak BSc(Hons), MSc, PhD(NSW)

Alan Leishman PhotoengravingEtchingCert

John Leslie BA(Dall), MS(UWisc), PhD(UWisc)

David Mabberley MA, PhD(Cambridge), DPhil(Oxon) (withdrawn Nov 2006)

Lyn McDougall BushRegenCert

Anthony Martin, BioTechCert, BioTechHigherCert, BAppSc(Riverina)

Peter Michael BAgSc(Hons), PhD(Adel)

Christopher Quinn, BSc (Hons)(Tas), PhD (Auk)

Helen Ramsay MSc, PhD(Syd)

Bettye Rees BSc(Hons)(Qld), PhD(NSW)

Rod Rice Higher UrbCertHort

Geoffrey Sainty DipAgr(WAC), GradDipExt(Hawkes)

Phil Spence

Terry Tame DipIndArts(STC), DipEd(Syd)

Joy Thompson BScAgr, MSc(Syd)

John Thomson MSc, MAgrSc, PhD(Melb)

Mary Tindale MSc, DSc(Syd)

Edwin Wilson BSc(NSW)

VOLUNTEERS

Beverley Allen, Kathleen Allen, Mike Atkinson, Lydia Bell, Margaret Bell, Pamella Bell, Chris Belshaw, Carol Bentley, Rosemary Blakeney, Wayne Brailey, Harry Brian, Ellen Brien, Louise Broadhead, Kathryn Brown, Dawn Bunce, David Buncel, Lynette Burns, Mary Cail, Diane Calder, Margaret Carrigg, Kathryn Chapman, Margot Child, Anne Collins, Anthony Curry, Barbara Darmanin, Mien de Hass, Jane D'Olier, David Drage, Sarah Dunstan, Helen Flinn, Gladys Foster, Pat Harris, Jane Helsham, Rachel Hill, Peta Hinton, Alick Hobbes, Beverley Honey, Mike Isbell, Trevor Kruger, Fred Langshaw, Gwenda Levy, Marie Lovett, Anne Lucas, Ann McCallum, Lorraine McCarthy, Malcolm McDonald, Ena Middleton, Margaret Morgan, Jenna Nielsen, Barbara Page, Jill Pain, Sally Paton, John Pearce, Aileen Phipps, Dorothy Pye, Beth Radford, Ann Rahaley, Daniel Robinson, Betty Ruthven, Theresa Sergeant, Evelyn Shervington, Graham Shields, Lucas Shuttleworth, Carol Sinclair, Rhiannon Stephens, Lois Stewart, Julie Taylor, Betty Thurley, Ruth Toop, Shelagh Trengove, Valerie Trigg, Sybil Unsworth, Rosemary Varley, Denise Walker, Ann Wilcher, Jean Williams, Lisa Woods.

STUDENTS 06-07

Student	Degree	University	Supervisors	Project Title
Alison Bentley	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Population biology of *Fusarium pseudograminearum*
Carolyn Blomley	PhD	University of Sydney	+Prof D. Guest, Dr E. Liew	Fungal Endophytes of *Theobroma cacao*
Jonathon Carbrera	PhD	Mainz University (Germany)	+Dr Gudrun Kadereit, +Prof Joachim Kadereit, Dr S. Jacobs	Studies in Australian Camphorosmeae (Chenopodiaceae).
Kerri Clarke	PhD	University of New England	+Assoc Prof J. Bruhl, +Dr N. Prakash, K. Wilson	Systematic studies in Abildgaardieae (Cyperaceae)
Endymion Cooper	BSc(Hons)	University of Sydney	+Dr Murray Henwood, +M. Pye, Dr E. Brown	Morphological and molecular variation in the *Telaranea centipes* group
Will Cuddy	PhD	University of NSW	+Assoc Prof B. Neilan, Dr B. Summerell	Investigate amelioration of impacts of irrigation salinity in wheat cropping using the cyanobacteria Nostoc and arbuscular mycorrhizal fungi
Yvonne Davila	PhD	University of Sydney	+Dr G.M. Wardle, Dr M. Rossetto	Ecological and evolutionary implications of variation in pollinator assemblages on *Trachymene incisa* (Apiaceae)
Jim Dellow	MScAgr	University of Sydney	+Prof D. Kemp, +Dr W. King, Dr S. Jacobs	Weedy Brassicaceae of NSW Wheat areas
Frances Elliot	PhD	Southern Cross University	+Prof R. Henry, Dr. M. Rossetto	Extent of clonality and taxonomic relationships in *Davidsonia*
Cassia Ferguson	BHortSc	University of Sydney	+Dr R. McConchie., Dr C. Offord	Effect of the addition of rock dust to potting mixes on the health of potted plants
Robert Gibson	PhD	University of New England	+Assoc Prof J. Bruhl, +Dr G. Vaughton, Dr B. Conn	Systematics of *Drosera peltata* complex

Student	Degree	University	Supervisors	Project Title
Joanne Green	PhD	Southern Cross University, Lismore	Drs S. Jacobs, +A. Reichelt-Brushett	Assessing saltmarsh rehabilitation
Margaret Heslewood	PhD	University of Adelaide	+Prof A. Lowe, Dr D. Crayn, Dr M. Rossetto	Genetic structure and differentiation across *Ceratopetalum* (Cunoniaceae)
Gavin Hinten	PhD	Southern Cross University	+Prof P. Baverstock, Dr. M. Rossetto	Patterns of mutation of microsatellite loci - a study using island populations of the Australian bush rat
John Hodgon	PhD	University of New England	+Assoc Prof J. Bruhl, Mrs K. Wilson, Dr A. Marchant	Systematics of *Juncus* (Juncaceae)
Chris Howard	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Population genetics of *Phytophthora cinnamomi*
Khalaf Hussein	PhD	University of Technology	Dr B. Summerell, +Dr J. Tarran, +L. Tesoriero	Diseases of Lettuce in hydroponics
James Indsto	MSc	University of Wollongong	Dr P. Weston, +Prof R. Whelan, +Dr M. Clements	Species relationships and pollination ecology of *Diuris* (Orchidaceae) of the Sydney region
Peter Jobson	PhD	University of Technology	+K. Brown, Dr P. Weston	A taxonomic revision of *Dillwynia* (Fabaceae: Sydney Faboideae: Mirbelieae)
Matthew Laurence	PhD	University of Sydney	Dr E. Liew, Dr B. Summerell, +Prof L. Burgess	The evolutionary and pathogenic potential of *Fusarium oxysporum* from native soils in Australia
Joanne Ling	PhD	University of Western Sydney	+Dr J Bavor, Dr S. Jacobs	Development of a Wetland Assessment protocol using biological techniques
Victoria Ludowici	BHortSc(Hons)	University of Sydney	Dr E. Liew, J. Siemon, Dr C. Offord, +Prof D. Guest	Mycorrhizal Associations of NSW Orchid Species, *Cryptostylis subulata, C. erecta* and *Thelymitra* sp.

Student	Degree	University	Supervisors	Project Title
David McKenna	PhD	University of Wollongong	+ Prof R. Whelan, +Assoc Prof D. Ayre, +Dr T. Auld, Dr P. Weston	Ecology of fire-sensitive *Persoonia* species: threatened Species recovery and Management
Hannah McPherson	MSc → PhD	University of New England	Dr D. Crayn, Dr M. Rossetto, +Dr C. Gross	Biogeography of the eastern tetrathecas: Elaeocarpaceae
Yola Metti	MSc	University of New South Wales	Dr A. Millar, +Prof P. Steinberg	Morphology and molecular phylogeny of the red algal *Laurencia* in NSW
Lucy Nairn	PhD	University of Melbourne	+Dr B. Downes, Dr T. Entwisle	Ecology of freshwater macroalgae in sandstone streams of the Southern Highlands, NSW
Jennie Nelson	MSc(Hons)	University of Western Sydney	+Assoc Prof S. Burgin, Dr T. Entwisle	Desmids of Western Sydney
Sophie Peterson	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Biology of *Phyllosticta telopeae*
Tijana Petrovic	PhD	University of Sydney	Dr E. Liew, +Prof L. Burgess, Dr B. Summerell	Taxonomy and Biogeography of *Fusarium* species associated with cultivated Sorghum in Australia
Arthur Pinaria	PhD	University of Sydney	Dr E. Liew, +Prof L. Burgess	Vanilla Stem Rot In Indonesia: Host Diversity and Pathogen Population Genetics
Matt Renner	PhD	University of Sydney	Dr E. Brown, +Dr G. Wardell	Relationships of the Austral family Lepidoziaceae
Christine Rockley	BNatHist(Illustration)	University of Newcastle	BGT Illustration	Natural History External Project – drawing endangered acacia
Josie Saul-Maora	PhD	University of Sydney	+Prof D. Guest, Dr E. Liew	Diversity of Phytophthora palmivara in PNG

Student	Degree	University	Supervisors	Project Title
Karen Sommerville	PhD	University of Technology, Sydney	+Dr A. Pulkownik, +Prof M. Burchett, Dr. M. Rossetto	Conservation of *Wilsonia backhousei* and *Lampranthus tegens*
Len Tesoriero	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Control of soil borne diseases in glasshouse crops Plant
Nguyen Vinh Truong	PhD	University of Sydney	Dr E. Liew, Dr B. Summerell, +Prof L. Burgess	Biology, Epidemiology and Population Structure of *Phytophthora capsici,* pathogen of Black Pepper Wilt in Vietnam
Sela Tupouniua	PhD	University of Sydney	Dr. E Liew, +Assoc Prof R. McConchie	Fungicide Resistance in *Podosphaera xanthii* (powdery mildew) of Squash in Tonga
Jillian Walsh	PhD	University of Sydney	Dr E. Liew, Dr B. Summerell, +Prof L Burgess	*Fusarium* species associated with native sorghum in Australia
Andrew Watson	MScAgr	University of Sydney	Dr B. Summerell, +Prof L Burgess	*Fusarium* species causing cob rot of maize in New South Wales
Trevor Wilson	PhD	University of Sydney	+Dr M. Henwood, Dr B. Conn	Systematic Studies in *Prostanthera* (Lamiaceae)
Paul Wynn	PhD	University of Sydney	+Dr B. Sutton, Dr C. Offord	Water use efficiency of Australian plants
Nick Yee	PhD	University of New South Wales	Dr A. Millar, Dr A. Marchant, +Prof G. Craft	Molecular phylogeny of the algal order Sporochnales
Ameera Yousiph	PhD	University of Sydney	E. Liew; A. Watson (NSW DPI); Prof L. Burgess	Fusarium Wilt of Snow Peas

+ external supervisor

Appendix B: REPRESENTATION ON EXTERNAL COMMITTEES

Doug Benson

Member, North Head Sanctuary Scientific Committee (Sydney Harbour Federation Trust); Member, National Trust Bush Management Advisory Committee.

John Benson

Member, Interagency Technical Working Group on native Vegetation preparing a definition of native vegetation and standards for determining the Extent, Type and Condition of native vegetation in NSW; Member of IUCN Commission of Ecosystem Management participant in workshop on threat criteria for ecosystems for 2008 IUCN World Congress.

Dr Barbara Briggs (Honorary Research Associate)

Member, Editorial Advisory Board, *Nordic Journal of Botany*; Committee Member, NSW Division of Australian & New Zealand Association for the Advancement of Science (ANZAAS).

Dr Elizabeth Brown (Senior Botanist) - KLW

Adjunct Lecturer, University of New England

Professor Carrick Chambers (Honorary Research Associate**)**

Member, Research Committee of Australia Pacific Science Foundation and Pacific Biological Foundation and The Hermon Slade Foundation until 30 May 2006; Member Griffin Reserves Advisory Committee for Willoughby City Council; Patron, Walter Burley Griffin Society Inc.

Dr Barry Conn

Editor, 'HISPID – Herbarium; Information Standards and Protocols for Interchange of Data', version 3; Coordinator, *Flora Malesiana* Urticaceae Working Group.

Dr Darren Crayn

Chair, Hansjorg Eichler Scientific Research Fund Committee; Member, Editorial Committee, Telopea; Vice President, Australian Systematic Botany Society; Councillor, Society of Australian Systematic Biologists; Adjunct Lecturer, University of New England.

Dr Tim Entwisle

Chair, NSW Biodiversity Research Network; Member, International Organising Committee for Eighth International Phycological Congress; Deputy Chair, Australian Academy of Science National Committee for Plant and Animal Sciences; Member, NSW Agricultural Scientific Collections Trust; Scientific Program Coordinator, International Botanical Congress 2011; Member, Scientific Committee for 3rd Global Botanic Gardens Congress; Member, International Advisory Committee for Botanic Gardens Conservation International; Member, Steering Committee for National Collaborative Research Infrastructure (NCRIS) bid; Deputy Chair, Blue Mountains World Heritage Institute; Member, Macarthur Advisory Board (MACROC); Member, Hyde Park Master Plan Reference Committee.

Peter Hind

Member, Management Committee, Vale of Avoca Recreational Reserve Trust; Leader, Society for Growing Australian Plants Fern Study Group.

Dr Surrey Jacobs

Member, Animal Care and Ethics Committee, Australian Museum; Adjunct Assoc. Professor, University of New England; Member, Scientific Advisory Panel for the Shoalhaven River; DEC Wetlands Initiatives; Member, Wetlands Committee of Hawkesbury Nepean Catchment Management Authority.

Dr Edward Liew

Adjunct Senior Lecturer, Faculty of Agriculture, Food and Natural Resources, The University of Sydney; Member, Wollemi Pine Conservation Management (Recovery) Team; Member, Phytophthora cinnamomi Threat Abatement Plan Working Group

Professor David Mabberley (Honorary Research Associate)

Director, University of Washington Botanic Gardens, Seattle, Washington, USA; Adjunct Professor, University of Western Sydney; Extraordinary Professor, Nationnaal Herbarium Nederland, Faculty of Natural Sciences, University of Leiden, The Netherlands; Adjunct Professor, College of Science, University of Western Sydney; President, International Association for Plant Taxonomy; Trustee, Sir Joseph Banks Archive Project, Royal Society and The Natural History Museum, London; Member, Scientific Committee, International Dendrology Society; Member Advisory Board, Flora of Peninsular Malaysia (Kuala Lumpur); Member Pacific Northwest Horticultural Trust (Seattle); Member Programs Selection Committee, American Public Gardens Association.

Bob Makinson

Member, NSW [Threatened Species] Scientific Committee; Member, Species Recovery Team for *Grevillea wilkinsonii* ; Member, Goobarragandra Valley Reserves Trust (Crown Lands Trust under Dept of Lands); Vice-president, Australian Network for Plant Conservation Inc.; Member, Wollemi Pine Conservation Management (Recovery) Team; Secretary, NSW Biodiversity Research Network BGT ; co-representative to DECC Biodiversity Conservation Managers Group.

Adam Marchant

Member of Board of Directors of the Workers' Educational Association (Sydney).

Tony Martin

Committee member, Microscopical Society of Australia.

Amelia Martyn

Member, Australian Society of Plant Scientists; Member, Women In Science Enquiry Network; Spokeswoman, Mount Annan Botanic Garden; Mentor, Willing and Able Mentoring (WAM) program

Patricia Meagher

Member, Wollemi Conservation Management (Recovery) Team.

Peter Michael (Honorary Research Associate)

Member, National Trust Bush Management Committee.

Dr Alan Millar

Editor-in-chief, Journal of the International Phycological Society - *Phycologia*; Deputy Chair, NSW; Fisheries Scientific Committee, Fisheries Management Act; Adjunct Professor of University of New South Wales and University of Melbourne; Member, International Organising Committee, International Phycological Congresses; Member, Nominations Committee, International Phycological Society; Member - International Marine Experts Group; Algal Consultant for International Union for the Conservationof Nature (IUCN); Consultant for Conservation International, Washington DC.

Cathy Offord

Member, NSW Cut-flower Consultative Committee; Program Committee member, International Protea Conference, Melbourne, April 2004; Member, Wollemi Pine Conservation Management Committee, member.

Dr Maurizio Rossetto

Member, IUCN/SSC Reintroduction Specialist Group; Member, *Fontainea oraria* Recovery Team; Member, *Elaeocarpus williamsianus* Recovery Team; Member, Genetic Society of Australia; Member, The Society for Conservation Biology Team; Adjunct Assoc. Professor, University of New England.

Sheryl Saban

Spokeswoman, Botanic Gardens Trust, Sydney.

Dr Brett Summerell

Chair, Council of Heads of Australian Herbaria; Member, Australian Museum, Research and Curation Advisory Committee; Member, International Society of Plant Pathology Committee on *Fusarium*; Member, Australian Biological Resources Study Advisory Committee; Member, Organising Committee for International Mycological Congress 2006; Adjunct Professor, Faculty of Agriculture, Food and Natural Resources, University of Sydney; Adjunct Professor, Department of Plant Pathology, Kansas State University.

Dr Peter Weston

Member, Editorial Advisory Board, *Kew Bulletin*; Adjunct Assoc. Professor, University of New England; Community Representative, Bushland Management Advisory Committee of Lane Cove Municipal Council

Karen Wilson

Convener, Global Plant Checklist Committee, International Organization for Plant Information; member of IOPI Species Plantarum Committee; ;Adjunct Assoc. Professor, University of New England; Council member, Linnean Society of New South Wales; Convener, Special Committee on Electronic Publishing, International Association for Plant Taxonomy; Co-Convener, Global Species Data Network Task Group, CODATA; Member, ICSU/CODATA ad hoc Group on Data and Information; Team chair, Species 2000; Chair, Taxonomy Group, Species 2000; Member, Electronic Catalogue of Names of Known Organisms Subcommittee, GBIF; Member, Species 2000 Asia-Oceania Committee.

Dr Peter Wilson

Member, International Advisory Board, *Candollea* (Geneva) and *Boissiera*; Adjunct Assoc. Professor, University of New England; Member, Committee of the Heads of Australian Herbaria Australian Plant Census Working Group;

Rusty Worsman

Member, Wollemi Pine Management and Recovery Committee.

Appendix C: RESEARCH GRANTS

FUNDING TO TRUST

The Australia and Pacific Science Foundation

Dr Adam Marchant and Dr George Orel - Genetic and horticultural assessment of the Australian native 'bush potato' (*Ipomoea costata*). $11,000 (3rd year of a 3-year $42,000 grant) (extended beyond 30 June 2006)

Australian Biological Resources Study (ABRS)

Dr Tim Entwisle and Dr Stephen Skinner - A Guide to Identification of benthic non-marine Cyanobacteria of Australia $26,400 (3rd year of a 3-year $74,000 grant) – delayed start

Dr Peter Wilson and Dr Chris Quinn – Generic position of the non persistent-fruited species of *Leptospermum* (Myrtaceae) $22,000 (2nd year of a 2 year $44,000 grant) - delayed start

Australian Research Council – Discovery Grant

Dr Maurizio Rossetto, Dr Darren Crayn with Dr M.S. Pole and Dr A. Lowe (Uni Adelaide) - Developing biogeographical know-how: improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers $282,000 shared with the University of Queensland. $4,529 to BGT (2nd year of a 3 year $58,609 grant)

Australian Systematic Botany Society (ASBS) - Hansjorg Eichler Research Fund

Margaret Heslewood (PhD in progress through Uni Adelaide) Phylogeography and biogeography of genera in the family Cunoniaceae in Australasia; focusing on the genus Ceratopetalum; grant will enable sampling from populations of *Ceratopetalum apetalum* (coachwood) at the northern limit of its range. $2,000

Department of the Environment and Water Resources (formerly Department of Environment and Heritage) – Natural Heritage Trust and National Action Plan on Salinity

John Benson and Bob Makinson NSW Native Vegetation Classification and Assessment $200,000 (2nd year of a 2 year $400,000 grant)

Friends of the Royal Botanic Gardens Sydney Inc.

Research Grants

BGT NSW Herbarium Internship Program $14,000

Travel Grants

Dr Barry Conn – 'Wallace in Sarawak – 150 Years Later' Conference $5,000

Scholarships

Hannah McPherson - Understanding past climate change: implications for the Australian flora. Laboratory technique training in France $2,000

Donna Osland – To attend and present at *The 6th International Congress on Education in Botanic Gardens* (Botanic Gardens Conservation International (BGCI) in association with the University of Oxford Botanic Gardens: Oxford UK, 10–14 September 2006) *More than a Plant Label: Creatively Engaging the Public* $7,000

Hermon Slade Foundation

Dr Maurizio Rossetto and Dr Peter Weston - Speciation in the Australian flora: testing explanatory hypotheses in waratahs and their allies $18,800 (1st year of a 3 year $90,000 grant)

Dr Elizabeth Brown – Relationships of the Austral family Lepidoziaceae $18,767 (delayed start – 3rd year of 3-year $56,000 grant) (extended beyond 30 June 2006)

Edwin Wilson and Phil Spence – Establishment of a breeding and propagation program of *Latouria* type high-altitude hybrids of New Guinea dendrobiums $20,000 (3rd year of 3-year $61,550 grant) (extended beyond 30 June 2006)

Dr Darren Crayn and Dr Maurizio Rossetto – Evolution and conservation genetics of Australasian Eleocarpaceae $29,490 (3rd year of 3-year $90,000 grant) (extended beyond 30 June 2006 to 31 Oct 2006))

Dr Cathy Offord - Storage of NSW rare and threatened NSW orchid species and their associated mycorrhizae $30,000 (3rd year of a 3 year $90,000 grant) (extended beyond 30 June 2006)

Land and Water Australia

Prof. B. Downes, Prof. I Rutherford, J. Catford (Uni Melb), Dr Tim Entwisle and L. Nairn - Flows and aquatic plants: an historical and experimental approach. $355,624 in total, $59,120 to BGT. (2nd year of a 2 year $118,240 grant)

NSW State Government Enhancement

Dr Tim Entwisle – Australia's Virtual Herbarium $83,500 (1st year of a 2 year $167,000 grant)

Pacific Biological Foundation

Dr Barry Conn – Interactive identification keys to the common trees of PNG $15,000 (3rd year of 3-year $45,000 grant) (extended beyond 30 June 2006)

Sydney Metropolitan Catchment Management Authority (SMCMA) and DECC (Science and Policy Division), Parks and Wildlife Division, Environmental Protection and Regulation Division

Dr Edward Liew, Dr Brett Summerell, Dr Cathy Offord, Dr Amelia Martyn, Bob Makinson, Dr Rose Daniel, Dr Tony Auld (SPD), Dr Keith McDougall (EPRD) and Dr David Keith (PWD) - Survey and Management of *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority $100,000

UK Millennium Commission

Dr Cathy Offord and Peter Cuneo Seed Quest NSW partnership to supply 250 seedbank collections per year of threatened species of NSW $277,000 (1st year of 3-year $831,000 grant)

FUNDING TO PARTNER ORGANISATIONS

Australian Centre for International Agricultural Research (ACIAR)

Dr Brett Summerelland Dr Edward Liew (with The University of Sydney and Hanoi Agricultural University) - Development of provincial and district level diagnosis and control of crop fungal diseases in Vietnam $166,000 (3rd year of a 3 year $500,000 grant to The University of Sydney)

Dr Edward Liew and Dr Brett Summerell (with The University of Sydney and Sam Ratulangi University) – Diagnosis and control of soilborne fungal diseases of plants in Indonesia $75,258 (2nd year of a 2-year $149,474 grant to The University of Sydney)

Australian Research Council – Discovery Grant

Dr Maurizio Rossetto and Dr Darren Crayn (with Dr A. Lowe, University of Adelaide) – Developing biogeographical know-how: improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers. $35,695 to BGT (delayed start to 1st year of a 3 year $282,000 grant).

Australian Research Council – Linkage

Dr Brett Summerell (with The University of Sydney) - Why does phosphite protect some plants against Phytophthora but not others? $29,665 (delayed start 3rd year of a 3 year $88,604 grant to The University of Sydney, plus shared $136,928)

Australian Research Council - Research Networks

Macquarie University (administrative body) along with BGT [B. Summerell, T. Entwisle, D. Crayn, P. Weston, M. Rossetto] and 40 other partners.

Australian – New Zealand Research Network for vegetation function (3rd year of sharing in $2,500,000 over 5 years)

Grains Research and Development Corporation

Dr Brett Summerell (with Department Primary Industries, Qld); University of Sydney and EnTox - Managing Mycotoxin Contamination of Maize (3rd year of a 3-year $226,000 grant to Department of Primary Industries, Qld)

Appendix E
Overseas Travel

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Other Funds
Dr Alan Millar, Principal Research Scientist	Kobe, Japan	To attend international macroalgal workshop	8 - 14 August 2006	$2,820	Nil	University of Kobe, Japan
Dr Alan Millar, Principal Research Scientist	Sicily, Italy	To attend Italian Phycological Conference	19 - 28 November 2006	$4,000	Nil	Allen Press, USA
Dr Tim Entwisle, Executive Director	Oxford, London, Edinburgh, United Kingdom and Singapore	To participate in international botanic gardens meetings, to visit leading botanic gardens and to visit Singapore botanic gardens on return	8 - 19 September 2006	$6,900	$6,900	Nil
Ms Lucy Nairn, Scientific Officer, Aquatic Plants	Oxford, United Kingdom	To attend the International Association for Landscape Ecology (UK) Conference on Water and the Landscape: The Landscape Ecology of Freshwater Ecosystems and the Annual Meeting of the British Ecological Society	31 August to 8 September 2006	$3,800	Nil	Grant from University of Melbourne
Ms Hannah McPherson Technical Officer (Part-time)/MSc Student	Marseilles, France	To attend the 10th Evolutionary Biology Meeting and visit relevant institutions to meet with experts in the field	5 Sept - 18 October 2006	$3,500	Nil	Friends of the Royal Botanic Gardens Sydney (Staff scholarship of $2,000) and University of New England (research student allowance of $1,500)
Dr Barry Conn, Senior Research Scientist, Plant Diversity	Lae, Papua New Guinea	To finalise the manuscript and website of the first release of the "Guide to Trees of PNG" publication	30 August - 14 Sept 2006	$6,800	Nil	Pacific Biological Foundation
Dr Amelia Martyn, Seed Research Officer	Kew, United Kingdom	To enter into discussions and experimental work at Millennium Seed Bank, Kew	14 Oct - 5 November 2006	$2,500	Nil	Millennium Seek Bank, Kew, UK
Dr Leahwyn Seed, Seed Technolgoy Officer	Kew, United Kingdom	To undertake training at Millennium Seed Bank	14 Oct - 3 November 2006	$2,500	Nil	Millennium Seek Bank, Kew, UK
Dr Elizabeth Brown, Systematic Bryologist	Santo, Vanuatu	To participate in joint research projects in Vanuatu, surveying bryophytes for SANTO 2006	30 Oct - 1 Dec 2006	$3,500	Nil	Institut de Recherche pur le Development, SANTO 2006 and personal contribution

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Other Funds
Mrs Karen Wilson, Special Botanist	London and Kew, United Kingdom and Leiden, Amsterdam	To participate in Species Plantarum (Flora of the World) meeting, to work on manuscripts at RBG Kew and National Herbarium of the Netherlands, and to participate in Species 2000 Team and Taxonomy Group meetings at Zoological Museum, University of Amsterdam	1 - 10 November 2006	$4,700	$2,600	Personal contribution
Dr Elizabeth Brown, Systematic Bryologist	Christchurch and Auckland, New Zealand	To present at workshop and conduct fieldwork in relation to Lepidoziaceae projects	18 - 19 Jan 2007	$2,000	Nil	Grants and personal contribution
Ms Leonie Stanberg, Technical Officer	Bangkok and Pataya, Thailand	To deliver cycad seed donation from BGT to Nong Nooch Tropical Botanical Gardens, to make Cycas DNA & voucher collections from wild collected plants in cultivation at NNTB Gardens and to participate in collaborative field work in central Thailand to locate & study 2 species of Cycas (one critically endangered).	2 - 18 December 2006	$2,500	Nil	Nong Nooch Tropical Botanical Gardens, personal contribution
Dr Edward Liew, Plant Pathologist/ Mycologist	Mandano, Indonesia	To visit Sam Ratulangi University for project discussions and planning	4-9 March 2007	$1,600	Nil	Australian Centre for Agricultural Research
Dr Tim Entwisle, Executive Director	China	To attend the 3rd Global Botanic Gardens Conference	14 April – 22 April 2007	$3,800	$3,800	Nil
Dr Tim Entwisle, Executive Director	Indonesia	To participate in workshop assisting the creation of new botanic gardens in Indonesia	20 April – 23 April 2007	$2,100	$300	Indonesian Botanic Gardens
Dr Barry Conn, Principal Research Scientist	Netherlands, Singapore, Indonesia	To attend 7th Flora Malesiana Symposium 2007 in the Netherlands; to visit Nationaal Herbarium Nederland in Leiden; to visit the Singapore Botanic Gardens and Herbarium and to visit Kebun Raya Bogor and Herbarium Bogoriense, Indonesia	15 June to 5 July 2007	$10,730	Nil	The Australia & Pacific Biological Foundation
Dr Brett Summerell, Director Science and Public Programs	Manhattan, Kansas	To teach and participate in International Fusarium Training workshop	22 June to 31 June 2007	$6,000	Nil	Kansas State University

Appendix E: COOPERATIVE RESEARCH

Chris Allen

- Sydney Harbour foreshore vegetation mapping 1:2,000 scale with Maritime.
- Native Vegetation Extent Map for Sydney Metropolitan Area 1:25,000 scale with Sydney Metropolitan CMA.

Dr Alan Archer

- Chemotaxonomy of species of the lichen genus Graphidaceae with Prof. J.A. Elix of the Australian National University.

Doug Benson

- Assessment of 1770 native vegetation, Historic Cook landing site, Kurnell with G Eldershaw (Parks & Wildlife Div. DEC)

Dr Barbara Briggs

- Phylogeny of Restionaceae with Prof. H.P. Linder, Zurich University, Switzerland.
- Systematics and karyology of Australian *Veronica* with Emeritus Prof. F. Ehrendorfer, University of Vienna, Austria.
- Systematics of Southern Hemisphere *Veronica* with Prof. P.J. Garnock-Jones, Victoria University of Wellington, New Zealand and D. Albach, Johannes Gutenberg-Universität Mainz, Germany.
- Classification of *Veronica* with Prof. F. Ehrendorfer, University of Vienna, Austria, Prof. P.J. Garnock-Jones, School of Biological Sciences, Victoria University of Wellington, New Zealand and Dr. Dirk Albach, Johannes Gutenberg-Universität Mainz, Germany.
- Phylogenetic position of Hydatellaceae with Dr A.D. Marchant, Jeffery M. Saarela and Dr Sean W. Graham, University of British Columbia, Vancouver, Canada.
- Reproductive morphology of families of Poales with Dr P.J. Rudall, Jodrell Laboratory, Royal Botanic Gardens, Kew.

Dr Elizabeth Brown

- Systematics of *Asterella* (Aytoniaceae) with Dr C. Cargill, Centre for Plant Diversity, Canberra.
- Molecular Phylogeny and Systematics of *Fossombronia* in NSW with W. Cuddy, H. McPherson and with Dr. C. Cargill, Centre for Plant Diversity, Canberra.
- Bryoflora of New Caledonia with Dr Jérôme Munzinger, IRD, Noumea.
- IBISCA Queensland and SANTO2006, an international project to study biodiversity.
- Horizontal gene transfer between bryophytes and *Amborella with* Prof. Jeffrey Palmer and Dr. Eric Knox of Indiana University.

Professor Carrick Chambers

- Classification and description of a new species of fern in the genus *Blechnum* recently collected in mountain areas near Mt Jaya in eastern Papuasia in collaboration with P. Edwards and R. Johns at the Royal Botanic Gardens Kew, England.

Dr Barry Conn

- Phylogeny of Westringia (Lamiaceae) with Dr R. de Koh, Royal Botanic Gardens, Kew, UK.
- Phylogeny of Urticaceae with Dr Chris Quinn, Julisasi T. Hadiah and Esti Ariyanti (both Kebun Raya Indonesia)
- Phylogeny of Chloantheae (Lamiaceae) with Dr Murray Henwood, Dr Nikola Streiber (both University of Sydney) and Dr Elizabeth Brown

- Systematics of *Logania albiflora* complex (Loganiaceae) with Anthony Whalen (Department of Environment and Heritage, Canberra)
- Guide to trees of Papua New Guinea with Kipiro Damas (Papua New Guinea National Herbarium)

Dr Darren Crayn

- Systematics and the evolution of ecophysiological traits in Bromeliaceae and relatives with Prof. J. Andrew C. Smith, University of Oxford, UK and Dr. K. Winter, Smithsonian Tropical Research Institute, Republic of Panama.
- Systematics, classification and evolution of the Ericaceae sens. lat. with Dr. C. Quinn, Dr. E. Brown and M. Heslewood, Botanic Gardens Trust, M. Hislop, Western Australian Herbarium, Prof. K.A. Kron, Wake Forest University, NC, USA, Dr. G. Jordan, University of Tasmania.
- Systematics and evolutionary dynamics of Elaeocarpaceae with Dr M. Rossetto, Botanic Gardens Trust.
- Spatial analysis of taxonomic and genetic diversity in Australian Ericaceae with Dr S. Bickford, CSIRO, Canberra.
- Evolution of leaf size in the Australian flora with Prof. M Westoby, T. Lenz and R. Gallagher, Macquarie University, Dr. P. Weston, Botanic Gardens Trust, Dr. A. Mast, Florida State University, FL, USA.
- Developing biogeographic know-how: Improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers, with Dr A. Lowe, University of Adelaide, Dr M. Pole, University of Queensland, Dr M. Rossetto, Botanic Gardens Trust, Prof. D. Lambert, Massey University, Palmerston North, NZ.
- Speciation on an oceanic island with Dr. V. Savolainen and Dr. W. Baker, Kew.

Dr Tim Entwisle

- Molecular systematics, biology and biogeography of freshwater red algae with Dr M. Vis (USA), Dr Alison Sherwood (USA) and Dr Orlando Necchi Jr (Brazil).
- Ecology of stream macroalgae and bryophytes with Dr B. Downes of The University of Melbourne, Victoria.

Joy Everett and Dr Surrey Jacobs

- Continuing studies in the grass tribe Stipeae with the Stipoid Grasses Working Group, including Dr M. Barkworth, Utah State University, USA; Dr R. Bayer, CSIRO, Canberra; C. Hsiao, USDA, USA; Dr M. Arriaga, Buenos Aires; Dr A. Torres, Buenos Aires and Dr F. Vasquez, Spain.

Ken Hill

- The Cycad Pages Internet site with Dr D. Stevenson, New York Botanical Garden, USA.
- Taxonomy of Asian cycads with A. Lindstrom, Nong Nooch Tropical Garden,Sattahip, Thailand.
- Systematics of the genus Cycas with Leonie Stanberg, Botanic Gardens Trust.

Dr Surrey Jacobs

- Macrophytes as indicators of stream health with G. Sainty, Sainty and Associates.
- Aponogetonaceae, Hydrocharitaceae and Menyanthaceae with D. Les, University of Connecticut, USA.
- Nymphaeaceae with Drs T. Borsch, Germany, Khidir Hilu, Virginia, USA, and C.B. Hellquist, North Adams, Massachusetts, USA.
- Chenopodiaceae with Dr. G. Kadereit, Prof. H. Freitag, Germany.

Dr Edward Liew

- Fusarium wilt of snow peas in Australia with Andrew Watson, Yanko Agricultural Institute, NSW Department of Primary Industries.
- Aetiology, epidemiology and control of Fusarium stem and root rot of vanilla in North Sulawesi, Indonesia with Professor Lester Burgess, The University of Sydney and Prof. Dan Sembel, Sam Ratulangi University, Indonesia.
- Population genetic structure of *Fusarium oxysporum* f.sp. *vanillae*, causal agent of vanilla stem and root rot throughout Indonesia with Professor Lester Burgess, The University of Sydney and Prof. Dan Sembel, Sam Ratulangi University, Indonesia.
- Clove decline caused by *Ceratocystis polychroma* in North Sulawesi, Indonesia with Professor Lester Burgess, The University of Sydney; Professor Michael Wingfield, Forestry and Agricultural Biotechnology Institute, Pretoria, South Africa and Prof. Dan Sembel, Sam Ratulangi University, Indonesia.
- Pathogen population structure, disease incidence and management of pineapple heart rot and black pepper wilt in Vietnam with Professor Lester Burgess, The University of Sydney.
- Diversity of *Phytophthora palmivora* on cocoa in Papua New Guinea with Professor David Guest, The University of Sydney.
- Fungal endophytes of cocoa (defensive mutualists or antagonistic parasites) with Professor David Guest, The University of Sydney.
- Evolutionary and pathogenic potential of *Fusarium oxysporum* from native soil and endophytic associations in Australia with Professor Lester Burgess, The University of Sydney.

Professor David Mabberley

- Molecular systematics of Labiatae (Viticoideae, Teucrioideae), esp. *Clerodendrum*, with Dr. D.L. Steane, Dept. Plant Science, University of Tasmania, Dr R.J.P. de Kok & Dr A.Paton, Royal Botanic Gardens, Kew, and Dr R.G. Olmstead, University of Washington.
- Molecular systematics of *Citrus*, with Dr R. Bayer, CSIRO Canberra, & Professor G. Andrew Beattie, University of Western Sydney.
- Systematics of Malesian Meliaceae and Labiatae, with Dr E. Soepdamo. FRIM, Kuala Lumpur & Dr C.M. Pannell, Oxford, UK.
- Systematics of Chinese Citrus and Meliaceae, with Dan Xiang Zhang, South China Botanical Institute, Guangdong, and Bruce Bartholomew (Californian Academy of Sciences, San Francisco).
- Study of Ferdinand Bauer colour-code for plant illustration, with Pilar San Pio, Madrid, Dr E. Pignatti-Wikus, Trieste and Dr C. Riedl-Dorn, Vienna (with Marion Westmacott).
- Catalogue of Robert Brown's publications and plant-names, with Malcolm Beasley and David Moore, The Natural History Museum, London.
- Effect of fire on Borneo rainforests with Karl Eichhorn, University of Leiden, The Netherlands.

Bob Makinson

- Taxonomy of *Astrotricha* with M.J. Henwood, University of Sydney, monograph and Flora of Australia treatment.
- Phylogeny of Proteaceae tribe Grevilleeae, with Austin Mast (University of Florida)

Dr Adam Marchant

- Genetic and horticultural assessment of the Australian native "Bush Potato" (*Ipomoea costata)* with G. Orel, UWS; A. Hill, independent consultant; K. Courtenay, TAFE-WA Kimberley; T. Harley, Kimberley Environmental Consultants; Assoc. Prof. P. Matthews, Museum of Ethnology, Osaka, Japan.
- Relationship of Australian Restionaceae with Dr B. Briggs (Botanic Gardens Trust, Sydney).
- Relationships of South Eastern Asian Theaceae species, with G. Orel, UWS; R. Cherry, Proprietor, and J. Rob, Paradise Plants wholesale nursery, Kulnura; T. Curry, TAFE Richmond; Prof. Gao. Fuyang Research Institute of Sub-Tropical Forestry, China; Prof. L. Legendre, Laboratoire de Biotechnologies Végétales appliquées aux Plantes Aromatiques et Médicinales, Université Jean Monnet, Saint Etiene, France; Prof. C. Parks, Uni. Of North Carolina, USA; Prof. Tran, Hanoi University, Viet Nam.
- Evolutionary relationships of basal angiosperms, with Dr J. M. Saarela and Prof. S. W. Graham, S. W., University of British Columbia, Vancouver, Canada; and Dr B. Briggs (Botanic Gardens Trust, Sydney).
- Relationships within Australian Apiales with Dr M. Henwood, University of Sydney; Dr A. Perkins, BGT and University of Sydney.

Amelia Martyn and Cathy Offord

- Research on seed dormancy in Rutaceae species with Dr Tony Auld and Mark Ooi, NSW Department of Environment and Conservation.
- Seed longevity studies for Australian species with Dr R. Probert (Millennium Seed Bank, Royal Botanic Gardens Kew) and Australian Millennium Seedbank partners.
- Germination and dormancy breaking for Australian species with Dr R. Probert and Dr J. Dickie (Millennium Seed Bank, Royal Botanic Gardens Kew) and Australian Millennium Seedbank partners.
- Research into seed desiccation tolerance with Dr S. Ashmore and Dr A. Parisi (Griffith University, Queensland) and Dr M.I. Daws (Millennium Seed Bank, Royal Botanic Gardens Kew).

Dr Alan Millar

- DNA research on Sporochnales with Nick Yee, Dr G.T. Kraft, University of Melbourne and Dr Adam Marchant.
- Systematics of coralline algae of the east coast of Australia with Dr Wm J. Woelkerling, La Trobe University, Victoria.
- New Zealand representatives of the red algal family Delesseriaceae with Dr W. Nelson, Museum of New Zealand, Wellington.
- Marine floristics of East African coast with Prof. E. Coppejens and Dr O. De Clerck, University of Gent, Belgium.
- Molecular phylogeny of red algal order Gelidiales with Dr Wilson Freshwater, University of North Carolina.
- Marine algae of New Caledonia with Prof. C. Payri, University of French Polynesia and Dr W. Prud'homme van Reine, University of Leiden.
- Biogeographical similarities between South Africa and eastern Australia with Prof. J. Bolton (University of Cape Town).
- Invertebrate epifauna of macroalgae with Dr G. Wilson and Dr D. Faith (Australian Museum)
- DNA research on the red algal genus *Laurencia* with Yola Metti and Prof. P. Steinberg, University of New South Wales.
- Morphology and molecular phylogeny of the green macroalgal genus *Chamaedoris* with Dr F. Leliaert, University of Gent, Belgium.
- Systematics of the red macroalgal family Ceramiaceae with Dr O. De Clerck, University of Gent, Belgium.

Dr Cathy Offord

- Rockdust as a potting mix additive, with Linda Lindongi, Dr R. McConchie, University of Sydney and Dr Geoff Cresswell.
- Flannel flower development with Dr R. Worrall, Dr N. Wade and L. Tesoreiro, NSW Agriculture and Dr L. Campbell, University of Sydney
- Lipid characterization of Araucariaceae seeds with Dr C. Duke and Dr R. Duke, University of Sydney.

Dr Chris Quinn

- Systematics and biogeography of the *Vittadinia* group of Astereae (Asteraceae) with Dr T.K. Lowrey, University of New Mexico, Albuquerque, USA.
- Molecular systematics of hopbushes and their allies (Sapindaceae) with A/Prof P.A. Gadek, James Cook University, Cairns.

Dr Helen Ramsay

- Bryaceae revision for the Flora of Australia vol. 51 (2006) with J. Spence, National Park Service, Page Arizona U.S.A.
- Sematophyllaceae revision for Australia (2002,2004) published with W.B. Schofield, University of British Columbia, Vancouver, Canada and B.C. Tan, University of Singapore, Singapore.
- Distribution and phytogeography of the mosses of north-east Queensland (2004) published with A. Cairns, James Cook University, Townsville, Qld

Dr Maurizio Rossetto

- Developing biogeographic know-how: improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers, with A Lowe (University of Adelaide), DM Crayn, MS Pole (UQ), D Lambert (Massey University, NZ) and PM Hollingsworth (Royal Botanic Gardens, Edinburgh).
- Phylogeographic studies on Elaeocarpus in northern Queensland, with A. Ford (CSIRO Atherton) and D. Crayn.
- Phylogenetic studies on the Australian Vitaceae, with Assoc. Prof. B. Jackes, James Cook University and Assoc Prof J. Wen (Smithsonian Institute, Washington DC, USA).
- Developing a multi-species recovery plan approach for threatened plants of the Border Ranges, with R. Kooyman.
- Variability theory - new applications for Shannon's index, with Assoc. Prof. W. Sherwin (UNSW).
- Population studies on clonal saltmarsh herb, with Karen Somerville and Dr A. Pulkownick (UTS).
- Genetic diversity in fragmented populations of Davidsonia (Cunoniaceae), with Prof. R. Henry and F. Elliot (SCU).
- Population and conservation genetics of Elaeocarpus holopetalus (Elaeocarpaceae), with Assoc. Prof. C. Gross (UNE).
- Population genetics of Elaeocarpus reticulatus, with M Whitehead (UNSW), W. Sherwin

John Siemon, Karen Sommerville & Cathy Offord

- Germination and seed storage of NSW orchid species with Dr C. Wood (University of Plymouth, UK) and Australian Millennium Seedbank partners.

Dr Brett Summerell

- Ecology and taxonomy of *Fusarium* and related fungi, soilborne diseases of plants caused by fungi, and fungal diseases in Vietnam and Indonesia with Professor Lester Burgess, University of Sydney.
- Diseases in hydroponic systems with Dr Jane Tarran, University of Technology Sydney
- Genetics of *Fusarium* with Professor John Leslie, Kansas State University.
- Diseases of trees with Professor Michael Wingfield, FABI, University of Pretoria.
- Biosystematics of fungi on Proteaceae and Myrtaceae with Prof. Pedro Crous, CBS Netherlands.
- *Phytophthora* root rot in NSW National Parks with Dr Keith McDougall from DEC.
- Biology and control of *Phytophthora* root rot with Professor David Guest, University of Sydney.

Dr Peter Weston

- Systematics, biogeography and comparative biology of the Proteaceae, with Associate Prof. N.P. Barker, Rhodes University, South Africa, Dr D. Cantrill, Royal Botanic Gardens Melbourne, Dr G. Jordan, University of Tasmania, Dr A. Mast, Florida State University, USA, Mr F. Rutschmann, University of Zurich, Switzerland, Dr H. Sauquet, Royal Botanic Gardens, Kew.
- Systematics, biogeography and comparative biology of the Diurideae (Orchidaceae) with Dr M.A. Clements, CSIRO Division of Plant Industry, Dr M. Henwood and Dr A. Perkins, University of Sydney, Mr J. Indsto, Westmead Institute for Cancer Research, Dr J. Mant and Dr R. Peakall, Australian National University, and Prof. R. Whelan (University of Wollongong).
- Floral development in the Calycanthaceae, with Mr Yannick Staedler and Prof. Peter Endress (University of Zurich, Switzerland).
- Phylogeny of the Goodeniaceae with Dr Siegfried Krauss, Kings Park and Botanic Garden, Perth.
- Assembly of Southern Floras, with Working Group 18 of the ARC-NZ Research Network for Vegetation Function, Macquarie University
- Evolutionary history of the Eastern Mesic Biome with the ARC Environmental Futures Network, University of Adelaide.

Karen Wilson

- Systematic studies in Juncaceae with Assoc.Prof. J. Bruhl (University of New England) and Dr J. Hodgon (Qld National Parks & Wildlife Service).
- Systematic studies in Abildgaardieae (Cyperaceae) with Assoc. Prof. J. Bruhl (University of New England), Dr K. Clarke and Dr K. Ghamkhar (University of Western Australia).
- Systematics of *Carpha* (Cyperaceae) with Assoc. Prof. J. Bruhl (University of New England) and Dr Xiufu Zhang.
- Systematics of Lepidosperma laterale (Cyperaceae) with Assoc. Prof. J. Bruhl (University of New England) and Dr J. Hodgon, (Qld National Parks & Wildlife Service).
- Spikelet structure in Cyperaceae, esp. *Exocarya*, with Dr J. Richards (Florida International University, Florida) and Assoc.Prof. J. Bruhl+(University of New England)
- Systematics of Schoenoplectus sens. lat. with Dr A. Muasya (University of Cape Town), Assoc. Prof. J. Bruhl (University of New England) et al.
- Systematic studies in tribe Schoeneae with Assoc.Prof. J. Bruhl, University of New England, and Dr J. Hodgon (Qld National Parks & Wildlife Service).

Dr Peter Wilson

- Systematics of the *Indigofera pratensis* complex with Dr A. Kazandjian, Simon Bolivar University, Caracas, Venezuela, Dr M. Waycott and Adjunct Associate Professor B. Jackes, School of Tropical Biology, James Cook University, Townsville.
- Relationships and generic concepts in the tribe Chamelaucieae, particularly *Baeckea* sens. lat. and *Micromyrtus*, with Dr B.L. Rye and Mr M. Trudgen, Western Australian Herbarium.
- Relationships and generic concepts in the *Verticordia/Darwinia/Chamelaucium* group with Dr M.D. Barrett, Kings Park and Botanic Garden; and Dr L.M. Copeland, New England University.
- Fossil fruit of Myrtaceae from the Eocene of South Australia with Dr J. Basinger, University of Saskatchewan, Canada; Dr David Greenwood, Brandon University, Manitoba, Canada; and Dr D. Christophel, University of Denver, Colorado, USA.
- Description of new species of *Xanthostemon* (Myrtaceae) from the Solomon Islands, with F. Pitisopa, Solomon Islands Forestry Department.

Appendix F: PLANT SCIENCES PUBLICATIONS

Archer, A.W. (2006). Additional lichen records from Australia 60: *Sclerophyton elegans* Eschw. *Australasian Lichenology* 59: 19.

Archer, A.W. (2006) The lichen family Graphidaceae in Australia. *Bibliotheca Lichenologica* 94: 1-191.

Archer, A.W., Messuti, M.I. in. De La Rosa & A.W. Archer (2006). A new species of *Pertusaria* from Valdivian rainforest, Argentina. *Lichenologist* 38: 263-266.

Elix, J.A. and **Archer, A.W.** (2007). Four new species of *Pertusaria* (lichenised Ascomycota) from Australia. *Australasian Lichenology* 60: 20-25.

Archer, A.W. (2007). *Graphis coenensis* A.W. Archer, a new name for *Graphis celata* (A.W. Archer) A.W. Archer. *Australasian Lichenology* 60: 13.

Archer, A.W. (2007). Key and Checklist for the lichen family Graphidaceae (Lichenised Ascomycota) in the Solomon Islands. *Systematics and Biodiversity* 5: 9-22.

Messuti, M.I. Becker, U. and **Archer, A.W.** (2007). New or interesting saxicolous *Pertusaria* species (Pertusariales: Pertusariaceae) from Zimbabwe. *Lichenologist* 39: 227-230.

Archer, A.W. and Elix, J.A. (2007). New species and new reports in the Australian Graphidaceae. *Telopea* **11**: 451-462.

Basinger, J.F., Greenwood, D.R, **Wilson**, **P.G.** and Christophel, D.C. (2007) Fossil flowers and fruits of capsular Myrtaceae from the Eocene of South Australia. *Canadian Journal of Botany* 85: 204–215.

Benson, D. and Eldershaw, G. (2007) Backdrop to encounter: the 1770 landscape of Botany Bay, the plants collected by Banks and Solander and rehabilitation of natural vegetation at Kurnell. *Cunninghamia* 10 (1): 113-137.

Benson, D., Murray, L., Lee, L.L., and **Wilson, K.L.** (2006) The botany of Botany Bay: People, Plants and Places. http://www.rbgsyd.nsw.gov.au/information_about_plants/botanical_info/Botany_of_Botany_Bay

Benson, D. and **Von Richter, L.** (2006) Ecology of Cumberland Plain Woodland Plants http://www.rbgsyd.nsw.gov.au/conservation_research/ecology_research/Ecology_of_Cumberland_Plain_Woodland

Benson, J.S. (2006) New South Wales Vegetation Classification and Assessment: Introduction – the classification, database, assessment of protected areas and threat status of plant communities. *Cunninghamia* 9(3): 331-382

Benson, J.S., **Allen, C.B.**, **Togher, C.** and **Lemmon, J.** (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant Communities of the NSW Western Plains. *Cunninghamia* 9(3): 383-451.

Bentley, A.R., Tunali, B., Nicol, J.M., Burgess, L.W. and **Summerell, B.A.** (2006) A survey of *Fusarium* species associated with wheat and grass stem bases in northern Turkey. *Sydowia* 58(2): 163-177.

Bentley, A.R., Cromey, M.G., Farrokhi-Nejad, R., Leslie, J.F., **Summerell, B.A.** and Burgess, L.W. (2006) *Fusarium* crown and root rot pathogens associated with wheat and grass stem bases on the South Island of New Zealand. *Australasian Plant Pathology* 35: 495-502.

Briggs, B.G. and Ehrendorfer, F. (2006) New Australian species and typifications in *Veronica* sens. lat. (Plantaginaceae). *Telopea* 11(3): 276-292.

Briggs, B.G. and Ehrendorfer, F. (2006) Chromosome numbers of Australian and New Guinean species of *Veronica* (Plantaginaceae). *Telopea* 11(3): 294-298.

Brown, E.A. (2007) Mosses and Liverworts. Pp 151–153 in Lemann, J., Simons, J., Smith, E., Wright, C., Moffat, J-R. and Elphick, M. (eds), *The Gib: Mount Gibraltar: Southern Highlands*. (Mount Gibraltar Landcare and Bushcare, Bowral)

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Entwisle, T.J. (2007) Biogeography of freshwater macroalgae. *Algae of Australia: Introduction,* pp. 566-579.

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Harvey, A.S., Phillips, L.E., Woelkerling, Wm J. and **Millar, A.J.K.** (2006) The Corallinaceae, subfamily Mastophoroideae (Corallinales, Rhodophyta) in south eastern Australia. *Australian Systematic Botany* 19(5): 387-429.

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Kooyman, R. and **Rossetto, M**. (2006) Factors influencing species selection for littoral rainforest restoration: do environmental parameters matter? *Ecological Management & Restoration* 7(2): 113-122.

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Lindstrom, A.J. & **Hill, K.D.** (2007) The genus *Cycas* (Cycadeae) in India. *Telopea* 11: 463-488.

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Mabberley D.J.and Juniper, B.E. (2006,). The story of the apple. Pp. 219 + numerous text figs & 36 colour plates. Timber Press, Portland, Oregon, & Cambridge, UK

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Makinson, R.O. (2006) Botanic Gardens and Conservation. In R.J. Henry (ed.) . The Haworth Press, 15 pp.

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Martyn, A.J., Thomas, C.R., O'Neill, M.E., **Offord, C.A.** and McConchie, R. (2007) Bract browning in waratahs (*Telopea* spp.) is not a localized calcium deficiency disorder. *Scientia Horticulturae* 112: 434-438.

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Ramsay, H.P. (2006) Chromosome numbers in some species of *Dicranoloma* from Australia, New Zealand and Papua New Guinea. *Telopea* 11(3): 308-313.

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Skinner, S., Millar, A.J. and Entwisle, T.J. (2007) Chlorophyta: Chlorophyceae, Ulvophyceae and Dasycladophyceae. *Algae of Australia: Introduction* 334-337, 338-340, 349-350.

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Whalen, A.J. and **Conn, B.J.** (2007) Status of *Logania falcata* and *L.* sp. aff. a*lbiflora* (Loganiaceae) *Telopea* 11: 393-397

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General Audience

Benson, J. (2007) The NSW VCA Project *National Parks Journal* 51(3): 26-27

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Entwisle, T.J. (2006) The true story of *Sirodotia goebelii*. *Australian Systematic Society Newsletter* 128: 13-15.

Entwisle, T. (2007) Botanical buffet - the importance of living collections for plant systematics. *BG Journal* 4(1): 16-20.

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Mabberley, D.J. and Smith, S. (2007) The journey to a snow gum woodland in Seattle. *Washington Park Arboretum Bulletin* 69(2): 12-15

Makinson, B. (2007) First plant science internship program a roaring success. *The Gardens* 73: 29

Marchant, A. (2006) Morning Glory in the Land of the Rising Sun *The Gardens* 70: 19.

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SCIENTIFIC PUBLICATIONS AVAILABLE FOR SALE

SCIENCE

Telopea (a journal of systematic research) and ***Cunninghamia*** (a journal of plant ecology for eastern Australia) are published by the Gardens in March and September (*Telopea*) and July and December (*Cunninghamia*). They are available from the Gardens Shops or by subscription, or on exchange to other organisations. Copies of most back issues are still available for sale from the Gardens Shop in Sydney.

Setting the Scene: the Native Vegetation of NSW (1999) by J.S. Benson, published by the Native Vegetation Advisory Council. $8.75.o/p

The nature of pre-European native vegetation in south-eastern Australia: a critique of Ryan, D.G., J.R. and Starr, B.J. (1995) The Australian Landscape — Observations of Explorers and Early Settlers (1997) by J.S. Benson & P.A. Redpath, offprint from Cunninghamia 5(2): 285-329, $5.50. o/p

Collection, Preparation and Preservation of Plant Specimens (Royal Botanic Gardens Sydney 2nd edition, 1995) $6.95.

Riverside Plants of the Hawkesbury*Nepean by J. Howell, L. McDougall & D. Benson (Royal Botanic Gardens Sydney, 1995) $10.95. o/p

Rare Bushland Plants of Western Sydney (1999) Revised edition, by Teresa James, Lyn McDougall and Doug Benson (Royal Botanic Gardens Sydney) $13.15.

Sydney's Bushland: More than meets the eye by J. Howell & D. Benson (Royal Botanic Gardens Sydney, 2000) $14.95

Mountain Devil to Mangrove: a Guide to Natural Vegetation of the Hawkesbury*Nepean Catchment by D. Benson, J. Howell and L. McDougall (Royal Botanic Gardens Sydney, 1996) $21.95.

Missing Jigsaw Pieces: the Bushland Plants of the Cooks River Valley by D. Benson, D. Ondinea & V. Bear (Royal Botanic Gardens Sydney, 1999) $13.15.

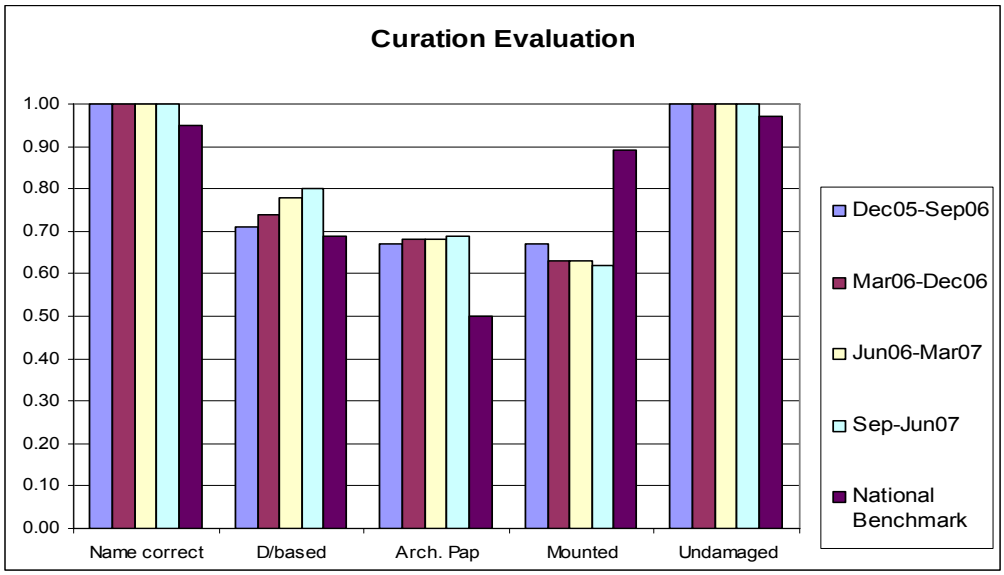
EDUCATION

Bush Foods of New South Wales by Kathy Stewart and Bob Percival. Aboriginal use of plants (Royal Botanic Gardens Sydney, 1996) $9.90 o/p

Appendix G: PERFORMANCE INDICATORS

Curation evaluation

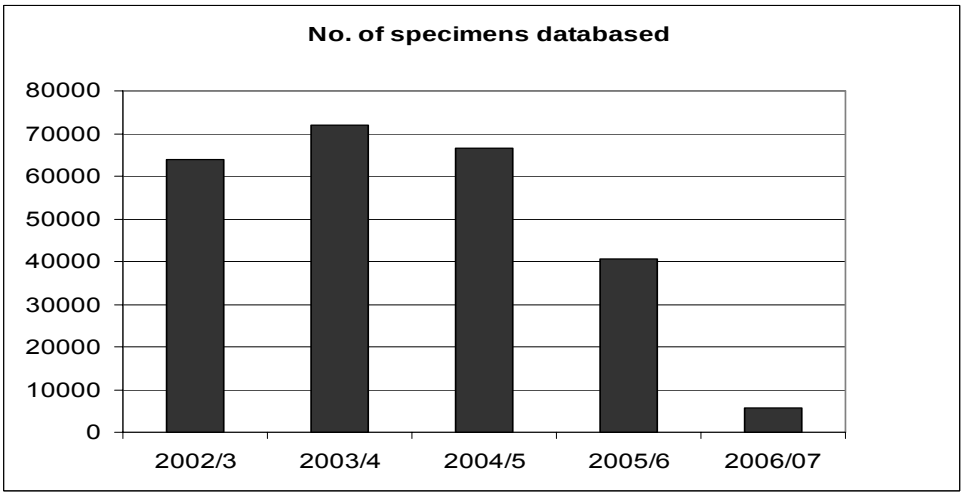
Curation of herbarium specimens in the National Herbarium of NSW in most cases met or exceeded the national benchmark for Australian herbaria. The large number of unmounted specimens is being addressed through the specimen mounting program, staffed by volunteers, which continues to make significant inroads into mounting the collection, especially new accessions.



There were a total of 4,975 standard new accessions added to the Herbarium, 522 more than last year.

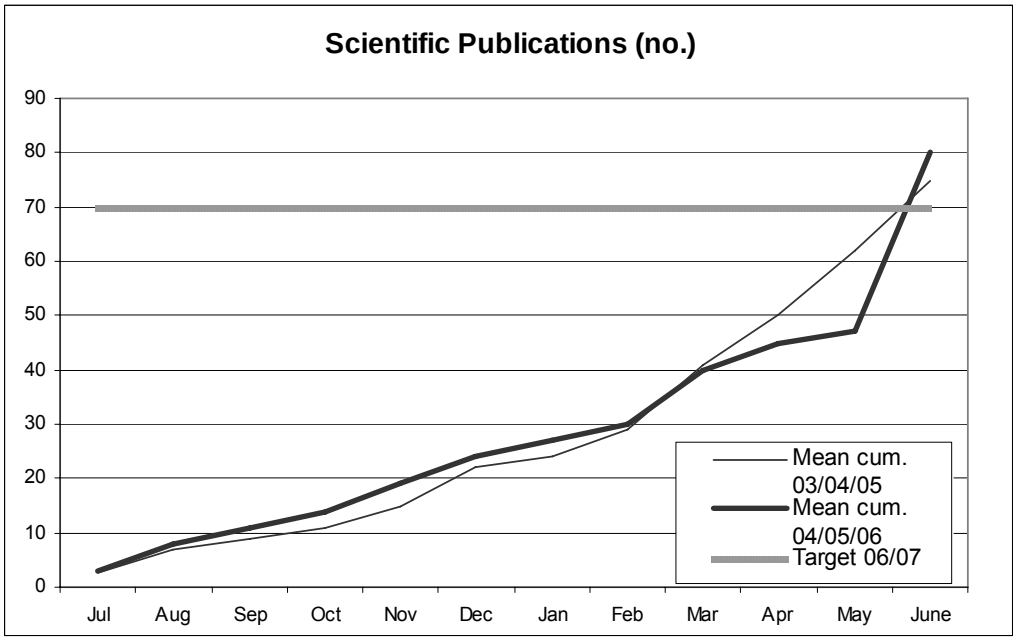
Numbers of specimens dtabased

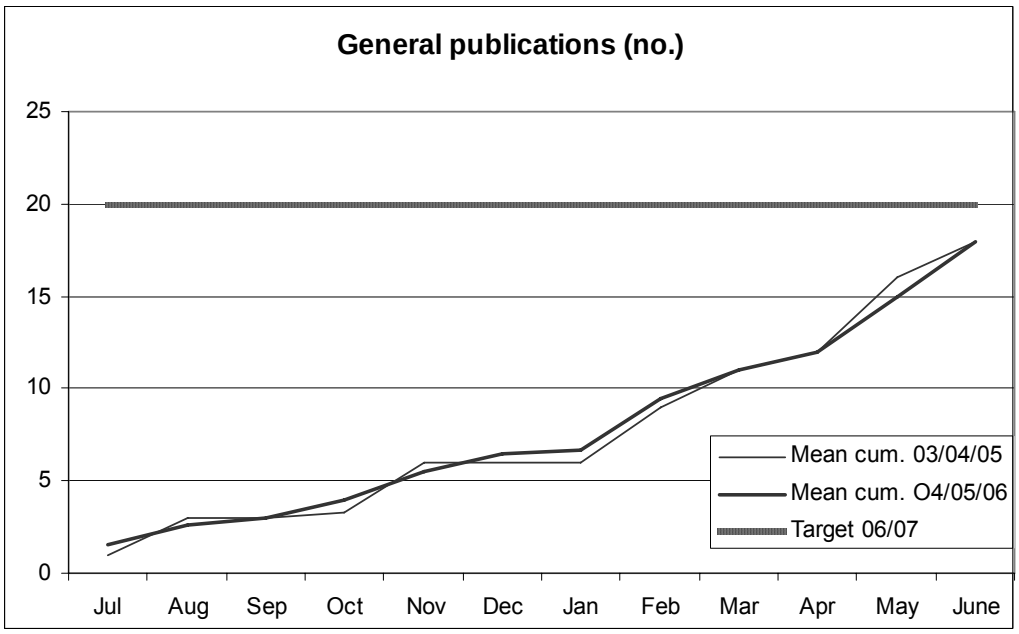
The level of databasing, as shown by the accompanying graph, was considerably lower than the previous year due to the completion of stage one of Australia's Virtual Herbarium project. Funding for stage 2 of this project was provided to the Trust and will accelerate databasing during 2007/8.



Publications

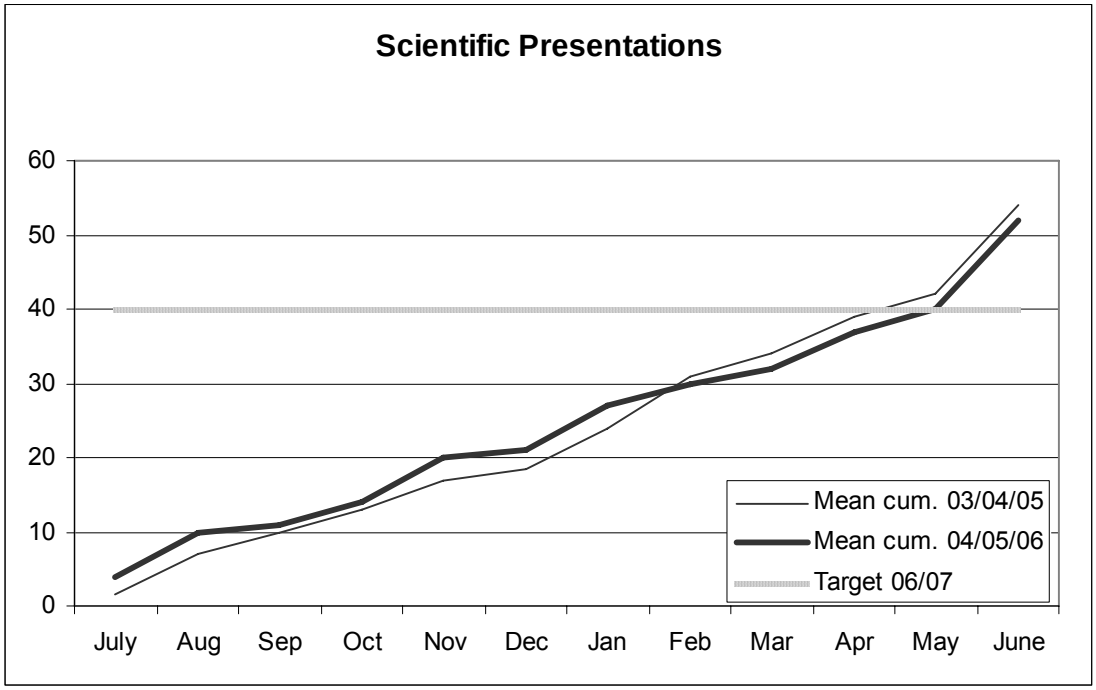
The Trust's aim is to publish a mix of papers for general and scientific audiences each year. Ninety three scientific publications were produced by Trust staff in a range of international journals, well over the target of 70. Eighteen general interest articles were published, just under the target of 20. Two volumes of each of the Trust's journals *Telopea* and *Cunninghamia* were published and included a range of scientific papers not only from staff of the Trust but also scientists from Australian and State government agencies and a number of universities.

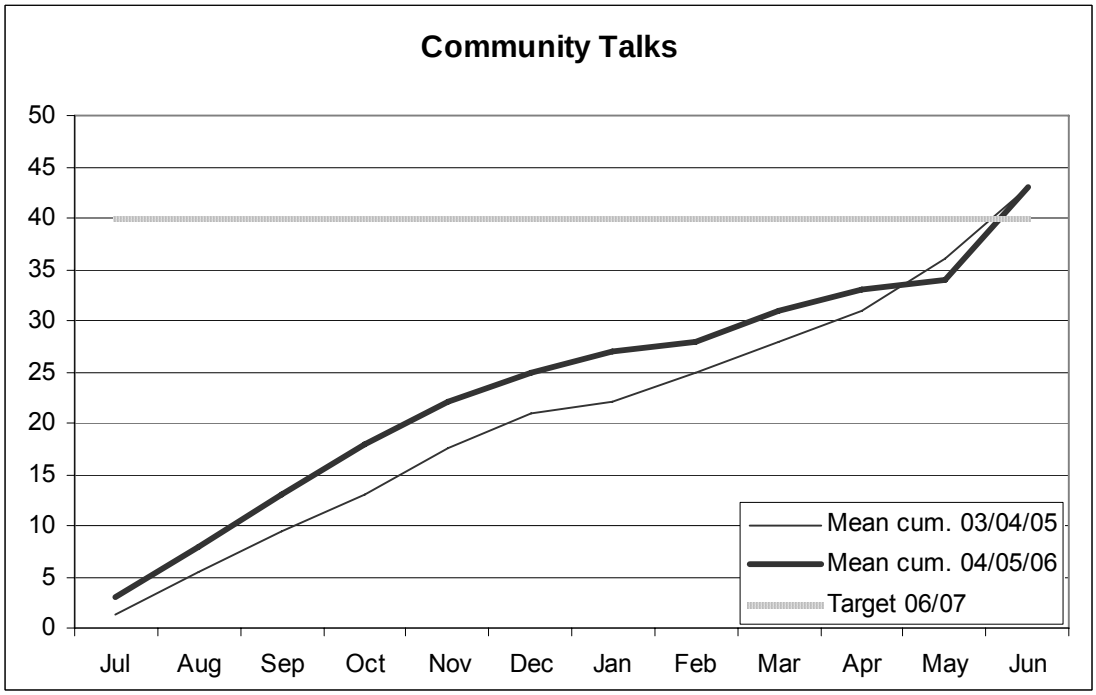




Presentations

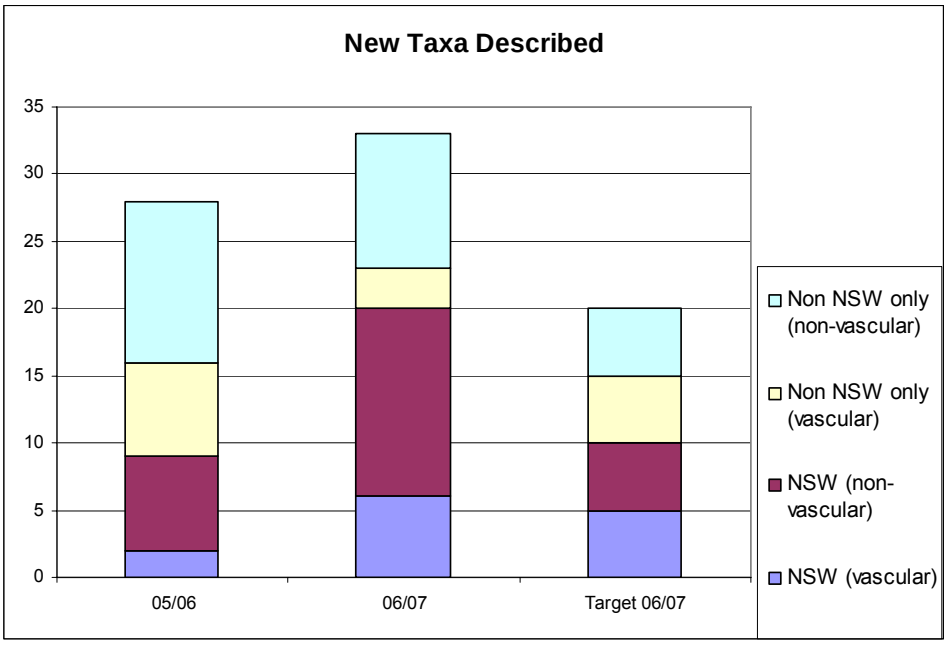
Trust scientists give a range of talks, not only at national and international scientific conferences, but also to a range of community groups, professional organisations and the public.

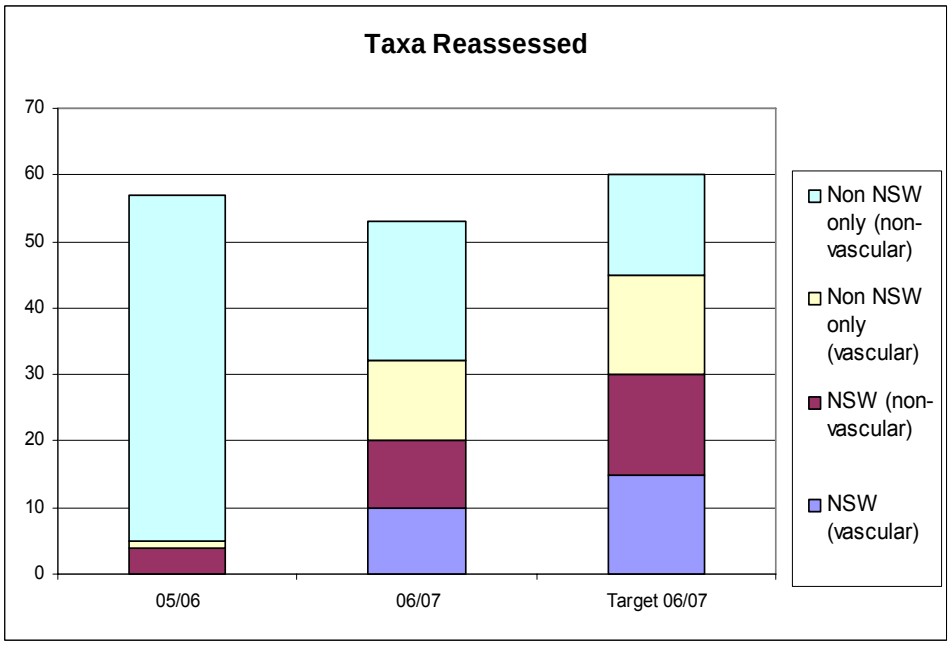




New taxa described or reassessed

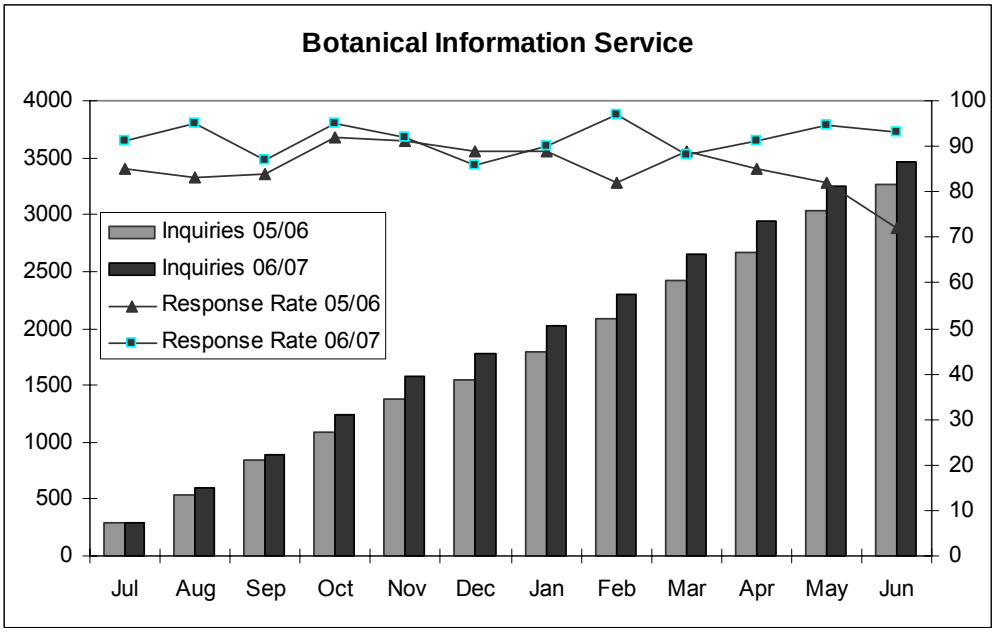
A number of species new to science were described by Trust scientists and honorary research associates this year. This included 9 species of vascular plants, 1 species of marine algae, 2 species of bryophytes, 9 lichens and 9 species of fungi (including two new genera).

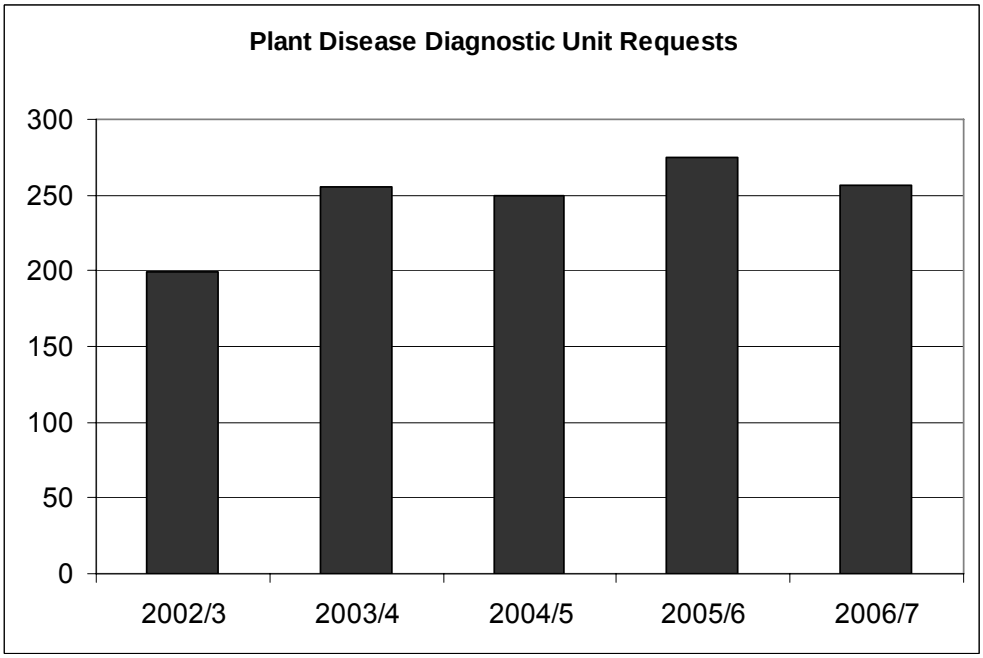


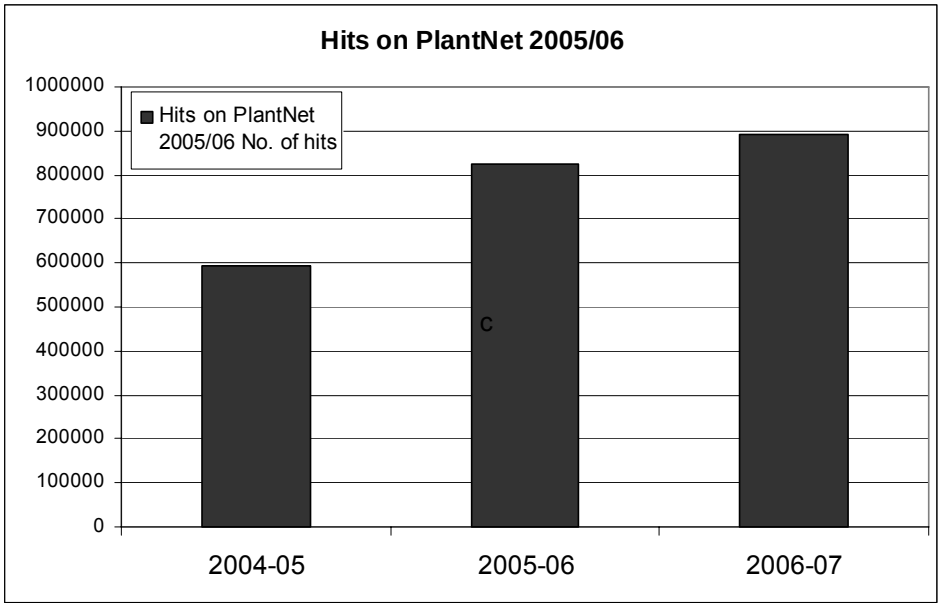


Inquiries for plant identification

The target for botanical information service delivery was 70% of inquiries to be answered within 7 days. This target was exceeded this year with 92% of inquiries answered within 7 days. The number of requests for diagnosis at the Plant Disease Diagnostic Unit (PDDU) exceeded the high levels achieved in 2004–05 and 2005-06. Most diagnoses were for detection of soil-borne pathogens, particularly those species causing Phytophthora root rot. PlantNET, including the NSW Flora Online website, is the Trust's online plant information service. Patronage continues to grow. It was available to a limited extent in previous years and was formally launched early in 2004–05.

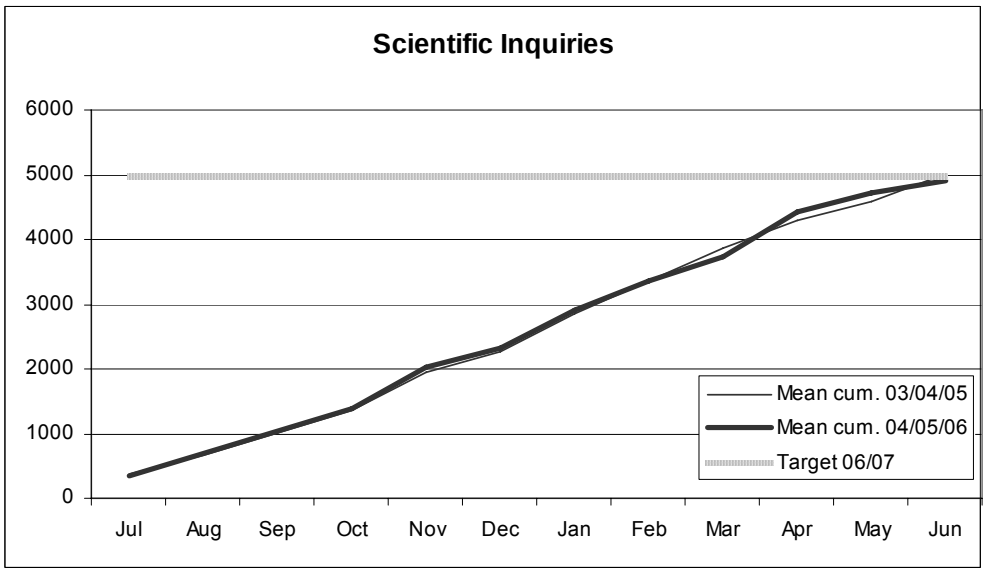






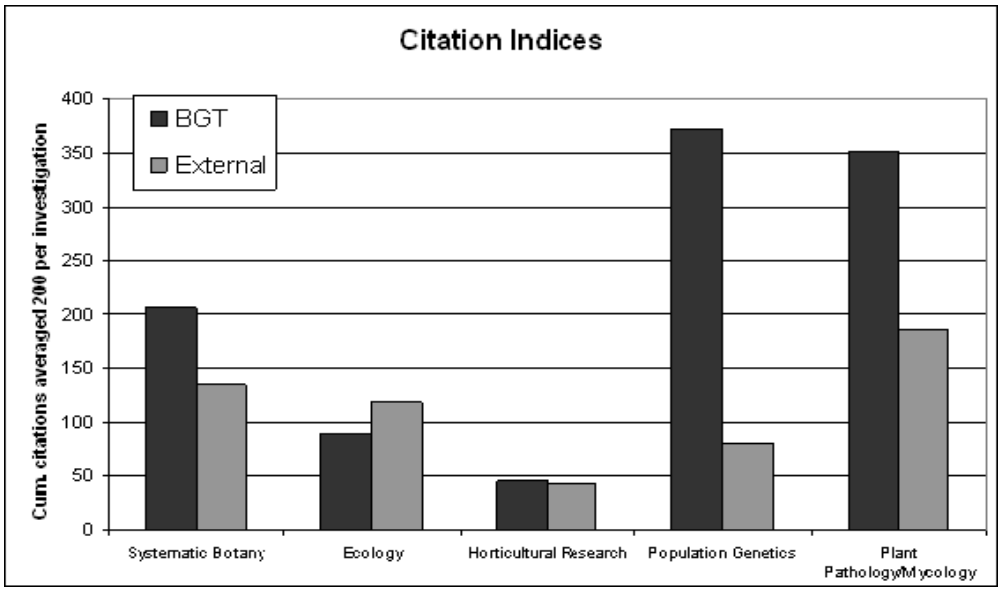
Scientific Inquiries

The majority of scientific inquiries are directed through either the Botanical Information Service or the Plant Disease Diagnostic Unit. However all members of the scientific staff receive a variety of inquiries dealing with their own area of expertise. In addition our internet information portal, PlantNET, elicits a variety of inquiries.



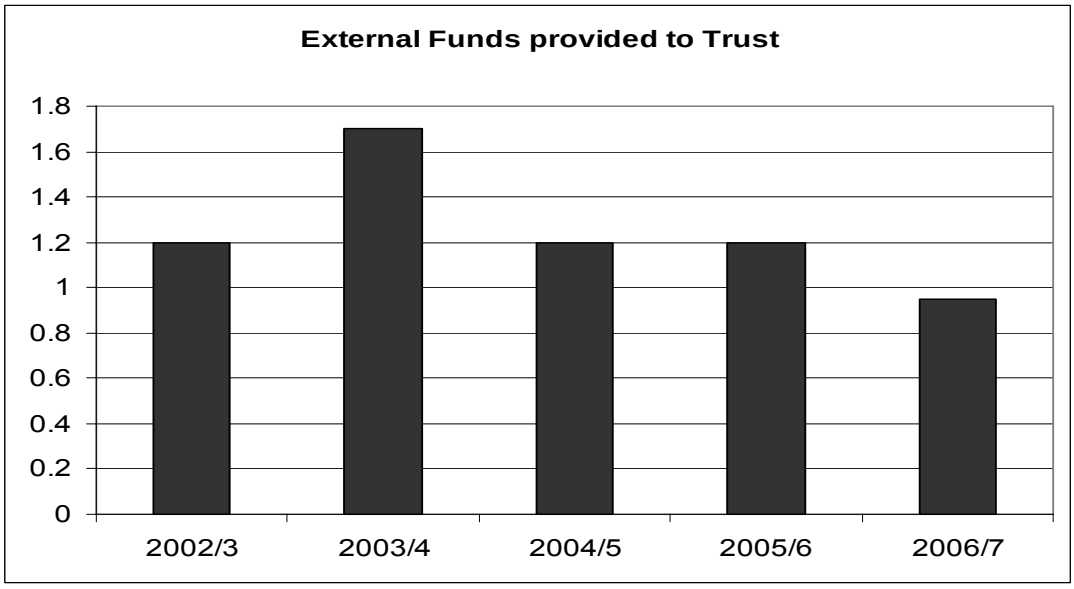
Citation indices

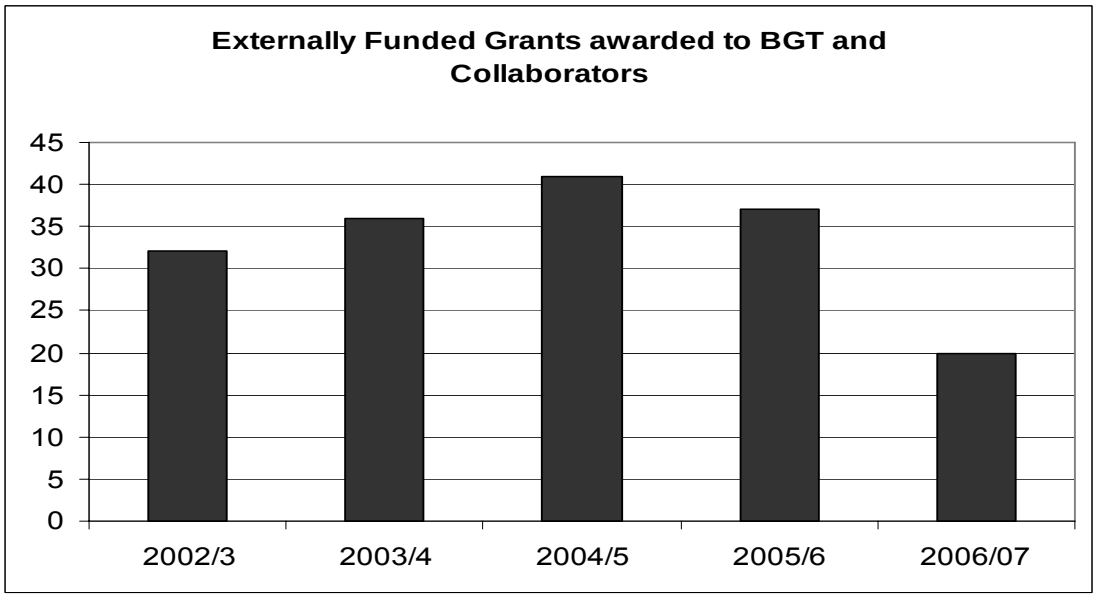
This graph compares the number of times scientific papers by groups of our researchers are cited in international journals with a comparative group of researchers from other Australian institutions. Note that this is not the complete number of times papers have been cited as the International Scientific Index does not collate information from all journals.

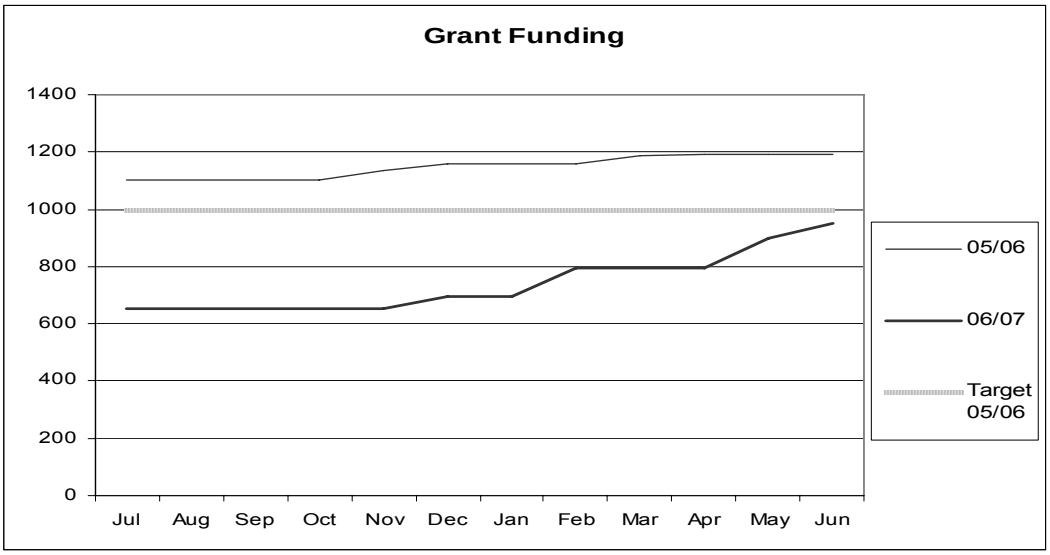


Grant Funding

The total value of grants was maintained at similar level as that achieved last year and the number of grants was maintained at a similar level to that of the past three years. Note that this includes grants awarded directly to the Trust as well as those awarded to other institutions where Trust staff are co-investigators. See Grant funding to the Trust for detailed list of grants awarded to the Trust.







Students supervised

Postgraduate students continue to make significant contributions to the Trust's scientific program, with over 40 supervised by Trust scientists and 12 based full-time with the Trust. This is close to capacity for supervision with existing staff levels.