ANNUAL REPORT

Plant Sciences Branch
Royal Botanic Gardens and Domain Trust

2003–2004

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

Botanic Gardens Trust
SYDNEY

www.rbgsyd.nsw.gov.au/information_about_plants/our_publication

Access Directory

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8.30 am to 5 pm, Monday to Friday

Mount Annan Botanic Garden
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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.

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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.

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

Cover photo: *Xanthorrhoea* spp. in Werrikimbee National Park affected by *Phytophthora* root rot.
Bottom of page: *Phytophthora cinnamomi*, the pathogen that causes this disease.

Contents

Highlights of the Year

- Third year of Australia's Virtual Herbarium (Stage 1), a five-year $10 million national project to database, and make available on the internet, specimen information from all major State and Territory herbaria.
- Co-supervision of 57 students, and continuing commitment to tertiary teaching, including the University of New England Biosystematics Course.
- Grant and enhancement funding of $1,158,000 (including Australia's Virtual Herbarium $400,000) to the Trust, and a further $240,500 to our partner organisations through collaborative projects. This total of $1.7 million is a record level for Plant Sciences Branch, with a continued high proportion of the funding directed to the Trust.
- Maintenance of diverse and high quality research programs, with nearly 90 publications for scientific audiences. Significant projects initiated during the year include: several studies on the consequences of habitat fragmentation in key species in rainforests in Australia, relationships between marine algae and the invertebrates associated with them, understanding the seed biology of threatened species, surveying the population dynamics of the *Phytophthora cinnamomi* and interactive keys to rainforest trees in New Guinea and freshwater algae in NSW.
- Launch of *FloraOnline*, the electronic version of the "Flora of New South Wales".
- Publication in *Telopea* of the Proceedings of the Robert Brown 200 international conference held by the Trust in 2002.
- Series of workshops organised by the Centre for Plant Conservation in collaboration with the Australian Network for Plant Conservation and Australian Association of Bush Regenerators on *Phytophthora* and translocation techniques.
- Establishment of the Red Box Gallery, with exhibitions on botanical art and the Margaret Flockton Prize in botanical illustration.
- Recognition and celebration of our role in biodiversity research through the sponsorship of our third Eureka Prize (awarded to Birds Australia).
- Launch of SeedQuest at the seedbank at Mount Annan Botanic Garden, a partnership with the Millennium Seed Bank at Royal Botanic Gardens Kew, resulting in expansion of the NSW Seedbank and associated research.

- Improvements and enhancements to the Trust library.
- No Lost-Time Injuries for the Branch.

Part 1: Introduction

The Plant Sciences Annual Report is again 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 Plant Sciences Branch 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 Sydney 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 remain one of the leading world 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 Plant Sciences

The Royal Botanic Gardens and Domain 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 Plant Sciences

- 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.

Part 2: Plant Sciences Branch

Review of Plant Sciences Branch

The Plant Sciences Branch of the Botanic Gardens Trust was reviewed in 1999 by an international and eminent team of six scientists and administrators, chaired by Professor Brian Huntley, Chief Executive Officer, National Botanical Institute, South Africa. This was the first review of the scientific program of the Trust and the terms of reference focused the review on program performance, relevance and future directions, collaboration and interaction, the role of the Scientific Committee and options for a restructure. At its 235th meeting (April 2003) the Trust agreed to a 10 yearly full external review and a 5 yearly minor review by the Scientific Committee of the Trust. Accordingly the branch was reviewed on March 16th, 2004 by a team of reviewers consisting of the members of the Scientific Committee of the Trust and Professor Andrew Beattie, Macquarie University, a member of the original review team.

SUMMARY OF REVIEW

Key questions that were addressed

- What are the current strengths and weaknesses of the Plant Sciences Branch?
- Have the recommendations of the Vision Document been met?
- How have changes to the 'environment' in which the Trust and science operate impacted on outcomes?
- Is science meeting the objectives and vision of the Trust Corporate Strategic Plan 2003-2005?
- Which areas of science need further review or redirection?
- Is the management and reporting structure effective?
- What is the ideal staffing and resource mix within the currently available, or achievable, budget?
- How effective are current approaches to teaching, student supervision and internships, and are there alternative approaches that could be considered?

Main findings of the Review Team

- The Botanic Gardens Trust has a contemporary and relevant scientific research program, providing the fundamental knowledge base for conservation and plant diversity.
- The Trust's research program provides essential and unique information that feeds into government and community natural resource management priorities. The Plant Sciences Branch, seen by the 1999 review as having too low a profile, is increasingly recognised throughout NSW, Australia and internationally.
- The review team agreed that undertaking original research beyond the boundaries of NSW is relevant and is to be encouraged.
- In recent years there has been a marked increased student demand for higher degrees by research. There is an expectation that scientists will pass on their knowledge through a commitment to mentoring the young, through teaching and research training; the outcome for the Trust in this respect is most positive.
- For the general public, there is now an expectation that national treasures, including those in herbaria, should be accessible freely in a virtual environment. The commitment to Australia's Virtual Herbarium project is consistent with this expectation, but puts increased pressure on resources and personnel.

Science Promotion

The Plant Sciences Branch continued to receive excellent media coverage, with a particular strength this year on numerous items on the children's TV show *Totally Wild*. Staff publicised their work in print, radio and television wherever the opportunities arose. Dr Tim Entwisle presented a fortnightly item on the Angela Catterns Breakfast Show, 702 ABC radio, and maintained his regular contributions to *Nature Australia* and *The Gardens*. Other publications and presentations for general audiences are included in the detailed reports for each section, and in the reference list at the end.

Royal Botanic Gardens and Domain Trust Eureka Prize for Biodiversity Research

The Trust's Eureka Prize is awarded to 'an individual, team or organisation for innovative scientific research that makes an outstanding contribution to the conservation of Australia's biodiversity'. The annual Eureka Prize Award ceremony was held in August, in Sydney. Over 700 scientists, science journalists, politicians and 'celebrities' were present when Director Frank Howarth awarded our third Eureka Prize for Biodiversity Research to Professor Henry Nix, President of Birds of Australia, for the development of 'Atlas of Australian Birds'. The record audience of 800 included leading scientists, journalist and State and Federal politicians. A wonderful science promotion opportunity! See http://www.amonline.net.au/eureka/biodiversity_research/2003_winner.htm for more information on the prize winner, and the prize. The two other finalists were: Marion Anstis, Frog Biologist, and Emeritus Professor Ray Specht, University of Queensland.. The judges this year were Peter Weston (Royal Botanic Gardens and Domain Trust), Gerry Cassis (Australian Museum), Kingsley Dixon (Kings Park, Perth) and Chris Dickman (University of Sydney).

Conference Hosting

Maurizio Rossetto and Bob Makinson, in collaboration with John Morgan from La Trobe University in Melbourne, organised a workshop on 'The Consequences of Habitat Fragmentation', held at our Sydney site in July 2003.

Teaching

The number of students supervised continues to increase – 57 compared with 55 last year**.** Staff also delivered guest lectures at various universities, sometimes presenting blocks of key lectures (e.g. Dr Darren Crayn at The University of New South Wales, Dr Brett Summerell at The University of Sydney, and Dr Tim Entwisle at The University of Technology Sydney).

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. The first residential school in Sydney was held at the Trust and the Australian Museum in July 2003.

Honorary research associates

Ms Gwen Harden, Mr Robert Kooyman and Mr Rod Rice were appointed as new Honorary Research Associates in June 2004. 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.

Janet Cosh Studentship

Over the summer of 2003–04, the Trust hosted two Cosh Summer Students, Bryony Horton and Leahwyn Seed. The eight–week studentship is funded by interest income generated by a bequest from the late Janet Cosh. The student devotes his or her time to a short research project under the supervision of one of the herbarium's systematists or ecologists (consistent with the terms of the Bequest). The purposes of this scheme are: to provide an opportunity for an outstanding undergraduate or newly graduated plant science student to be part of a real plant taxonomic or ecological research project; to encourage a young scientist at a decisive point in their education to consider a career in plant taxonomy or ecology; and to contribute to the investigation of a problem in plant taxonomy or ecology that is relevant to the broader goals of the Plant Sciences Branch and organisation.

Scientific Committee of the Trust

The 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), Fleur Kreel (lawyer and writer, Paddington), Dr Jan Tarran (University of Technology, Sydney) and Michael Wright (Parks and Wildlife Service, Department of Environment and Conservation).

The committee met three times during 2003/04, coinciding with the Trust meetings as well as meeting for the Review of Plant Sciences Branch (see above). 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 Plant Science Program.

Part 3: Conservation & Horticultural Section

Research Section

This Section brings together the Trust's broad expertise in ecology, conservation biology, research horticulture 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. Honours student Jo Green (Southern Cross University) completed a study of the usefulness. as environmental indicators, of wetland epiphytes. PhD student Jo Ling continued her investigation and comparison of techniques for wetland assessment using microphyte and macroinvertebrate assemblages.

Classification and status assessment of the vegetation of NSW

John Benson is developing an authoritative typology of the vegetation communities of the State, involving a complete review of literature and survey data, field checking, and mobilising much of the Trust's expert knowledge on the subject. The project mirrors similar work in the United States, Canada and Europe. A database with 89 fields has been established to store information on each listed plant community. These fields include 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 criteria, reservation codes, photograph and a general description. Standard reports from the database will provide summaries of the status of each community. Over the longer term this data should form the basis for a detailed book on the vegetation of NSW.

Classification of the Western Plains of NSW (defined by the eight most western IBRA Bioregions) is finalised. Minor details are currently being consolidated, as is the linkage of images to the database and improving database functionality. The next step will be to adapt the work for publication. A grant has been secured to continue employment of project officer Jedda Lemmon for one year from August 2004. This period will be devoted to collating new and existing floristic data to extend the classification into the Western Slopes of NSW (as defined by the South0-West Slopes, Brigalow Belt South, and Nandewar IBRA Bioregions).

Conservation committees

The Trust has been represented by CHR staff on many governmental committees and working groups in the conservation area in the past. Owing to the wide-ranging reorganization of natural resources management and conservation in New South Wales over the last year, several collaborating departments are in a state of organizational flux, and many of the old linkage committees and groups have been effectively abolished. It is expected that new linkage bodies will emerge during the course of 2004-5. Direct Trust representation on some may be reduced compared to the past situation, as a consequence of our incorporation into DEC. The Branch is working actively to maintain and extend connections within DEC to ensure that Trust concerns and expertise are transmitted to new committees as they emerge.

Continuing membership on government conservation committees includes:

- NSW Scientific Committee: Doug Benson
- NSW Fisheries Scientific Committee: Alan Millar

- NSW Biodiversity Advisory Council: Cathy Offord was appointed during the year
- NSW Cut-flower Advisory committee: Cathy Offord was appointed during the year
- State Wetlands Advisory Committee: Surrey Jacobs was a member until termination of the committee in 2004 as part of the State NRM reforms
- Wollemi Pine Management and Recovery Committee: The Trust is represented by Patricia Meagher, Cathy Offord, John Benson, Rusty Worsman and Bob Makinson.

Continuing membership on non-government conservation committees includes:

- Australian Network for Plant Conservation (National Management Committee): Bob Makinson (Vice-President), Tracey Armstrong (member).

During the year, Cathy Offord was a member of the organizing committee for the highly successful *Fifth Australian Workshop on Native seed Biology*, held in Brisbane in June 2004.

Internationally, John Benson is a member of the IUCN (World Conservation Union) Commission on Ecosystem Management, and the Species Survival Commission Red-List Committee

Ecology of Sydney plant species

Part 10 of the popular series documenting the ecology of plants in the Sydney region is due for publication in *Cunninghamia* in 2004. Part 10 covers the monocotyledon families Lemnaceae to Zosteraceae (with 300 species) including the large and interesting Orchid family. This will be followed by the final part in the series covering the Poaceae family, the grasses.

Ecological monitoring

The Gardens has contributed over the years to a number of long-term monitoring projects, providing information of importance to vegetation management and conservation. Doug Benson and Jocelyn Howell continued their long-term monitoring program of Cumberland Plain Woodland vegetation started in 1990. The monitoring component, based at Mount Annan Botanic Garden, now includes monthly assessments of plant species abundance as they respond to seasonal changes. Following experimental burns in September 2001 and September 2002, the recovery of populations and recruitment of seedlings is being studied. Seed dispersal and longevity studies for some of the rarer groundcover species have been included. This is providing

insights into plant species distributions and recruitment issues that are relevant to management of the Endangered Ecological Communities of Western Sydney.

Surrey Jacobs has continued involvement in monitoring the effects of increased environmental flows in the Snowy River.

John Benson continued ecological monitoring of Wollemi Pine populations in the wild, as part of activities mandated by the Wollemi Pine Recovery Team.

Lotte von Richter coordinates the Streamwatch Committee at Mount Annan Botanic Garden.

Freshwater macroalgal ecology

Lucy Nairn continued her PhD project on the ecology of macroalgal communities in the Kangaroo Valley, south of Sydney. The project is funded as part of a large ARC grant held by co-supervisors Dr Barbara Downes, The University of Melbourne, and Dr Tim Entwisle. Lucy is investigating the influence of various environmental variables, including water temperature and depth; nutrients; riparian vegetation; flow velocity; light availability and substratum, on macroalgal communities. She has completed her fieldwork and is currently analysing data and writing up.

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 TSC Act. Less than 3% of the community remains – most of it has been ploughed for crops and improved pasture. GIS layers on soils, woody vegetation, salinity, cadastre, soils, slope and travelling stock routes have been obtained. 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 of the plant species distributions. 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 genetic research

Conservation genetics research investigates how novel DNA-based information can support the conservation and management of threatened species and endangered communities. Current work is progressing actively with a number of publications in peer-

reviewed international journals either published, in press or in preparation. An ARC-funded project on the consequences of habitat fragmentation in two rare *Elaeocarpus* species (rainforest trees), found that population dynamics differed remarkably despite apparent similarities in habit and distribution. *Elaeocarpus williamsianus* was found to mostly rely on vegetative reproduction, with all but one population being reduced to single clones because of habitat fragmentation (Rossetto *et al*. 2004 Biological Conservation 117(1): 33-39). While the absence of efficient dispersal mechanisms for *Elaeocarpus* spp 'Rocky Creek', resulted in the development of significantly different provenances within a very narrow geographical range (Rossetto *et al in prep*). Further work on the final description of the latter species is currently being completed by an Honour student funded by a Hermon Slade grant to Rossetto and Crayn. Work on another highly restricted rainforest tree, *Eidothea hardeniana* (an ancestral Proteaceae), is also providing novel insights on the long term survival of tree species within confined population. This species appear to be reliant on individual persistence rather than rapid colonisation of available habitat, thus ensuring that genetic diversity is maintained even within small populations (Rossetto *et al in prep*). Further work on another rainforest species, *Acronychia littoralis*, as discovered unexpected hybrid origin for this endangered taxon (Rossetto *et al In Press - Biological Conservation*); the identification of this new and very interesting species complex provide an interesting basis for further studies on the evolution of new species. A number of PhD projects also co-supervised by M. Rossetto and involving a component of conservation genetics (on *Hakea pulvinifera* and *Wilsonia backhousii*) are also progressing.

Population genetics and ecology – *Persoonia*

The management of protected natural areas needs to be based on knowledge of the ecology and population structure of organisms that live in them. Preferably, this should include knowledge of the demography and genetics of rare or threatened species that they include. Postgraduate students Paul Rymer and David McKenna have been collaborating with Principal Research Scientist Dr Peter Weston in trying to elucidate the causes of rarity in fire-sensitive *Persoonia* species by comparing the genetic structure and demography of rare and common species. They have conducted a comparative study investigating two pairs of closely related taxa: *P. lanceolata* (common) versus *P. glaucescens* (rare) and *P. mollis* subsp. *nectens* (common) versus *P. mollis* subsp. *maxima* (rare). A third rare species, *P. bargoensis*, is also being studied.

Persoonia fruits are plum-like and are dispersed by vertebrates, primarily wallabies. A fruit removal experiment showed that significantly more fruits were removed from

common as opposed to rare species. Conversely, herbivores destroyed significantly more fruits of rare than common species. No relationship was found between fruit removal and either plant patch size, fruit quantity, or plant density. Although these results are hard to explain, they do suggest that the rare species will be more vulnerable to extinction in disturbed environments than the common species.

The demographic data collected for these species is being used to construct population viability models for the various populations of each species. The aim of these models is to obtain a relatively rapid insight into what is happening to these species given that little is known of their general ecology.

Population genetics and ecology – *Elaeocarpus, Nothofagus, Trachymene*

A population genetic study on the consequences of habitat fragmentation and on the extent and distribution of genetic diversity in a early-successional rainforest tree (*Elaeocarpus grandis*, family Elaeocarpaceae) has been completed by Maurizio Rossetto and external collaborators at NPWS and Southern Cross University. It was found that this species is capable of rapidly colonising available habitat including a range of sites within the highly disturbed Big Scrub (Rossetto *et al. in press - Heredity*). Some loss of diversity occurs as a consequence of these new founder events but these processes are fairly similar to those that followed rainforest expansion at the end of the last glacial period (approx. 10,000 ago). In fact it was found that all the population across NSW are genetically similar, suggesting recent expansion from centres of diversity such as the Nightcap Ranges. This is important information, as this species is often used as a precursor to rainforest regeneration due to its rapid growth. The genetic information suggests that a single provenance exists within NSW and that material can be collected from all accessible populations, as long as much diversity as possible is included (since inbreeding depression appears to cause failed seed germination in this species). A comparative genetic study is currently being completed by an Honour student on another common species, *Elaeocarpus reticulatus*. The aim is to assess differences in population dynamics between two species with different habitat preferences (*E. reticulatus* is usually found in wet sclerophyll rather than rain forest) and dispersal agents (*E. reticulatus* fruits are considerably smaller than in *E. grandis*). A broader study on the biogeography and radiation of the Elaeocarpaceae in general (including the old Tremandraceae) is also underway, with funding from both Hermon Slade (Elaeocarpaceae) and ABRS (Tremandraceae).

A NPWS-funded student project on *Nothofagus moorei* (family Nothofagaceae)has also investigated the extent and distribution of variation within this species (Taylor *et al in*

prep). It was found that in this wind dispersed species clear differentiation exists among northern and southern provenances. Also clonality was found to be much less prevalent than initially suspected and to be pretty much limited to the clearly recognizable stem rings that characterise the northern populations in particular.

Finally a PhD study investigating the consequences of changes in pollinator cohorts within *Trachymene incisa* (family Apiaceae) populations is currently progressing. Genetic work is about to start, with the development of dedicated microsatellite libraries well underway.

Sydney Region vegetation studies

Ecologists Doug Benson and Jocelyn Howell continued a series of observational studies on vegetation dynamics at various sites in the Sydney Basin Bioregion. These include wetland communities on the Hawkesbury-Nepean floodplain, associated riparian vegetation and moist forest sites. Sites which have been focussed on recently include Blue Gum High Forest at Blackwood Sanctuary and Loreto College, Beecroft-Normanhurst, Turpentine-Ironbark Forest at Silverwater Nature Reserve and Kurnell Dune Forest at Kurnell.

Wollemi Pine ecological studies

John Benson is preparing 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

Cumberland Plain seed biology

The Cumberland Plain is a complex of 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. Dr Cathy Offord and her Horticultural Research team continued investigations into the seed biology of under and mid story species from these communities with a view to implementation of conservation measures including restoration. Technical officer Lotte von Richter has been working with students and staff collecting and germinating seeds from the conserved bushland area at Mount Annan and other parts of the Cumberland Plain. More than 150 species have been studied so far and the results will be summarized in a series of publications.

Orchid research

A proof-of-concept study on seedbanking of NSW Threatened terrestrial orchid species and associated mycorrhizae, funded by the Hermon Slade Orchid Fund, was completed at Mount Annan. Funding was secured to scale up the project to include a wider range of NSW orchid species over three years, commencing June 2004 (Hermon Slade Foundation and UWS small project grant).

Proteaceae development

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. A paper by Cathy Offord on the reproductive biology of the Waratah was published during the year in the International Journal of Plant Sciences.

Waratah flower quality is severely reduced by browning of the floral bracts prior to harvest. PhD student, Amelia Martyn who has been working at Mount Annan Botanic Garden and with local growers investigating the causes of bract browning, completed her research and is writing up her thesis. Her work strongly suggests bract browning is caused by strong sunlight, overnight chilling, water stress and wind damage and that flower quality may be improved by growing under shade cloth. These observations indicate that photo-inhibition (a decrease in photosynthetic efficiency) may play a leading role in bract browning in waratah. She presented her findings at several international conferences during the year.

Seed biology of threatened species

In 2003, the Mount Annan research team and NSW Seedbank team formed a strategic alliance with the UK-based Millennium Seedbank Global Seedbanking Program (MSBP). The MSBP aims, by 2010, to store 10% of the world's dryland species, with replicate seedbanks in countries or regions of origin, and to build seed science capacity in global biodiversity hotspots. In late 2003 we received almost one million dollars worth of funding for a three-year program to collect, store and research NSW plant species, with a possible extension of the work to 2010. Funding includes staff (Scientific Officer and Technical Officer) for three years to research seed biology of NSW species. The success of this proposal was based on a number of factors including the burgeoning seed research program at Mount Annan. A number of collaborative projects focused on threatened species seed biology were developed with other MSBP partners in Australia and the UK. The seed collections side of the BGT/MSBP partnership has also been launched under the banner NSW SeedQuest.

Wollemi pine

A number of collaborative research projects have yielded significant findings about the life and times of the Wollemi pine including ongoing research with Dr Roger Heady from the ANU on SEM on wood and leaves and tissue culture with the Queensland Forest Research Institute and NZ Forest Research. A paper, by Dr Rod Peakall of ANU, working with Mount Annan scientists and others, was published in Molecular Ecology. It describes the very low genetic variability found in several members of the family *Araucariaceae* studied and in the Wollemi pine in particular, and poses some questions about the consequences of low diversity in such species. Another paper was published in Annals of Botany describing the work conducted with Mount Annan Botanic Garden by Dr Geoff Burrows of Charles Sturt University on the nature of the axillary meristems and the development of epicormic shoots and branches in the Wollemi pine. The work shows that unlike most conifers, the Wollemi pine possesses long-lived meristematic potential in leaf axils. This work is now focussing on the production of basal shoots and the vascular connections of the branches that may give further clues to the survival strategies of this species. Work in cooperation with Dr N. Prakash of UNE, funded by the Slade Foundation, continued to investigate the cone and seed production and embryology of the pine and a publication is being prepared on this work.

A poster on Wollemi pine seed storage was presented at the Australian Native Seed Biology Workshop in Brisbane (June 2004). Work has commenced with Wollemi Australia in preparation for the commercial release of plants in late 2005. The Wollemi

pine website was significantly updated and receives to the largest number of hits on the BGT site (after the homepage).

Fungi and Plants Theme

Fungi causing leaf-spot diseases of the Proteaceae

A major study documenting and describing the species of fungi causing leaf spot diseases on plants in the family Proteaceae was funded by the Hermon Slade Foundation. Professor Pedro Crous, of the Centraalbureau voor Schimmelcultures, The Netherlands, and Dr Joanne Taylor, University of Botswana, are collaborating on research on this project. Samples of leaf disease from a diversity of different Proteaceae throughout eastern Australia were collected and large numbers of fungi isolated. A number of new species of fungi have been described and documented during this project including several on economically important species of Proteaceae grown for cut flower production. PhD student Sophie Peterson continued studies on the biology of *Phyllosticta telopeae*, a fungus that causes a leaf spot of the waratah. Sophie is investigating the population genetics of this fungus in natural and cultivated ecosystems and the impact that fire has on genetic diversity in the fungus.

Fusarium

A project funded by the Australian Biological Resource Study on the taxonomy of *Fusarium* in Australia resulted in the clarification of the identity of *Fusarium* spp. in most of the major fungal collections within Australia. Several new species of *Fusarium* were identified by PhD students, Hien Phan and Ruth Amata. A collaborative project with researchers from CSIRO Plant Industries to characterise populations of *Fusarium oxysporum* from cotton and native *Gossypium* species was commenced. Studies continued on the photography and documentation of all significant *Fusarium* species for future inclusion in a monograph on this genus. Brett Summerell provided advice to a number of land managers following an outbreak of Fusarium Wilt of Canary Island Date palms in Melbourne.

Phytophthora root rot in New South Wales national parks

Phytophthora cinnamomi causes root rot and dieback in several National Parks throughout New South Wales as well as important bushland reserves in Sydney Harbour foreshores. This research is in collaboration with Dr Keith McDougall, National Parks and Wildlife Service and Professor David Guest, University of Sydney. Our research has

focused on the identification of the presence of the pathogen in several national parks and is causing significant damage to certain ecosystems with potential detrimental effects to several threatened plant and animal species. Detailed studies of the impact of the pathogen were conducted at Barrington Tops National Park, Werrikimbee National Park, Royal National Park and Beecroft Peninsula Reserve. PhD student Ratiya Pongpisutta continued studies on the extent of morphological, genetic and pathogenic variation in the organism within New South Wales while PhD student Chris Howard continued studies using microsatellite markers to assess genetic variability within populations of *P. cinnamomi* as a tool to explore the epidemiology and distribution of the pathogen within National Parks.

Fungal diseases in Sulawesi, Indonesia

The Australian Centre for International Agricultural Research (ACIAR) provided funding to the RBG and the University of Sydney to research diseases affecting cloves and vanilla in North Sulawesi Indonesia. The funding also allows for the establishment of a laboratory at Sam Ratulangi University at Manado, Sulawesi that will provide diagnostic capabilities for the region. A new species of Ceratocystis has been recovered from cloves (which is a species of *Syzygium*) and has been demonstrated to cause a dieback disease in cloves and species of Fusarium have been shown to cause a stem rot disease in Vanilla. Both diseases have a significant impact on the economic stability of the region.

Communication and Services

Cunninghamia: a journal of plant ecology for eastern Australia

Cunninghamia is the flagship publication for the ecology program at the Royal Botanic Gardens. It publishes high quality science of relevance to land and water managers, environmental scientists, consultants, revegetation groups, and other members of the general community. Papers are contributed by our own research staff, universities, National Parks and Wildlife Service and other government agencies, and private researchers.

Each issue contains a diverse range of papers, from large vegetation surveys to detailed accounts of rare species and communities. Volume 8 has been published in a new A4 format to allow a large amount of data to be presented more efficiently. Highlights of issues 1 and 2 of volume 8 include:

- Systematic classification and field identification of native vegetation communities of the Cumberland Plain of Western Sydney
- Vegetation surveys of Ironbark Nature Reserve, Arakoola Nature Reserve and Paroo Darling National park
- Vegetation mapping of the NSW wheat belt covering map sheets Cobar-Nyngan-Gilgandra and Nymagee-Narromine-Dubbo
- Floristic descriptions of *Sphagnum*-dominated communities in Victoria
- Pollination studies of *Tetratheca juncea* (Tremandraceae) and *Pollia crispata* (Commelinaceae), breeding system studies of *Hicksbeachia pinnatifolia* and *Triunia youngiana* (Proteaceae) and germination studies of *Hakea dohertyi* (Proteaceae)
- Ecological studies on eucalypt regeneration in woodland and long term changes in coastal dune vegetation
- Description and phytosociological analysis of Wallum vegetation on the NSW North Coast
- Plant species recently recognised as naturalised in NSW.

Plant disease diagnosis

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 utilised by both external clients and the three Garden sites to promote plant health and appropriate horticultural practices and to minimise pathogen spread through environmentally safe treatments.

This year the Diagnostic Unit processed 259 samples, 223 from external clients (an increase of 37% over the previous year) and 36 from within the Gardens. For the first time since the Unit was set up in1998, the majority of enquiries 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 (32%), and other Government Departments and Local Councils provided the remaining 22%.

This expansion of our client base reflects an increased awareness of the benefits of accurate disease monitoring in large-scale situations. It also illustrates the higher profile the Unit has achieved in the commercial arena from both increased media coverage and the development of specialised and unique diagnostic techniques. Most notable examples of this are the testing of the Sydney Harbour foreshores and National Parks

for *Phytophthora cinnamomi*, and the application of molecular probes for *Armillaria* spp. and *Fusarium oxysporum* detection.

The results of the Units' disease diagnoses illustrate a number of trends.

- Tests for soil borne diseases, (*Phytophthora* spp., *Armillaria* spp and *Rhizoctonia* spp) continue to dominate. This year *Phytophthora* assays were by far the most nominated (50%), with *Armillaria* tests being the second most requested (15%). This scale of *Phytophthora* testing is expected to continue as public awareness of the extent of dieback problems increases. The Unit has also been able to combine its diagnostic role with the research work of a PhD student, Chris Howard, whose development of a PCR –based technique has enabled the differentiation of species of *Phytophthora*. As in previous years the contribution of environmental factors such as drought and pollution are considerable in the development of the overall disease complex.
- In the three Gardens *Phytophthora* testing was also the most frequent assay (64%). *P cinnamomi* was detected at the Sydney and Mt Annan sites but not at Mt Tomah. Unfortunately however *Armillaria* was detected at Mt Tomah this year. The distinctive *Armillaria* fruiting bodies did appear at a small number of Sydney RBG sites this year but the overall incidence of this disease is dropping following the replanting of new beds and the isolation of infected beds.
- The Unit has continued to use the recently developed molecular test for Armillaria on suspect root and wood samples, most notably for other Botanic Gardens which are undertaking their own *Armillaria* eradication programmes.
- The spread of Fusarium Wilt of the Canary Island Date Palm, caused by *Fusarium oxysporum* f. sp. *canariensis*, has continued, with more infected palms detected in both Victoria and NSW. This year, isolations from plant tissue sampled in trunk cores rather than from frond rachis has seen the detection of this disease improve. Results from new infections in Victoria indicate that, based on DNA variability, the *Fusarium oxysporum* population may be more diverse than previously presumed. This has important ramifications for the potential spread and host range of this pathogen.
- The remainder of disease problems processed by the Unit include stem and leaf fungal infections (10%), insect infestation (4%), secondary saprophytes (5%), culture identifications (5%), virus problems and identification of wood decay organisms in standing trees (7%).

Centre for Plant Conservation

The Centre, which completed its first triennium in June 2004, has continued to provide a significant point of linkage between the Trust's activities and external clients (comprising other sections of DEC, other State and federal Departments, a range of non-governmental organisations, and a wider community constituency interested in plant conservation issues).

The year saw the completion of a bracket of three public-awareness events on Die-back Disease (*Phytophthora cinnamomi*) as a threat to native bushland. The series was organised in conjunction with three external organisations, including the Sydney Harbour Federation Trust, and drew heavily on the research and collaborative connections established by the Trust's Plant Pathology Unit.

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. Two Trust staff (CPC Coordinator Bob Makinson, and Tracey Armstrong from the Mount Annan records section) are members in individual capacity of the ANPC national committee. Several Trust staff have been involved through presentations at ANPC training courses and in editing of ANPC publications, and two as co-authors of the second edition of the ANPC's *Guidelines for the Translocation of Threatened Plants in Australia*, a fully revised edition of a 1997 document that has become a national standard in threatened species management. The revised edition has 'supported' status from the new NRM Ministerial Council, reaffirming their status as a national standard. The Centre has also hosted two one-day ANPC workshops on translocation techniques, with a total of 135 attendees, and a public launch of the new edition *Guidelines*.

The Centre's work was broadly appraised by the Plant Sciences external review team in March 2004 and received a favourable assessment. This is to be followed in late 2004 by a more detailed internal Plant Sciences review of the CPC and conservation activity in general, as part of adjustment to the broad reforms in government policy and service delivery and our new Departmental and staffing situations.

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). 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, the maintenance of living collections of conservation significance, and the AVH project etc. GIS includes any electronic data and data layers that have a spatial component.

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 this data in relation to other species to help describe taxonomic distributions and characterise ecological communities. We further use this 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 (in particular legal boundary, survey, other state and a-biotic 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.

This data is 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 bi-annual 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.

With the new DEC still forming, the implementation of new catchment management boundaries, changes to the Threatened Species Act and the loss of vegetation mapping in NSW, there will be many new sets of data for us to obtain and to produce. We frequently exchange data within the DEC, other agencies and NGOs which requires ongoing discussions on data formats to enable efficient and safe transfers, storage and archiving of data. In addition we now have enhanced GIS software and new printing capabilities to streamline analysis, and production of outputs in more timely and economic ways.

Part 4: 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 about one 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 the next few years is 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 journal *Telopea* is published by the Plant Diversity Section.

Flora of Australia Theme

Bryophytes

Dr Elizabeth Brown, Bob Coveny and Will Cuddy attended a bryophyte workshop in Rawson, Victoria as part of an Australasian Bryological Society meeting. Fieldwork was undertaken in New South Wales (including Lord Howe Island) by Dr Brown to collect specimens of *Fossombronia* and Lepidoziaceae. Phylogenetic analyses of the Lepidoziaceae (Hepaticae), based on chloroplast and ribosomal DNA data are being compared with morphological data to provide new insights into the relationships and evolution of this group in Australia, New Zealand, New Caledonia and Papua New Guinea. Preliminary data suggest the genus *Drucella* is sister to the remainder of the Lepidoziaceae. Margaret Heslewood is assisting with this research which is partially funded by the Hermon Slade Foundation.

Research in the Fossombroniaceae continued with funding from the New South Wales Biodiversity Research Strategy. Will Cuddy maintains a living collection of *Fossombronia*. This living collection enables all stages of the life cycle to be observed. Pure cultures of several collections have been generated from capsules sent to Dr Christine Cargill (CSIRO). These cultures provide the most reliable source of material for DNA work. The combination of morphological and molecular data is being used to identify and describe species of *Fossombronia* in NSW.

Honorary Research Associate Dr Helen Ramsay, in collaboration with J.R. Spence (Glen Canyon Nature Reserve, Page, USA) and A.J. Shaw (Duke University, Durham USA), continued work on the Bryaceae for Flora of Australia. Dr Ramsay also pursued her revision of the Sematophyllaceae in collaboration with B.C. Tan (Singapore University) and W.B. Schofield (University of British Columbia).

Cyperaceae

Karen Wilson continued studies of various genera in the family Cyperaceae, largely in collaboration with Dr Jeremy Bruhl (University of New England) and students whom they jointly supervise. The morphology and anatomy of the large widespread genus *Fimbristylis* and its allies continues to be studied by PhD student Ms Kerri Clarke, and the phylogenetic relationships based on molecular data continue to be studied by Kioumars Ghamkhar, another PhD student, with Dr Adam Marchant as a co-supervisor. Papers summarizing research into the phylogeny of the Abilgaardieae and photosynthetic pathways in the family are being prepared. These are based on presentations that were made at the 'Monocot 3' Conference in California (U.S.A.).

Elaeocarpaceae/Tremandraceae

Recent work by Drs Darren Crayn and Maurizio Rossetto indicates the Australian endemic family Tremandraceae is closely related to the genus Elaeocarpus (Elaeocarpaceae), which is fascinating in view of the profound ecological differences of these two groups. Molecular phylogenetic and biogeographic studies are being used to clarify origins and patterns of diversification among lineages within the Elaeocarpaceae/Tremandraceae complex. Within the phylogenetic framework, analysis of population-level genetic diversity will be undertaken for selected species in order to provide an insight into comparative evolutionary responses and speciation mechanisms in dry-adapted shrubs and rainforest tree species.

Ericaceae: Styphelioideae

In collaboration with Honorary Research Associate Dr Chris Quinn, Margaret Heslewood and Dr. Darren Crayn, Dr Elizabeth Brown has continued revision of the systematics of subfamily Styphelioideae. A molecular analysis of the tribe Styphelieae has been submitted for publication. This reveals that many of the current generic concepts are at variance with the molecular estimate of relationships. They are now conducting combined molecular and morphological analyses of groups identified within the tribe in order to establish morphologically defined genera that receive molecular support. Current work deals with the *Cyathodes* group.

Dr Brown is preparing for publication a molecular analysis of the tribe Epacreae. The results do not support the recognition of either *Budawangia* (1 species) or *Rupicola* (4 spp.), which are both endemic to south-eastern NSW. Each genus is shown to be a specialised lineage that is placed within the much larger and more widespread genus *Epacris*.

Drs Brown, Darren Crayn and Jocelyn Powell have submitted a paper revising the genus *Lissanthe*. One new species is described, two are transferred from the genus *Leucopogon* and the genus description emended.

Fabaceae: Faboideae

Dr Peter Wilson continued work on the genus *Indigofera*, in the family Fabaceae. The first part of a revision of the genus has just been published in *Telopea*. Work on the remaining part of the revision is progressing as is coding of all Australian species of the genus for a CD identification tool. Studies in the *Indigofera pratensis* species complex with Dr Aniuska Kazandjian, formerly a PhD student at James Cook University, Townsville, continued and a paper based on her research is in preparation.

Freshwater Algae

Dr Tim Entwisle, Hannah McPherson and Dr Morgan Vis (Ohio University, USA) published their paper in Australian Systematic Botany on a taxonomically obscure group of freshwater red algae, *Batrachospermum pseudogelatinosum* Entwisle & Vis, from Australia and New Zealand (Stewart Island).

Dr Stephen Skinner and Dr Entwisle continued their revision of the filamentous green algal genus *Oedogonium* in Australia, funded (half-time) by Australian Biological Resources Study. This three-year project commenced in January 2001, and has now been extended for a further eighteen months to include the remaining genera in the family Oedogoniaceae (i.e. *Bulbochaete* and *Oedocladium*). For *Bulbochaete* there are 4–5 distinctive local species and a number of local varieties and curiously our flora shows clear floristic links to those known for China and the subcontinent. The revision has now been completed and is about to be submitted.

Commencing in July 2004, Dr Skinner, funded (half–time) by Australian Biological Resources Study, and Dr Entwisle are preparing 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 will complement the already available guides to coccoid and filamentous planktonic freshwater Cyanobacteria prepared by Dr Baker at SAWater, Dr Fabbro at Central Queensland University, and Dr McGregor at Queensland government Aquatic Ecosystems Health Unit. It is hoped also to be able to produce some floristic reviews of families and genera as part of this work.

Dr Skinner and Dr Entwisle have also obtained funding from the Herman Slade Foundation to complete a survey of the macroalgae of the Border Rivers/Gwydir Catchment Area with a view to presenting a catalogue of these organisms for the catchment with its interesting upland water systems and the wetlands of the inland deltas that feed the Barwon and eventually Darling River.

In conjunction with Dr Simon Townsend and his team at the Northern Territory government Water Monitoring Unit, Dr Skinner and Dr Entwisle have compiled species lists of macroalgae in the Darwin and Daly River catchments. A paper on the Zygnemataceae of these catchments, including *Mougeotia* (6 species), *Spirogyra* (7 species) and *Zygnema* (at least 4 species) is in preparation and will complement recent work in this family by Mr Lewis and Dr Entwisle.

Dr Skinner and Dr Entwisle have revised the records of freshwater Cladophoraceae for Australia, demonstrating the presence and distribution of Rhizoclonium (1 species), Pithophora (1 species, new local variety), Cladophora (5 species) and a freshwater variety of Wittrockiella from Lord Howe Island.

Lamiaceae

Nikola Streiber (PhD student) and her supervisors (Drs Barry Conn, Elizabeth Brown and Murray Henwood) have continued their research into the phylogeny of the Australian endemic tribe Chloantheae. Preliminary results suggest that the circumscription of several genera require adjustment.

Lichens

Dr Alan Archer, Honorary Research Associate has continued his research into the Australian Graphidaceae with further specimens from Christmas Island, the Philippines and the Solomon Islands examined.

Marine Algae

Dr Alan Millar and Dr George Wilson (Australian Museum) have begun a collaborative study of marine algae and their associated invertebrates. This project, partially funded by the Hermon Slade Foundation, is showing that while host specificity may not be as high as predicted, the number of different invertebrate species inhabiting a given plant can be as high as 85. Such species are hoped be useful as surrogates for predicting biodiversity hot spots along the coastal regions.

Dr Millar's survey of the marine algae of New Caledonia in collaboration with Professor Claude Payri from the University of French Polynesia (sponsored by the French Government) has moved into stage two. Type specimens collected by French naturalists and sent to Europe for description, have all be examined in the light of this New Caledonian research. Of the 66 types now housed in the National Herbarium Netherlands (Leiden), 10 have required new combinations and many have been shown to be valid names for recently described species.

Mr Nick Yee's research on the molecular phylogeny of the brown algal order Sporochnales (supervised by Dr Millar) has been converted to a PhD. Mrs Yola Metti, formerly from the University of British Columbia, Vancouver, Canada, has begun an MSc with Dr Millar on the molecular phylogeny of the red algal genus Laurencia.

The new green algal species *Struvea thoracica* has been described in collaboration with Dr Gerald Kraft (University of Melbourne), and 23 new records for the State of New South Wales have been published in the scientific journal *Phycological Research.*

Myrtaceae

A detailed analysis of the *Chamelaucium* alliance (Geraldton Wax group)(Myrtaceae) continued with funding from the Australian Biological Resources Study and with the assistance of Margaret Heslewood. A three and a half week field trip, to collect further research material, was undertaken in late winter 2003, with collections made in South Australia and the south-eastern section of Western Australia. The data matrix for this project now includes sequence of over 170 species in this group, with the current phase of research focussed on the genera *Micromyrtus* and *Thryptomene*. Other work continues on an analysis of relationships in the eastern Australian species that have been referred to the genus *Babingtonia*. Sequences of the nuclear region known as ETS has been added to the existing chloroplast DNA sequences in an attempt to clarify the status of these species, which earlier results have shown not to belong to *Babingtonia*. The latter project will also involve gathering of morphological data to be analysed in

combination with the molecular. It is anticipated that new genera will need to be described to accommodate these species.

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.

Restionaceae

Study of the Restionaceae by Dr Barbara Briggs continued using both morphological and DNA data. Papers naming new Western Australian species of *Hypolaena* and *Chordifex* have been published and new combinations in *Chordifex* made for four eastern Australian species transferred from other genera.

Asia-Pacific Biodiversity Initiative Theme

Elaeocarpaceae

As part of a new project investigating phylogeny, biogeography and evolution in the family Elaeocarpaceae, Drs Darren Crayn and Maurizio Rossetto have established a collaboration with Dr. Mark Coode (Kew), an acknowledged authority on Elaeocarpaceae in the Asia-Pacific region. A primary aim of this project is to discover the origins of the Australian members of the family, which requires knowledge of their relationships with the other Asia-Pacific members of the Elaeocarpaceae.

Juncaceae

PhD student John Hodgon continued his research into Sectional and species limits, as well as hybridization within *Juncus*. This research is supervised by Assoc. Prof. Jeremy Bruhl (UNE), Dr Adam Marchant and Mrs Karen Wilson.

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. In particular, the Trust is represented on the Executive Committees of key international database groups (particularly, member of the *Herbarium Information Committee*, member of the IUBS *Taxonomic Database Working Group*, Chair of the *Global Plant Checklist Committee* of *International Organisation for Plant Information*, vice-chair of the *Global Biodiversity Information Facility (GBIF) Node Managers Committee*, member of *GBIF Electronic Catalogue of Names Committee*, and member of the project team of *Species 2000*). Karen Wilson was one of the editors of the Species 2000/ITIS Catalogue of Life Annual Checklist 2004 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.

Urticaceae

Phylogenetic analyses of the Urticales by Julisasi Hadiah (Kebun Raya Bogor, Indonesia), Barry Conn and Christopher Quinn, based on chloroplast DNA data, support the monophyly of the Urticaceae, *Boehmeria*, *Pilea* and *Procris*, but not of *Elatostema*. At the tribal level, both Boehmerieae and Lecantheae appear paraphyletic, although this may be an artefact of the low taxon sampling. Preliminary analyses of relationships within *Elatostema* do not support the recognition of the subgenus *Pellionia*. Furthermore, *Elatostema* appears paraphyletic, with *E. curtisii* and *E. repens* placed sister to *Procris*, whereas the remaining members of *Elatostema* constitute a very robust clade. Current studies are now focused on the infrageneric relationships within *Elatostema*.

The systematics of *Procris sensu stricto* is currently being studied by Esti Aryianti (a MSc student from Kebun Raya Purwodadi, Indonesia), Barry Conn and Dr Murray Henwood (University of Sydney). Clarification of the phenetic and phylogenetic infrageneric relationship is being investigated, based on morphological features. About twenty species are recognized, two of which are new to science and one is a new combination. Current research is seeking to clarify whether or not the inclusion of

Elatostema curtisii and *E. repens* into *Procris* require the morphological circumscription of the latter to be modified.

Interactive Keys to the Commercial Trees of Papua New Guinea

This joint project by Barry Conn and Kipiro Damas (Papua New Guinea National Herbarium) is preparing a DELTA dataset to produce keys and descriptions of the common commercial timber species of the Morobe Province of Papua New Guinea. Images are also being incorporated wherever possible. Approximately 350 tree species have been included in the study. The focus is on commercial timber trees, but some non-timber species have also been included. The emphasis has been on trees that grow to at least 20 m high. The information will soon be released to a publicly accessible website when sufficiently complete to warrant public comment. This three-year project is partially supported by the Pacific Biological Foundation.

Origins and Evolution Theme

Basal-relictual angiosperms

Dr Peter Weston has continued his collaboration with an international team to investigate the reproductive biology of species in the paraphyletic 'ANITA' grade of basal angiosperms. The main lineages of this assemblage differentiated very early in the evolutionary history of angiosperms so all of them are likely to show unusual, uniquely specialised characteristics. More importantly, any feature for which these taxa are consistent is likely to be primitive for the angiosperms as a whole. The research team has found that *Amborella trichopoda* (Amborellaceae), the sister species of all other extant angiopserms, is pollinated by both wind and a range of insect species, mostly beetles. *Trimenia moorei* (Trimeniaceae), is also pollinated by wind and insects but the latter constitute a more diverse array of taxa, including species of bees, saw flies and hover flies. These findings are consistent with the hypothesis that ancestral angiosperms had relatively unspecialised pollination systems. Particularly significant is the discovery that *Trimenia moorei* is self-incompatible, raising the possibility that self-incompatibility systems evolved before the major radiation of the angiosperms. *Amborella trichopoda* was also found to be highly specialised in playing host to a remarkably complex community of insect parasites and parasitoids. Two manuscripts by Dr Weston and his colleagues, describing aspects of the reproductive biology of these plants, have been accepted for publication.

Casuarinaceae

Karen Wilson continued a major study of the family Casuarinaceae with interstate collaborators Dr Dorothy Steane (Hobart) and Professor Robert Hill (Adelaide). The project will bring together molecular, morphological, anatomical and palaeontological data to investigate relationships of and within the family, testing hypotheses put forward by the late Dr Lawrie Johnson.

Elaeocarpaceae/Tremandraceae

How and why did some representatives of the original Gondwanan flora survive within the small remaining pockets of Australian rainforest, while others disappeared or adapted to arid conditions and radiated more widely? To what extent has biotic exchange among Australian refugia and with neighbouring Gondwanan floras contributed to the biodiversity we see in our rainforests today? Drs Darren Crayn and Maurizio Rossetto have continued their project to investigate the phylogeny, biogeography and within-species diversity of the plant family Elaeocarpaceae in order to understand some of the evolutionary mechanisms that have influenced speciation and distribution patterns within the Australian flora. They are using molecular tools to discover the evolutionary relationships among the members of the family, and between the family and its closest relatives. Results to date strongly support some recent suggestions that the Australian endemic family Tremandraceae, which are mostly dry-adapted small shrubs, is a a derived lineage within Elaeocarpaceae. This raises some very interesting questions about evolution in the Australian flora which will be the subject of further investigations.

Freshwater red algae

The long-standing collaboration between Dr Tim Entwisle and Dr Morgan Vis (Ohio University, USA) continued, with contributions in recent years from Hannah McPherson. Fields trips to New Caledonia, New Zealand and Tasmania yielded substantial material for molecular sequencing. Collections from New Caledonia included a new species and recollections of *B. bourrelleyi*. Trips to New Zealand and Tasmania uncovered several species that had not been collected from particular localities for 50 years. *Batrachospermum ranuliferum*, a Tasmanian species previously known from only one locality, was collected at a second site.

The study involves other collaborators in southern hemisphere countries (including Orlando Necchi in Brazil), and seeks to clarify relationships within the freshwater red algal order Batrchospermales, particularly those of Gondwanic origin. A workshop on the

biogeography of the Batrachospermales will be held at the International Phycological Congress in South Africa in 2005.

Myrtaceae

The phylogeny of the family Myrtaceae has been the subject of ongoing collaborative work between Dr Peter Wilson and Honorary Research Associate Dr Chris Quinn, formerly of the University of NSW. The paper that has resulted from our collaboration with Dr K.J. Sytsma at the University of Madison, Wisconsin, and other colleagues is now in press with the *International Journal of Plant Sciences*. Entitled "Clades, clocks, and continents: historical and biogeographical analysis of Myrtaceae, Vochysiaceae, and relatives in the southern hemisphere", the paper examines the evolutionary relationships between the Myrtaceae and its closest relatives and uses fossil dating of nodes on the phylogenetic tree as a basis for a discussion of the biogeography of this group of taxa.

A paper “Molecular systematics of Myrtaceae based on *mat*K sequences” was presented as part of a Myrtaceae mini-symposium at the ‘150 Years’ Conference held in Melbourne. This represented a synopsis of much work sequencing the chloroplast *mat*K region of at least 65 genera genera across the family, worldwide. This presentation formed the basis of a paper entitled “Relationships within Myrtaceae sensu lato based on a *mat*K phylogeny” that was later submitted to, and is now in press in, the journal *Plant Systematics and Evolution*. In this publication, a new classification of the family will be proposed, the first new formal classification of the whole family since 1898.

Collaborative work has begun with Dr Jim Basinger, University of Saskatchewan, Canada; Dr David Greenwood, Brandon University, Manitoba, Canada, and Dr David Christophel, University of Denver, Colorado, USA to describe a fossilised fruit of capsular Myrtaceae. Specimens of this taxon were recovered from a clay deposit in South Australia dating from the Eocene and were able to be examined by Scanning Electron Microscopy. A paper is being prepared that will name this fossil species and discuss its possible relationships.

Orchidaceae

It can reasonably be said that Australia has the sexiest orchids on earth: our country is the centre of diversity for sexually deceptive orchids. The flowers of these plants mimic the smell, feel, and appearance of female insects and are pollinated by male insects, which attempt to copulate with them. The diurid orchid genus *Chiloglottis* belongs to a lineage that exploits male thynnine wasps in this way, with each orchid species pollinated by a different species of wasp. The intimacy of this relationship prompted the

suggestion that these orchids and wasps may have co-evolved over millions of years, diversifying together. Phylogeny reconstructions allow us to make all kinds of scientific inferences about evolutionary history that previously were the realm of pure speculation. Postgraduate student Jim Mant and his co-supervisor, Dr Peter Weston tested the co-evolutionary hypothesis of sexual deception in *Chiloglottis* by reconstructing the phylogenies of both the orchid species and their pollinators. Interestingly, their results have falsified this hypothesis, showing instead that *Chiloglottis* is probably much younger than the insect group that it exploits and that the orchid lineages have 'switched' pollinators frequently during their evolutionary history. Together with their colleagues, Dr Rod Peakall (Australian National University) and Dr Florian Schiestl (Geobotanical Institute ETH Zurich, Switzerland), they published a paper in *Evolution* describing these results. Dr Weston presented their results at the Third International Conference on the Comparative Biology of the Monocotyledons, held in Ontario, California, in March-April, 2003.

Poales

Continuing from their studies on Restionaceae, Dr Adam Marchant and Honorary Research Associate Dr Barbara Briggs continued their studies of the families related to Poaceae and Restionaceae. Sequence data on chloroplast DNA was obtained from further taxa and from the *mat*K gene. The results of analyses of these data provide support for the Centrolepidaceae as either the sister group to Restionaceae or embedded in that family. There is also robust support for the small Western Australian family Ecdeiocoleaceae, with Joinvilleaceae of the Old World tropics, as the closest living relatives of Poaceae. Thee regions of the chloroplast DNA have been sequenced in *Georgeantha* and *Ecdeiocolea*, the two members of Ecdeiocoleaceae.

Proteaceae

Dr Briggs continued her collaboration with Dr R.L. Bieleski of the Horticulture and Food Research Institute of New Zealand Ltd. on an investigation of the complex sugars, polyols, of Proteaceae. A paper reporting the polyols of 82 species and discussing the taxonomic significance of the findings has been submitted.

Management of 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. 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. Funding of $10 million over five years was secured to complete Australia's Virtual Herbarium: the Commonwealth Government matching $4 million of State and Territory funds, with an additional $2 million to be raised from Private donors.

In New South Wales, the total number of specimens data processed is 470,000, representing about 60% of the total collections. Although it will prove difficult for the Branch to fully data process the Australian material held by our herbarium, progress has been significantly improved during this financial year. Once these data are fully available to the broader community, 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.

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

Dr Barry Conn, Gary Chapple, and Chris Ward continued to work with KE Software to implement the *NSW Collections* database for the Gardens. The new system incorporates herbarium, horticultural, and floristic survey data into a single database system. Images of plants, including herbarium collections are being included in the database. The *NSW Collections* database is almost fully implemented. Solutions to present data to the *PlantNET* website are being developed outside of the database framework. The ability to return the result of complex database queries has caused considerable concerns. Sophisticated report writing routines have been developed by Linn Linn Lee to handle these complex queries.

Communication and Services

Botanical Information Service

PlantNET

The electronic version of the 'Flora of New South Wales' has been developed as part of the Trust's *PlantNET* website (http//:plantnet.rbgsyd.nsw.gov.au). This *FloraOnline* module was developed by Ken Hill. 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. As part of the launch of *FloraOnline*, the *PlantNET* website was re-designed by Barry Conn, Linn Linn Lee (design and programming) and Karen Rinkel (design). The new website provides the user with several search options and links to other important information that were not available on the previous site. Currently, *PlantNET* is being developed so that plant information, identification keys and images from any region of New South Wales will be available.

Forensic Identification

Government analysts identified forensic material (*Cannabis*) in 32 cases for the Police Service, resulting in revenue of $1760.

Public Reference Collection

Environmental consultants, students, government agencies, and the general community spent nearly 100 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 some neighbouring regions of the world. *Telopea* is an internationally recognised journal and all papers are peer-reviewed.

Telopea volume 10(2) was published. This issue is unique in that it presents papers from the *Robert Brown 200* international conference held in 2002, at the Botanic Gardens Trust, Sydney. This conference was one of a series of events held around Australia to celebrate the successes of Matthew Flinders' voyage, two hundred years after the *Investigator* touched various points in its circumnavigation of Australia. This issue contains 6 papers from this conference.

Highlights include:

- An introduction to the importance of Robert Brown to Australian botany
- The importance of Brown's pioneering work in several plant groups, including the Apocynaceae, Gesneriaceae, Poaceae, Rhamnaceae, Restionaceae, and Scropulariaceae.

Seven other miscellaneous papers were also published in this issue. Highlights include:

- Four new Australian species, one from each of the following families: Cycadaceae, Malvaceae, Poaceae, and Restionaceae
- Further research into the non-marine algae of Australia
- A taxonomic revision of several lichen genera in the family Graphidaceae
- A comparative study of the floristics of southern China and Indo-Malesia.

Vegetation Mapping Identifications

The Trust continued to provide a consultant identification service to the Department of Land and Water Conservation's State Vegetation Mapping Program.

Part 5: 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 and coordinates Critical Incident Planning for the Sydney site.

Library

The Botanic Gardens Library has a world-class collection of botanic, taxonomic and horticultural literature. Its holdings include the latest publications, as well as extensive heritage historical collections of books, journals, manuscripts, photographs, botanical illustrations and maps.

Developments

There has been considerable activity in the Library in the last year and much has been achieved. This can be variously attributed to the assistance of 4 trainee Library Technicians, a large team of volunteers, 3 months of casual assistance, and the Library Manager working full-time since February 2004. And to the new Internet-based Library catalogue going online in July 03.

A conservation project was established with considerable private donations and Friends funding. These funds are being used to conserve significant historic items, and to undertake a Conservation Assessment to prepare a preservation plan for the Library and its collections.

Staff and volunteers have been relocating and sorting at-risk materials (photographs, slides, illustrations, maps, plans, posters & manuscripts), and storing them in archival storage conditions. A stocktake of the journal collection is also being undertaken by volunteers to create a complete listing of the Library's holdings.

The Library staff has been involved throughout the year with exhibitions, displays of heritage materials, induction & student tours and giving lectures. In addition staff have been involved in ongoing discussions with the other two DEC Libraries regarding the development of cooperative services.

Physically the Library has had many changes – the annexation of an external corridor and cleaners cupboard to provide additional storage (including specialist secure storage for the photographic and image collections); new UV filters on windows and UV blinds; improvements to furnishings; extended Reference Collection shelving and the reorganisation of facilities to provide improved work space for readers, library staff and the volunteer teams.

Botanical Illustration

The Botanical illustrators provide illustrations for Trust publications as well as for other sections within DEC. They also maintain the illustration archive both as original illustrations and as an electronic database.

Major taxonomic projects

Ongoing taxonomic work has been completed for publication in *Telopea, Cunninghamia, American Journal of Botany, Australian Systematic Botany, RBG news,* and PhD theses for botanists, honorary research associates and students.

Major projects completed include:

- seeds from seventy-six species of plants from the Mount Annan Cumberland Plain Woodland illustrated in pencil, scanned and prepared for publication
- ongoing fern illustrations of *Blechnum and Stenochlaena* species
- nine plates representing the family Proteaceae
- marine algae species - ongoing
- ongoing illustration Threatened and Vulnerable species
- 8 plates on *Procris* (Urticaceae) species
- Intermittent work undertaken for Education and Graphic Design sections.

Digital Imaging Project

Illustrations are scanned as they are completed, added to the multimedia module of Emu and linked to the taxonomy and catalogue modules. Electronic versions of the illustrations are now available to staff and will shortly be available on the internet. Higher resolution scans are available for publishing when required. The remaining works, namely Margaret Flockton's drawings and approximately 100 *Eucalytpus* and *Corymbia* illustrations and a collection of Epacridaceae illustrations, are yet to be scanned and added to NSW Collections. A small "gallery" of illustrations is now located in the illustration section of the RBG web page.

Illustrations from volumes 3 and 4 of the Flora of NSW (approximately 2200 images), were digitally photographed at high and low resolution. These are now available for viewing on EMU and "Flora on-line".

Endangered and Vulnerable Plants

The national Endangered and Vulnerable Species Project is continuing with 85 endangered species now illustrated. The current focus of this project is to illustrate New South Wales species being listed as endangered nationally. In line with this project the illustrators are working with NSW National Parks and Wildlife Service, Conservation, Programs and Planning Division, (Northern Directorate) to provide illustrations for their Threatened Species Recovery plans. The illustrations are either sourced from the archive or done to order. Approximately 32 plants have been illustrated to date. Illustrations are soon to be provided for DEC's Threatened species information booklet and website.

Illustration Archive

Illustrations from past and current papers were collected from botanists, and are now filed for future use in web-based projects such as PlantNET and the new Collections Database. The archive also allows the illustrations to be available on request whilst being stored safely.

Volunteers and training

- Regular assistance is given to staff requiring help when scanning images.

Scanning

- Scanning of black and white illustrations for publication in external journals is undertaken by the illustrators.

Exhibitions and Awards

- The Illustrators, together with the Resources team, curated the inaugural exhibition in the new Red Box Gallery. The exhibition, title “Four Centuries - Five Artists, Australian Plants Illustrated”, Included the work of Sydney Parkinson, William Archer, Margaret Flockton, Lesley Elkan and Catherine Wardrop.
- The illustrators assisted in the establishment of the ‘Margaret Flockton Award for Botanical Illustration’. Sponsored by the Friends of The Gardens, the Award’s inaugural year was a great success, with 46 entries. A successful exhibition was mounted in the Red Box Gallery displaying selected entries (see Red Box Gallery).

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 exchanges 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 is accredited as an approved Australian Quarantine and Inspection Service (AQIS) facility. This enables us to process specimens received from overseas, and provide a quarantine service for other Australian herbaria.

Integrated Pest Management

The Integrated Pest Management (IPM) program is designed to protect the herbarium collection from insect pests. This program is based on a minimal approach to chemical use and relies on integrated non-harmful treatments such as freezing, good house keeping, environmental control, pest monitoring and the use of low toxicity chemicals targeting insect pests.

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 data-base. A major priority is to ensure that all out-going loan material is mounted and data based 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 basing type specimens, and curation of the algae and lichen collections.

Databasing program

Volunteers databased in excess of 3,835 specimens during the year, a small decline on last year's 4,398 specimens. This decrease was due to the reduction in numbers databased by Syd Pinner due to his ill health. Incoming exchange specimens from Canberra continued to be entered through Rapid with the use of electronic exchange of data. It is hoped to increase the number of herbariums that provide electronic for incoming exchange.

Specimen mounting program

Fifty-six regular volunteers mounted 25,145 specimens on archival paper, a slightly lower number than last year (25,760 specimens). Outgoing loans, incoming exchange, specimens data based by the AVH and fragile or vulnerable groups within the Herbarium collection were given highest priority. A total of 1,240 cryptogam specimens were also mounted, data based and packaged, slightly less than last year.

Other volunteer programs

Volunteers assisted with limited general curation and research in the Plant Sciences Branch. Projects included the maintenance of the Public Reference Collection, and assisting with herbarium research for the Ecology of Sydney Plants Species series. Mounting and some curation of marine algal material were also carried out. Two of the volunteers have been assisting with the setting up of the computer based Topographical Map system. This will enable previously data based specimens which did not include latitudes and longitudes to be corrected with latitudes and longitudes. This will subsequently allow mapping to be carried out on the largest possible data set.

Electron Microscopy

Facilities

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. We also have access to a transmission electron microscope (TEM) through Sydney Hospital.

Equipment Changes

The Scanning Electron Microscope was unfortunately out of action for some time this year. The most significant of those interruptions was due to the failure of a circuit board controlling the camera system. Because of then high replacement costs and uncertain availability of parts, a digital image capture system has been installed to replace the camera system. The PC housing the SpectrumMono digital image capture system is networked, allowing users to save images directly to their personal drives while operating the SEM. Images can then be burnt to CD and printed as required. The new system will save time and money where previously film was used as the capture system requiring developing and scanning to CD.

A new sputter coater was purchased this year to replace an obsolete unit. The new coater provides better and faster coating of specimens for examination in the SEM.

SEM Projects

Elizabeth Norris has been continuing with the leaf and epidermes study of *Nassella* and *Piptochaetium* using SEM and light microscopy. This work forms part of an international collaborative project concerning the tribe Stipeae. From her results she is building a matrix with respect to the relationships of these two genera.

Honorary Research Associate Christopher Quinn has completed asurvey of pollen and leaf micromorphology of species in the *Cyathodes* clade of the Styphelieae (Ericaceae). This has enabled completion of a combined analysis of molecular and nonmolecular data for the group. This work has been written up for publication, but is presently waiting on loan material from PERTHof two undescribed taxa which will be added to the analyses before submission of the article. He is presently completing a survey of surface micromorphology of the leaves, pollen and seeds of the Eastern species of *Babingtonia* and their allies (family Myrtaceae) for inclusion in a nonmolecular database to complement the molecular analyses of this group. Both studies are supporting the recognition of new genera that will shortly be described.

TEM Projects

The major application of the TEM is the examination of specimens for the Australian Quarantine and Inspection Service (AQIS) on behalf of the Plant Pathology Diagnostic Service. A total of 33 samples were processed for AQIS this year.

Molecular Systematics Laboratory

The Molecular Systematics Laboratory provides facilities for DNA-based studies of plant relationships, to supplement whole plant and anatomical comparisons.

Graduate student research projects

- Kioumars Ghamkhar (under the supervision of Jeremy Brulh, UNE Armidale, Karen Wilson and Adam Marchant) submitted his PhD thesis on Abildgaardieae (Cyperaceae). A paper on his work has been submitted for publication.
- A paper reporting on the molecular genetic work of former PhD student Xiufu Zhang has been published in *Molecular Phylogenetics and Evolution* (with co-authors Marchant, K. Wilson, and Bruhl).
- Nicholas Yee's MSc cantidature at the University of Melbourne (supervised by Gerry Kraft, U.Melb., Alan Millar and Adam Marchant) has been upgraded to a PhD.
- Nikola Streiber (supervised by Murray Henwood, U.Syd., Elizabeth Brown, and Barry Conn) has submitted her PhD thesis, on phylogenetics of Chloanthaceae.
- A report on the molecular genetic component of George Orel's PhD (supervised by Judyth McLeod and Graeme Richards, UWS, and Adam Marchant) was published in the journal HortScience in September 2003.

Staff and Research Associate projects

- Murray Henwood, of the School of Biological Sciences, University of Sydney, was the Visiting Research Fellow in the latter part of 2003. His work on relationships within Australian Apiaceae (in collaboration with Adam Marchant and Andrew Perkins) was presented at the *Southern Connections Botanical Conference* in Cape Town in January 2004.
- Bettye Rees and Adam Marchant (with G. C. Zuccarello, University of Leiden) published their findings on Australian *Gymnopilus* species in *Australasian Mycologist*.

- Andrew Perkins, Gillian Towler, George Orel and Adam Marchant were successful in obtaining a grant from the Australian Flora Foundation, to study the Solanum brownii species-complex.

Building Infrastructure

Brown Building Water Leaks

The Department of Commerce has continued to investigate the cause of leaks in the roof of the Brown Building. Diagnostic architects from the Rice Daubney Group carried out the investigations and identified the causes of the leaks. Additional funds in the 2003/04 Capital Program will be allocated to repair the leaks.

Red Box Gallery

Due to a generous bequest from the estate of Nellie Mackie, a former long term volunteer in the Herbarium Mounting Program, we were able to develop the Brown Building Void or Atrium area into an exhibition space. The space, with dedicated lighting track and movable panels will enable the Trust to mount exhibitions of much of the material held in our various collections. The space is also available for commercial use by outside organisations.

Exhibitions

The Trust mounted two successful exhibitions in the Red Box Gallery in 2003/04

Four Centuries – Five Artists. Australian Plants Illustrated'.
20 November 2003 to 27 February 2004.

This exhibition displayed botanical illustration over the last four centuries with the works of Sydney Parkinson (the artist responsible for the illustrations in *Bank's Florilegium*), the Tasmanian architect and botanical collector William Archer and illustrations by our own artists, Margaret Flockton, Lesley Elkan and Catherine Wardrop. The exhibition was made possible due to generous support from the Tasmanian Museum and Art Gallery and the Rothwell family who arranged the loan of the Archer illustrations.

Margaret Flockton Award for Botanical illustration and the Award Exhibition
14 March 2004 to 2 July 2004

The Margaret Flockton Award was presented for the first time this year. The aim of the Award is to give recognition and credit to Margaret Flockton, who was the botanical artist at the Gardens from 1901 to 1927. The Award, sponsored by the Friends of The

Gardens, will also help to raise the profile of botanical illustration in the general community. The award was well accepted within the botanical art community with 46 works representing 22 artists from every State except the NT. Of these, 24 works from 17 different artists were selected for exhibition.

The Award Exhibition contained 24 selected works from the Award, as well as four drawings by Celia Rosser and 15 Margaret Flockton illustrations. The exhibition was seen by over 2000 people and was one of the venues in the inaugural *Museums Light up Sydney* program on Saturday 17th April 2004.

Health and Safety

Throughout the year, with the cooperation of the Trust's OH&S officer and the OH&S Committee, the Branch continued with the implementation of Occupational Health and Safety Programs.

Critical Incident Planning and Implementation.

The Resources Manager is responsible for the updating and implementation of the Critical Incident Plan (CIP) at the Sydney site.

During the year, there were 35 major incidents in the Sydney Gardens

Achievements throughout the year include:

- ongoing training of staff in emergency procedures
- up-date of evacuation procedures on the Sydney site
- desk-top exercise simulating a major emergency

Part 6: Appendices

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

STAFF

Director Plant Sciences
Tim Entwisle BSc(Hons)(Melb)PhD(La Trobe)
Brett Summerell BScAgr(Hons), PhD(Syd) (Senior Research Scientist) (Acting)

Administrative Assistant
Kristina McColl BSc(Hons)(UNSW), BushRegenCert
Ifeanna Tooth BSc (Syd), Adv Cert Urb Hort (OTEN) (temp, in part)

CENTRE FOR PLANT CONSERVATION

Coordinator
Bob Makinson BA(Biology)Macq

CONSERVATION AND HORTICULTURAL RESEARCH

Manager
Brett Summerell BScAgr(Hons), PhD(Syd) (Senior Research Scientist)
Bob Makinson BA(Biology)Macq (Acting)

NSW Vegetation

Principal Research Scientist
Surrey Jacobs, BScAgr, PhD(Syd)

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

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

Senior Technical Officers
Chris Allen BEng, BSc(Biology)(Syd), PhD (Syd)
Jocelyn Howell BPharm(Syd), BSc(Macq)

Technical Officer
Jedda Lemmon BA(Sociology)(UNSW)BushRegenCert II (temp)

Technical Assistant
Lyn McDougall BushRegenCert

Fungi and Plants

Senior Technical Officers
Linda Gunn BAgSc(Hons)(Melb)
Suzanne Bullock NZCS, MSc(UNSW)

Technical Officers
Alex Newman CertAmenHort(SA), AdvCertHort(SA), BScAg(Hons)(Adel), BMus(Adel)
Julie Bates, AssDipAppSc(Ultimo TAFE) (temp)

Horticultural Research and Development

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

Technical Officers
Lotte von Richter BScAgr(Syd), MScAgr(Syd)
Patricia Meagher BScUrbanHort(Hons)(UTS) (temp)

Senior Technical Officers
John Siemon, BHortSc(Hons) (Uni Qld)

Horticulturalists
Faye Cairncross AdvCertUrbanHort

Technical Officer
Mishy McKensy (temp) (commenced 5.04)

Technical Assistant
Andrew Orme (temp) (commenced 5.04)
Mishy McKensy BSc(Syd) temp

PLANT DIVERSITY

Manager
Barry Conn BScEd, MSc(Melb), MBA (CSturt), PhD(Adel) (Senior Research Scientist)

Research and Curation

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

Senior Research Scientists
Ken Hill BSc(Hons), MSc(UNE)

Research Scientist
Peter Wilson BSc(Hons), PhD(UNSW)

Special Botanist
Karen Wilson BScAgr(Syd), MSc(UNSW)

Senior Systematic Botanist & Scientific Editor (Telopea)
Joy Everett BioTechCert (Syd TAFE), BSc(Hons), MSc(Syd)

Botanists

Darren Crayn BSc(Hons), PhD (UNSW)
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
Andrew Perkins BSc (Hons), PhD (Syd) (LDD 30.04.04)
Clare Herscovitch BSc(Hons)(Syd)
Gillian Towler BSc(Macq), AssDipAppSc (HortParkMgt), TreeSurgCert
Hannah McPherson BSc (Hons) (UNSW)
Katherine Downs, BA (UNSW), BSc(Hons) (Syd)
Leonie Stanberg BSc(Syd), DipEd(SCAE)
Linn Linn Lee BA, BSc(Hons) (Syd) (temp)
Liz Norris BSc(Hons) (Macquarie) (temp)
Margaret Heslewood BSc(Hons) (Syd) (temp)
Nick Yee BSc (Hons)(Melb) (temp) (LDD 7.03)
Nikola Streiber, BSc(Hons) (Bonn) (temp) (LDD3.04)
Paul Rymer BSc (Hons) (UWS) (temp) (commenced 29.04.04)
Wayne Cherry BScAgr(Syd), GradDipBioSc(UNSW)
Will Cuddy BSc(AppPhysGeog) (Hons) (UNSW) (temp) (LDD 12.03)

Herbarium Assistant
Zonda Erskine AssDip in FAP(Sydney TAFE)

Australia's Virtual Herbarium

Co-ordinator
Phillip Kodela BSc(Hons), PhD(UNSW) (temp)

Botanists
Peter Jobson BSc(Hons) (La Trobe), MSc (James Cook) (temp) (LDD28.11.03)
Andrew Perkins BSc (Hons), PhD (Syd) (LDD 30.09.03)

Database staff
Karen Biddle (temp)
Emma Cornelius BSc(Hons) UNSW (temp) (LDD12.12.03)
Helen Jolley BSc (temp) (LDD30.04.04)
Gary Koh BA (Commerce) (Hons) ANU (temp) (LDD4.11.03)
Andrew Orme, Hort TradeCert (TAFE) (temp) (LDD30.04.04)
Ifeanna Tooth BSc(Syd), Adv Cert Urb Hort (OTEN) (temp, in part)
Will Cuddy BSc(AppPhysGeog) (Hons) (UNSW) (temp) (LDD 23.6.04)
Amber Pares (temp) (commenced 03.04)
Jacqueline Millott BEnvSc(Hons)(UoW) (temp) commenced (9.2.04)
Rachael Gallagher (temp) (commenced 3.04)
Lucy Nairn BSc(Hons) (Monash) (temp) (commenced 12.03)
Fiona Powell BSc(Hons) (UNSW) (temp) (commenced 3.04)
Kathy Downs BA (UNSW), BSc(Hons) (Syd) (temp, in part) (LDD31.12.03)

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 Assistant
Rosie Arnold (LDD 18.06.04)
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)
Catherine Wardrop BA(Vis)(ANU), PostGradDipIllus(Newc)

Volunteer Program

Volunteer Program Supervisor
Alan Leishman PhotoengravingEtchingCert

HONORARY RESEARCH ASSOCIATES
Alan Archer PhD(City Lond), CChem, FRSC
Peter Bernhardt BA, MA(SUNY), PhD(Melb)
Don Blaxell BSc(UNSW), DipAgr(Vic)

Barbara Briggs BSc(Hons), PhD(Syd), PSM
Carrick Chambers AM, MSc(NZ & Melb), PhD(Syd), Hon.LLD(Melb), Hon.DSc(UNSW), AHRIH
Mike Dingley BioTechCert (STC)
Lionel Gilbert, OAM, BA (Hons) PhD(UNE), LCP(Lond)
Norman Hall BForSc
John Leslie BA(Dall), MS(UWisc), PhD(UWisc)
David Mabberley MA, PhD(Cambridge), DPhil(Oxon)
Christopher Quinn, BSc (Hons) (Tas), PhD (Auk)
Helen Ramsay MSc, PhD(Syd)
Bettye Rees BSc(Hons)(Qld), PhD(UNSW)
Geoffrey Sainty DipAgr(WAC), GradDipExt(Hawkes)
Phil Spence
Joy Thompson BScAgr, MSc(Syd)
Mary Tindale MSc, DSc(Syd)
Peter Michael BAgSc(Hons)PhD(Adel)
Terry Tame DipIndArts(STC), DipEd(Syd)
Prof John Thomson MSc, MAgrSc, PhD(Melb)
Edwin Wilson, BSc (UNSW)

VOLUNTEERS

Mike Atkinson, Lydia Bell, Chris Belshaw, Carol Bentley, Margaret Bell, Alicia Boyd, Patricia Bradney, Sunday Brent, Harry Brian, Dawn Bunce, Lynette Burns, Margaret Carrigg, Kathryn Chapman, Dianne Colder, Kristin Connell, Alexander Debono, Eleanor Eakins, Gwen Elliott, Rosemary Farley, Helen Flinn, Gladys Foster, Estelle Geering, Carole Gordon, Mien de Haas, Pat Harris, Janet Heywood, Jane Helsham, Rachel Hill, Alick Hobbs, Beverley Honey, William Isbell, Eniko Krasznai, Fred Langshaw, Marie Lovett, Ann McCallum, Miriam Mathews, Ena Middleton, Joseph Miniter, Joan Moore, Muhammad Masood, Jill Pain, Edwin Pearson, Aileen Phips, Syd Pinner, Dorothy Pye, Elizabeth Radford, John Richards, Rod Roberts, Mananejela Rodojih, Betty Ruthven, Graham Shields, Juliet Taylor, Betty Thurley, Ruth Toop, Shelagh Trengove, Michael Turley, Sybil Unsworth, Rosemary Varley, Ann Wilcher.

STUDENTS

Student	Degree	University	Supervisors	Project Title
Ruth Amata	MScAgr	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	Fusarium species associated with millet in Australia and Africa
Alison Bentley	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	Population biology of *Fusarium pseudograminearum*
Betty Mauliya Bustam	MSc	University of New South Wales	+Dr P. Adam, J. Everett Dr S. Jacobs	Systematics of *Austrostipa* (Gramineae)

Student	Degree	University	Supervisors	Project Title
Jonathon Carbrera		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)
Yvonne Davila	PhD	University of Sydney	+Dr G.M. Wardle, Dr M. Rossetto	Reproductive and evolutionary ecology of *Trachymene incisa* (Apiaceae)
Pete Donaldson	BScAgr	University of Sydney	Dr C. Offord, L. von Richter	Seed germination of Australian species
Heather England	BSc (Hons)	University of New South Wales	+Assoc .. P. Adam, Dr C. Allen	Invasion of weeds in Blue Gum High Forest
Alex Freebairn	PhD	University of Sydney	+Dr P. Martin, Dr C. Offord	Reproductive biology and breeding of Grevillea
Kioumars Ghamkhar	PhD	University of New England	+Assoc. Prof. J. Bruhl, Dr A. Marchant, Mrs. K. Wilson	Molecular study of Abildgaardieae (Cyperaceae)
Robert Gibson	PhD	University of New England	+Assoc. Prof. J. Bruhl, +Dr G. Vaughton, Dr B. Conn	Systematics of *Drosera peltata* complex
Joanne Green	BSc (Hons)	Southern Cross University	Dr S. Jacobs, Dr. S. Skinner	Aufwuchs as a stream health indicator
Greg Guerin	PhD	University of Adelaide	Dr W. Barker, Dr R. Hill, Dr B. Conn	"Systematics of Hemigenia and Microcorys (Lamiaceae)"
Adele Harvey	PhD	La Trobe University	+Dr Wm J. Woelkerling, Dr A. Millar	The crustose coralline algae of NSW
Ken Hill	PhD	University of Technology	+Dr Ken Brown, Dr P. Weston	Phylogeny and biogeography Technology of the genus *Cycas*
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

Student	**Degree**	**University**	**Supervisors**	**Project Title**
James Indsto	MSc	University of	Dr P. Weston,	Species relationships and

		Wollongong	+Prof. R. Whelan +Dr M. Clements	pollination ecology of *Diuris* (Orchidaceae) of the Sydney region
Karen Jackson	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	*Fusarium* mycotoxins in wheat grain
Peter Jobson	PhD	University of Technology	+Dr D. Morrison replaced by Ken Brown, Dr P. Weston	A taxonomic revision of *Dillwynia* (Fabaceae: Sydney Faboideae: Mirbelieae)
Aniuska A. Kazandjian	PhD	James Cook University	+Assoc. Prof. B. Jackes, Dr P. Wilson	Systematics of the *Indigofera pratensis* complex (Fabaceae): A Morphological and Molecular Approach
Joanne Ling	PhD	University of Western Sydney	+Dr J Bavor, Dr S. Jacobs	Development of a Wetland Assessment protocol using biological techniques
Patricia Lu-Irving	BSc (Hons)	University of Sydney	Dr Adam Marchant, Dr Andrew Perkins, +Dr Murray Henwood	Molecular systematics of genus *Trachymene* (Apiaceae)
David Maynard	BSc (Hons)	University of New South Wales	Dr M. Rossetto, Dr D. Crayn +Dr S.Bonser	Systematics of *Elaeocarpus* sp. 'Rocky Creek'
Kylie McCall	BHortSc	University of Sydney	J. Siemon, L. von Richter	Storage of seed and mycorrhiza of threatened Australian orchid species
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
Linda McLaughlin	BSc (Hons)	University of New England	K Wilson +Dr J Bruhl	Systematic studies in *Schoenus* (Cyperaceae)
Amelia Martyn	PhD	University of Sydney	+Dr R. McConchie, Dr C.Offord	Causes of bract browning in *Telopea* species
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
Lyle Mildenhall	BEnvSc (Hons)	University of Wollongong	L. von Richter	Seed ecology and population structure of the endangered plant species *Leionema lachnaeoides*
Lucy Nairn	PhD	University of Melbourne	+Dr B. Downes, Dr T. Entwisle	Ecology of freshwater macroalgae in sandstone streams of the Southern Highlands, NSW

Student	Degree	University	Supervisors	Project Title
Chris Nancarrow	PhD deferred	University of Wollongong	+ Prof. R. Whelan, +Assoc. Prof. D. Ayre, Dr P. Weston, Dr C. Offord	Reproductive character Displacement and adaptation of three co-occurring *Persoonia* species
Jennie Nelson	MSc (Hons)	University of Western Sydney	+Assoc. Prof. S. Burgin, Dr T. Entwisle	Desmids of Western Sydney
Alex Newman	PhD	Macquarie University	+Assoc. Prof. D. Hales, Dr B. Summerell	Biology of the fig psyllid
George Orel	PhD	University of Western Sydney	+Dr Judyth McLeod, +Graeme Richards, Dr A Marchant	Assessment of horticultural suitability of undomesticated species of Juglandaceae
Sophie Peterson	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	Biology of *Phyllosticta telopeae*
Tijana Petrovic	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	Populations of *Fusarium* on sorghum
Hien Phan	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	*Fusarium* spp. associated with Australian grasses in Northern Queensland
Ratiya Pongpisutta	PhD	University of Sydney	+Prof. L Burgess, Dr B. Summerell	Variability of *Phytophthora cinnamomi* in National Parks in NSW
Matt Renner	PhD	University of Sydney	Dr Elizabeth Brown +Dr Glenda Wardell	Relationships of the Austral family Lepidoziaceae
Karin Rutten	PhD	University of Wollongong	Dr A. Millar	Macro-algal blooms and Management
Paul Rymer	PhD	University of Wollongong	+ Prof. R. Whelan, +Assoc. Prof. D. Ayre, +Dr T. Auld, Dr P. Weston	Genetics of fire-sensitive *Persoonia* species threatened species recovery and management
Josie Saul	PhD	University of Sydney	+Prof. D. Guest & Dr. B. Summerell	Diversity of Phytophthora palmivara in PNG
Robin Stanger	BSc (Hons)	University of Newcastle	Dr C. Offord, L. von Richter	Are habitat specificity and limited reproductive ability affecting the population dynamics of *Prostanthera junonis* ?
Nikola Streiber	PhD	University of Sydney	+Dr M. Henwood, Dr E. Brown, Dr B. Conn	The systematics of Chloantheae (Lamiaceae)
Karen Sommerville	PhD	University of	+Dr Alex Pulkownik,	Conservation of *Wilsonia*

		Technology, Sydney	+Prof M. Burchett, Dr. M. Rossetto	*backhousia* and *Lampranthus tegens*

Student	Degree	University	Supervisors	Project Title
Jennifer Smith	PhD	University of New England	Assoc Prof C Gross, Assoc Prof N Prakash, Dr M Rossetto	Ecology, biology and conservation of *Hakea pulvinifera*
Kathleen Taylor	BSc (Hons)	University of Queensland	Dr M. Rossetto, + A. Lowe (UQ)	Genetic diversity and population structure in *Nothofagus moreii*
Len Tesoriero	PhD	University of Sydney	+Prof. L. Burgess, Dr B. Summerell	Control of soil borne diseases in glasshouse crops
Ha Nguyen Tran	PhD	University of Sydney	Dr B. Summerell +Prof. L Burgess	Populations of *Fusarium* on maize
Nguyen Vinh Truong	PhD	University of Sydney	Dr. B. Summerell	Quick wilt of black pepper in Vietnam
Jillian Walsh	PhD	University of Sydney	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
Sabine Wilkins	PhD	University of Berlin	+Prof. W. Greuter, Dr S. Jacobs	Taxonomic studies in the Floating leaved species of *Potamogeton* (Potamogetonaceae) in Australia
Michael Whitehead	BSc (Hons)	UNSW	Dr M. Rossetto, Dr D. Crayn +Dr W. Sherwin	Population Genetics of the Blueberry Ash (*Elaeocarpus reticulatus*)
Nick Yee	PhD	University of New South Wales	Dr A. Millar, Dr A. Marchant, +Prof. G. Craft	Molecular phylogeny of the algal order Sporochnales

Appendix B: REPRESENTATION ON EXTERNAL COMMITTEES

Doug Benson

Member, NSW Scientific Committee, Threatened Species Conservation Act; Member, Institute of Wildlife Research, University of Sydney; Member, National Trust Bush Management Advisory Committee

John Benson

Member, Integrated Biodiversity Conservation Assessment panel; Member, Institute of Wildlife Research, University of Sydney; Member, IUCN Species Survival Commission Plant Specialist Group; Member, IUCN Commission for Ecosystem Management; Member, Wollemi Pine Conservation Team; Member, Technical Working Group Vegetation Reforms NSW; Member Technical Working Group Vegetation Reforms NSW..

Dr Barbara Briggs (Honorary Research Associate)

Member, Editorial Committee *Taxon*; Member, Editorial Advisory Board, Nordic Journal of Botany; Committee Member, NSW Division of Australian & New Zealand Association for the Advancement of Science (ANZAAS); Member, General Committee on Botanical Nomenclature; Member, Standing Committee on Names in Current Use.

Professor Carrick Chambers (Honorary Research Associate)

Member, Research Committee of Australia and Pacific Science Foundation and also Pacific Science Foundation; Member, Griffin Reserves Advisory Committee for Willoughby City Council; Member, Australian Standards Committee preparing a Guide for the Valuation of Amenity Trees; Committee Member, Walter Burley Griffin Society Inc.

Dr Barry Conn

Editor, Handbooks of the Flora of Papua New Guinea; Member, Editor, 'HISPID - Herbarium Information Standards and Protocols for Interchange of Data', version 3; International Working Group on Taxonomic Databases for Plant Sciences; Member, Herbarium Information Systems Committee (HISCOM); Member, NSW Natural Resources Information Management Strategy (NRIMS); Member, NSW Metadata Working Group (NRIMS); Member, NSW Biodiversity Working Group (NRIMS); Board Member, CANRI (NRIMS); Coordinator, Flora Malesiana Urticaceae Working Group.

Dr Tim Entwisle

Chair, Biological Diversity Advisory Council; Chair, NSW Biodiversity Research Network; Member, Biodiversity Strategy Implementation Group; Chair, Australian Systematic Botany Editorial Advisory Committee; Chair, Council of Heads of Australian Herbaria; Research Associate, School of Biological Sciences, The University of Sydney; Member, International Organising Committee for Eighth International Phycological Congress; Member, Australian Biological Resources Study Advisory Committee, Member, Australian Academy of Science National Committee for Plant and Animal Sciences; Member, NSW Agricultural Scientific Collections Trust.

Ken Hill

Member, Cycad Specialist Group, IUCN.

Peter Hind

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

Jocelyn Howell

Member, Cumberland Regional Advisory Panel (scientific research).

Dr Surrey Jacobs

Member, Animal Care and Ethics Committee, Australian Museum; Member, State Wetlands Advisory Committee for implementing State Wetland Policy (whole of State policy).

Alan Leishman

Member, Heritage (Built and Environmental) Advisory Committee, Campbelltown City Council; Public Officer, Australian Bird Study Association.

Professor David Mabberley (Honorary Research Associate)

Member, Faculty of Natural Sciences, University of Leiden, The Netherlands; Honorary Director and member of Management Group, Joseph Banks Archive Project, Royal Society and The Natural History Museum, London; Council Member, International Association for Plant Taxonomy; Member, Editorial Board, *Journal of South Asian Natural History*.

Lyn McDougall

A Trustee, Katandra Bushland Sanctuary Trust

Bob Makinson

Member, Species Recovery Team for *Grevillea wilkinsonii* ; Member, Goobarragandra Valley Reserves Trust (Crown Lands Trust under DLWC); Vice-president, Australian Network for Plant Conservation Inc.; Member, Wollemi Pine Conservation Management (Recovery) Team; Secretary, NSW Biodiversity Research Network

Adam Marchant

Council of the Workers' Educational Association (Sydney).

Tony Martin

President, Microscopical Society of Australia.

Patricia Meagher

Member, Wollemi Conservation Management (Recovery) Team; Member, Greening Australia Technical Committee.

Peter Michael

Member, National Trust Bush Management Committee.

Dr Alan Millar

Member, International Organising Committee, International Phycological Congresses; Member, Nominations Committee, International Phycological Society; Deputy Chair, Fisheries Scientific Committee, Fisheries Management Act; Associate Editor, morphology and taxonomy – journal *Phycologia*; Member, Intra-agency Work Group for NSW Aquatic Biodiversity Strategy; International Marine Experts Group; Research Associate of University of New South Wales.

Cathy Offord

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

Dr Maurizio Rossetto

Member, IUCN/SSC Reintroduction Specialist Group; Member, *Fontainea oraria* Recovery Team.

Dr Brett Summerell

Regional Councillor, NSW, Australasian Plant Pathology Society;
Member, International Society of Plant Pathology Committee on *Fusarium*;

Vice-President, International Mycological Association.
Member, Forest Health Advisory Committee, NSW
Member, Organising Committee for International Mycological Congress 2006
Honorary Research Associate, Faculty of Agriculture, Food and Natural Resources, University of Sydney

Dr Mary Tindale (Honorary Research Associate)

Member, Special Committee for Pteridophyta, International Association for Plant Taxonomy.

Dr Peter Weston

Systematics, biogeography and comparative biology of the Proteaceae with Dr T. Auld, NSW National Parks and Wildlife Service, Associate Professor D. Ayre, Mr D. McKenna, Mr P. Rymer and Professor R. Whelan, University of Wollongong, Dr N.P. Barker, Rhodes University, South Africa, Associate Professor M.D. Crisp and S. Gilmore, Australian National University, Dr A.W. Douglas, University of Mississippi, Dr C.L. Gross, Dr S. Hoot, University of Wisconsin, Mr R.M. Kooyman, University of New England, Dr Austin Mast, Florida State University, Ms C. Porter

Karen Wilson

Convener, Global Plant Checklist Committee, International Organization for Plant Information; 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 member, Species 2000; Chair, Taxonomy Group, Species 2000; Vice-Chair (to Dec.), Member (from Dec.) Participant Node Managers Committee, GBIF; 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*.
Member, Committee on Suprageneric Names, International Association for Plant Taxonomy

Appendix C: AVAILABLE SCIENTIFIC PUBLICATIONS

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.**

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.**

Flora of New South Wales: supplement to vol 1 (2000), vol 1 (2000)(revised edition with supplement), vol 2 (2002) (second edition), vol 3 (1992), vol 4 (1993), edited by Gwen Harden (NSW University Press).

Collection, Preparation and Preservation of Plant Specimens (Royal Botanic Gardens Sydney 2nd edition, 1995) **$6.85**

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

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) **$27.95**

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**

Plants of Pooncarie and the Willandra Lakes by M. Porteners and L. Ashby. A guide to the plant species native to Pooncarie and the Willandra Lakes region in south-western New South Wales (Royal Botanic Gardens Sydney, 1996) **$8.75**

Hispid 3 (1996) by Dr B. Conn. Herbarium Information Standards and Protocols for Interchange of Data, Version Three. Also available on Internet http://www.rbgsyd.gov.au/HISCOM (booklet, free to participating institutions).

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**

Appendix D: RESEARCH GRANTS

FUNDING TO TRUST

The Australia & Pacific Science Foundation

Dr Adam Marchant and Dr George Orel- Genetic and horticultural assessment of the Australian native "bush potato" (*Ipomoea costata*). $14,000 (1st year of a 3-year $42,000 grant)

Australia Flora Foundation

Dr Adam Marchant, Dr George Orel, Gillian Towler, Andrew Perkins - Exploring the horticultural potential of native Australian flowering shrubs in the *Solanum brownii* Group $3,500 (1st year of a 3-year $11,000 grant)

Australian Biological Resources Study

Dr Darren Crayn & Dr Maurizio Rossetto - A revision of *Tetratheca* & *Tremandra* and assessment of the phylogeny and biogeography of Tremandraceae & Elaeocarpaceae $25,000

Dr Tim Entwisle and Dr Stephen Skinner – Taxonomic revision of *Oedogonium* (Chlorophyta) $30,000 (3rd year of 3-year $75,000 grant)

Dr Tim Entwisle and Dr Stephen Skinner – *Bulbochaete* C. Agardh *and Oedogonium* Shahl (Oedogoniales, Chlorophyta) in Australia $15,000

Dr Surrey Jacobs - Provision of Flora of Australia manuscript for the Stipeae $6,000 (2nd year of a 2-year $12,000 grant)

Dr Brett Summerell and Dr Lester Burgess - Taxonomy of *Fusarium* in Australia $32,100

Dr Peter Wilson – Defining generic limits within the *Chamelaucium* alliance (Myrtaceae) $40,000 (2nd year of 3-year $118,000 grant)

Community Access to Natural Resources Information (CANRI)

Dr Tim Entwisle and Nick Yee – ALGKEY - Interactive key to the genera of freshwater algae in NSW $50,000

Louisa Murray – HerbLink project: Electronically scanning herbarium collections from NSW $57,000

Ken Hill & Dr Barry Conn - PlantNET infrastructure - Integration with the State Government's BioNet and Community Access to Natural Resources Information systems $52,000

Department of Infrastructure, Planning and Natural Resources (DIPNR)

Dr Barry Conn and Barbara Wiecek – Plant Identification for native vegetation mapping $50,000

Dr Brett Summerell – Mapping validation $112,000 (3rd year of 3-year $336,000 grant; delayed start)

Environment Australia (Department of Environment and Heritage)

John Benson - Vegetation Classification Project $70,000

Environmental Protection Agency (now part of Department of Environment and Planning)

Janelle Hatherly & Bob Makinson - Big Answers to Big Questions - public forums and Internet resources $50,000

Global Biodiversity Information Facility

Dr Barry Conn - Repatriation of electronic data to the Papua New Guinea National Herbarium (LAE) USD$49,000

Hermon Slade Foundation

Dr Elizabeth Brown – Relationships of the Austral family Lepidoziaceae $18,500 (delayed start - 1st year of 3-year $56,000 grant)

Edwin Wilson and Phil Spence – Establishment of a breeding and propagation program of *Latouria* type high-altitude hybrids of New Guinea dendrobiums $20,500 (2nd year of 3-year $61,550 grant)

Dr Darren Crayn & Dr Maurizio Rossetto – Evolution and conservation genetics of Australasian Eleocarpaceae $29,490 (2nd year of 3-year $90,000 grant)

Dr Cathy Offord – Seed development of the Wollemi Pine $12,000 (2nd year of a 2-year $24,556 grant)

Dr Alan Millar – Marine Benthic Algae and Invertebrates of Southern NSW $11,000 (2nd year of 2-year $23,000 grant)

Dr Cathy Offord - Storage of NSW rare and threatened NSW orchid species and their associated mycorrhizae $32,000 (1st year of a 3 year $97,000 grant)

Dr Tim Entwisle & Dr Stephen Skinner - Survey of Macroalgae in the Gwydir and Border Rivers Catchments $15, 600

Hermon Slade Orchid Fund

Lotte von Richter, Dr Cathy Offord and John Siemon – Improved orchid seed storage techniques $8,000

Janet Cosh Fund

Dr Elizabeth Brown & Will Cuddy – Bryophyte and Lichen Mounting $8,422

Ken Hill & Leonie Stanberg - Imaging of drawings for online Flora of New South Wales $9,894

NSW Biodiversity Strategy

John Benson – Plant Community Classification Project $29,700 (2nd year of 2-year $67,320 grant)

Dr Tim Entwisle, Dr Stephen Skinner with David Eldridge (DIPNR) – Guidelines for monitoring non-vascular (non-marine) plants Guidelines for monitoring non-vascular (non-marine) plants $64,000

Dr Cathy Offord - Testing and viability assessment of NSW threatened species; seed bank collection $27,000 (2nd year of a 2 year $54,000 grant)

NSW State Government Enhancement

Dr Tim Entwisle **–** Australia's Virtual Herbarium $400,000 (2nd year of 2-year $800,000 grant; next 2 years to be funded by the Commonwealth and private sector)

Pacific Biological Foundation

Dr Barry Conn – Interactive identification keys to the common trees of PNG $15,000 (2nd year of 3-year $45,000 grant)

UK Millenium Commission

Seed Quest NSW partnership to supply 250 seedbank collections per year of threatened species of NSW $240,000 (1st year of 3-year $730,000 grant)

FUNDING TO PARTNER ORGANISATIONS

Australian Biological Resources Study

A/Prof Paul Gadek, Dr Chris Quinn & Dr Judy West – Evolution and radiation of Australian hopbushes and allied genera. (1st year of a 3 year grant to James Cook University).

Australian Centre for International Agricultural Research

Dr Brett Summerell (with The University of Sydney) – Diagnosis and control of soil borne diseases in Indonesia $133,333 (3rd year of 3-year $400,000 grant to The University of Sydney)

Australian Research Council

Dr Peter Weston (with The University of Western Australia, AGWEST, National Parks and Wildlife Service, Australian Museum, Botanic Gardens & Parks Authority) – A biological basis for efficient breeding of native plants for exports: Australian Goodeniaceae $57,231 (2nd year of 3-year $158,000 grant to the University of Western Australia)

Grains Research & Development Corporation

Dr Brett Summerell(with Department Primary Industries, Qld); University of Sydney and EnTox - Managing Mycotoxin Contamination of Maize (2nd year of a 3-year $226,000 grant to Department of Primary Industries, Qld)

National Science Foundation

APPENDIX E: OVERSEAS TRAVEL JULY 2003 – JUNE 2004

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Funds
Dr Allan Millar, Senior Research Scientist	Belfast, Northern Ireland	Participate in European Phycological Congress	19-28 July 2003	$5,500	No cost	Grant funding for algal research
Dr Tim Entwisle, New Caledonia	New Caledonia	Collect and preserve for microscopic and molecular study a range of freshwater algae	6-16 July 2003	$5,826	No cost	Grant for freshwater algal study; plus some contract lecturing and marking
Dr Darren Crayn, Botanists (Tropical Systematics)	Papua New Guinea; Lae, regional centres within the Morobe province, Mt Hagen	To conduct field research and assist in development of framework for the "Electronic Interactive Key to Common Trees of Papua New Guinea" project	12 July – 12 August 2003	$4,500	No cost	Hermon Slade Foundation
Mrs Karen Wilson, Special Botanist	Tsukuba, Japan	Participate in Joint International Forum on Biodiversity Information	4 – 10 October, 2003	$4,000	$1,200	Japanese National Institute for Environmental Studies
	Taipei, Taiwan	Participate in Species 2000 Team meeting	12 October 2003	$300	No cost	Academy of Science in Taipei
	Taipei, Taiwan	Participate in workshop and associated field excursion	13 – 16 October 2003	$2,500	No cost	Academy of Science in Taipei

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Funds
Dr Darren Crayn, Botanist (Tropical Systematics) Dr Elizabeth Brown, Systematic Bryologist	New Caledonia	Conduct field research	29 October – 14 November 2003	$2,480	No cost	Hermon Slade Foundation; personal funds
Mr Peter Cuneo, Manager – Natural Heritage Dr Cathy Offord, Conservation & Horticulture Research Scientist	United Kingdom Ardingly, West Sussex	Complete negotiations, project documentation and legal agreement for the RBG&DT/Millennium seedbank partnership. Conduct seed technology/ technical training review and develop collaborative seed research program at the Millennium Seedbank	P. Cuneo 18 October – 4 November 2003 C. Offord 21 October – 4 November 2003	$9,516	$5,916 – meal allowance and incidentals	Royal Botanic Gardens, Kew and personal funds
Dr Alan Millar, Senior Research Scientist	Cape Town and Johannesburg, South Africa	Participate in Southern Connections and Phycological Society of South Africa Congresses	18 – 31 January 2004	$5,350	No cost	Southern Connections secretariat and Phycological Society of South Africa
Mrs Karen Wilson, Special Botanist	Reading, UK	Participate in Species 2000 meeting	14 – 16 November 2003	$2,100	$300	Species 2000 Europa and Trust
	Reading, UK	Meeting with CODATA Executive Director to discuss plans for Australian CODATA activities	17 November 2003	$400	No cost	CODATA

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Funds
	Kew, UK	Meeting at Royal Botanic Gardens Kew with other members of IOPI Global Plant Checklist project	18 November 2003	$100	$100	Trust
Hannah McPherson, Scientific Technical Officer	New Zealand	Collect and preserve for microscopic and molecular study a range of freshwater algae	30 November – 9 December 2003	US$6,000	No cost	National Science Foundation grant administered by Ohio State University
Dr Tim Entwisle, Executive Director	China – Xishuanganna (Yunnan Province)	Participate in international conference on botanic gardens, and tour of parks and gardens in Yunnan.	28 February – 9 March 2004	$6,343	$2,343	Xishauangbanna Tropical Botanical Garden
Dr Surrey Jacobs, Principal Research Scientist	The Philippines (Manilla; Los Banos)	Review project on bamboo for Australian Centre for International Agricultural Research	15 – 20 March 2004	$4,500	No cost	Australian Centre for International Agricultural Research
Mrs Karen Wilson, Special Botanist	Oaxaca, Mexico	Participate in GBIF governing board meeting, in symposium, and in meetings of GBIF Node Managers Committee and ECAT Subcommittee	25 – 30 April 2004	$4,300	$100	GBIF
	Washington DC, USA	Participate in Species 2000 meetings	3 – 7 May 2004	$2,200	$500	CODATA
	Aarhus, Denmark	Review Danish Biodiversity Information Facility with Prof Loeschcke at Aarhus	10 – 12 May 2004	$2,500	No cost	Danish Natural Science Research Council

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Funds
Dr Barry Conn, Manager Plant Diversity Section, Senior Research Scientist	Papua New Guinea / Lae	Interactive Identification Tools for common trees of Papau New Guinea Repatriation of biodiversity data to the Papua New Guinea National Herbarium	19 April – 4 May 2004	$5,200	No cost	Pacific Biological Foundation and GBIF
Ms Linn Linn Lee, Technical Officer	Papua New Guinea / Lae	Interactive Identification Tools for common trees of Papau New Guinea Repatriation of biodiversity data to the Papua New Guinea National Herbarium	19 April – May 2004	$3,000	No cost	GBIF
Mrs Karen Wilson, Special Botanist	Natural History Museum, London, UK	Participate in GBIF's ECAT Subcommittee meeting	17 – 18 June 2004	$500	No cost	GBIF
	Royal Botanic Gardens Kew, UK	Participate in Global Strategy for Plant Conservation global plant checklist meeting	28 – 30 June 2004	$600	No cost	Species 2000
	University of Reading, UK	Participate in Species 2000 meeting	1 -2 July 2004	$500	No cost	Species 2000
	Panama City, Panama	Participate in Species Plantarum meeting	14 – 16 July 2004	$700	$500	

Dr Tim Entwisle (with Morgan Vis, Ohio University, Orlando Necchi, John Boulton) - A robust phylogeny of the Batrachospermales (Rhodophyta) (2nd year of a 2-year $226,000 grant to Ohio University)